Supporting Information

Practical and Scalable Kinetic Resolution of BINOLs Mediated by a Chiral Counterion

Benjamin A. Jones*, Tudor Balan†, John D. Jolliffe, Craig D. Campbell, and Martin D. Smith*

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1. General Information

Reactions requiring moisture-sensitive reagents were carried out in flame-dried glassware, under an atmosphere of argon (balloon pressure). Dichloromethane, tetrahydrofuran and toluene were purified by filtration through activated alumina columns employing the method of Grubbs et al.\(^1\) Water was purified by an Elix® UV-10 system. Reagents were used directly as supplied by major chemical suppliers, or following purification procedures described by Perrin and Armarego.\(^2\) Petrol 40-60 refers to the fraction of petroleum ether which boils in the range 40-60 °C. Brine refers to a saturated aqueous solution of sodium chloride.

Silica gel chromatography was carried out using Merck Geduran® Silica gel (40-63 μm particle size). Thin layer chromatography (TLC) was carried out using pre-coated, aluminium backed plates (Merck Kieselgel 60 F254). Visualisation was achieved with ultraviolet irradiation (254 nm) and staining with permanganate. NMR spectroscopy was carried out using Bruker Avance spectrometers in the deuterated solvent stated, using the residual non-deuterated solvent signal as an internal reference (\(^1\)H NMR: CDCl\(_3\) (7.26), (CD\(_3\))\(_2\)SO (2.50); \(^{13}\)C NMR: CDCl\(_3\) (77.16), (CD\(_3\))\(_2\)SO (39.52); \(^{19}\)F NMR: CFCI\(_3\) (0.00)). Chemical shifts are quoted in ppm, based on appearance rather than interpretation. Signal patterns are indicated as: br s, broad singlet; s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet. Coupling constants, J, are quoted to the nearest 0.1 Hz and are presented as observed. All \(^{19}\)F NMR spectra are reported as proton/fluorine decoupled unless otherwise stated.

Infrared spectra were prepared as a neat film and were recorded using a Bruker Tensor 27 FTIR spectrometer using an ATR module.

Low resolution mass spectrometry was carried out using ESI and was performed on a Micromass LCT Premier Spectrometer. HRMS was carried out using Bruker MicroTDF and Micromass GCT spectrometers under electrospray ionization (ESI) or ammonia chemical ionization (ACI)/electron ionization (EI) conditions respectively. Analytical chiral HPLC was carried out on a Dionex UltiMate 3000 HPLC system comprising a Dionex LPG-3400A pump, WPS-3000SL autosampler and TCC-3000SD column S2 compartment, and a Daicel Chiralpak column (0.46 cm × 25 cm), equipped with an appropriate guard column (0.4 cm × 1 cm). For compound **Bn-15** (2-(benzyloxy)-2′-methoxy-7-methyl-1,1′-binaphthalene), chiral analytical HPLC was performed on a SHIMADZU Prominance-i LC2030-LT instrument. Melting points were determined using a Reichert melting point apparatus and are uncorrected.

Optical rotations were recorded on a Schmidt-Haensch Unipol L2000 polarimeter and values are quoted in deg·mL·g\(^{-1}\)·dm\(^{-1}\). Concentrations are quoted in g/100 mL.
2. Catalyst synthesis

Representative procedure:

**N-(2,3,4-trifluorobenzyl)hydrocinchoninium bromide (8)**

To a suspension of hydrocinchonine (1.00 g, 3.37 mmol, 1.00 equiv) in tetrahydrofuran (34.0 mL) was added 2,3,4-trifluorobenzyl bromide (759 mg, 0.44 mL, 3.37 mmol, 1.00 equiv). The mixture was heated at 75 °C for 16 h and cooled to room temperature to give a white precipitate. The solids were collected in a funnel and washed successively with diethyl ether (200 mL), tetrahydrofuran (200 mL), ethyl acetate (100 mL) and petroleum ether 40-60 (200 mL). The resulting powder was dried under vacuum to give N-(2,3,4-trifluorobenzyl)hydrocinchoninium bromide (8) (1.57 g, 89% yield) as a white solid.

**m.p. > 250 °C (CH₂Cl₂/MeOH)**

**IR (film) ν_{max}/cm⁻¹**: 3164, 2959, 1516, 1493, 1457, 1307, 1126, 1072, 1044, 1013, 995, 963, 931, 899, 813, 777, 762, 753, 684, 636, 616.

**¹H NMR (500 MHz, CDCl₃)** δ 8.83 (d, J = 3.6 Hz, 1H), 8.28 (d, J = 8.3 Hz, 1H), 8.25 (br. s, 1H), 7.86 (d, J = 3.4 Hz, 1H), 7.51 (d, J = 8.1 Hz, 1H), 7.05 (q, J = 7.3 Hz, 1H), 6.96 (t, J = 7.1 Hz, 1H), 6.45 (app d, J = 19.0 Hz, 2H), 6.21 (d, J = 11.9 Hz, 1H), 5.52 (d, J = 12.1 Hz, 1H), 4.33-4.17 (m, 3H), 2.99 (dd, , J = 11.2, 8.4 Hz, 1H), 2.67 (q, J = 9.9 Hz, 1H), 2.00 (app t, J = 12.1 Hz, 1H), 1.89-1.58 (m, 4H), 1.59-1.37 (m, 3H), 0.90-0.76 (m, 3H), 0.70 (br s, 1H).

**¹³C NMR (126 MHz, CDCl₃, ¹⁹F decoupled)** δ 149.5, 147.1, 130.3, 129.6, 128.3, 127.0, 123.6, 123.5, 119.7, 113.1, 113.0, 67.3, 65.8, 57.4, 56.5, 36.2, 24.6, 24.3, 24.2, 21.8, 11.4.

**HRMS (ESI⁺)** C₂₅H₂₆ON₂F₃⁺ [M-Br]⁺: requires 441.21482, found: 441.21426, Δ -1.3 ppm.
3. Extended optimisation table

Figure 1. Catalysts used during optimisation studies
| Entry | Cat | Base | Solvent | R-X (eq) | Time | s | Conv | Starting material e.r. | Product e.r. |
|-------|-----|------|---------|----------|------|---|------|-----------------------|------------|
| 1     | CN1 | KOH (25% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 18h | 1.1 | 55% | 52.5:47.5 | 52:48 |
| 2     | CD2 | KOH (25% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 18h | 1.1 | 50% | 51.5:48.5 | 51.5:48.5 |
| 3     | 3   | KOH (25% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 18h | 1.2 | 42% | 52.5:47.5 | 52.5:47.5 |
| 4     | QN3 | KOH (25% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 18h | 1.1 | 50% | 51:49 | 51:49 |
| 5     | 3   | NaOH (25% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 18h | 1.2 | 36% | 52:48 | 53.5:46.5 |
| 6     | 3   | RbOH (25% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 18h | 1.3 | 35% | 55.5:44.5 | 51.5:48.5 |
| 7     | 3   | CsOH (25% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 18h | 1.2 | 42% | 52.5:47.5 | 52.5:46.5 |
| 8     | 3   | K₂CO₃ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 18h | 2.7 | 12% | 53:47 | 72:28 |
| 9     | 3   | Cs₂CO₃ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 18h | 2.5 | 13% | 53:47 | 71:29 |
| 10    | 3   | K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 18h | 3.1 | 13% | 53:47 | 73.5:26.5 |
| 11    | QD4 | K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 48h | 9.3 | 24% | 62:38 | 89:11 |
| 12    | QD5 | K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 48h | 2.3 | 16% | 53.5:46.5 | 68.5:31.5 |
| 13    | QD6 | K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 48h | 1.9 | 18% | 53:47 | 64:36 |
| 14    | QD7 | K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 48h | 4.8 | 3% | 51:49 | 79.5:20.5 |
| 15    | QD8 | K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 48h | 2.8 | 10% | 52.5:47.5 | 73.5:26.5 |
| 16    | QD9 | K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 48h | 3.0 | 2% | 51:49 | 74.5:25.5 |
| 17    | QD10| K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 48h | 2.9 | 4% | 51:49 | 76:24 |
| 18    | QD11| K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 48h | 5.3 | 29% | 62.5:37.5 | 80:20 |
| 19    | QD12| K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 48h | 7.3 | 13% | 55.5:45.5 | 88:12 |
| 20    | 4   | K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 48h | 13 | 27% | 65:35 | 90:10 |
| 21    | 5   | K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 48h | 7.6 | 5% | 52:48 | 91:9 |
| 22    | QD13| K₃PO₄ (50% aq, 5.0 eq) | PhCH₃ (0.1 M) | BnBr (0.6) | 48h | 5.6 | 13% | 55:45 | 83:17 |
| Entry | Cat  | Base          | Solvent       | R-X (eq)       | Time | s  | Conv  | Starting material e.r. | Product e.r. |
|-------|------|---------------|---------------|----------------|------|----|-------|------------------------|--------------|
| 23    | QD14 | K$_3$PO$_4$ (50% aq, 5.0 eq) | PhCH$_3$ (0.1 M) | BnBr (0.6) | 48h | 7.4 | 14%   | 56:44                  | 87:13        |
| 24    | QD15 | K$_3$PO$_4$ (50% aq, 5.0 eq) | PhCH$_3$ (0.1 M) | BnBr (0.6) | 48h | N/A | N/A   | 50:50                  | 51:49        |
| 25    | QD16 | K$_3$PO$_4$ (50% aq, 5.0 eq) | PhCH$_3$ (0.1 M) | BnBr (0.6) | 48h | 8.9 | 6%    | 52.5:47.5             | 90.5:9.5     |
| 26    |       | K$_3$PO$_4$ (50% aq, 5.0 eq) | PhCH$_3$ (0.1 M) | **Allyl bromide** (0.6) | 48h | 7.2 | 13%   | 55:45                  | 85:15        |
| 27    |       | K$_3$PO$_4$ (50% aq, 5.0 eq) | PhCH$_3$ (0.1 M) | **Allyl iodide** (0.6) | 48h | 7.1 | 35%   | 68:32                  | 83:17        |
| 28    |       | K$_3$PO$_4$ (50% aq, 5.0 eq) | PhCH$_3$ (0.1 M) | MeI (0.6)   | 48h | 3.5 | 19%   | 56:44                  | 76:24        |
| 29    |       | K$_3$PO$_4$ (50% aq, 5.0 eq) | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 12  | 35%   | 71:29                  | 89:11        |
| 30    |       | K$_3$PO$_4$ (s, 2.0 eq)       | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 6.4 | 45%   | 74.5:25.5              | 80:20        |
| 31    |       | K$_3$PO$_4$ (s, 5.0 eq)       | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 4.4 | 44%   | 70:30                  | 75:25        |
| 32    |       | K$_3$PO$_4$ (s, 10.0 eq)      | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 5.5 | 55%   | 81:29                  | 75:25        |
| 33    |       | Na$_3$PO$_4$ (s, 5.0 eq)      | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 8.5 | 12%   | 55:45                  | 88.5:11.5    |
| 34    |       | Na$_3$PO$_4$ (15% aq.)        | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 6.1 | 42%   | 71.5:28.5              | 80:20        |
| 35    |       | Na$_2$CO$_3$ (s, 5.0 eq)      | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | N/A | N/A   | 50:50                  | 75:25        |
| 36    |       | Na$_2$CO$_3$ (25% aq, 5.0 eq) | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 9.7 | 9%    | 54:46                  | 90:10        |
| 37    |       | K$_2$CO$_3$ (s, 5.0 eq)       | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 8.8 | 11%   | 55:45                  | 89:11        |
| 38    |       | K$_2$CO$_3$ (50% aq, 5.0 eq) | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 12  | 12%   | 55.5:45.5              | 91.5:8.5     |
| 39    |       | Cs$_2$CO$_3$ (s, 2.0 eq)      | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 1.7 | 39%   | 56.5:43.5              | 60:40        |
| 40    |       | Cs$_2$CO$_3$ (50% aq, 5.0 eq) | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 8.2 | 26%   | 62.5:37.5              | 86.5:13.5    |
| 41    |       | NaOH (25% aq, 5.0 eq)         | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 2.7 | 57%   | 70:30                  | 65:35        |
| 42    |       | KOH (25% aq, 5.0 eq)          | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 3.0 | 63%   | 76:24                  | 65.5:34.5    |
| 43    |       | CsOH (25% aq, 5.0 eq)         | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 3.8 | 60%   | 78.5:21.5              | 69:31        |
| 44    |       | RbOH (25% aq, 5.0 eq)         | PhCH$_3$ (0.1 M) | BnI (0.6)   | 48h | 6.1 | 56%   | 83.5:16.5              | 76:24        |
| Entry | Cat  | Base          | Solvent       | R-X (eq)        | Time | s  | Conv | Starting material e.r. | Product e.r. |
|-------|------|---------------|---------------|----------------|------|----|------|------------------------|--------------|
| 46    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | $\text{Et}_2\text{O}$ (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 7.7 | 34%  | 68:32                  | 84.5:15.5    |
| 47    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | $^3\text{BuOMe}$ (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 4.7 | 42%  | 69.5:30.5              | 76.5:23.5    |
| 48    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | Mesityl oxide (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 2.4 | 73%  | 76.5:23.5              | 60:40        |
| 49    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | $\text{CH}_2\text{Cl}_2$ (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 8.2 | 68%  | 97:3                   | 72:28        |
| 50    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | $\text{CHCl}_3$ (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 10  | 57%  | 91:9                   | 79.5:20.5    |
| 51    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | $\text{PhH}$ (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 14  | 53%  | 90:10                  | 85:15        |
| 52    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | $\text{PhCF}_3$ (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 2.4 | 43%  | 62:38                  | 66:34        |
| 53    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | m-Xylene (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 15  | 10%  | 55:45                  | 93:17        |
| 54    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | p-Xylene (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 13  | 7%   | 53:47                  | 92.5:7.5     |
| 55    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | 1,2-Dichloro-ethane (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 7.6 | 72%  | 98:2                   | 69:31        |
| 56    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | $\text{CCl}_4$ (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 8.6 | 29%  | 65:35                  | 86.5:13.5    |
| 57    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | 2-MeTHF (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 9.7 | 34%  | 69:31                  | 87:13        |
| 58    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | $^3\text{Pr}_2\text{O}$ (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 2.1 | 8%   | 51:54                  | 67.5:32.5    |
| 59    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | $\text{THF}$ (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 2.5 | 67%  | 74.5:25.5              | 62:38        |
| 60    | 4    | $\text{K}_3\text{PO}_4$ (50% aq, 5.0 eq) | 1,4-Dioxane (0.1 M) | $\text{BnI}$ (0.6) | 48h  | 6.6 | 60%  | 88:12                  | 75:25        |
| 61    | 4    | $\text{K}_3\text{PO}_4$ (s, 5.0 eq) | 9:1 PhH/CHCl$_3$ (0.1 M) | $\text{BnOTs}$ (0.6) | 72h  | 2.5 | 56%  | 68:32                  | 64:36        |
| 62    | 4    | $\text{K}_2\text{CO}_3$ (50% aq, 5.0 eq) | $\text{PhH}$ (0.1 M) | $\text{BnOTs}$ (0.6) | 72h  | 8.5 | 48%  | 80:20                  | 81:19        |
| 63    | 4    | $\text{Cs}_2\text{CO}_3$ (50% aq, 5.0 eq) | $\text{PhH}$ (0.1 M) | $\text{BnOTs}$ (0.6) | 72h  | 6.0 | 41%  | 80:20                  | 71:29        |
| 64    | QD15 | $\text{K}_2\text{CO}_3$ (50% aq, 5.0 eq) | $\text{PhH}$ (0.1 M) | $\text{BnOTs}$ (0.6) | 72h  | 15  | 55%  | 92:8                   | 85:15        |
| 65    | QD12 | $\text{K}_2\text{CO}_3$ (50% aq, 5.0 eq) | $\text{PhH}$ (0.1 M) | $\text{BnOTs}$ (0.6) | 72h  | 13.9| 57%  | 94:6                   | 83:17        |
| 66    | QD4  | $\text{K}_2\text{CO}_3$ (50% aq, 5.0 eq) | $\text{PhH}$ (0.1 M) | $\text{BnOTs}$ (0.6) | 72h  | 5.8 | 43%  | 72:28                  | 79:21        |
| Entry | Cat   | Base       | Solvent       | R-X (eq)   | Time | s  | Conv | Starting material e.r. | Product e.r. |
|-------|-------|------------|---------------|------------|------|----|------|------------------------|--------------|
| 67    | QD13  | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.1 M)  | BnOTs (0.6) | 72h  | 3.4 | 50%  | 70:5:29.5             | 70:30        |
| 68    | QD14  | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.1 M)  | BnOTs (0.6) | 72h  | 6.5 | 57%  | 85:15                 | 76:24        |
| 69    | 6     | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.1 M)  | BnOTs (0.6) | 72h  | 21  | 54%  | 94.5:5.5              | 88:12        |
| 70    | CN17  | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.1 M)  | BnOTs (0.6) | 48h  | 1.8 | 50%  | 60:40                 | 60:40        |
| 71    | CN18  | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.1 M)  | BnOTs (0.6) | 48h  | 3.9 | 44%  | 68.5:31.5             | 73.5:26.5    |
| 72    | CN19  | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.1 M)  | BnOTs (0.6) | 48h  | 2.7 | 37%  | 61:39                 | 68.5:31.5    |
| 73    | CN20  | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.1 M)  | BnOTs (0.6) | 48h  | 2.4 | 47%  | 65.5:36.5             | 65.5:34.5    |
| 74    | 7     | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.1 M)  | BnOTs (0.6) | 48h  | 21  | 48%  | 87:13                 | 91.5:9.5     |
| 75    | CN1   | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.1 M)  | BnOTs (0.6) | 48h  | 2.9 | 51%  | 68:32                 | 67:33        |
| 76    | CN21  | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.1 M)  | BnOTs (0.6) | 48h  | 4.3 | 37%  | 65.5:34.5             | 76:24        |
| 77    | CN22  | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.1 M)  | BnOTs (0.6) | 48h  | 17  | 44%  | 82:18                 | 90:10        |
| 78    | QD16  | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.1 M)  | BnOTs (0.6) | 72h  | 21  | 55%  | 94:6                  | 88:12        |
| 79    | QD16  | K₂CO₃ (50% aq, 5.0 eq) | PhMe (0.1 M) | BnOTs (0.6) | 72h  | 19  | 43%  | 81:19                 | 90.5:9.5     |
| 80    | QD16  | K₂CO₃ (50% aq, 5.0 eq) | C₂H₅Cl₂ (0.1 M) | BnOTs (0.6) | 72h  | 9   | 31%  | 66:5:33.5             | 86:14        |
| 81    | QD16  | K₂CO₃ (50% aq, 5.0 eq) | CHCl₃ (0.1 M) | BnOTs (0.6) | 72h  | 10  | 45%  | 79:21                 | 85:15        |
| 82    | QD16  | K₂CO₃ (50% aq, 5.0 eq) | m-Xylene (0.1 M) | BnOTs (0.6) | 72h  | 19  | 44%  | 82:18                 | 90.5:9.5     |
| 83    | QD16  | K₂CO₃ (50% aq, 5.0 eq) | p-Xylene (0.1 M) | BnOTs (0.6) | 72h  | 22  | 47%  | 84:16                 | 89:11        |
| 84    | QD16  | K₂CO₃ (50% aq, 5.0 eq) | PhCF₃ (0.1 M) | BnOTs (0.6) | 72h  | 7.5 | 22%  | 60:40                 | 86:14        |
| 85    | QD16  | K₂CO₃ (50% aq, 5.0 eq) | Et₂O (0.1 M) | BnOTs (0.6) | 72h  | 12  | 49%  | 84:16                 | 85:15        |
| 86    | QD16  | K₂CO₃ (50% aq, 5.0 eq) | Pr₂O (0.1 M) | BnOTs (0.6) | 72h  | 5.0 | 31%  | 64:36                 | 80.5:19.5    |
| 87    | QD16  | K₂CO₃ (50% aq, 5.0 eq) | 'BuO introduction (0.1 M) | BnOTs (0.6) | 72h  | 11  | 47%  | 81:19                 | 85:15        |
| 88    | QD16  | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.2 M)  | BnOTs (0.6) | 72h  | 12  | 41%  | 79.5:20.5             | 87:13        |
| Entry | Cat | Base | Solvent | R-X (eq) | Time | Conv | Starting material e.r. | Product e.r. |
|-------|-----|------|---------|----------|------|------|---------------------|-------------|
| 89    | QD16 | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.05 M) | BnOTs (0.6) | 72h | 19 | 43% | 81:19 | 90.5:9.5 |
| 90    | QD16 | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 72h | 25 | 44% | 83.5:16.5 | 92:8 |
| 91    | CN22 | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 72h | 26 | 43% | 83:17 | 93:7 |
| 92    | 8   | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 72h | 32 | 46% | 87:13 | 93.5:6.5 |
| 93    | 8   | NaOH (25% aq, 2.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 24h | 9.2 | 51% | 83.5:16.5 | 82.5:17.5 |
| 94    | 8   | KOH (25% aq, 2.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 24h | 7.8 | 50% | 81:19 | 81:19 |
| 95    | 8   | CsOH (25% aq, 2.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 24h | 19 | 49% | 88:12 | 89:11 |
| 96    | 8   | KHCO₃ (25% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 24h | 33 | 4% | 51.5:48.5 | 94:6 |
| 97    | 8   | KF (25% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 24h | 20 | 8% | 54:46 | 95:5 |
| 98    | 8   | CsF (25% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 24h | 40 | 2% | 51:49 | 97.5:2.5 |
| 99    | 8   | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (1.0) | 24h | 32 | 53% | 96.5:3.5 | 90.5:9.5 |
| 100   | 8   | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (1.0) | 24h | 32 | 44% | 84.5:15.5 | 94:6 |
| 101   | 8   | Na₃PO₄ (s, 5.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 24h | 30 | 28% | 67.5:32.5 | 95.5:4.5 |
| 102   | 8   | K₃PO₄ (50% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 24h | 34 | 48% | 90:5:9.5 | 93:7 |
| 103   | 8   | Rb₂CO₃ (50% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 24h | 29 | 40% | 79.5:20.5 | 94:6 |
| 104   | 8   | NaOH (25% aq, 2.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 48h | 10 | 54% | 87.5:12.5 | 82:18 |
| 105   | 8   | KOH (25% aq, 2.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 48h | 8.2 | 8% | 85:1:45 | 80:20 |
| 106   | 8   | CsOH (25% aq, 2.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 48h | 20 | 55% | 95:5 | 87:13 |
| 107   | 8   | KHCO₃ (25% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 48h | 27 | 4% | 53:47 | 96.5:3.5 |
| 108   | 8   | KF (25% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 48h | 53 | 10% | 55:45 | 98:2 |
| 109   | 8   | CsF (25% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (0.6) | 48h | 25 | 4% | 52:48 | 96:4 |
| 110   | 8   | K₂CO₃ (50% aq, 5.0 eq) | PhH (0.025 M) | BnOTs (1.0) | 48h | 25 | 58% | 99:1 | 85.5:14.5 |
| Entry | Cat     | Base                                      | Solvent       | R-X (eq) | Time | s   | Conv | Starting material e.r. | Product e.r. |
|-------|---------|-------------------------------------------|---------------|----------|------|-----|------|------------------------|--------------|
| 111   | 8       | K₂CO₃ (50% aq, 5.0 eq)                    | PhH (0.025 M) | BnOTs (1.0) | 48h  | 32  | 51%  | 93:7                   | 92:8         |
| 112   | 8       | Na₃PO₄ (s, 5.0 eq)                        | PhH (0.025 M) | BnOTs (0.6) | 48h  | 29  | 35%  | 74:26                  | 94.5:5.5     |
| 113   | 8       | K₃PO₄ (50% aq, 5.0 eq)                    | PhH (0.025 M) | BnOTs (0.6) | 48h  | 31  | 54%  | 96.5:3.5               | 90.5:9.5     |
| 114   | 8       | Rb₂CO₃ (50% aq, 5.0 eq)                   | PhH (0.025 M) | BnOTs (0.6) | 48h  | 31  | 47%  | 88:12                  | 93:7         |
| 115   | 8       | K₂CO₃ (sat. aq, 5.0 eq)                   | PhH (0.025 M) | BnOTs (0.6) | 48h  | 35  | 50%  | 93:7                   | 93:7         |
| 116   | 8       | K₂CO₃ (sat. aq, 5.0 eq)                   | PhH (0.025 M) | BnOTs (0.7) | 48h  | 35  | 55%  | 98.5:1.5               | 89.5:10.5    |
| 117   | 8       | K₂CO₃ (sat. aq, 5.0 eq)                   | PhH (0.025 M) | BnOTs (0.8) | 48h  | 34  | 57%  | 99.5:0.5               | 87.5:12.5    |
| 118   | 8       | K₂CO₃ (sat. aq, 5.0 eq)                   | PhH (0.025 M) | BnOTs (0.9) | 48h  | 25  | 60%  | 99.5:0.5               | 83.5:16.5    |
| 119   | 8       | K₂CO₃ (sat. aq, 5.0 eq)                   | PhH (0.025 M) | BnOTs (1.0) | 48h  | 26  | 60%  | >99.5:0.5              | 83:17        |
| 120   | 8       | K₂CO₃ (sat. aq, 5.0 eq)                   | PhH (0.025 M) | BnOTs (1.5) | 48h  | 13  | 69%  | >99.5:0.5              | 72:28        |
| 121   | 8       | K₂CO₃ (sat. aq, 5.0 eq)                   | 9:1 PhH /CH₂Cl₂ (0.025 M) | BnOTs (0.6) | 48h  | 31  | 45%  | 85.5:14.5              | 93.5:6.5     |
| 122   | 8       | K₂CO₃ (sat. aq, 5.0 eq)                   | 9:1 PhH /CHCl₃ (0.025 M) | BnOTs (0.6) | 48h  | 31  | 46%  | 87:13                  | 93:7         |
| 123   | 8       | K₂CO₃ (sat. aq, 5.0 eq)                   | 9:1 PhH /Et₂O (0.025 M) | BnOTs (0.6) | 48h  | 34  | 48%  | 90:10                  | 93.5:6.5     |
| 124   | 8       | K₂CO₃ (s, 5.0 eq)                         | 9:1 PhH /Et₂O (0.025 M) | BnOTs (0.6) | 48h  | 34  | 46%  | 87.5:12.5              | 94:6         |
| 125   | 8       | K₃PO₄ (sat. aq, 5.0 eq)                   | 9:1 PhH /Et₂O (0.025 M) | BnOTs (0.6) | 48h  | 32  | 46%  | 87.5:12.5              | 93.5:6.5     |
| 126   | 8       | K₂CO₃ (sat. aq, 5.0 eq)                   | 9:1 PhH /Et₂O (0.025 M) | BnOTs (1.0) | 24h  | 36  | 49%  | 91.5:8.5               | 93.5:6.5     |
| 127   | 8       | K₂CO₃ (sat. aq, 5.0 eq)                   | 9:1 PhH /Et₂O (0.025 M) | BnOTs (1.5) | 24h  | 35  | 54%  | 98:2                   | 90:10        |
4. Synthesis of Racemic BINOLs

Racemic BINOLs were synthesised as shown below. Brominated 2-naphthols (see subsections for synthetic routes) were dimerised following a literature procedure. 6,6’-dibromo BINOL (54) was prepared by bromination of racemic BINOL. Monomethylation gave the $C_2$ symmetric brominated methyl BINOLs. Debromination with n-BuLi followed by aqueous quenching gave the non-$C_2$ symmetric bromination BINOLs. The C-Br bonds were then further functionalised through a variety of reactions.

![Synthesis of substituted BINOLs by C-Br bond transformation](image)

Synthesis of substituted BINOLs by C-Br bond transformation. Conditions: A: PhB(OH)$_2$ (1.20 equiv.), Pd(PPh$_3$)$_4$ (5 mol%), Na$_2$CO$_3$ (2.50 equiv.), dioxane-H$_2$O, 90 °C, 16 h. Conditions B: MeMgI (3.00 equiv.), Pd(dppf)Cl$_2$ (10 mol%), THF, Δ. Conditions C: morpholine, Pd$_2$(dba)$_3$ (1 mol%), DavePhos (1.2 mol%), LiHMDS (2.20 equiv.), THF. Conditions D: NaOMe (12.0 equiv.), CuCl (3.00 equiv.), Me$_2$CO, 90 °C, 16 h. Conditions E: PhB(OH)$_2$ (2.40 equiv.), Pd(PPh$_3$)$_4$ (5 mol%), Na$_2$CO$_3$ (5.00 equiv.), dioxane-H$_2$O, 90 °C, 16 h. Conditions F: MeMgI (10.0 equiv.), Pd(dppf)Cl$_2$ (10 mol%), THF, Δ. Conditions G: MeB(OH)$_2$ (4.0 equiv.), Pd(dppf)Cl$_2$-CH$_2$Cl$_2$ (10 mol%), Cs$_2$CO$_3$ (4.0 equiv), 1,4-dioxane, Δ. Conditions H: ArB(OH)$_2$ (2.5 equiv), Pd(PPh$_3$)$_4$ (0.05 equiv), Na$_2$CO$_3$ (2 M aq, 5.0 equiv), DME, Δ.
4.1. 7-Substituted BINOLs

7-Bromonaphthalen-2-ol (50)

Following a modified literature procedure. Bromine (6.14 mL, 19.1 g, 120 mmol, 1.20 equiv.) was added dropwise over 30 minutes to a suspension of PPh₃ (31.4 g, 120 mmol, 1.20 equiv.) in acetonitrile (50 mL) at 0 °C. The reaction was warmed to room temperature, 2,7-dihydroxynaphthalene (16.0 g, 100 mmol, 1.00 equiv.) was added and the reaction was heated at 90 °C for 1 hour. Acetonitrile was removed in vacuo, the flask was fitted with a gas trap filled with saturated Na₂SO₃ solution and the reaction was heated at 250 °C for 1 hour. The resulting mixture was dissolved in CH₂Cl₂ and filtered through a plug of silica and concentrated. Purification via flash column chromatography (50% CH₂Cl₂ – petroleum ether to 100% CH₂Cl₂) afforded 7-Bromonaphthalen-2-ol (50) (7.48 g, 30%) as a brown solid.

m.p. = 119-120 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν_max/cm⁻¹: 3366, 2923, 1652, 1577, 1506, 1473, 1457, 1253, 1209, 921, 626.

¹H NMR (500 MHz, CDCl₃) δ = 7.87 (d, J = 1.68 Hz, 1H), 7.74 (d, J = 8.82 Hz, 1H), 7.65 (d, J = 8.66 Hz, 1H), 7.42 (dd, J = 8.71, 1.92 Hz), 7.13 (dd, J = 8.81, 2.49 Hz, 1H), 7.08 (d, J = 2.35 Hz), 5.05 (s, 1H).

¹³C NMR (126 MHz, CDCl₃) δ = 154.1, 135.8, 129.9, 129.4, 128.3, 127.3, 127.0, 120.8, 118.2, 108.7.

HRMS (ESI⁻) C₁₀H₇⁷⁹BrO [M-H]⁻ requires 220.9608; found 220.9607, Δ -0.5 ppm.

Data in agreement with literature reported⁴
7,7'-Dibromo-[1,1'-binaphthalene]-2,2'-diol (53)

7-Bromonaphthalen-2-ol (50) (7.48 g, 33.5 mmol, 1.00 equiv.) was dissolved in CH$_2$Cl$_2$ (220 mL) and [Cu(TMEDA)OHCl)]$_2$ (155 mg, 0.0350 mmol, 1 mol%) was added. The reaction was stirred for 16 hours at room temperature open to air. The reaction mixture was filtered through a short silica plug eluting with CH$_2$Cl$_2$. Evaporation of the solvent gave 7,7'-dibromo-[1,1'-binaphthalene]-2,2'-diol (53) (6.28 g, 85%) as an off-white solid.

**m.p.** = 115-117 °C (CH$_2$Cl$_2$).

**IR** (film) $\nu_{\text{max}}$/cm$^{-1}$: 3466, 1611, 1500, 1418, 1378, 1317, 1213, 1195, 1171, 1128, 836, 739.

**$^1$H NMR** (400 MHz, CDCl$_3$) $\delta = 7.94$ (d, $J = 8.9$ Hz, 2H), 7.76 (d, $J = 8.6$ Hz, 2H), 7.47 (d, $J = 8.7$ Hz, 2H), 7.37 (d, $J = 8.9$ Hz, 2H), 7.23 (s, 2H), 5.04 (s, 2H).

**$^{13}$C NMR** (101 MHz, CDCl$_3$) $\delta = 153.6$, 134.6, 131.7, 130.2, 127.9, 127.8, 125.9, 122.4, 118.3, 109.5.

**HRMS** (ESI$^-$) C$_{20}$H$_{12}$Br$_2$O$_2$ [M-H]$^-$ requires 440.91310, found: 440.91330, $\Delta +0.5$ ppm.

Data in agreement with literature reported$^4$
7,7'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (30)

![Chemical Structure](image)

7,7'-dibromo-[1,1'-binaphthalene]-2,2'-diol (53) (6.38 g, 14.4 mmol, 1.00 equiv.) was dissolved in acetone (115 mL) and K$_2$CO$_3$ (2.58 g, 18.7 mmol, 1.30 equiv.) followed by iodomethane (984 µL, 2.24 g, 15.8 mmol, 1.10 equiv.) were added. The reaction was heated under reflux for 16 hours. Upon cooling to room temperature, the solvent was removed in vacuo. The residue was partitioned between water and CH$_2$Cl$_2$ and the phases were separated. The aqueous layer was extracted twice with CH$_2$Cl$_2$ and the organic layers were combined, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (1:1 CH$_2$Cl$_2$ – petroleum ether 40-60) gave 7,7'-dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (30) (3.21 g, 49%) as an off-white solid.

**m.p. = 179-181 °C (CH$_2$Cl$_2$/petroleum ether 40-60).**

**IR (film) $\nu_{\text{max}}/\text{cm}^{-1}$:** 3503, 1612, 1497, 1255, 1088, 830, 754.

**$^1$H NMR (500 MHz, CDCl$_3$) $\delta =$**
- 8.02 (d, J = 9.1 Hz, 1H),
- 7.87 (d, J = 8.9 Hz, 1H),
- 7.76 (d, J = 8.7 Hz, 1H),
- 7.73 (d, J = 8.7 Hz, 1H),
- 7.47 (d, J = 9.1 Hz, 1H),
- 7.46 (dd, J = 8.7, 1.9 Hz, 1H),
- 7.40 (dd, J = 8.6, 1.9 Hz, 1H),
- 7.35 (d, J = 8.9 Hz, 1H),
- 7.28 (d, J = 1.9 Hz, 1H),
- 7.15 (d, J = 1.9 Hz, 1H),
- 4.88 (s, 1H),
- 3.81 (s, 3H).

**$^{13}$C NMR (127 MHz, CDCl$_3$) $\delta =$**
- 156.9, 152.1, 135.3, 135.1, 131.6, 130.2, 130.1, 130.1, 128.0, 127.9, 127.8, 127.0, 126.7, 126.5, 122.5, 121.4, 118.1, 114.0, 113.8, 113.7, 56.7

**HRMS (ESI\') C$_{21}$H$_{14}$Br$_2$O$_2$ [M-H]:** requires 454.92878, found: 454.92905 $\Delta +0.6$ ppm.
2'-methoxy-7,7'-dimethyl-[1,1'-binaphthalen]-2-ol (32)

To a flask containing 7,7'-dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (30) (200 mg, 0.437 mmol, 1.00 equiv.), Pd(dppf)Cl$_2$-CH$_2$Cl$_2$ (35.6 mg, 0.044 mmol, 0.10 equiv.), cesium carbonate (569 mg, 1.75 mmol, 4.00 equiv.) and methylboronic acid (104 mg, 1.75 mmol, 4.00 equiv.), was added 1,4-dioxane (4.50 mL, N$_2$ sparged). The resulting suspension was heated at 105 °C for 48 h. The mixture was cooled to room temperature, diluted with EtOAc (10.0 mL) and filtered through a short plug of silica (eluting with EtOAc). The resulting solution was concentrated in vacuo and purified by flash column chromatography (2:1 petroleum ether 40-60 – diethyl ether) to give 2'-methoxy-7,7'-dimethyl-[1,1'-binaphthalen]-2-ol (32) as an off-white powder (138 mg, 96%)

m.p. = 75-79 °C (CH$_2$Cl$_2$/petroleum ether 40-60)

IR (film) ν$_{max}$/cm$^{-1}$: 3489, 3431, 3046, 3012, 2917, 2848, 1624, 1510, 1458, 1360, 1322, 1263, 1249, 1216, 1182, 1170, 1152, 1085, 831, 756.

$^1$H NMR (500 MHz, CDCl$_3$) δ$_H$: 8.01 (d, $J = 9.1$ Hz, 1H), 7.85 (d, $J = 8.9$ Hz, 1H), 7.80 (d, $J = 8.3$ Hz, 1H), 7.76 (d, $J = 8.5$ Hz, 1H), 7.41 (d, $J = 9.1$ Hz), 7.28 (d, $J = 8.8$ Hz, 1H), 7.21 (dd, $J = 8.3$, 1.49 Hz, 1H), 7.15 (dd, $J = 8.3$, 1.5 Hz, 1H), 6.95 (d, $J = 0.4$ Hz, 1H), 6.82 (d, $J = 0.5$ Hz, 1H), 4.81 (s, 1H), 3.78 (s, 3H), 2.27 (s, 3H), 2.25 (s, 3H)

$^{13}$C NMR (126 MHz, CDCl$_3$) δ$_C$: 156.4, 151.3, 137.4, 136.2, 134.4, 134.1, 130.8, 129.5, 128.1, 128.1, 127.9, 127.5, 126.7, 125.7, 124.0, 123.8, 116.5, 114.9, 114.8, 113.0, 56.8, 22.1, 22.1

HRMS (ESI$^+$) C$_{23}$H$_{21}$O$_2$ [M+H]$^+$ requires 329.15361; found 329.15366, Δ +0.2 ppm.
7,7′-Dibromo-2′-methoxy-[1,1′-binaphthalen]-2-ol (30) (2.52 g, 5.50 mmol, 1.00 equiv.) was dissolved in THF (55 mL) and cooled to −78 °C. n-BuLi (1.6 M in hexane, 6.87 mL, 11.0 mmol, 2.00 equiv.) was added by syringe pump over 1 hour after which time the reaction was stirred for a further 1 hour at −78 °C. The reaction was quenched by dropwise addition of water. After warming to room temperature, saturated ammonium chloride solution was added. EtOAc was added and the phases were separated. The aqueous phase was extracted twice with EtOAc and the combined organic layers were washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was purified by column chromatography (20% EtOAc-petroleum ether 40-60) to give 7-bromo-2′-methoxy-[1,1′-binaphthalen]-2-ol (13) (1.54 g, 77%)

m.p. = 171-172 °C. (EtOAc/petroleum ether 40-60)

IR (film) ν max/cm⁻¹: 3496, 1612, 1501, 1352, 1250, 1168, 828, 809, 754.

¹H NMR (CDCl₃, 400 MHz) δ = 8.08 (d, J = 9.1 Hz, 1H), 7.91 (d, J = 8.1 Hz, 1H), 7.86 (d, J = 9.0 Hz, 1H), 7.72 (d, J = 8.6 Hz, 1H), 7.49 (d, J = 9.1 Hz, 1H), 7.42–7.37 (m, 2H, 1), 7.35 (d, J = 8.9 Hz, 1H), 7.32 (ddd, J = 8.2, 6.8, 1.4 Hz, 1H), 7.19 (d, J = 1.8 Hz, 1H), 7.15 (dd, J = 8.4, 1.1 Hz, 1H), 4.93 (s, 1H), 3.82 (s, 4H).

¹³C NMR (CDCl₃, 101 MHz) δ = 156.2, 152.2, 135.2, 133.9, 131.6, 129.9, 129.9, 129.6, 128.4, 127.7, 127.0, 126.8, 124.6, 124.4, 121.2, 118.0, 114.6, 114.3, 113.8, 56.7.

HRMS (ESI⁻) C₂₁H₁₅O₂⁷⁹Br [M−H]⁻ requires 377.01827; found 377.01807, Δ −0.5 ppm.
7-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (13) (170 mg, 0.448 mmol, 1.00 equiv.) was dissolved in DMF (4.5 mL) then CuCl (133 mg, 1.34 mmol 3.00 equiv.) and NaOMe (4.4 M in MeOH, 1.22 mL, 5.38 mmol, 12.0 equiv.) were added sequentially. The reaction was heated at 100 °C for 16 h then cooled to room temperature. Ice water was added followed by hydrochloric acid (3 M). The resulting suspension was extracted 3 times with EtOAc and the combined organic layers were washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (3:1 CH₂Cl₂ – petroleum ether 40-60 to 9:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2',7-dimethoxy-[1,1'-binaphthalen]-2-ol (14) as an off-white solid (99.7 mg, 67%).

**m.p.** = 137-139 °C (CH₂Cl₂/ petroleum ether 40-60).

**IR (film)** $\nu_{max}/\text{cm}^{-1}$: 3495, 3427, 3058, 3007, 2936, 28238, 1621, 1592, 1511, 1464, 1430, 1368, 1331, 1264, 1248, 1221, 1199, 1166, 1148, 1082, 833, 815, 752.

**$^1$$H$ NMR** (500 MHz, CDCl₃) $\delta$ = 8.05 (d, $J$ = 9.1 Hz, 1H), 7.90 (d, $J$ = 8.1 Hz, 1H), 7.83 (d, $J$ = 8.8 Hz, 1H), 7.77 (d, $J$ = 8.9 Hz, 1H), 7.48 (d, $J$ = 9.1 Hz, 1H), 7.38 (ddd, $J$ = 1.2, 6.8, 8.1 Hz, 1H), 7.30 (ddd, $J$ = 1.3, 6.8, 8.4 Hz, 1H), 7.25-7.20 (m, 2H), 6.99 (dd, $J$ = 2.5, 8.9 Hz, 1H), 6.37 (d, $J$ = 2.5 Hz, 1H), 4.92 (s, 1H), 3.82 (s, 3H), 3.51 (s, 3H).

**$^{13}$$C$ NMR** (126 MHz, CDCl₃) $\delta$ = 158.3, 156.0, 151.9, 135.2, 133.9, 131.2, 129.8, 129.6, 128.2, 127.4, 125.0, 124.7, 124.3, 115.5, 115.2, 115.1, 114.3, 113.9, 104.3, 56.8, 55.1.

**HRMS (ESI$^+$)** $\text{C}_{22}\text{H}_{19}\text{O}_3^+$ [M+H]$^+$: requires: 331.13287, found: 331.13297, Δ +0.3 ppm.
2'-Methoxy-7-methyl-[1,1'-binaphthalen]-2-ol (15)

7-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (13) (443 mg, 1.20 mmol, 1.00 equiv.) and Pd(dppf)Cl$_2$·CH$_2$Cl$_2$ (98 mg, 0.12 mmol, 10 mol%) were dissolved in THF (15 mL) and MeMgCl solution (3 M in Et$_2$O, 2 mL, 6.00 mmol, 5.00 equiv.) was added. The resulting solution was heated under reflux for 16 hours. On cooling to room temperature, saturated ammonium chloride solution was added and phases were separated. The aqueous phase was extracted twice with EtOAc and the combined organic layers were washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was purified by column chromatography (9:1 petroleum ether 40-60 – EtOAc) to give 2'-methoxy-7-methyl-[1,1'-binaphthalen]-2-ol (15) (334 mg, 88%) as an off-white solid.

**m.p.** = 87-88 °C (EtOAc/petroleum ether 40-60).

**IR** (film) $\nu_{\text{max}}/\text{cm}^{-1}$: 3481, 3396, 1704, 1621, 1591, 1508, 1473, 1459, 1431, 1378, 1362, 1332, 1265, 1248, 1220, 1184, 1172, 1146, 1129, 1083, 1053, 1041, 1020, 977, 908, 859, 833, 811, 775, 747, 676, 629.

$^1$H **NMR** (400 MHz, CDCl$_3$) $\delta$ = 8.06 (1H, d, $J$ = 9.0 Hz), 7.92 (1H, d, $J$ = 8.1 Hz), 7.87 (1H, d, $J$ = 8.9 Hz), 7.78 (1H, d, $J$ = 8.3 Hz), 7.50 (1H, d, $J$ = 9.1 Hz), 7.40 (1H, ddd, $J$ = 8.1, 6.6, 1.3 Hz), 7.35–7.28 (2H, m), 7.24–7.15 (2H, m), 6.84 (1H, s), 4.90 (1H, s), 3.82 (3H, s), 2.27 (3H, s).

$^{13}$C **NMR** (101 MHz, CDCl$_3$) $\delta$ = 156.0, 151.3, 136.2, 134.1, 134.0, 131.0, 129.5, 129.5, 128.1, 128.0, 127.4, 127.3, 125.6, 125.0, 124.2, 123.8, 116.5, 115.6, 114.5, 113.9, 56.7, 29.8.

**HRMS** (ESI') $^{13}$C$_{22}$H$_{18}$O$_2$ [M-H]$^-$ requires 313.12340; found 313.12326, $\Delta$ -0.5 ppm.
7-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (13) (548 mg, 1.50 mmol, 1.00 equiv.), phenyl boronic acid (220 mg, 1.80 mmol, 1.20 equiv.) and Pd(PPh₃)₄ (86.7 mg, 0.0750 mmol, 5 mol%) were charged to a flask fitted with a water-cooled condenser. The flask was evacuated and backfilled with argon three times. 1,2-Dimethoxyethane (Argon sparged, 15 mL) was added followed by aqueous Na₂CO₃ solution (Argon sparged, 2 M, 1.87 mL, 2.50 equiv.). The flask was fitted with an argon balloon and heated at 90 °C for 16 hours. After cooling to room temperature, 1 M HCl solution was added and the solution was extracted three times with CH₂Cl₂, the combined organic layers were dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was purified by column chromatography (9:1 petroleum ether 40-60 – EtOAc) to give 2'-methoxy-7-phenyl-[1,1'-binaphthalen]-2-ol 16) (410 mg, 71%) as a white solid.

**m.p.** = 86-87 °C (EtOAc/petroleum ether 40-60).

**IR** (film) νₓ max/cm⁻¹: 3489, 3055, 2935, 2837, 2361, 1619, 1591, 1507, 1456, 1377, 1264, 1247, 1166, 1131, 1055, 839, 811, 752, 697.

**¹H NMR** (400 MHz, CDCl₃) δₓ H = 7.93 (d, J = 9.0 Hz, 1H), 7.86–7.82 (m, 2H), 7.79 (dt, J = 8.3, 1.0 Hz, 2H), 7.48 (dd, J = 8.5, 1.8 Hz, 2H), 7.37 (d, J = 9.1 Hz, 2H), 7.31–7.24 (m, 4H), 7.23–7.10 (m, 6H), 3.70 (s, 3H).

**¹³C NMR** (101 MHz, CDCl₃) δₓ C = 156.0, 151.7, 141.6, 139.2, 134.1, 134.0, 131.2, 129.6, 129.5, 128.7, 128.6, 128.4, 128.3, 127.5, 127.4, 127.1, 124.9, 124.3, 123.2, 123.0, 117.6, 115.4, 115.2, 113.8, 56.7.

**HRMS** (ESI⁺) C₂₇H₂₆O₂ [M+H]+ requires 377.15361; found 377.15363, Δ +0.1 ppm.
4.2. 6-Substituted BINOLs

6,6'-Dibromo-[1,1'-binaphthalene]-2,2'-diol (54)

(+)-BINOL (14.3 g, 50.0 mmol, 1.00 equiv.) was dissolved in acetonitrile (250 mL) and the resulting solution cooled to 0 °C. Bromine (7.70 mL, 24.0 g, 150 mmol, 3.00 equiv.) was added dropwise over 10 minutes. The reaction was stirred for 3 hours at 0 °C after which time saturated Na$_2$SO$_3$ solution was added. The solution was extracted three times with CH$_2$Cl$_2$ and the combined organic layers were dried over sodium sulfate, filtered and concentrated to give 6,6'-dibromo-[1,1'-binaphthalene]-2,2'-diol (54) (22.2 g, 100%) as an off-white solid.

m.p. = 115-117 °C (CH$_2$Cl$_2$).

$^1$H NMR (500 MHz, CDCl$_3$) $\delta = 8.05$ (d, $J = 2.0$ Hz, 2H), 7.90 (d, $J = 9.0$ Hz, 2H), 7.40 (d, $J = 9.0$ Hz, 2H), 7.37 (dd, $J = 2.0$, 9.0 Hz, 2H), 6.96 (d, $J = 9.0$ Hz, 2H), 5.04 (s, 2H).

$^{13}$C NMR (127 MHz, CDCl$_3$) $\delta = 153.1$, 132.0, 131.0, 130.9, 130.7, 130.6, 126.0, 119.1, 118.2, 110.8.

Data in agreement with literature reported.$^5$
6,6′-Dibromo-2′-methoxy-[1,1′-binaphthalen]-2-ol (33)

\[
\begin{align*}
\text{Br} & \quad \text{Br} \\
& \quad \text{OH} \\
& \quad \text{OMe}
\end{align*}
\]

6,6′-Dibromo-[1,1′-binaphthalene]-2,2′-diol (54) (22.20 g, 50.0 mmol, 1.00 equiv.) and KO\textsubscript{2}CO\textsubscript{3} (8.97 g, 55.0 mmol, 1.10 equiv.) were suspended in acetone (400 mL) and iodomethane (7.80 g, 3.43 mL, 65.0 mmol, 1.30 equiv) was added. The resulting suspension was heated under reflux for 16 hours after which time the reaction was cooled to room temperature. The solvent was removed by evaporation and the residue was partitioned between water and CH\textsubscript{2}Cl\textsubscript{2}. The phases were separated and the aqueous layer was extracted twice with CH\textsubscript{2}Cl\textsubscript{2}. The combined organic layers were dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (1:1 CH\textsubscript{2}Cl\textsubscript{2} – petroleum ether) afforded 6,6′-dibromo-2′-methoxy-[1,1′-binaphthalen]-2-ol (30) (13.5 g, 59%) as a white solid.

\textbf{m.p.} = 115-117 °C (CH\textsubscript{2}Cl\textsubscript{2}/petroleum ether 40-60).

\textbf{IR} (film) \textit{v}_{\text{max}}/\text{cm}^{-1}: 3480, 3059, 2935, 2837, 2361, 2341, 1614, 1583, 1493, 1459, 1440, 1418, 1381, 1347, 1325, 1303, 1262, 1246, 1210, 1195, 1171, 1146, 1133, 1087, 1068, 1046, 976, 939, 904, 876, 808, 770, 738, 703, 672, 611.

\textbf{\textsuperscript{1}H NMR} (400 MHz, CDCl\textsubscript{3}) \text{δ} 8.05 (s, 1H), 8.01 (s, 1H), 7.96 (d, \textit{J} = 9.1 Hz, 1H), 7.81 (d, \textit{J} = 8.9 Hz, 1H), 7.49 (d, \textit{J} = 9.1 Hz, 1H), 7.39-7.24 (m, 2H), 7.00 (d, \textit{J} = 9.0 Hz, 1H), 6.86 (d, \textit{J} = 8.9 Hz, 1H), 4.90 (s, 1H), 3.81 (s, 3H).

\textbf{\textsuperscript{13}C NMR} (101 MHz, CDCl\textsubscript{3}) \text{δ} = 156.2, 151.7, 132.5, 132.3, 130.9, 130.5, 130.4, 130.3, 130.2, 129.9, 129.2, 126.6, 126.6, 118.8, 118.2, 117.3, 115.0, 114.8, 114.7, 56.7.

Data in agreement with literature reported\textsuperscript{6}
2'-Methoxy-6,6'-diphenyl-[1,1'-binaphthalen]-2-ol (4)

To a flask containing 33 (500 mg, 1.09 mmol, 1.00 equiv), phenylboronic acid (333 mg, 2.73 mmol, 2.50 equiv) and Pd(PPh$_3$)$_4$ (63.1 mg, 54.6 µmol, 0.05 equiv) was added 1,2-dimethoxyethane (11.50 mL, Ar sparged) and sodium carbonate (2.0 M aq, 2.72 mL, Ar sparged). The resulting mixture was heated to 90 °C for 16 hours and cooled to room temperature before addition of water (10 mL) and EtOAc (10 mL). The layers were separated and the aqueous layer was extracted with EtOAc (10 mL × 2). The combined organic layers were washed with brine, dried over anhydrous MgSO$_4$, filtered and the solvent removed under reduced pressure. The resulting solid was purified by flash column chromatography (2:1 CH$_2$Cl$_2$ – petroleum ether 40-60) to give the title compound 34 as a white solid (316 mg, 0.70 mmol, 64% yield).

m.p. = 192-194 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

IR (film) $\nu_{\text{max}}$/cm$^{-1}$: 3531, 1595, 1493, 1383, 1357, 1264, 1191, 1087, 810, 756, 699.

$^1$H NMR (500 MHz, CDCl$_3$) $\delta_H$: 8.15-8.11 (m, 2H), 8.10 (d, $J = 1.7$ Hz, 1H), 7.99 (d, $J = 8.9$ Hz, 1H), 7.71-7.67 (m, 4H), 7.59 (dd, $J = 1.8$, 8.8 Hz, 1H), 7.53 (d, $J = 9.1$ Hz, 1H), 7.53 (dd, $J = 1.9$, 8.7 Hz, 1H), 7.50-7.44 (m, 4H), 7.42 (d, $J = 8.9$ Hz, 1H), 7.40-7.33 (m, 1H), 7.31 (d, $J = 8.8$ Hz, 1H), 7.18 (d, $J = 8.7$ Hz, 1H), 5.01 (s, 1H), 3.85 (s, 3H).

$^{13}$C NMR (126 MHz, CDCl$_3$) $\delta_C$: 156.2, 151.6, 141.3, 140.9, 137.1, 136.2, 133.3, 133.1, 131.6, 130.3, 129.8, 129.5, 129.0, 128.9, 127.4, 127.3, 127.2, 127.1, 127.0, 126.3, 126.2, 125.6, 125.5, 118.1, 115.3, 115.0, 114.3, 56.8.

HRMS (ESI') $C_{33}H_{23}O_2^-$ [M-H]: requires 451.17035, found: 451.17053, Δ +0.4 ppm.
To a flask containing 3 (500 mg, 1.09 mmol, 1.00 equiv), (4-fluorophenyl)boronic acid (382 mg, 2.73 mmol, 2.50 equiv) and Pd(PPh\(_3\))\(_4\) (63.1 mg, 54.6 μmol, 0.05 equiv) was added 1,2-dimethoxyethane (11.50 mL, Ar sparged) and Na\(_2\)CO\(_3\) (2.0 M aq, 2.72 mL, Ar sparged). The resulting mixture was heated to 90 °C for 16 hours and cooled to room temperature before addition of water (10 mL) and EtOAc (10 mL). The layers were separated and the aqueous layer was extracted with EtOAc (10 mL × 2). The combined organic layers were washed with brine, dried over anhydrous MgSO\(_4\), filtered and the solvent removed under reduced pressure. The resulting solid was purified by flash column chromatography (2:1 CH\(_2\)Cl\(_2\) – petroleum ether 40-60) to give the title compound 6 as a white solid (436 mg, 0.89 mmol, 82% yield).

**m.p.** = 145-147 °C (CH\(_2\)Cl\(_2\)/petroleum ether 40-60).

**IR** (film) \(\nu_{\text{max}}/\text{cm}^{-1}\): 3525, 1604, 1515, 1473, 1265, 1159, 1087, 820.

\(^1\text{H NMR}\) (500 MHz, CDCl\(_3\)) \(\delta_H\): 8.12 (d, \(J = 9.1\) Hz, 1H), 8.06 (d, \(J = 1.8\) Hz, 1H), 8.02 (d, \(J = 1.8\) Hz, 1H), 7.97 (d, \(J = 8.9\) Hz, 1H), 7.65-7.59 (m, 4H), 7.54 (d, \(J = 9.1\) Hz, 1H), 7.51 (dd, \(J = 1.9, 8.8\) Hz, 1H), 7.45 (dd, \(J = 1.9, 8.7\) Hz, 1H), 7.40 (d, \(J = 8.9\) Hz, 1H), 7.28 (d, \(J = 8.8\) Hz, 1H), 7.18-7.10 (m, 5H), 4.97 (s, 1H), 3.85 (s, 3H).

\(^{13}\text{C NMR}\) (126 MHz, CDCl\(_3\)) \(\delta_C\): 162.6 (d, \(J = 246.7\) Hz), 162.5 (d, \(J = 246.0\) Hz), 156.3, 151.6, 137.8 (d, \(J = 3.4\) Hz), 137.0 (d, \(J = 3.4\) Hz), 136.1, 135.2, 133.3, 133.0, 131.5, 130.3, 129.8, 129.5, 128.9 (app. t, \(J = 7.6\) Hz), 127.1, 126.1, 126.0, 125.7, 125.6, 118.2, 116.0, 115.9, 115.8, 115.7, 115.2, 115.0, 114.4, 56.9.

\(^{19}\text{F NMR}\) (470 MHz, CDCl\(_3\), \(^1\text{H}\) decoupled) \(\delta_F\): -115.6 (s), -116.1 (s).

**HRMS** (ESI\(^+\)) \(C_{33}H_{21}F_2O_4\) \([\text{M-H}]^+\): requires 487.15151, found: 487.15134, Δ -0.4 ppm.
1,1'-(2-Hydroxy-2'-methoxy-[1,1'-binaphthalene]-6,6'-diyl)bis(4,1-phenylene))bis(ethan-1-one) (36)

To a flask containing 33 (500 mg, 1.09 mmol, 1.00 equiv), (4-acetylphenyl)boronic acid (447 mg, 2.73 mmol, 2.50 equiv) and Pd(PPh₃)₄ (63.1 mg, 54.6 μmol, 0.05 equiv) was added 1,2-dimethoxyethane (11.50 mL, Ar sparged) and Na₂CO₃ (2.0 M aq, 2.72 mL, Ar sparged). The resulting mixture was heated to 90 °C for 16 hours and cooled to room temperature before addition of water (10 mL) and EtOAc (10 mL). The layers were separated and the aqueous layer was extracted with EtOAc (10 mL × 2). The combined organic layers were washed with brine, dried over anhydrous MgSO₄, filtered and the solvent removed under reduced pressure. The resulting solid was purified by flash column chromatography (19:1 CH₂Cl₂ – diethyl ether to 9:1 CH₂Cl₂ – diethyl ether) to give the title compound 36 as a pale yellow solid (280 mg, 0.52 mmol, 48% yield).

m.p. = 161-163 °C (CH₂Cl₂/diethyl ether).

IR (film) νmax/cm⁻¹: 3340, 1674, 1598, 1497, 1358, 1268, 1249, 1057, 818, 751.

¹H NMR (500 MHz, CDCl₃) δH: 8.15 (app. d, J = 8.8 Hz, 3H), 8.03 (app. d, J = 8.2 Hz, 4H), 8.00 (d, J = 8.9 Hz, 1H), 7.76 (app. dd, J = 1.8, 8.4 Hz, 4H), 7.58 (dd, J = 1.8, 8.9 Hz, 1H), 7.55 (d, J = 9.3 Hz, 1H), 7.52 (dd, J = 1.9, 8.8 Hz, 1H), 7.43 (d, J = 8.9 Hz, 1H), 7.31 (d, J = 8.8 Hz, 1H), 7.17 (d, J = 8.8 Hz, 1H), 5.18 (s, 1H), 3.86 (s, 3H), 2.63 (s, 6H).

¹³C NMR (126 MHz, CDCl₃) δC: 197.9, 197.9, 156.6, 152.1, 145.9, 145.4, 135.9, 135.7, 135.6, 134.7, 133.8, 133.6, 131.8, 130.6, 129.6, 129.4, 129.2, 129.1, 127.3, 126.9, 126.8, 126.8, 125.9, 125.8, 125.7, 118.5, 115.2, 115.0, 114.5, 56.8, 26.8.

HRMS (ESI⁺) C₃₇H₂₉O₄⁺ [M+H]⁺: requires: 537.20604, found: 537.20612, Δ +0.2 ppm.
To a flask containing 33 (500 mg, 1.09 mmol, 1.00 equiv), (4-(trifluoromethoxy)phenyl)boronic acid (562 mg, 2.73 mmol, 2.50 equiv) and Pd(PPh₃)₄ (63.1 mg, 54.6 μmol, 0.05 equiv) was added 1,2-dimethoxyethane (11.50 mL, Ar sparged) and Na₂CO₃ (2.0 M aq, 2.72 mL, Ar sparged). The resulting mixture was heated to 90 °C for 16 hours and cooled to room temperature before addition of water (10 mL) and EtOAc (10 mL). The layers were separated and the aqueous layer was extracted with EtOAc (10 mL × 2). The combined organic layers were washed with brine, dried over anhydrous MgSO₄, filtered and the solvent removed under reduced pressure. The resulting solid was purified by flash column chromatography (2:1 CH₂Cl₂ – petroleum ether 40-60) to give the title compound 37 as a white solid (511 mg, 0.82 mmol, 75% yield).

m.p. = 110-112 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν max/cm⁻¹: 3521, 1598, 1497, 1251, 1211, 1164, 1089, 1059, 854.

¹H NMR (500 MHz, CDCl₃) δ H: 8.14 (d, J = 9.1 Hz, 1H), 8.08 (d, J = 1.8 Hz, 1H), 8.05 (d, J = 1.8 Hz, 1H), 7.98 (d, J = 8.9 Hz, 1H), 7.70-7.65 (m, 4H), 7.55 (d, J = 9.1 Hz, 1H), 7.52 (dd, J = 1.9, 8.8 Hz, 1H), 7.46 (dd, J = 1.9, 8.8 Hz, 1H), 7.41 (d, J = 8.9 Hz, 1H), 7.34-7.27 (m, 5H), 7.16 (d, J = 8.8 Hz, 1H), 4.98 (s, 1H), 3.86 (s, 3H)

¹³C NMR (126 MHz, CDCl₃) δ C: 156.4, 151.8, 148.8, 148.8, 148.6, 140.1, 139.7, 135.7, 134.8, 133.5, 133.2, 131.7, 130.4, 129.7, 129.5, 128.6, 128.6, 1270, 126.5, 126.4, 126.0, 125.8, 125.7, 121.5, 121.4, 120.7 (q, J = 257.4 Hz), 118.4, 115.1, 115.0, 114.4, 56.8.

¹⁹F NMR (470 MHz, CDCl₃) δ F: -57.8 (s).

HRMS (ES⁺) C₃₅H₂₁F₆O₄⁺ [M-H]⁺: requires: 619.13495, found: 619.13458, Δ -0.6 ppm.
6,6'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (33) (1.95 g, 4.26 mmol, 1.00 equiv.) was dissolved in THF (43 mL) and cooled to −78 °C. nBuLi (1.6 M in hexane, 5.33 mL, 8.52 mmol, 2.00 equiv.) was added by syringe pump over 1 hour after which time the reaction was stirred for a further 1 hour at −78 °C. The reaction was quenched by dropwise addition of water. After warming to room temperature, saturated ammonium chloride solution was added. EtOAc was added and the phases were separated. The aqueous phase was extracted twice with EtOAc and the combined organic layers were washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (4:1 petroleum ether 40-60 – EtOAc) afforded 6-bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (21) (1.27 g, 82%) m.p. = 132-133 °C (EtOAc/petroleum ether 40-60).

**IR** (film) $\nu_{\text{max}}$/cm$^{-1}$: 3514, 3059, 2936, 2839, 1588, 1504, 1498, 1474, 1459, 1432, 1379, 1350, 1331, 1307, 1262, 1245, 1205, 1182, 1167, 1144, 1129, 1085, 1053, 974, 936, 903, 879, 866, 809, 782, 747, 673.

**$^1$H NMR** (400 MHz, CDCl$_3$) $\delta$ = 7.97 (d, $J$ = 9.1 Hz, 1H), 8.02 (d, $J$ = 2.1 Hz, 1H), 7.91 (d, $J$ = 8.1 Hz, 1H), 7.81 (d, $J$ = 8.9 Hz, 1H), 7.48 (d, $J$ = 9.1 Hz, 1H), 7.41 (obs. m, 1H), 7.37 (d, $J$ = 8.8 Hz, 1H), 7.33–7.26 (m, 2H), 7.14 (d, $J$ = 8.5 Hz, 1H), 6.93 (d, $J$ = 9.0 Hz, 1H), 4.96 (s, 1H, OH), 3.81 (s, 3H).

**$^{13}$C NMR** (101 MHz, CDCl$_3$) $\delta$ = 156.0, 151.6, 133.9, 132.3, 131.4, 130.3, 129.1, 129.6, 129.4, 128.9, 128.3, 127.5, 126.7, 124.6, 124.3, 118.6, 117.0, 115.3, 114.5, 113.7, 56.0

**HRMS** (ESI$^-$) C$_{21}$H$_{15}$O$_2$Br [M–H]$^-$ requires 377.01827; found 377.01807, $\Delta$ -0.5 ppm.

Data in agreement with literature$^7$
2',6-dimethoxy-[1,1'-binaphthalen]-2-ol (23)

6-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (21) (190 mg, 0.500 mmol, 1.00 equiv.) was dissolved in DMF (5.0 mL) then CuCl (149 mg, 1.50 mmol 3.00 equiv.) and NaOMe (4.4 M in MeOH, 1.37 mL, 6.00 mmol, 12.0 equiv.) were added sequentially. The reaction was heated at 100 °C for 1 h then cooled to room temperature. Ice water was added followed by hydrochloric acid (3 M). The resulting suspension was extracted 3 times with EtOAc and the combined organic layers were washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (3:1 CH$_2$Cl$_2$ – petroleum ether 40-60 to 9:1 CH$_2$Cl$_2$ – petroleum ether 40-60) afforded 2',6-dimethoxy-[1,1'-binaphthalen]-2-ol (23) as an off-white solid (104 mg, 63%).

**m.p.** = 160-162 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

**IR** (film) $\nu_{\text{max}}$/cm$^{-1}$: 3501, 3430, 3056, 3007, 2936, 2839, 1620, 1600, 1508, 1464, 1433, 1366, 1331, 1265, 1249, 1236, 1209, 1171, 1148, 1125, 1083, 1056, 1033, 852, 811, 752

**$^1$H NMR** (500 MHz, CDCl$_3$) $\delta$ = 8.04 (d, $J = 9.1$ Hz, 1H), 7.90 (d, $J = 8.2$ Hz, 1H), 7.81 (d, $J = 8.9$ Hz, 1H), 7.47 (d, $J = 9.1$ Hz, 1H), 7.38 (ddd, $J = 1.2$, 6.9, 8.1 Hz, 1H), 7.35 (d, $J = 8.9$ Hz, 1H), 7.29 (ddd, $J = 1.3$, 6.9, 8.4 Hz, 1H), 7.22-7.18 (m, 2H), 6.98 (d, $J = 9.2$ Hz, 1H), 6.92 (dd, $J = 2.6$, 9.2 Hz, 1H), 4.82 (s, 1H), 3.90 (s, 3H), 3.81 (s, 3H).

**$^{13}$C NMR** (126 MHz, CDCl$_3$) $\delta$ = 156.0, 155.9, 149.8, 134.1, 131.1, 130.1, 129.5, 129.1, 128.5, 128.3, 127.4, 126.5, 125.0, 124.3, 119.0, 118.0, 115.6, 115.4, 113.9, 106.6, 56.8, 55.4.

**HRMS** (ESI$^+$) C$_{22}$H$_{19}$O$_3$ $^+$ [M+H]$^+$: requires: 331.13287, found: 331.13303, $\Delta$ +0.5 ppm.
2'-Methoxy-6-morpholino-[1,1'-binaphthalen]-2-ol (19)

6-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (21) (379 mg, 1.00 mmol, 1.00 equiv.), Pd$_2$(dba)$_3$ (9.2 mg, 0.0100 mmol, 1 mol%) and DavePhos (4.7 mg, 0.0120 mmol, 1.2 mol%) were added to a Schlenk flask. The flask was evacuated and backfilled with argon three times. Morpholine (105 mg, 105 µL, 1.20 mmol, 1.20 equiv.) was added followed by LiHMDS solution (1 M in THF, 2.2 mL, 2.2 mmol, 2.2 equiv.) and the reaction was stirred at room temperature for 16 hours. 1 M HCl solution was added and the reaction was stirred for 30 minutes. 1 M NaHCO$_3$ solution was added and the aqueous solution was extracted three times with CH$_2$Cl$_2$. The combined organic layers were dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was purified by column chromatography (3:2 petroleum ether 40-60 – EtOAc) to give 2'-methoxy-6-morpholino-[1,1'-binaphthalen]-2-ol (19) (244 mg, 63%) as an off-white solid.

m.p. = 231-232 °C (EtOAc/petroleum ether 40-60).

IR (film) $\nu_{\text{max}}$/cm$^{-1}$: 3283, 1608, 1591, 1506, 1461, 1449, 1380, 1356, 1335, 1309, 1282, 1265, 1253, 1228, 1199, 1182, 1167, 1146, 1134, 1113, 1088, 1062, 1044, 1022, 960, 934, 879, 856, 848, 817, 798, 779, 772, 759, 747, 731, 699, 666, 638, 616.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta_H$ = 7.94 (d, $J$ = 9.0 Hz, 1H), 7.79 (d, $J$ = 8.1 Hz, 1H), 7.66 (d, $J$ = 8.8 Hz, 1H), 7.37 (d, $J$ = 9.1 Hz, 1H), 7.26 (ddd, $J$ = 8.1, 6.7, 1.3 Hz, 1H), 7.20 (d, $J$ = 8.9 Hz, 1H), 7.18–7.14 (m, 1H), 7.09 (m, 2H), 6.93–6.83 (m, 2H), 4.69 (br. s, 1H), 3.81–3.74 (m, 4H), 3.69 (s, 3H), 3.15–3.05 (m, 4H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta_C$ = 155.9, 149.8, 147.2, 134.0, 130.9, 130.0, 129.4, 128.9, 128.6, 128.1, 127.3, 125.9, 125.0, 124.2, 119.6, 117.9, 115.6, 115.1, 113.9, 111.0, 67.0, 56.7, 50.1.

HRMS (ESI$^+$) C$_{25}$H$_{23}$O$_3$N [M+H]$^+$ requires 386.17507; found 386.17477, Δ -0.8 ppm.
6-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (21) (365 mg, 1.00 mmol, 1.00 equiv.), phenyl boronic acid (144 mg, 1.20 mmol, 1.20 equiv.) and Pd(PPh_3)_4 (57.8 mg, 0.0500 mmol, 0.0500 equiv.) were charged to a flask fitted with a water-cooled condenser. The flask was evacuated and backfilled with argon three times. Argon sparged 1,2-dimethoxyethane (10 mL) was added followed by argon sparged aqueous Na_2CO_3 solution (2 M, 1.25 mL, 2.50 equiv.). The flask was fitted with an argon balloon and heated at 90 °C for 16 hours. After cooling to room temperature, 1 M HCl solution was added and the solution was extracted three times with CH_2Cl_2, the combined organic layers were dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was purified by column chromatography (9:1 petroleum ether 40-60 – EtOAc) to give 2'-methoxy-6-phenyl-[1,1'-binaphthalen]-2-ol (20) (233 mg, 62%) as a white solid.

m.p. = 208-209 °C (EtOAc/petroleum ether 40-60).

IR (film) \( \nu_{\text{max}} / \text{cm}^{-1} \): 3513, 1507, 1493, 1145, 817, 755, 705.

^1^H NMR (400 MHz, CDCl_3) \( \delta = 8.01–7.93 \) (m, 2H), 7.87 (d, \( J = 8.9 \) Hz, 1H), 7.82 (d, \( J = 8.1 \) Hz, 1H), 7.58 (m, 2H), 7.44–7.11 (m, 9H), 7.05–7.01 (m, 1H), 4.86 (br. S, 1H), 3.73 (s, 3H)

^1^C NMR (101 MHz, CDCl_3) \( \delta = 156.0, 151.4, 141.2, 136.0, 134.0, 133.0, 131.2, 130.1, 129.5, 129.4, 128.8, 128.2, 127.4, 127.2, 127.0, 126.1, 126.1, 125.4, 124.9, 124.2, 117.9, 115.2, 115.0, 113.8, 56.7.

HRMS (ESI^+) \( \text{C}_{27}\text{H}_{20}\text{O}_2 \) [M+H]^+ requires 377.15361; found 377.15365, \( \Delta +0.1 \) ppm.
4.3. 5-Substituted BINOLs

1-Bromo-6-methoxynaphthalene (57)

Following a modified literature procedure. Triphenylphosphite (28.9 mL, 34.1 g, 110 mmol, 1.1 equiv.) was dissolved in CH$_2$Cl$_2$ (300 mL) and the resulting solution was cooled to -78 °C. Bromine (6.15 mL, 20.3 g, 120 mmol, 1.20 equiv.) was added followed by dropwise addition of Et$_3$N (18.1 mL, 13.2 g, 130 mmol, 1.30 equiv.) over 30 minutes. 6-Methoxy-3,4-dihydronaphthalen-1(2H)-one (17.6 g, 100 mmol, 1.00 equiv.) was added and the reaction was warmed to room temperature and stirred for 16 hours after which time the reaction was heated at 45 °C for 2 hours. Upon cooling to room temperature saturated Na$_2$SO$_3$ solution was added and the resulting solution was extracted three times with CH$_2$Cl$_2$. The combined organic layers were washed with water, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (39:1 petroleum ether 40-60 – CH$_2$Cl$_2$ to 19:1 petroleum ether 40-60 – CH$_2$Cl$_2$) afforded the vinyl bromide which was found to be unstable and was therefore used immediately in the next reaction.

The product of the previous step (18.5 g, crude) was dissolved in benzene (155 mL) and DDQ (19.3 g, 85.1 mmol) was added and the reaction was stirred at room temperature for 2 hours after which time saturated Na$_2$SO$_3$ solution was added and the resulting suspension was extracted 3 times with EtOAc. The combined organic layers were washed 3 times with saturated NaHCO$_3$ solution, brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (39:1 petroleum ether 40-60 – CH$_2$Cl$_2$ to 19:1 petroleum ether 40-60 – CH$_2$Cl$_2$) afforded 1-bromo-6-methoxynaphthalene (57) (6.93 g, 29% over 2 steps) as a light-yellow oil.

**IR** (film) $\nu_{\text{max}}/\text{cm}^{-1}$ 1623, 1501, 1469, 1424, 1359, 1263, 1236, 1197, 1169, 1125, 1032, 957, 916, 840, 818, 803, 775, 745, 658.

**$^1$H NMR** (500 MHz, CDCl$_3$) $\delta$ = 8.16 (d, $J = 9.28$ Hz, 1H), 7.72 (d, $J = 8.35$ Hz, 1H), 7.64 (d, $J = 7.19$ Hz, 1H), 7.32-7.24 (m, 2H), 7.15 (d, $J = 2.50$ Hz, 1H), 3.96 (s, 3H).

**$^{13}$C NMR** (126 MHz, CDCl$_3$) $\delta$ = 158.2, 135.9, 128.8, 127.6, 127.5, 126.8, 126.7, 122.7, 120.0, 106.1, 55.4.

Data in agreement with literature reported$^8$
5-Bromonaphthalen-2-ol (51)

1-Bromo-6-methoxynaphthalene (57) (6.93 g, 29.2 mmol, 1.00 equiv.) was dissolved in CH$_2$Cl$_2$ (146 mL) and the resulting solution was cooled to 0 °C. BBr$_3$ (3.37 mL, 8.75 g, 35.4 mmol, 1.20 equiv.) was added dropwise over 5 minutes. The reaction was allowed to warm to room temperature and was stirred for 16 hours. The reaction was quenched with water and extracted 3 times with CH$_2$Cl$_2$. The combined organic layers were dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (1:1 CH$_2$Cl$_2$ – petroleum ether) gave 5-bromonaphthalen-2-ol (51) (6.35 g, 97%) as an off-white solid.

**m.p. =** 104-105 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

**IR (film) **$\nu$ max/cm$^{-1}$: 3244, 1625, 1563, 1504, 1427, 1382, 1252, 1230, 965, 773.

**$^1$H NMR** (400 MHz, CDCl$_3$) $\delta$ = 8.18 (d, $J$ = 9.1 Hz, 1H), 7.69-7.62 (m, 2H), 7.28 (app. t, partially obscured, $J$ = 8.8 Hz), 7.22 (dd, $J$ = 9.1, 2.6 Hz, 1H), 7.18 (d, $J$ = 2.5, 1H), 5.09 (br. s, 1H).

**$^{13}$C NMR** (101 MHz, CDCl$_3$) $\delta$ = 154.0, 135.8, 129.4, 127.7, 127.5, 127.0, 126.4, 122.8, 119.0, 109.9.

**HRMS (ESI')** C$_{10}$H$_7$BrO [M-H]$^-$ requires 220.96081, found: 220.96070, $\Delta$ -0.5 ppm.

Data in agreement with literature reported$^8$
5,5'-Dibromo-[1,1'-binaphthalene]-2,2'-diol (55)

![Structure diagram of 5,5'-Dibromo-[1,1'-binaphthalene]-2,2'-diol (55)]

5-Bromonaphthalen-2-ol (51) (6.35 g, 28.5 mmol, 1.00 equiv.) was dissolved in CH₂Cl₂ (190 mL) and [Cu(TMEDA)OHCl]₂ (130 mg, 0.280 mmol, 1 mol%) was added. The reaction was stirred for 16 hours at room temperature open to air. The reaction mixture was filtered through a short silica plug eluting with CH₂Cl₂. Evaporation of the solvent gave 5,5'-dibromo-[1,1'-binaphthalene]-2,2'-diol (55) (6.28 g, 100%) as an off-white solid.

**m.p.** = 79-80 °C (CH₂Cl₂).

**IR** (film) ν max/cm⁻¹: 3367, 2923, 2360, 1698, 1615, 1572, 1541, 1497, 1395, 1331, 1252, 1197, 1132, 981, 913, 820, 799, 656.

**¹H NMR** (500 MHz, CDCl₃) δ = 8.46 (d, J = 9.48 Hz, 2H), 7.70 (dd, J = 7.15, 0.89, 2H), 7.51 (d, J = 9.30 Hz, 2H), 7.17 (dd, J = 8.41, 7.33 Hz, 2H), 7.09 (d, J = 8.59 Hz, 2H), 5.09 (s, 2H).

**¹³C NMR** (126 MHz, CDCl₃) δ = 153.4, 134.7, 131.0, 128.4, 128.0, 128.0, 124.0, 123.5, 119.0, 111.0.

**HRMS** (ESI⁺) C₂₀H₁₁⁷⁹Br₂O₂ [M+H]⁺ requires 440.91203, found: 440.91260, Δ +1.3 ppm.
5,5'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (38)

5,5'-Dibromo-[1,1'-binaphthalene]-2,2'-diol (55) (5.80 g, 13.1 mmol, 1.00 equiv.) was dissolved in acetone (115 mL) and K₂CO₃ (2.35 g, 17.0 mmol, 1.30 equiv.) followed by iodomethane (900 µL, 2.04 g, 14.4 mmol, 1.10 equiv.) were added. The reaction was heated under reflux for 16 hours. Upon cooling to room temperature, the solvent was removed in vacuo. The residue was partitioned between water and CH₂Cl₂ and the phases were separated. The aqueous layer was extracted twice with CH₂Cl₂ and the organic layers were combined, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (1:1 CH₂Cl₂ – petroleum ether 40-60) gave 5,5'-dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (38) (3.02 g, 50%) as an off-white solid.

m.p. = 133-135 °C (CH₂Cl₂/petroleum ether 40-60).

**IR** (film) ν max/cm⁻¹: 3525, 2923, 2848, 2360, 2341, 1772, 1733, 1716, 1698, 1684, 1652, 1611, 1588, 1560, 1394, 1371, 1192, 1050, 913, 752, 690, 668, 655.

**¹H NMR** (500 MHz, CDCl₃) δ H: 8.53 (d, J = 9.5 Hz, 1H), 8.37 (d, J = 9.3 Hz, 1H), 7.69 (dd, J = 6.49, 1.9 Hz, 1H), 7.63 (dd, J = 7.38, 1.0 Hz, 1H), 7.60 (d, J = 9.4 Hz, 1H), 7.47 (d, J = 9.2 Hz, 1H), 7.16-7.10 (m, 2H), 7.07 (dd, J = 8.40, 7.4 Hz, 1H), 6.98 (d, J = 8.5 Hz, 1H), 4.91 (s, 1H), 3.86 (s, 3H).

**¹³C NMR** (127 MHz, CDCl₃) δ C: 156.6, 151.9, 135.2, 135.0, 130.9, 129.4, 128.3, 127.9, 127.8, 127.6, 127.5, 126.9, 124.7, 124.7, 123.2, 123.2, 118.8, 115.1, 115.1, 114.6, 56.6.

**HRMS** (ESI⁺) C₂₁H₁₃O₂⁷⁹Br₂ [M-H]⁻ requires 454.92878; found 454.92850, Δ = -0.6 ppm.
2’-methoxy-5,5’-dimethyl-[1,1’-binaphthalen]-2-ol (39)

To a flask containing 5,5’-dibromo-2’-methoxy-[1,1'-binaphthalen]-2-ol (38) (200 mg, 0.437 mmol, 1.00 equiv.), Pd(dppf)Cl₂·CH₂Cl₂ (35.6 mg, 0.044 mmol, 0.10 equiv.), cesium carbonate (569 mg, 1.75 mmol, 4.00 equiv.) and methylboronic acid (104 mg, 1.75 mmol, 4.00 equiv.), was added 1,4-dioxane (4.50 mL, N₂ sparged). The resulting suspension was heated at 105 °C for 48 h. The mixture was cooled to room temperature, diluted with EtOAc (10.0 mL) and filtered through a short plug of silica (eluting with EtOAc). The resulting solution was concentrated in vacuo and purified by flash column chromatography (2:1 petroleum ether 40-60 – diethyl ether) to give 2’-methoxy-5,5’-dimethyl-[1,1’-binaphthalen]-2-ol (39) as an off-white powder (135 mg, 94%)

m.p. = 142-144°C. (CH₂Cl₂/petroleum ether 40-60)

IR (film) ν max/cm⁻¹: 3530, 2917, 2849, 1613, 1595, 1511, 1458, 1405, 1381, 1327, 1266, 1210, 1180, 1153, 1091, 1074, 1050, 802, 757

¹H NMR (500 MHz, CDCl₃) δH: 8.23 (dd, J = 9.2, 0.4, 1H), 8.08 (d, J = 9.2 Hz, 1H), 7.51 (d, J = 9.4 Hz, 1H), 7.38 (d, J = 9.2 Hz, 1H), 7.20 (d, J = 6.8 Hz), 7.18-7.13 (m, 2H), 7.10 (dd, J = 8.4, 7.0 Hz, 1H), 7.03 (d, J = 8.5, 1H), 6.90 (d, J = 8.3 Hz, 1H), 4.85 (s, 1H), 3.80 (s, 3H), 2.76 (s, 3H), 2.74 (s, 3H)

¹³C NMR (126 MHz, CDCl₃) δC: 155.9, 151.1, 134.7, 134.6, 134.5, 134.1, 128.7, 128.3, 127.4, 127.3, 126.4, 126.1, 125.2, 124.4, 123.5, 117.0, 116.1, 113.4, 56.8, 19.8, 19.8.

HRMS (ESI⁺) C_{23}H_{21}O_{2}⁺ [M+H]⁺ requires 329.15361; found: 329.15364, Δ +0.1 ppm
2′-methoxy-5,5′-diphenyl-[1,1′-binaphthalen]-2-ol (40)

To a flask containing 38 (500 mg, 1.09 mmol, 1.00 equiv), phenylboronic acid (333 mg, 2.73 mmol, 1.00 equiv) and Pd(PPh₃)₄ (63.1 mg, 54.6 μmol, 0.05 equiv) was added 1,2-dimethoxyethane (11.50 mL, Ar sparged) and sodium carbonate (2.0 M aq, 2.72 mL, Ar sparged). The resulting mixture was heated to 90 °C for 16 hours and cooled to room temperature before addition of water (10 mL) and EtOAc (10 mL). The layers were separated and the aqueous layer was extracted with EtOAc (10 mL × 2). The combined organic layers were washed with brine, dried over anhydrous MgSO₄, filtered and the solvent removed under reduced pressure. The resulting solid was purified by flash column chromatography (1:1 CH₂Cl₂ – petroleum ether 40-60 to 2:1 CH₂Cl₂ – petroleum ether 40-60) to give the title compound 40 as a white solid (360 mg, 0.80 mmol, 73% yield).

m.p. = 134-136 °C. (CH₂Cl₂/petroleum ether 40-60)

IR (film) νₓ/cm⁻¹: 3534, 3058, 2917, 2360, 1608, 1510, 1491, 1463, 1405, 1324, 1264, 1187, 1118, 1086, 809, 760, 702.

¹H NMR (500 MHz, CDCl₃) δH: 8.14 (d, J = 9.4 Hz, 1H), 7.99 (d, J = 9.4 Hz, 1H), 7.61-7.51 (m, 8H), 7.51-7.41 (m, 3H), 7.37-7.23 (m, 7H), 7.13 (dd, J = 8.0, 1.1 Hz, 1H), 4.94 (s, 1H), 3.83 (s, 3H).

¹³C NMR (126 MHz, CDCl₃) δC: 156.0, 151.3, 141.4, 141.0, 140.8, 140.7, 134.7, 134.3, 130.3, 129.6, 128.5, 128.4, 128.2, 127.8, 127.5, 127.4, 127.3, 127.1, 126.2, 125.5, 124.7, 117.5, 115.7, 115.6, 113.7, 56.8.

HRMS (ESI⁻) C₃₃H₂₅O₂⁻ [M-H]⁻ requires 451.17035; found: 451.17035, Δ -0.0 ppm
5,5'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (38) (2.37 g, 5.17 mmol, 1.00 equiv.) was dissolved in THF (52 mL) and cooled to −78 °C. n-BuLi (2.5 M in hexane, 4.14 mL, 10.3 mmol, 2.00 equiv.) was added by syringe pump over 1 hour after which time the reaction was stirred for a further 1 hour at −78 °C. The reaction was quenched by dropwise addition of water. After warming to room temperature, saturated ammonium chloride solution was added. EtOAc was added and the phases were separated. The aqueous phase was extracted twice with EtOAc and the combined organic layers were washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (4:1 petroleum ether 40-60 – EtOAc) afforded 5-bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (24) (1.03 g, 52%)

**m.p.** = 152-153 °C (EtOAc/petroleum ether 40-60).

**IR** (film) $\nu_{\text{max}}$/cm$^{-1}$: 3486, 3409, 2980, 1613, 1592, 1507, 1461, 1369, 1346, 1333, 1268, 1252, 1231, 1214, 1192, 1173, 1147, 1131, 1086, 1055, 807, 751.

**$^1$H NMR** (400 MHz, CDCl$_3$) $\delta$ = 8.35 (d, $J = 9.3$ Hz, 1H), 8.07 (d, $J = 9.1$ Hz, 1H), 7.91 (d, $J = 8.4$ Hz, 1H), 7.61 (dd, $J = 5.9$, 2.5 Hz, 1H), 7.48 (d, $J = 9.0$ Hz, 1H), 7.45 (d, $J = 9.0$ Hz, 1H), 7.38 (ddd, $J = 8.1$, 6.8, 1.3 Hz, 1H), 7.30 (ddd, $J = 8.3$, 6.8, 1.4 Hz, 1H), 7.13 (d, $J = 7.5$ Hz, 1H), 7.07–7.00 (m, 2H), 4.98 (s, 1H), 3.81 (s, 3H).

**$^{13}$C NMR** (101 MHz, CDCl$_3$) $\delta$ = 156.1, 152.1, 135.2, 134.0, 131.5, 129.5, 129.2, 128.4, 127.7, 127.5, 126.9, 125.0, 124.8, 124.4, 123.3, 118.9, 115.6, 114.8, 113.8, 56.7.

**HRMS** (ESI$^+$) $^{79}$Br [M+H]$^+$ requires 377.01827; found 377.01822, $\Delta$ 0.1 ppm.
5-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (24) (190 mg, 0.500 mmol, 1.00 equiv.) was dissolved in DMF (5 mL) then CuCl (149 mg, 1.50 mmol 3.00 equiv.) and NaOMe (4.4 M in MeOH, 1.37 mL, 6.00 mmol, 12.0 equiv.) were added sequentially. The reaction was heated at 100 °C for 1 h then cooled to room temperature. Ice water was added followed by hydrochloric acid (3 M). The resulting suspension was extracted 3 times with EtOAc and the combined organic layers were washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (1:1 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2',5-dimethoxy-[1,1'-binaphthalen]-2-ol (23) as an off-white solid (123 mg, 75%).

**m.p.** = 80-81 °C (CH₂Cl₂/ petroleum ether 40-60).

**¹H NMR** (400 MHz, CDCl₃) δ = 8.38 (d, J = 9.1 Hz, 1H), 8.04 (d, J = 9.1 Hz, 1H), 7.97-7.86 (m, 1H), 7.47 (d, J = 9.1 Hz, 1H), 7.42-7.32 (m, 2H), 7.29 (ddd, J = 8.2, 6.7, 1.4 Hz, 1H), 7.20 (dd, J = 8.5, 1.2 Hz, 1H), 7.14 (dd, J = 8.5, 7.6 Hz, 1H), 6.68 (d, J = 7.6 Hz, 1H), 6.64 (d, J = 8.5 Hz, 1H), 4.93 (s, 1H), 4.02 (s, 3H), 3.81 (s, 3H).

**¹³C NMR** (101 MHz, CDCl₃) δ = 156.0, 155.9, 151.8, 135.0, 134.1, 131.0, 129.4, 128.1, 127.3, 126.7, 125.0, 124.2, 124.0, 121.0, 117.4, 116.4, 115.6, 114.9, 113.8, 101.7, 56.7, 55.5.

**IR** (film) ν max/cm⁻¹: 3493, 3434, 3063, 3003, 2958, 2936, 2838, 1620, 1591, 1464, 1431, 1415, 1333, 1301, 1268, 1252, 1223, 1165, 1149, 1122, 1076, 1052, 1020.

**HRMS** (ESI⁺) C_{22}H_{18}O_{3} [M+H]^+ requires 331.13287; found 31.13293, Δ +0.2 ppm
5-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (24) (379 mg, 1.00 mmol, 1.00 equiv.) and Pd(dppf)Cl$_2$.CH$_2$Cl$_2$ (98 mg, 0.100 mmol, 10 mol%) were dissolved in THF (10 mL) and MeMgCl solution (3 M in Et$_2$O, 1.70 mL, 5.00 mmol, 5.00 equiv.) was added. The resulting solution was heated under reflux for 16 hours. On cooling to room temperature, saturated ammonium chloride solution was added and phases were separated. The aqueous phase was extracted twice with EtOAc and the combined organic layers were washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was purified by column chromatography (9:1 petroleum ether 40-60 – EtOAc) to give 2'-methoxy-7-methyl-[1,1'-binaphthalen]-2-ol (22) (334 mg, 88%) as an off-white solid.

m.p. = 135-136 °C (EtOAc/petroleum ether 40-60).

IR (film) $\nu_{\text{max}}$/cm$^{-1}$: 3507, 1592, 1272, 1210, 1186, 1067, 808, 800, 752.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ = 8.00 (d, $J$ = 9.1 Hz, 1H), 7.94 (d, $J$ = 9.0 Hz, 1H), 7.80 (d, $J$ = 8.3 Hz, 1H), 7.37 (d, $J$ = 9.1 Hz, 1H), 7.30 (d, $J$ = 9.2 Hz, 1H), 7.27–7.24 (m, 1H), 7.20–7.14 (m, 1H), 7.09–6.98 (m, 3H), 6.83 (d, $J$ = 8.2 Hz, 1H), 4.81 (s, 1H), 3.70 (s, 3H), 2.65 (s, 3H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ = 156.0, 151.0, 134.5, 134.1, 133.9, 131.0, 129.4, 128.2, 128.1, 127.3, 126.3, 126.0, 125.0, 124.3, 124.2, 123.4, 117.0, 115.6, 115.6, 113.8, 56.7, 19.8.

HRMS (ESi$^+$) C$_{22}$H$_{20}$O$_2$ [M+H]$^+$ requires 315.13796; found 315.13797, $\Delta$ 0.0 ppm.
4.4. 4-Substituted BINOLs

8-Bromo-6-methoxy-3,4-dihydronaphthalen-1(2H)-one (58)

Following a modified literature procedure, 6-methoxy-3,4-dihydronaphthalen-1(2H)-one (25.0 g, 142 mmol, 1.00 equiv.) and methoxyamine hydrochloride (23.4 g, 284 mmol, 2.00 equiv.) were dissolved in ethanol (284 mL) and pyridine (28.4 mL) was added. The resulting solution was stirred at room temperature for 16 hours. The solution was concentrated in vacuo and 2 M HCl solution was added followed by CH$_2$Cl$_2$. The organic phase was separated and the aqueous phase was extracted twice with CH$_2$Cl$_2$. The combined organic layers were washed with 1 M NaHCO$_3$ solution, brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was used without further purification.

The crude oxime ether was dissolved in acetic acid (568 mL). Pd(OAc)$_2$ (1.59 g, 7.01 mmol, 5 mol% equiv.) and N-bromosuccinimide (30.3 g, 170 mmol, 1.20 equiv.) were added and the reaction was heated at 80°C for 1 hour. On cooling to room temperature, the reaction mixture was filtered through celite and concentrated. The residue was dissolved in Et$_2$O and the resulting solution was washed with water, washed three times with NaOH solution (1 M), washed with brine and concentrated to give the crude product which was used without further purification.

The crude brominated oxime ether was dissolved in 2:3 dioxane-6M HCl (710 mL) and the solution was heated under reflux for 1 hour. On cooling to room temperature, the solution was extracted three times with Et$_2$O and the combined organic layers were washed with NaOH solution (1 M), brine and concentrated to give the crude product. Recrystallization from hexane-EtOAc afforded 8-bromo-6-methoxy-3,4-dihydronaphthalen-1(2H)-one (58) (21.0 g, 58%) as an off-white solid.

**m.p.** = 115-117 °C (n-hexane-EtOAc)

**IR** (film) $\nu_{\text{max}}$/cm$^{-1}$: 1946, 1675, 1586, 1555, 1245, 1121, 1038, 884, 874, 841, 791.

**$^1$H NMR** (CDCl$_3$, 400 MHz) $\delta$ = 7.06 (d, $J = 2.6$ Hz, 1H), 6.68 (dd, $J = 2.6$, 1.1 Hz, 1H), 3.82 (s, 3H), 2.93 (app. t, $J = 6.1$ Hz, 2H), 2.62 (dd, $J = 7.2$, 6.0 Hz, 2H) 2.05 (tt, $J = 7.3$, 6.2 Hz, 2H).

**$^{13}$C NMR** (CDCl$_3$, 101 MHz) $\delta$ = 195.4, 161.8, 148.8, 124.2, 123.6, 119.9, 113.0, 55.7, 39.9, 31.5, 22.5.

**HRMS** (ESI$^+$) C$_{11}$H$_{11}$O$_2$Br [M+H]$^+$ requires 255.00152; found 255.00160, $\Delta$ +0.3 ppm.

Data in agreement with literature reported$^9$
8-Bromo-6-methoxy-3,4-dihydronaphthalen-1(2H)-one (58) (21.0 g, 82.3 mmol, 1.00 equiv.) was dissolved in ethanol (164 mL) and the solution was cooled to 0 °C. NaBH₄ (6.22 g, 165 mmol, 2.00 equiv.) was added portionwise and the reaction was allowed to warm to room temperature over 16 hours. Saturated ammonium chloride solution was added and the mixture was extracted three times with CH₂Cl₂. The combined organic layers were washed with water, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was used without further purification.

The crude alcohol was dissolved in PhMe (411 mL), TsOH.H₂O (1.57 g, 8.23 mmol, 0.100 equiv.) was added and the reaction was heated under reflux for 30 minutes. On cooling to room temperature, powdered KOH (462 mg, 8.23 mmol, 0.100 equiv.) and stirring was continued for 10 minutes. DDQ (24.2 g, 107 mmol, 1.30 equiv.) was added and the reaction was heated at 40 °C for 2 hours and cooled to room temperature. The solvent was removed in vacuo and the residue was suspended in 1:4 CH₂Cl₂ – petroleum ether 40-60 and filtered through a short silica plug eluting with the same solvent mixture. The solvent was removed in vacuo to give the crude product which was used without further purification.

The crude alkene was dissolved in CH₂Cl₂ (411 mL) and cooled to 0 °C. BBr₃ (9.50 mL, 24.7 g, 99.0 mmol, 1.20 equiv.) was added dropwise over 5 minutes and the reaction was allowed to warm to room temperature and stirred for 16 hours. The reaction was cooled to 0 °C and quenched by dropwise addition of water. The resulting biphasic solution was extracted three times with CH₂Cl₂ and the combined organic layers were washed with water, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was recrystallised from hexane-EtOAc to give 1-bromo-3-methoxynaphthalene (56) (12.9 g, 70%) as a yellow solid.

\[ \text{m.p.} = 91-92 \, ^\circ\text{C} \] (n-hexane/EtOAc)

\[ \text{IR (film) } \nu_{\max}/\text{cm}^{-1} : 3173, 2944, 2914, 1599, 1566, 1243, 1117, 1078, 1041, 1015, 855, 807. \]

\[ ^{1}\text{H NMR (400 MHz, CDCl₃) } \delta = 8.14 (d, J = 7.4 \text{ Hz}, 1H), 7.66 (d, J = 7.6 \text{ Hz}, 1H), 7.55-7.35 (m, 3H, H₇), 7.14 (d, J = 2.4 \text{ Hz}, 1H), 5.38 (s, 1H). \]

\[ ^{13}\text{C NMR (101 MHz, CDCl₃) } \delta = 153.1, 135.3, 127.7, 127.4, 127.1, 127.0, 125.1, 123.8, 122.0), 109.9. \]

\[ \text{HRMS (ESI')} \ C_{10}H_{5}O^{79}\text{Br [M+H]}^{+} \text{ requires } 220.96075; \text{ found } 220.96065, \Delta = 0.5 \text{ ppm.} \]

Data in agreement with literature reported\(^8\)
4,4'-Dibromo-[1,1'-binaphthalene]-2,2'-diol (41)

[Chemical structure image]

4-Bromonaphthalen-2-ol (56) (12.9 g, 58.0 mmol, 1.00 equiv.) was dissolved in CH₂Cl₂ (400 mL) and [Cu(TMEDA)OHCl]₂ (269 mg, 0.580 mmol, 1 mol%) was added. The reaction was stirred for 16 hours at room temperature open to air. The reaction mixture was filtered through a short silica plug eluting with CH₂Cl₂. Evaporation of the solvent gave 4,4'-dibromo-[1,1'-binaphthalene]-2,2'-diol (41) (12.9 g, 100%) as an off-white solid.

**m.p.** = 212-213°C (CH₂Cl₂).

**IR** (film) νmax/cm⁻¹: 3509, 3464, 1573, 1371, 1217, 1189, 1175, 1148, 1131, 933, 871, 758.

**¹H NMR** (400 MHz, CDCl₃) δ = 8.29 (d, J = 8.8 Hz, 2H), 7.74 (s, 2H), 7.49 (ddd, J = 8.3, 6.8, 1.2 Hz, 2H), 7.36 (ddd, J = 8.2, 6.8, 1.3 Hz, 2H), 7.14 (d, J = 8.4 Hz, 2H), 5.04 (s, 2H, OH).

**¹³C NMR** (101 MHz, CDCl₃) δ = 152.4, 134.0, 128.6, 128.3, 128.0, 126.1, 125.7, 124.6, 122.1, 110.6.

**HRMS** (ESI⁻) C₂₀H₁₂O₂⁷⁹Br₂ [M-H]⁻ requires 442.91108; found 442.91085, Δ -0.2 ppm.

Data in agreement with literature reported¹⁰
**4,4'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (38)**

![Chemical Structure](image)

4,4'-Dibromo-[1,1'-binaphthalene]-2,2'-diol (41) (12.9 g, 29.0 mmol, 1.00 equiv.) was dissolved in acetone (230 mL) and K$_2$CO$_3$ (5.20 g, 37.7 mmol, 1.30 equiv.) followed by iodomethane (1.99 mL, 4.53 g, 31.9 mmol, 1.10 equiv.) were added. The reaction was heated under reflux for 16 hours. Upon cooling to room temperature, the solvent was removed *in vacuo*. The residue was partitioned between water and CH$_2$Cl$_2$ and the phases were separated. The aqueous layer was extracted twice with CH$_2$Cl$_2$ and the organic layers were combined, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification *via* flash column chromatography (1:1 CH$_2$Cl$_2$ – petroleum ether) gave 4,4'-dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (38) (6.42 g, 47%) as an off-white solid.

**m.p.** = 83-84 °C (CH$_2$Cl$_2$/petroleum ether 40-60)

**IR** (film) $\nu_{\text{max}}$/cm$^{-1}$ 3511, 3405, 3394, 3383, 3360, 3352, 3333, 1581, 1499, 1316, 1258, 1241, 1211, 1193, 1169, 1149, 1131, 1098, 1060, 1027, 946, 912, 842, 755, 744.

**$^1$H NMR** (CDCl$_3$, 400 MHz) $\delta$ = 8.32–8.24 (m, 2H), 7.82 (s, 1H), 7.71 (s, 1H), 7.49 (ddd, $J$ = 8.4, 6.8, 1.2 Hz, 1H), 7.43 (ddd, $J$ = 8.3, 6.9, 1.2 Hz, 1H), 7.33 (ddd, $J$ = 8.1, 6.7, 1.2 Hz, 1H), 7.27 (ddd, $J$ = 8.2, 5.6, 1.2 Hz, 1H), 7.19 (br. d, $J$ = 8.5 Hz, 1H), 7.04 (br. d, $J$ = 8.7 Hz, 1H), 4.89–4.84 (m, 1H), 3.81 (s, 3H).

**$^{13}$C NMR** (CDCl$_3$, 121 MHz) $\delta$ = 155.6, 151.1, 134.6, 134.4, 128.4, 128.2, 127.9, 127.7, 127.5, 127.5, 125.9, 125.8, 125.3, 125.2, 124.8, 124.2, 121.8, 118.2, 114.9, 114.7, 57.0.

**HRMS** (ESI$^-$) C$_{21}$H$_{14}$O$_2$Br$_2$ [M-H]$^-$ requires 456.92673; found 456.92651, Δ+0.1 ppm.
4,4'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (38) (3.66 g, 8.00 mmol, 1.00 equiv.) was dissolved in THF (80 mL) and cooled to -78 °C. BuLi (2.5 M in hexane, 6.40 mL, 16.0 mmol, 2.00 equiv.) was added by syringe pump over 1 hour after which time the reaction was stirred for a further 1 hour at -78 °C. The reaction was quenched by dropwise addition of water. After warming to room temperature, saturated ammonium chloride solution was added. EtOAc was added and the phases were separated. The aqueous phase was extracted twice with EtOAc and the combined organic layers were washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was purified by column chromatography (4:1 petroleum ether 40-60 – EtOAc) to give 7-bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (28) (2.09 g, 69%).

m.p. = 171-172 °C (EtOAc/petroleum ether 40-60).

IR (film) ν_{max}/cm^{-1}: 3457, 3435, 3424, 3416, 1588, 1261, 1247, 1209, 1173, 1149, 806, 745.

\textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}) δ = 8.16 (d, J = 8.7 Hz, 1H), 7.97 (d, J = 9.1 Hz, 1H), 7.81 (d, J = 8.5 Hz, 1H), 7.63 (s, 1H), 7.38 (d, J = 9.1 Hz, 1H), 7.31 (m, 2H), 7.23–7.15 (m, 2H), 7.06 (d, J = 8.5 Hz, 1H), 6.97 (d, J = 7.7 Hz, 1H), 4.84 (s, 1H), 3.72 (s, 3H).

\textsuperscript{13}C NMR (101 MHz, CDCl\textsubscript{3}) δ = 155.9, 151.0, 134.5, 133.8, 131.4, 129.4, 128.2, 127.7, 127.5, 127.4, 127.2, 125.3, 124.7, 124.6, 124.3, 123.7, 121.7, 115.3, 114.4, 113.6, 56.6.

HRMS (ESI\textsuperscript{+}) C\textsubscript{21}H\textsubscript{13}O\textsubscript{2}Br [M+H]\textsuperscript{+} requires 377.01827; found 377.01785, Δ -1.1 ppm.
4-Bromo-2’-methoxy-[1,1′-binaphthalen]-2-ol (28) (379 mg, 1.00 mmol, 1.00 equiv.) was dissolved in DMF (10 mL) then CuCl (279 mg, 3.00 mmol, 3.00 equiv.) and NaOMe (4.4 M in MeOH, 2.70 mL, 12.0 mmol, 12.0 equiv.) were added sequentially. The reaction was heated at 100 °C for 1 h then cooled to room temperature. Ice water was added followed by hydrochloric acid (3 M). The resulting suspension was extracted 3 times with EtOAc and the combined organic layers were washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (1:1 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2’,4-dimethoxy-[1,1′-binapthalen]-2-ol (29) as an off-white solid (276 mg, 84%).

**m.p.** = 171-172 °C (CH₂Cl₂/petroleum ether 40-60).

**IR** (film) ν_{max}/cm⁻¹: 3490, 3430, 2961, 2938, 1619, 1591, 1388, 1263, 1230, 1174, 1115, 763.

**¹H NMR** (400 MHz, CDCl₃) δ = 8.17 (d, J = 8.4 Hz, 1H), 7.93 (d, J = 9.1 Hz, 1H), 7.80 (d, J = 8.1 Hz, 1H), 7.37 (d, J = 9.1 Hz, 1H), 7.27 (ddd, J = 8.0, 6.4, 1.6 Hz, 1H), 7.23–7.10 (m, 4H), 6.90 (d, J = 8.3 Hz, 1H), 6.66 (s, 1H), 4.85 (s, 1H), 3.98 (s, 3H), 3.71 (s, 3H).

**¹³C NMR** (101 MHz, CDCl₃) δ = 156.9, 156.3, 151.5, 134.5, 134.3, 130.9, 129.5, 128.1, 127.2, 127.1, 125.1, 124.5, 124.1, 122.6, 122.2, 121.6, 115.4, 113.9, 106.9, 96.5, 56.7, 55.7.

**HRMS** (ESI⁺) C₂₂H₁₈O₃ [M+H]⁺ requires 331.13287; found 31.13272, Δ −0.5 ppm.
2'-Methoxy-4-methyl-[1,1'-binaphthalen]-2-ol (26)

![Structure of 2'-Methoxy-4-methyl-[1,1'-binaphthalen]-2-ol (26)](structure_image)

4-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (28) (379 mg, 1.00 mmol, 1.00 equiv.) and Pd(dppf)Cl₂.CH₂Cl₂ (82.6 mg, 0.100 mmol, 10 mol%) were dissolved in THF (10 mL) and MeMgCl solution (3 M in Et₂O, 1.7 mL, 5.00 mmol, 5.00 equiv.) was added. The resulting solution was heated under reflux for 16 hours. On cooling to room temperature, saturated ammonium chloride solution was added and phases were separated. The aqueous phase was extracted twice with EtOAc and the combined organic layers were washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was purified by column chromatography (9:1 petroleum ether 40-60 – EtOAc) to give 2'-methoxy-4-methyl-[1,1'-binaphthalen]-2-ol (28) (249 mg, 79%) as an off-white solid.

**m.p.** = 137-138 °C (EtOAc/petroleum ether 40-60).

**IR** (film) ν<sub>max</sub>/cm⁻¹: 3504, 3434, 3388, 1592, 1508, 1262, 1247, 1223, 1183, 1093, 1065, 804, 754, 744, 666, 643

**¹H NMR** (400 MHz, CDCl₃) δ = 7.96–7.87 (m, 2H), 7.79 (d, J = 7.3 Hz, 1H), 7.37 (d, J = 9.1 Hz, 1H), 7.26 (m, 2H), 7.19–7.08 (m, 4H), 6.98 (d, J = 8.6 Hz, 1H), 4.78 (br. s, 1H), 3.70 (s, 3H), 2.69 (s, 3H).

**¹³C NMR** (101 MHz, CDCl₃) δ = 156.1, 150.7, 136.5, 134.2, 134.0, 131.0, 129.4, 128.5, 128.1, 127.3, 126.2, 125.4, 125.1, 124.4, 124.1, 123.1, 118.3, 115.6, 113.8, 113.0, 56.7, 19.6.

**HRMS** (ESI⁺) C<sub>22</sub>H₁₈O₂ [M+H]⁺ requires 315.13796; found 315.13791, Δ −0.2 ppm.
2’-Methoxy-4-phenyl-[1,1'-binaphthalen]-2-ol (27)

![Structural formula of 2'-Methoxy-4-phenyl-[1,1'-binaphthalen]-2-ol (27)](image)

4-Bromo-2’-methoxy-[1,1'-binaphthalen]-2-ol (28) (379 mg, 1.00 mmol, 1.00 equiv.), phenyl boronic acid (144 mg, 1.20 mmol, 1.20 equiv.) and Pd(PPh₃)₄ (57.8 mg, 0.0500 mmol, 0.0500 equiv.) were charged to a flask fitted with a water-cooled condenser. The flask was evacuated and backfilled with argon three times. 1,2-Dimethoxyethane (Ar sparged, 10 mL) was added followed by aqueous Na₂CO₃ solution (Ar sparged, 2 M, 1.25 mL, 2.50 equiv.). The condenser was fitted with an argon balloon and heated at 90 °C for 16 hours. After cooling to room temperature, 1 M HCl solution was added and the solution was extracted three times with CH₂Cl₂, the combined organic layers were dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was purified by column chromatography (9:1 petroleum ether 40-60 – EtOAc) to give 2’-methoxy-4-phenyl-[1,1'-binaphthalen]-2-ol (27) (314 mg, 84%) as a white solid.

**m.p.** = 103-104 °C (EtOAc/petroleum ether 40-60).

**IR** (film) νmax/cm⁻¹: 3657, 2980, 2888, 1382, 1169, 1142, 1088, 1060, 945, 809, 762, 746, 702.

**¹H NMR** (400 MHz, CDCl₃) δ = 7.96 (d, J = 9.0 Hz, 1H), 7.85–7.75 (m, 2H), 7.53 (dt, J = 6.1, 1.4 Hz, 2H), 7.47–7.34 (m, 4H), 7.29 (ddd, J = 8.1, 6.3, 1.7 Hz, 1H), 7.25–7.09 (m, 5H), 7.03 (dd, J = 8.1, 1.7 Hz, 1H), 4.87 (s, 1H), 3.74 (s, 3H).

**¹³C NMR** (101 MHz, CDCl₃) δ = 156.1, 150.6, 142.1, 140.5, 134.2, 134.1, 131.1, 130.2, 129.5, 128.3, 128.2, 127.6, 127.4, 126.4, 126.3, 125.2, 125.0, 124.2, 123.3, 118.5, 115.3, 114.6, 113.8, 56.7.

**HRMS** (ESI⁺) C₂₇H₂₀O₂ [M+H]⁺ requires 377.15361; found 377.15358, Δ –0.1 ppm.
2'-Methoxy-4,4'-diphenyl-[1,1'-binaphthalen]-2-ol (42)

4,4'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (38) (458 mg, 1.00 mmol, 1.00 equiv.), phenyl boronic acid (293 mg, 2.40 mmol, 2.40 equiv.) and Pd(PPh₃)₄ (57.8 mg, 0.05 mmol, 5 mol%) were charged to a flask fitted with a water-cooled condenser. The flask was evacuated and backfilled with argon three times. 1,2-Dimethoxyethane (Argon sparged, 10 mL) was added followed by aqueous Na₂CO₃ solution (Argon sparged, 2 M, 2.50 mL, 5.00 equiv.). The flask was fitted with an argon balloon and heated at 90 °C for 16 hours. After cooling to room temperature, 1 M HCl solution was added and the solution was extracted three times with CH₂Cl₂, the combined organic layers were dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was purified by column chromatography (9:1 petroleum ether 40-60 – EtOAc) to give 2'-methoxy-4,4'-diphenyl-[1,1'-binaphthalen]-2-ol (42) (384 mg, 85%) as a white solid.

m.p. = 118-120 °C (EtOAc – petroleum ether 40-60)

IR (film) νₘₐₓ/cm⁻¹: 3526, 3407, 3056, 2970, 2935, 1587, 1344, 1224, 1175, 1144, 763, 702, 658.

¹H NMR (CDCl₃, 400 MHz) δ = 7.87–7.82 (m, 2H), 7.58–7.35 (m, 11H), 7.29–7.11 (m, 7H), 4.95 (s, 1H), 3.77 (s, 3H).

¹³C NMR (CDCl₃, 121 MHz) δ =155.4, 150.7, 143.6, 142.2, 140.5, 140.5, 134.6, 134.3, 130.2, 130.1, 128.5, 128.3, 127.8, 127.8, 127.6, 127.4, 127.3, 126.5, 126.4, 126.4, 125.4, 125.3, 124.3, 123.3, 118.5, 114.9, 114.7, 114.6, 56.7.

HRMS (ESI⁺) C₃₃H₂₄O₂ [M+H]⁺ requires 453.18491; found 453.18411, Δ –1.8 ppm.
2′-Methoxy-4,4′-dimethyl-[1,1′-binaphthalen]-2-ol (43)

4,4′-dibromo-2′-methoxy-[1,1′-binaphthalen]-2-ol (38) (687 mg, 1.50 mmol, 1.00 equiv.) and Pd(dppf)Cl$_2$.CH$_2$Cl$_2$ (122 mg, 0.15 mmol, 10 mol%) were dissolved in THF (15 mL) and MeMgCl solution (3 M in Et$_2$O, 5.00 mL, 15.0 mmol, 10.0 equiv.) was added. The resulting solution was heated under reflux for 16 hours. On cooling to room temperature, saturated ammonium chloride solution was added and phases were separated. The aqueous phase was extracted twice with EtOAc and the combined organic layers were washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was purified by column chromatography (9:1 petroleum ether 40-60 – EtOAc) to give 2′-methoxy-4,4′-dimethyl-[1,1′-binaphthalen]-2-ol (43) (224 mg, 45%) as an off-white solid.

**m.p.** = 178-180 °C (EtOAc – petroleum ether 40-60)

**IR** (film) $\nu_{\text{max}}$/cm$^{-1}$: 3519, 2980, 1591, 1342, 1264, 1220, 1179, 1171, 1136, 1111, 1058, 999, 869, 758

$^1$H NMR (CDCl$_3$, 400 MHz) $\delta$ = 8.13–7.92 (m, 2H), 7.48–7.21 (m, 7H), 7.15–7.09 (m, 1H), 4.92 (s, 1H), 3.83 (s, 3H), 2.89 (s, 3H), 2.82 (s, 3H).

$^{13}$C NMR (CDCl$_3$, 121 MHz) $\delta$ = 155.6, 150.8, 137.9, 136.4, 134.3, 134.1, 128.7, 128.5, 127.0, 126.1, 125.6, 125.5, 124.4, 124.3, 124.0, 123.0, 118.2, 115.0, 113.4, 113.2, 56.7, 20.1, 19.6.

**HRMS** (ESI$^+$) C$_{23}$H$_{20}$O$_2$ [M+H]$^+$ requires 329.15361; found 329.15279, $\Delta$ –1.4 ppm.
4.5 BINOLs Prepared by Other Synthetic Routes

2'-Methoxy-6'-nitro-[1,1'-binaphthalen]-2-ol was prepared following a reported method.\textsuperscript{7}

BINOLs 1, 9 and 10 were prepared by alkylation of racemic [1,1'-binaphthalam]-2,2'-diol.

BINOLs 12, 17 and 25 were prepared by deprotection of racemic benzylated compounds.\textsuperscript{11}

BINOL 31 was prepared by dimerization of commercially available 7-methoxy-2-naphthol, followed by mono-alkylation.
2'-Methoxy-[1,1'-binaphthalen]-2-ol (1)

[1,1'-binaphthalene]-2,2'-diol (5.00 g, 17.4 mmol, 1.00 equiv.) and K₂CO₃ (3.14 g, 22.7 mmol, 1.30 equiv.) were suspended in acetone (140 mL) and iodomethane (2.73 g, 1.20 mL, 19.2 mmol, 1.10 equiv) was added. The resulting suspension was heated under reflux for 16 hours after which time the reaction was cooled to room temperature. The solvent was removed by evaporation and the residue was partitioned between water and CH₂Cl₂. The phases were separated and the aqueous layer was extracted twice with CH₂Cl₂. The combined organic layers were dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (1:1 CH₂Cl₂ – petroleum ether 40-60 to 3:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2'-methoxy-[1,1'-binaphthalen]-2-ol (1) (2.27 g, 43%) as a white solid.

m.p. = 151-153 °C (CH₂Cl₂/petroleum ether 40-60)

¹H NMR (500 MHz, CDCl₃) δ = 8.06 (d, J = 9.1 Hz, 1H), 7.95 (d, J = 9.2 Hz, 1H), 7.93 (d, J = 9.3 Hz, 1H), 7.91 (d, J = 10.6 Hz, 1H), 7.49 (d, J = 9.1 Hz, 1H), 7.42 (d, J = 1.9 Hz, 2H), 7.36 (t, J = 7.4 Hz, 1H), 7.32 (t, J = 7.7 Hz, 1H), 7.27 (t, J = 8.3 Hz, 1H), 7.24 (d, J = 9.0 Hz, 1H), 7.12 (d, J = 8.4 Hz, 1H), 5.00 (s, 1H), 3.81 (s, 3H).

¹³C NMR (101 MHz, CDCl₃) δC = 156.1, 151.3, 134.1, 133.9, 131.1, 129.9, 129.5, 129.2, 128.2, 127.4, 126.5, 125.0, 124.9, 124.3, 123.3, 117.6, 115.4, 115.1, 113.9, 56.7

Data in agreement with literature¹²
Following a modified literature procedure,\textsuperscript{10} to a solution of [1,1'-binaphthalene]-2,2'-diol (1.43 g, 5.00 mmol, 1.00 equiv), triphenylphosphine (1.31 g, 5.00 mmol, 1.00 equiv) and isopropyl alcohol (1.50 g, 1.91 mL, 25.0 mmol, 5.00 equiv) in tetrahydrofuran (50 mL) was added diisopropyl azodicarboxylate (1.01 g, 0.98 mL, 5.00 mmol, 1.00 equiv) dropwise. The resulting mixture was stirred at room temperature for 24 h before being concentrated in vacuo. The crude product was purified by flash column chromatography (3:2 CH\textsubscript{2}Cl\textsubscript{2} – petroleum ether 40-60) to give 2'-Isopropoxy-[1,1'-binaphthalen]-2-ol (9) (910 mg, 55%) as a white solid.

\textsuperscript{1}H NMR (500 MHz, CDCl\textsubscript{3}) \( \delta \) 8.00 (d, \( J = 9.0 \) Hz, 1H), 7.93-7.88 (m, 2H), 7.86 (d, \( J = 8.1 \) Hz, 1H), 7.45 (d, \( J = 9.0 \) Hz, 1H), 7.40-7.33 (m, 2H), 7.31 (ddd, \( J = 0.8, 7.2, 7.7 \) Hz, 1H), 7.29-7.24 (m, 1H), 7.21 (ddd, \( J = 1.3, 6.9, 8.3 \) Hz, 1H), 7.18 (d, \( J = 8.5 \) Hz, 1H), 7.07 (d, \( J = 8.4 \) Hz, 1H), 5.08 (s, 1H), 4.44 (sept, \( J = 6.1 \) Hz, 1H), 1.13 (d, \( J = 6.1 \) Hz, 3H), 0.99 (d, \( J = 6.1 \) Hz, 3H).

\textsuperscript{13}C NMR (126 MHz, CDCl\textsubscript{3}) \( \delta \) 154.8, 151.4, 134.4, 134.0, 130.8, 129.9, 129.7, 129.2, 128.2, 128.1, 127.2, 126.3, 125.4, 125.3, 124.5, 123.2, 118.2, 118.0, 117.7, 115.7, 72.7, 22.4, 22.3.

HRMS (ESI\textsuperscript{+}): \( C_{23}H_{21}O_2^+ \) [M+H]\textsuperscript{+} requires 329.15361, found: 329.15366, \( \Delta +0.2 \) ppm.

Data in agreement with literature\textsuperscript{13}
2'-{(Benzyloxy)-[1,1'-binaphthalen]-2-ol (10)

[1,1'-binaphthalene]-2,2'-diol (2.00 g, 6.98 mmol, 1.00 equiv.) and K$_2$CO$_3$ (1.25 g, 9.08 mmol, 1.30 equiv.) were suspended in acetone (56.0 mL) and benzyl bromide (1.31 g, 0.91 mL, 7.68 mmol, 1.10 equiv) was added. The resulting suspension was heated under reflux for 7 hours after which time the reaction was cooled to room temperature. The solvent was removed by evaporation and the residue was partitioned between water and CH$_2$Cl$_2$. The phases were separated and the aqueous layer was extracted twice with CH$_2$Cl$_2$. The combined organic layers were dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (1:2 CH$_2$Cl$_2$ – petroleum ether 40-60 to 1:1 CH$_2$Cl$_2$ – petroleum ether 40-60) afforded 2'-{(benzyloxy)-[1,1'-binaphthalen]-2-ol (10) (1.27 g, 48%) as a light brown solid.

m.p. = 108-110 °C (CH$_2$Cl$_2$/petroleum ether 40-60)

$^1$H NMR (500 MHz, CDCl$_3$) δ 7.99 (d, $J$ = 9.0 Hz, 1H), 7.96 (d, $J$ = 8.9 Hz, 1H), 7.91 (t, $J$ = 7.3 Hz, 1H), 7.48 (d, $J$ = 9.1 Hz, 1H), 7.43-7.38 (m, 2H), 7.37-7.24 (m, 3H), 7.23-7.18 (m, 3H), 7.13 (d, $J$ = 8.5 Hz, 1H), 7.10-7.04 (m, 2H), 5.16-5.06 (m, 2H), 5.00 (s, 1H).

$^{13}$C NMR (126 MHz, CDCl$_3$) δ 155.0, 151.4, 137.0, 134.2, 133.9, 130.9, 129.9, 129.8, 129.3, 128.2, 128.2, 127.8, 127.4, 127.0, 126.5, 125.1, 125.1, 124.5, 123.4, 117.6, 116.9, 116.0, 115.2, 71.2

Data in agreement with literature$^{13}$
2'-Hydroxy-[1,1'-binaphthalen]-2-yl pivalate (59)

(±)-BINOL (5.72 g, 20.0 mmol, 1.00 equiv.) was dissolved in MeCN and Et$_3$N (8.40 mL, 11.6 g, 60.0 mmol, 3.00 equiv.) was added. The resulting solution was cooled to 0 °C and pivaloyl chloride (2.40 mL, 2.44 g, 20.2 mmol, 1.01 equiv.) was added dropwise. The reaction was warmed to room temperature and stirred for an additional 5 hours. Et$_2$O was added and the mixture was washed with aqueous HCl (1 M), aqueous NaHCO$_3$ then brine. The organic phase was dried over anhydrous sodium sulfate, filtered and concentrated in vacuo to give the crude product which was purified via flash column chromatography (4:1 petroleum ether 40-60 – EtOAc) to give 2'-hydroxy-[1,1'-binaphthalen]-2-yl pivalate (59) (4.00 g, 54%) as a white solid.

m.p. = 118-120 °C (EtOAc/petroleum ether 40-60).

$^1$H NMR (400 MHz, CDCl$_3$) $\delta = 8.11$ (d, $J = 8.8$ Hz, 1H), 8.01 (d, $J = 8.3$ Hz, 1H), 7.92 (d, $J = 8.9$ Hz, 1H), 7.86 (d, $J = 8.0$ Hz, 1H), 7.54 (ddd, $J = 8.1$, 5.9, 2.1 Hz, 1H), 7.42 (d, $J = 8.9$ Hz, 1H), 7.40–7.33 (m, 4H), 7.29 (ddd, $J = 8.2$, 6.6, 1.4 Hz, 1H), 7.10 (dd, $J = 8.4$, 1.1 Hz, 1H), 5.19 (s, 1H), 0.82 (s, 9H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta = 177.8$, 151.8, 148.3, 133.6, 133.5, 132.2, 130.7, 130.3, 129.0, 128.3, 127.9, 127.5, 126.7, 126.2, 125.6, 124.6, 123.5, 123.0, 121.8, 118.2, 114.2, 38.8, 26.5.

LRMS (ESI$^+$) C$_{25}$H$_{22}$O$_3$ [M–H]$^-$ requires 369.1; found 369.0.

Data in agreement with literature$^7$
2'-Hydroxy-6'-nitro-[1,1'-binaphthalen]-2-y1 pivalate (60)

2'-Hydroxy-[1,1'-binaphthalen]-2-y1 pivalate (59) (2.00 g, 5.40 mmol, 1.00 equiv.) was dissolved in Et₂O (54 mL) and the resulting solution was cooled to 0 °C. HNO₃ (conc., 3.35 mL) followed by H₂SO₄ (conc., 1.35 mL) were added. After 2 hours the mixture was poured into ice/water and diluted with Et₂O. The organic phase was washed three times with water, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. The crude oil was triturated with 1:1 CH₂Cl₂ – petroleum ether 40-60 to give 2'-hydroxy-6'-nitro-[1,1'-binaphthalen]-2-y1 pivalate (60) (1.16 g, 52%) was a yellow solid.

m.p. = 204-206 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν_max/cm⁻¹: 3374, 1737, 1618, 1530, 1494, 1479, 1331, 1292, 1283, 1128, 741.

¹H NMR (400 MHz, DMSO-d₆) δ = 10.51 (br. s, 1H), 8.97 (d, J = 2.5 Hz, 1H), 8.30 (d, J = 9.1 Hz, 1H), 8.12 (d, J = 8.9 Hz, 1H), 8.08 (d, J = 8.4 Hz, 1H), 7.95 (dd, J = 9.4, 2.5 Hz, 1H), 7.51 (m, 3H), 7.38 (ddd, J = 8.2, 6.8, 1.3 Hz, 1H), 7.16 (d, J = 8.4, 1H), 7.02 (d, J = 9.4 Hz, 1H), 0.70 (s, 9H).

¹³C NMR (101 MHz, DMSO-d₆) δ = 175.9, 157.6, 147.4, 142.8, 137.3, 133.3, 132.8, 131.9, 129.7, 128.8, 127.3, 126.5, 126.1, 126.1, 125.6, 125.5, 124.4, 122.8, 120.8, 119.9, 114.6, 26.5.

LRMS (ESI⁻) C₂₅H₂₁NO₅ [M−H]⁻ requires 414.1; found 414.0.

Data in agreement with literature⁷
2'-Methoxy-6'-nitro-[1,1'-binaphthalen]-2-ol (11)

2'-Hydroxy-6'-nitro-[1,1'-binaphthalen]-2-yl pivalate (60) (1.20 g, 2.89 mmol, 1.00 equiv.) was dissolved in acetone (30 mL) and K$_2$CO$_3$ (798 mg, 5.78 mmol, 2.00 equiv.) followed by iodomethane (0.27 mL, 616 mg, 4.33 mmol, 1.50 equiv.) were added. The reaction was heated under reflux for 24 hours then cooled to room temperature. The crude mixture was concentrated to approximately 10 mL before addition of water (50 mL). A yellow solid was precipitated and collected by filtration. The crude solid was dissolved in CH$_2$Cl$_2$ and the resulting solution was washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product which was used without further purification.

The crude methylated BINOL was dissolved in 3:1 THF/water (14 mL) and KOH (196 mg) was added. The reaction was stirred for 6 hours at 70 °C, cooled to room temperature then partially concentrated in vacuo to remove THF. 1 M HCl was added and the solution was extracted three times with CH$_2$Cl$_2$. The combined organic layers were washed 5 times with 1 M HCl, dried over anhydrous sodium sulfate, filtered and concentrated to give the crude product. Purification via flash column chromatography (4:1 CH$_2$Cl$_2$ – petroleum ether 40-60) gave 2'-methoxy-6'-nitro-[1,1'-binaphthalen]-2-ol (11) (582 mg, 55%).

**m.p.** = 234-236 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

**IR** (film) $\nu_{\text{max}}$/cm$^{-1}$: 3058, 2934, 2840, 1597, 1493, 1472, 1467, 1327, 1267, 1244, 1198, 1142, 1128, 1093, 1081, 1047, 910, 812, 798, 740.

**$^1$H NMR** (400 MHz, CDCl$_3$) $\delta$ = 8.86 (d, $J = 2.3$ Hz, 1H), 8.25 (d, $J = 9.1$ Hz, 1H), 8.01 (dd, $J = 9.3$, 2.4 Hz, 1H), 7.94 (d, $J = 8.9$ Hz, 1H), 7.89 (d, $J = 8.1$ Hz, 1H), 7.64 (d, $J = 9.2$ Hz, 1H), 7.38–7.30 (m, 2H), 7.30–7.21 (m, 3H), 6.94 (d, $J = 8.4$ Hz, 1H), 3.88 (s, 3H).

**$^{13}$C NMR** (101 MHz, CDCl$_3$) $\delta$ = 158.9, 151.3, 144.1, 137.0, 133.4, 133.3, 130.4, 129.2, 128.4, 127.5, 126.8, 126.6, 125.2, 124.3, 123.6, 120.6, 117.6, 116.3, 115.3, 113.8, 56.7.

**HRMS** (ESI') $\text{C}_{21}\text{H}_{15}\text{NO}_4$ [M-H]$^-$ requires 344.09283; found 344.09256, $\Delta$ −0.8 ppm.

Data in agreement with literature$^7$
2'-Methoxy-6'-methyl-[1,1'-binaphthalen]-2-ol (12)

Ammonium formate (473 mg, 7.50 mmol, 6.00 equiv.) and Pd/C (10% wt, 40 mg) were added to a solution of 2'-Methoxy-6'-methyl-1,1'-binaphthalen-2-ol\textsuperscript{11} (505 mg, 1.25 mmol) in 9:1 ethyl acetate/methanol in a sealed pressure tube. The suspension was then stirred at 50 °C for 24 h. after cooling to room temperature, the reaction mixture was filtered through celite, washing the filtercake with ethyl acetate, and the filtrate was subsequently washed twice with water and concentrated under reduced pressure. Purification of the residue via column chromatography eluting with a gradient from 1:2 dichloromethane/petrol 40-60 to 1:1 dichloromethane/petrol 40-60 afforded 2'-methoxy-6'-methyl-[1,1'-binaphthalen]-2-ol (12) (379 mg, 97 %) as a white solid.

\textbf{m.p.} = 81-82 °C (dichloromethane/petrol 40-60).

\textbf{1}H NMR (400 MHz, CDCl\textsubscript{3}) \( \delta = 7.97 \) (d, \( J = 9.1 \) Hz, 1H), 7.92 (d, \( J = 8.9 \) Hz, 1H), 7.88 (dd, \( J = 8.1 \), 0.9 Hz, 1H), 7.69 (d, \( J = 1.8 \) Hz, 1H), 7.45 (d, \( J = 9.1 \) Hz, 1H), 7.38 (d, \( J = 8.9 \) Hz, 1H), 7.33 (ddd, \( J = 8.1 \), 6.7, 1.2 Hz, 1H), 7.24 (ddd, \( J = 8.3 \), 6.8, 1.4 Hz, 1H), 7.14 (dd, \( J = 8.7 \), 1.7 Hz, 1H), 7.12-7.06 (m, 2H,), 4.97 (br s, 1H, OH), 3.79 (s, 3H), 2.49 (s, 3H).

\textbf{13}C NMR (101 MHz, CDCl\textsubscript{3}) \( \delta = 155.5, 151.3, 133.9, 133.9, 132.3, 130.4, 129.8, 129., 129.7, 129.2, 128.2, 127.2, 126.5, 125.0, 124.9, 123.3, 117.6, 115.4, 115.3, 114.0, 56.8, 21.5.

\textbf{IR} (film) \( \nu_{\text{max}}/\text{cm}^{-1} \): 3490, 3424, 3058, 3017, 2937, 2918, 2839, 1620, 1595, 1515, 1501, 1463, 1379, 1353, 1334, 1300, 1250, 1228, 1147, 1084, 1051.

\textbf{HRMS} (ESI\textsuperscript{-}): \( \text{C}_{22}\text{H}_{18}\text{O}_{2} \) [M-H\textsuperscript{-}] requires = 313.1234; found = 313.1233, \( \Delta +0.3 \) ppm.
A solution of 2-(benzyloxy)-7-fluoro-2'-methoxy-1,1'-binaphthalene\textsuperscript{11} (579 mg, 1.42 mmol) in degassed 1:9 methanol/ethyl acetate (1 mL) was added to palladium on carbon (10 wt %, 42 mg). The reaction mixture was stirred under an atmosphere of hydrogen (balloon) for 24 hours. The reaction mixture was then filtered through a plug of celite which was subsequently washed with ethyl acetate. The filtrate was concentrated under reduced pressure. Purification of the residue via column chromatography eluting with a gradient from 1:1 dichloromethane/petrol 40-60 to 2:1 dichloromethane/petrol 40-60 afforded 7-fluoro-2'-methoxy-[1,1'-binaphthalen]-2-ol (17) (454 mg, 99 %) as a white solid.

\textbf{m.p.} = 201-202 °C (dichloromethane/petrol 40-60).

\textit{\textsuperscript{1}H NMR} (400 MHz, CDCl\textsubscript{3}) \(\delta = 8.06 (d, J = 9.1 \text{ Hz}, 1H), 7.93-7.87 (m, 2H), 7.84 (dd, J = 8.9, 5.8 \text{ Hz}, 1H), 7.48 (d, J = 9.1 \text{ Hz}, 1H), 7.39 (ddd, J = 8.1, 6.8, 1.3 \text{ Hz}, 1H), 7.35-7.28 (m, 2H), 7.20-7.15 (m, 1H), 7.09 (ddd, J = 8.9, 8.3, 2.6 \text{ Hz}, 1H), 6.67 (dd, J = 11.3, 2.6 \text{ Hz}, 1H), 4.99 (br s, 1H), 3.82 (s, 3H).

\textit{\textsuperscript{13}C NMR} (101 MHz, CDCl\textsubscript{3}) \(\delta = 161.7 (d, J = 244.8 \text{ Hz}), 156.2, 152.3, 135.2 (d, J = 9.4 \text{ Hz}), 133.9, 131.5, 130.6 (d, J = 9.4 \text{ Hz}), 129.8, 129.6, 128.4, 127.6, 126.2, 124.7, 124.4, 116.8 (d, J = 2.5 \text{ Hz}), 114.9 (d, J = 5.3 \text{ Hz}), 113.8, 113.5 (d, J = 25.4 \text{ Hz}), 108.5 (d, J = 22.1 \text{ Hz}), 56.7.

\textit{\textsuperscript{19}F NMR} (376 MHz, CDCl\textsubscript{3}) \(\delta = -114.0.

\textbf{IR} (film) \(\nu_{\text{max}}/\text{cm}^{-1}: 3492, 3428, 3062, 2840, 1624, 1592, 1508, 1472, 1431, 1378, 1360, 1230, 1200, 1166, 1149, 1135, 1080, 1053, 1021.

\textbf{HRMS} (ESI\textsuperscript{-}): \(\text{C}_{21}\text{H}_{15}\text{FO}_{2} \text{[M-H]}^{-}\) requires 317.0983; found 317.0981, \(\Delta = -0.6 \text{ ppm.}\)
1-(2-Methoxynaphthalen-1-yl)phenanthren-2-ol (25)

Ammonium formate (260 mg, 4.12 mmol) and Pd/C (10 wt %, 105 mg) were added to a solution of 2-(benzyloxy)-1-(2-Methoxynaphthalen-1-yl)phenanthren-2-ol\textsuperscript{11} (303 mg, 0.687 mmol) in 9:1 ethyl acetate/methanol in a sealed pressure tube. The suspension was then stirred at 50 °C for 48 h. After cooling to room temperature, the reaction mixture was filtered through celite, washing the filtercake with ethyl acetate, and the filtrate was subsequently washed twice with water and concentrated under reduced pressure. Purification of the residue \textit{via} column chromatography eluting with a gradient from 1:2 dichloromethane/petrol 40-60 to 1:1 dichloromethane/petrol 40-60 afforded the title compound 1-(2-Methoxynaphthalen-1-yl)phenanthren-2-ol (25) (228 mg, 95 %) as a white solid.

\textbf{m.p.} = 123-125 °C (dichloromethane/petrol 40-60).

\textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}) \( \delta = 8.79 \) (d, \( J = 9.0 \) Hz, 1H), 8.71 (d, \( J = 8.2 \) Hz, 1H), 8.08 (d, \( J = 9.1 \) Hz, 1H), 7.93 (dd, \( J = 8.2, 0.9 \) Hz, 1H), 7.81 (dd, \( J = 7.8, 1.3 \) Hz, 1H), 7.67 (ddd, \( J = 8.4, 7.0, 1.4 \) Hz, 1H), 7.58-7.47 (m, 4H), 7.40 (ddd, \( J = 8.1, 6.7, 1.3 \) Hz, 1H), 7.30 (ddd, \( J = 8.1, 6.7, 1.3 \) Hz, 1H), 7.24-7.18 (m, 1H), 7.05 (d, \( J = 9.1 \) Hz, 1H), 4.98 (br s, 1H), 3.82 (s, 3H).

\textsuperscript{13}C NMR (101 MHz, CDCl\textsubscript{3}) \( \delta = 156.1, 152.3, 134.2, 132.6, 131.3, 130.0, 130.8, 129.5, 128.6, 128.3, 127.7, 127.6, 126.8, 125.7, 124.9, 124.9, 124., 124.4, 124.4, 122.4, 117.3, 116.5, 115.6, 113.9, 56.8.

\textbf{IR} (film) \( \nu_{\text{max}}/\text{cm}^{-1} \): 3495, 3424, 3057, 2936, 2839, 1620, 1592, 1529, 1506, 1460, 1431, 1420, 1332, 1306, 1268, 1250, 1214, 1203, 1171, 1146, 1119, 1076, 1057, 1034, 1020.

\textbf{HRMS} (ESI\textsuperscript{−}): \( \text{C}_{25}\text{H}_{18}\text{O}_2 [\text{M-H}]^{-} \) requires 349.1234; found 349.1233, \( \Delta = 0.3 \).
Following a modified literature procedure, to a solution of 7-methoxynaphth-2-ol (1.50 g, 8.61 mmol) in CH$_2$Cl$_2$ (15.0 mL) was added Cu-TMEDA complex (400 mg, 0.86 mmol). The mixture was sonicated in air for 30 seconds and then stirred for 16 hours at room temperature under an air atmosphere. The solvent was removed under reduced pressure and the resulting crude mixture was purified by flash column chromatography (1:1 pet ether 40-60/CH$_2$Cl$_2$ to CH$_2$Cl$_2$) to give the title compound 61 as a yellow-brown solid (826 mg, 2.38 mmol, 55% yield).

$^1$H NMR (400 MHz, CDCl$_3$) $\delta_H$: 7.85 (d, $J = 8.8$ Hz, 2H), 7.77 (d, $J = 8.9$ Hz, 2H), 7.21 (d, $J = 8.9$ Hz, 2H), 7.03 (d, $J = 8.9$ Hz, 2H), 6.47 (s, 2H), 5.08 (s, 2H), 3.57 (s, 6H)

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta_C$: 159.2, 153.4, 134.8, 131.2, 130.1, 124.9, 116.1, 115.2, 110.2, 103.2, 55.3

HRMS (ESI') C$_{22}$H$_{17}$O$_4^-$ [M-H]$^-$: requires 345.1132, found: 345.1134, $\Delta$ +0.58 ppm.

Data in agreement with literature reported.
2',7,7'-Trimethoxy-[1,1'-binaphthalen]-2-ol (31)

To a solution of 61 (826 mg, 2.38 mmol) in acetone (24 mL) was added K$_2$CO$_3$ (493 mg, 3.57 mmol) and methyl iodide (0.22 mL, 3.57 mmol). The resulting suspension was heated at 70 °C for 16 hours and cooled to room temperature. The solvent was removed under reduced pressure followed by addition of water (20 mL) and CH$_2$Cl$_2$ (30 mL). The layers were separated and the aqueous layer was extracted with CH$_2$Cl$_2$ (20 mL × 3). The combined organic layers were dried over anhydrous MgSO$_4$, filtered and the solvent removed under reduced pressure. The resulting crude mixture was purified by flash column chromatography (2:1 petroleum ether 40-60 – CH$_2$Cl$_2$ to 1:1 petroleum ether 40-60 – CH$_2$Cl$_2$) to give the title compound 31 as an off-white solid (577 mg, 1.60 mmol, 67% yield).

**m.p.** = 96-98 °C (CH$_2$Cl$_2$/petroleum ether 40-60)

**IR** ($v_{max}$/cm$^{-1}$, ATR): 3484, 2937, 1621, 1511, 1462, 1262, 1221, 813, 756.

**$^1$H NMR** (400 MHz, CDCl$_3$) $\delta_H$: 7.97 (d, $J = 8.8$ Hz, 1H, H$_4$), 7.87-7.75 (m, 3H, H$_6$, H$_{16}$ and H$_{18}$), 7.33 (d, $J = 8.8$ Hz, 1H, H$_3$), 7.23 (d, $J = 8.5$ Hz, 1H, H$_{15}$), 7.06 (d, $J = 9.1$ Hz, 1H, H$_{19}$), 7.01 (d, $J = 8.8$ Hz, H$_7$), 6.51 (s, 1H, H$_{21}$), 6.43 (s, 1H, H$_9$), 4.98 (s, 1H, OH), 3.82 (s, 3H, H$_{12}$), 3.56 (s, 3H, H$_{11}$ or H$_{23}$), 3.54 (s, 3H, H$_{11}$ or H$_{23}$).

**$^{13}$C NMR** (101 MHz, CDCl$_3$) $\delta_C$: 158.9, 158.2, 156.6, 151.7, 135.3, 134.9, 130.7, 129.8, 129.7, 129.5, 124.9, 124.6, 116.8, 115.1, 114.9, 114.3, 114.2, 111.0, 104.1, 103.2, 56.5, 55.0.

**HRMS** (ESI$^-$): C$_{23}$H$_{19}$O$_4^-$ [M-H]$: requires 359.1289, found: 359.1290, $\Delta$ +0.28 ppm.
5. General Procedure for the Counterion Mediated Kinetic Resolution of BINOLs

General Procedure A:

The appropriate methyl BINOL (0.150 mmol, 1.00 equiv.), benzyl tosylate* (59.1 mg, 0.225 mmol, 1.50 equiv.) and N-(2,3,4-trifluorobenzyl)hydrocinchoninium bromide (7.8 mg, 0.015 mmol, 0.10 equiv.) were added to a 7 mL vial equipped with a magnetic stirrer bar (pictured below) under air. Benzene (5.40 mL) and diethyl ether (0.60 mL) were added followed by K$_2$CO$_3$ (sat. aq., 208 µL). The reaction was stirred at 1000-1400 rpm at room temperature (20-25°C) for the required reaction time**. Piperidine*** (0.30 mL) was added and stirring was continued for a further 30 minutes. Hydrochloric acid (3 M aq., 0.50 mL) was added dropwise and the phases were separated and the aqueous phase was extracted with EtOAc (2 × 5.00 mL). The combined organic layers were concentrated in vacuo and purified by flash column chromatography using the appropriate eluent to give the corresponding enantioenriched benzylated product and recovered starting material.

* Benzyl tosylate was prepared following a literature procedure$^{12}$ and stored at −20 °C in the dark.

** The reaction time was varied between different substrates to achieve the desired conversion. Typical reaction times were between 24 and 48 hours.

*** Piperidine was added to consume excess benzyl tosylate. This is done to stop the reaction at the desired conversion and to prevent side product formation during purification.
Kinetic resolution equations

Consider a reaction in which enantiomers R and S of the starting material react to give enantiomers R' and S' of the product, respectively.

After a certain period of time, assuming, without loss of generality that enantiomer S reacts faster than enantiomer R, we have the enantiomeric excess of the starting material given by

\[ ee = \frac{[R] - [S]}{[R] + [S]} \]

Similarly, the enantiomeric excess of the product can be expressed as

\[ ee' = \frac{[S'] - [R']}{[S'] + [R']} \]

Considering also that the conversion c is given by the formula

\[ c = \frac{[S'] + [R']}{[S] + [R] + [S'] + [R']} \]

We can deduce a relationship between the c, ee and ee' in the form of Equation 1.

\[ ee = ee' \frac{c}{1 - c} \quad (Equation \ 1) \]

Assuming that each enantiomer reacts according to first order kinetics and that there is no background reaction and no other side-reactions, the ratio between the reaction rate of enantiomer S (kS) and that of enantiomer R (kR) is called the S-factor (s). From these assumptions an equation can be derived for s as a function of c and ee:

\[ s = \frac{\log([1-c](1-ee))}{\log([1-c](1+ee))} \quad (Equation \ 2) \]
6. Counterion Mediated Kinetic Resolution of BINOLs

Kinetic resolution of 2'-methoxy-[1,1'-binaphthalen]-2-ol (1)

Following **General procedure A**, 2'-methoxy-[1,1'-binaphthalen]-2-ol (1) (45.0 mg, 0.15 mmol) was reacted for 24 h. Purification via flash column chromatography (30% CH₂Cl₂ – petroleum ether 40-60 to 80% CH₂Cl₂ – petroleum ether 40-60) afforded 2-(benzyloxy)-2'-methoxy-1,1'-binaphthalene (Bn-1) as an off-white solid (28.6 mg, 49%, 90:10 e.r.) and recovered starting material (1) (21.2 mg, 47%, 98:2 e.r.).

*(S)-2-(Benzyloxy)-2'-methoxy-1,1'-binaphthalene (Bn-1):*  
**m.p.** = 130-132 °C (CH₂Cl₂/petroleum ether 40-60).

**IR** (film) ν_max/cm⁻¹: 3058, 3037, 2933, 1591, 1506, 1262, 1249, 1220, 1190, 1061, 806, 746, 734.

**¹H NMR** (400 MHz, CDCl₃) δ_H = 8.01 (d, J = 9.0 Hz, 1H), 7.92 (d, J = 9.4 Hz, 1H), 7.90–7.85 (m, 2H), 7.47 (d, J = 9.0 Hz, 1H), 7.44 (d, J = 9.0 Hz, 1H), 7.34 (m, 1.3 Hz, 2H), 7.25–7.20 (m, 3H), 7.20–7.12 (m, 4H), 7.02–6.95 (m, 2H), 5.35–4.85 (m, 2H), 3.77 (s, 3H).

**¹³C NMR** (101 MHz, CDCl₃) δ_C = 155.1, 154.2, 137.7, 134.3, 134.2, 129.6, 129.6, 129.5, 129.4, 129.1, 128.3, 128.1, 128.0, 127.4, 126.9, 126.5, 126.4, 125.6, 125.5, 123.9, 123.6, 121.0, 119.6, 116.3, 114.0, 71.4, 56.8.

**HRMS** (ESI⁺) C₂₈H₂₂O₂ [M+Na]⁺ requires 413.15120; found 413.15147, Δ 0.6 ppm.

**Chiral HPLC:** (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min⁻¹, λ = 289 nm) τ_R (major) = 8.0 min, τ_R (minor) = 11.8 min.

[α]_D^{25} = -58.7 (c = 1.00, CHCl₃).

Data in agreement with literature reported.¹¹

*(R)-2'-Methoxy-[1,1'-binaphthalen]-2-ol (1):*

**m.p.** = 108-109 °C (CH₂Cl₂/petroleum ether b.p. 40-60 °C).

**Chiral HPLC:** (Chiralpak ADH, 7.5% iPrOH, 90% hexane, 1.0 mL min⁻¹, λ = 290 nm) τ_R (major) = 25.7 min, τ_R (minor) = 16.6 min.

[α]_D^{25} = +42.0 (c = 0.50, acetone).
Kinetic resolution of 2'-isopropoxy-[1,1'-binaphthalen]-2-ol (9)

Following General procedure A, 2'-isopropoxy-[1,1'-binaphthalen]-2-ol (9) (49.3 mg, 0.150 mmol) was reacted for 27 h. Purification via flash column chromatography (3:1 petroleum ether 40-60 – CH2Cl2 to 1:1 CH2Cl2 – petroleum ether 40-60) afforded 2-(benzyloxy)-2'-isopropoxy-1,1'-binaphthalene (Bn-9) as an off-white solid (33.4 mg, 53%, 89.5:10.5 e.r.) and recovered starting material (9) (23.3 mg, 47%, 96.0:4.0 e.r.)

(S)-2-(benzyloxy)-2'-isopropoxy-1,1'-binaphthalene (Bn-9):

**m.p.** = 43-45 °C (CH2Cl2/petroleum ether 40-60).

**IR** (film) νmax/cm⁻¹: 3059, 2975, 2928, 1622, 1592, 1506, 1454, 1327, 1262, 1241, 1223, 1147, 1132, 1112, 1088, 1054, 1018, 806, 748, 696

**1H NMR** (500 MHz, CDCl3) δH: 7.94 (d, J = 9.1 Hz, 1H), 7.92-7.86 (m, 2H), 7.85 (d, J = 8.2 Hz, 1H), 7.43 (d, J = 8.8 Hz, 1H), 7.39 (d, J = 8.8 Hz, 1H), 7.35-7.29 (m, 2H), 7.19-7.12 (m, 4H), 7.07-7.00 (m, 2H), 5.11-5.02 (m, 2H), 4.41 (sept, J = 6.1 Hz, 1H), 1.04 (d, J = 6.2 Hz, 1H), 0.95 (d, J = 6.0 Hz, 1H)

**13C NMR** (126 MHz, CDCl3) δC: 154.2, 153.9, 137.9, 134.5, 134.3, 129.6, 129.5, 129.2, 129.1, 128.2, 127.9, 127.9, 127.4, 126.9, 126.3, 126.2, 125.8, 125.7, 123.7, 123.7, 122.0, 121.3, 118.1, 116.2, 72.3, 71.3, 22.6, 22.4

**HRMS** (ESI⁺) C30H27O2 [M+H]+ requires 419.20056; found 419.20059, Δ +0.1 ppm.

**Chiral HPLC:** (Chiralpak ADH, 5% iPrOH, 95% hexane, 1.00 mL min⁻¹, λ = 290 nm) τR (major) = 5.1 min, τR (minor) = 5.6 min

[α]D²⁵ = −80.0 (c = 1.00, CHCl₃).

(R)-2'-isopropoxy-[1,1'-binaphthalen]-2-ol (9):

**m.p.** = 54-56 °C (CH2Cl2/petroleum ether 40-60).

**Chiral HPLC:** (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.00 mL min⁻¹, λ = 290 nm) τR (major) = 21.1 min, τR (minor) = 6.7 min

[α]D²⁵ = −68.9 (c = 1.00, CHCl₃).
Kinetic resolution of 2'-{benzyloxy}-[1,1'-binaphthalen]-2-ol (10)

Following General procedure A, 2'-{benzyloxy}-[1,1'-binaphthalen]-2-ol (10) (56.5 mg, 0.150 mmol) was reacted for 27 h. Purification via flash column chromatography (2:1 petroleum ether 40-60 – CH₂Cl₂ to 1:2 CH₂Cl₂ – petroleum ether 40-60) afforded 2,2'-bis(benzyloxy)-1,1'-binaphthalene (Bn-10) as an off-white solid (29.2 mg, 42%, 90.5:9.5 e.r.) and recovered starting material (9) (25.3 mg, 45%, 94.5:5.5 e.r.)

(S)-2,2'-bis(benzyloxy)-1,1'-binaphthalene (Bn-10):

m.p. = 97-99 °C (CH₂Cl₂/petroleum ether 40-60).

¹H NMR (500 MHz, CDCl₃) δ_H: 7.85 (d, J = 9.01 Hz, 2H), 7.80 (d, J = 8.12 Hz, 2H), 7.34 (d, J = 9.01 Hz, 2H), 7.28-7.23 (m, 2H), 7.18-7.12 (m, 4H), 7.08-6.98 (m, 6H), 6.89 (d, J = 6.94 Hz, 1H), 5.00-4.92 (m, 2H).

¹³C NMR (126 MHz, CDCl₃) δ_C: 154.2, 137.7, 134.3, 129.6, 129.4, 128.2, 128.0, 127.4, 126.8, 126.4, 125.7, 123.8, 120.9, 116.1, 71.3

Chiral HPLC: (Chiralpak ADH, 10% i-PrOH, 90% hexane, 1.00 mL min⁻¹, λ = 290 nm) τ_R (major) = 7.3 min, τ_R (minor) = 8.7 min

[α]₂⁰<SUB>D</SUB> = -34.6 (c = 1.00, CHCl₃).

Data in agreement with literature reported.¹⁶

(R)-2'-{benzyloxy}-[1,1'-binaphthalen]-2-ol (10):

m.p. = 108-110 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 20% i-PrOH, 80% hexane, 1.00 mL min⁻¹, λ = 290 nm) τ_R (major) = 35.2 min, τ_R (minor) = 19.5 min

[α]₂⁰<SUB>D</SUB> = +1.5 (c = 1.00, CHCl₃).
Kinetic resolution of 2’-methoxy-6’-nitro-[1,1’-binaphthalen]-2-ol (11)

Following General procedure A, 2’-methoxy-6’-nitro-[1,1’-binaphthalen]-2-ol (11) (51.8 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:7 petroleum ether 40-60 – CH₂Cl₂ to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2’-(benzyloxy)-2-methoxy-6-nitro-1,1’-binaphthalene (Bn-11) as an off-white solid (35.0 mg, 54%, 90:10 e.r.) and recovered starting material (11) (20.1 mg, 39%, 99.5:0.5 e.r.).

(S)- 2’-(benzyloxy)-2-methoxy-6-nitro-1,1’-binaphthalene (Bn-11):

- **m.p.** = 111-112 °C (CH₂Cl₂/petroleum ether 40-60).
- **IR** (film) ν\textsubscript{max}/cm\textsuperscript{-1}: 3062, 3031, 3010, 2960, 2938, 2841, 1619, 1599, 1594, 1529, 1496, 1462, 1328, 1247, 1220, 1098, 1055, 1046, 807, 740.
- **¹H NMR** (400 MHz, CDCl\textsubscript{3}) \(\delta\) = 8.86 (d, \(J = 2.3\) Hz, 1H), 8.18 (d, \(J = 8.7\) Hz, 1H), 7.97 (d, \(J = 9.3\) Hz, 1H), 7.94 (dd, \(J = 9.4, 2.4\) Hz, 1H), 7.89 (d, \(J = 8.2\) Hz, 1H), 7.59 (d, \(J = 9.1\) Hz, 1H), 7.46 (d, \(J = 9.1\) Hz, 1H), 7.36 (ddd, \(J = 8.1, 6.7, 1.2\) Hz, 1H), 7.29–7.23 (m, 1H), 7.19 (d, \(J = 9.4\) Hz, 1H), 7.16 (dd, \(J = 5.1, 2.0\) Hz, 3H), 7.11–7.06 (m, 1H), 7.02–6.96 (m, 2H), 5.09 (d, \(J = 2.1\) Hz, 2H), 3.81 (s, 3H).
- **¹³C NMR** (101 MHz, CDCl\textsubscript{3}) \(\delta\) = 158.3, 154.1, 143.8, 137.4, 137.1, 133.9, 132.0, 130.1, 129.5, 128.3, 128.3, 127.7, 127.2, 127.0, 126.8, 126.8, 125.2, 124.9, 124.1, 120.2, 119.8, 119.1, 115.8, 115.4, 71.2, 56.6.
- **HRMS** (ESI\textsuperscript{+}) \(C_{28}H_{21}O_4N\) [M+Na]\textsuperscript{+} requires 458.13738; found 458.13644, Δ -2.0 ppm.
- **Chiral HPLC:** (Chiralpak AD, 10% iPrOH, 90% hexane, 1.0 mL min\textsuperscript{-1}, \(\lambda = 279\) nm) \(\tau_R\) (major) = 14.2 min, \(\tau_S\) (minor) = 26.1 min.
  
  \[\alpha\]\textsubscript{D}\textsuperscript{25} = +46.4 (c = 1.00, CHCl\textsubscript{3}).

(R)- 2’-methoxy-6’-nitro-[1,1’-binaphthalen]-2-ol (11):

- **m.p.** = 195-197 °C (CH₂Cl₂/petroleum ether 40-60).
- **Chiral HPLC:** (Chiralpak AD, 10% iPrOH, 90% hexane, 1.0 mL min\textsuperscript{-1}, \(\lambda = 277\) nm) \(\tau_R\) (major) = 27.4 min, \(\tau_S\) (minor) = 29.8 min.
  
  \[\alpha\]\textsubscript{D}\textsuperscript{25} = −114.5 (c = 1.00, CHCl\textsubscript{3}).
Kinetic resolution of 2'-methoxy-6'-methyl-[1,1'-binaphthalen]-2-ol (12)

Following General procedure A, 2'-methoxy-6'-methyl-[1,1'-binaphthalen]-2-ol (12) (47.1 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:7 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2'(benzyloxy)-2-methoxy-6-methyl-1,1'-binaphthalene (Bn-12) as an off-white solid (32.6 mg, 54%, 80:20 e.r.) and recovered starting material (12) (18.6 mg, 39%, 99:1 e.r.).

(R)-2'(Benzyloxy)-2-methoxy-6-methyl-1,1'-binaphthalene (Bn-12):

m.p. = 109-110 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) νₘₐₓ/cm⁻¹: 3060, 3031, 2934, 2920, 1594, 1504, 1272, 1263, 1252, 1221, 1093, 1060, 805, 734.

¹H NMR (400 MHz, CDCl₃) δ = 7.92 (dd, J = 9.0, 2.2 Hz, 2H), 7.87 (d, J = 8.2 Hz, 1H), 7.71–7.62 (m, 1H), 7.45 (d, J = 5.0 Hz, 1H), 7.43 (d, J = 5.0 Hz, 1H), 7.34 (dd, J = 8.1, 6.4, 1.6 Hz, 1H), 7.28–7.21 (m, 2H), 7.19–7.17 (m, 3H), 7.07 (m, 2H), 7.05–7.00 (m, 2H), 5.09 (d, J = 12.6 Hz, 1H), 5.05 (d, J = 12.7 Hz, 1H), 3.75 (s, 3H), 2.48 (s, 2H).

¹³C NMR (101 MHz, CDCl₃) δ = 154.9, 154.5, 138.1, 134.6, 133.3, 132.7, 129.9, 129.9, 129.6, 129.1, 128.6, 128.3, 127.7, 127.3, 127.2, 126.7, 125.9, 125.7, 124.2, 121.5, 119.8, 116.8, 114.5, 71.8, 57.2, 21.9.

HRMS (ESI⁺) C₂₉H₂₄O₂ [M+Na]⁺ requires 427.16685; found 427.16644, Δ 1.0 ppm.

Chiral HPLC: (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min⁻¹, λ = 295 nm) τᵣ (major) = 12.2 min, τᵣ (minor) = 7.8 min.

[α]²⁵D = −32.5 (c = 1.00, CHCl₃).

Data in agreement with literature reported.¹¹

(S)- 2'-Methoxy-6'-methyl-[1,1'-binaphthalen]-2-ol (12):

m.p. = 137-138 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, λ = 341 nm) τᵣ (minor) = 11.5 min, τᵣ (major) = 12.9 min.

[α]²⁵D = −80.6 (c = 1.00, CHCl₃).
Kinetic resolution of 7-bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (13)

Following General procedure A, 7-bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (13) (56.9 mg, 0.150 mmol) was reacted for 36 h. Purification via flash column chromatography (3:7 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2-(benzyloxy)-7-bromo-2'-methoxy-1,1'-binaphthalene (Bn-13) as an off-white solid (37.3 mg, 53%, 85:15 e.r.) and recovered starting material (13) (22.5 mg, 40%, 99.5:0.5 e.r.).

(S)- [2-(Benzyloxy)-7-bromo-2'-methoxy-1,1'-binaphthalene] (Bn-13):

m.p. = 64-65 °C (CH₂Cl₂/petroleum ether 40-60).
IR (film) ν_max/cm⁻¹: 3061, 3032, 2837, 1613, 1497, 1267, 1255.

¹H NMR (400 MHz, CDCl₃) δ = 7.92 (d, J = 9.1 Hz, 1H), 7.81 (d, J = 8.2 Hz, 1H), 7.77 (d, J = 9.3 Hz, 1H), 7.62 (d, J = 8.7 Hz, 1H), 7.37 (d, J = 9.0 Hz, 1H), 7.33–7.23 (m, 4H), 7.19–7.12 (m, 1H), 7.10–6.99 (m, 4H), 6.91–6.85 (m, 2H), 5.03–4.91 (m, 3H), 3.68 (s, 4H).

¹³C NMR (101 MHz, CDCl₃) δ = 154.9, 154.7, 137.3, 135.4, 133.9, 129.8, 129.7, 129.2, 129.2, 128.2, 128.0, 127.8, 127.4, 127.4, 127.2, 126.7, 126.5, 125.1, 123.6, 121.0, 120.1, 118.4, 116.2, 113.7, 71.0, 56.6.

HRMS (ESI⁺) C₂₈H₂₁O₂⁷⁹Br [M+Na]⁺ requires 491.06171; found 491.06180, Δ +0.2 ppm.

Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 98% hexane, 1.0 mL min⁻¹, λ = 295 nm) τ_R (major) = 7.5 min, τ_S (minor) = 8.7 min.

[α]₀²⁵ = −23.2 (c = 1.00, CHCl₃).
Data in agreement with literature reported.¹¹

(R)- 7-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (13):

m.p. = 178-179 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, λ = 295 nm) τ_R (minor) = 11.6 min, τ_S (major) = 13.7 min.

[α]₀²⁵ = −53.8 (c = 1.00, CHCl₃).
Kinetic resolution of 2',7-dimethoxy-[1,1'-binaphthalen]-2-ol (14)

Following General procedure A, 2',7-dimethoxy-[1,1'-binaphthalen]-2-ol (14) (49.6 mg, 0.150 mmol) was reacted for 27 h. Purification via flash column chromatography (3:1 petroleum ether 40-60/CH$_2$Cl$_2$ to 1:3 petroleum ether 40-60/CH$_2$Cl$_2$) afforded 2-(benzyloxy)-2',7-dimethoxy-1,1'-binaphthalene (Bn-14) as an off-white solid (32.5 mg, 52%, 88.5:11.5 e.r.) and recovered starting material (14) (21.2 mg, 43%, 99.0:1.0 e.r.).

(S)-2-(benzyloxy)-2',7-dimethoxy-1,1'-binaphthalene (Bn-14)

m.p. = 51-53 ºC (CH$_2$Cl$_2$/petroleum ether 40-60).

IR (film) $\nu_{\text{max}}$/cm$^{-1}$: 3060, 2934, 2836, 1624, 1593, 1509, 1461, 1426, 1354, 1318, 1264, 1224, 1178, 1147, 1092, 1063, 1045, 1029, 828, 812, 749, 696

$^1$H NMR (500 MHz, CDCl$_3$) $\delta_H$: 8.00 (d, $J = 9.13$ Hz, 1H), 7.90 (d, $J = 8.07$ Hz, 1H), 7.84 (d, $J = 8.92$ Hz, 1H), 7.77 (d, $J = 8.92$ Hz, 1H), 7.47 (d, $J = 9.13$ Hz, 1H), 7.34 (ddd, $J = 8.07$, 6.58, 1.43 Hz, 1H), 7.28 (d, $J = 8.91$ Hz, 1H), 7.26-7.19 (m, 2H), 7.19-7.12 (m, 3H), 7.02 (dd, $J = 8.90$, 2.45 Hz, 1H), 7.00-6.93 (m, 2H), 6.49 (d, $J = 2.39$ Hz, 1H), 5.10-5.00 (m, 2H), 3.78 (s, 3H), 3.51 (s, 3H)

$^{13}$C NMR (126 MHz, CDCl$_3$) $\delta_C$: 158.2, 155.1, 154.8, 137.8, 135.6, 13.1, 129.6, 129.5, 129.4, 129.1, 128.2, 128.0, 127.4, 126.8, 126.4, 125.6, 125.1, 123.6, 119.8, 119.7, 116.3, 114.0, 113.6, 104.2, 71.2, 56.8, 55.1.

HRMS (ESI$^+$) C$_{29}$H$_{25}$O$_3$ $^{+} [M+H]^+$ requires 421.17982; found: 421.17953, Δ -0.68 ppm.

Chiral HPLC: (Chiralpak ODH, 5% $^3$PrOH, 95% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 8.8 min, $\tau_R$ (minor) = 9.9 min.

[$\alpha$]$_D^{25} = -5.2$ (c = 1.00, CHCl$_3$).

(R)-2',7-dimethoxy-[1,1'-binaphthalen]-2-ol (14)

m.p. = 103-105 ºC (CH$_2$Cl$_2$/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 15% $^3$PrOH, 85% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 17.9 min, $\tau_R$ (minor) = 13.5 min.

[$\alpha$]$_D^{25} = -105.3$ (c = 1.00, CHCl$_3$).
Kinetic resolution of 2'-methoxy-7-methyl-[1,1'-binaphthalen]-2-ol (15)  

Following General procedure A, 2'-methoxy-7-methyl-[1,1'-binaphthalen]-2-ol (15) (47.2 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:7 CH$_2$Cl$_2$ – petroleum ether 40-60 to 4:1 CH$_2$Cl$_2$ – petroleum ether 40-60) afforded 2-(benzylox)-2'-methoxy-7-methyl-1,1'-binaphthalene (bn-15) as an off-white solid (34.0 mg, 56%, 86:14 e.r.) and recovered starting material (15) (18.6 mg, 39%, 99.5:0.5 e.r.).

(S)- 2-(benzylox)-2'-methoxy-7-methyl-1,1'-binaphthalene (Bn-15):

m.p. = 69-70 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

IR (film) $\nu_{\text{max}}$/cm$^{-1}$: 3054, 2836, 1624, 1593, 1506, 1470, 1452, 1263, 826, 810.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ = 8.02 (d, $J$ = 9.0 Hz, 1H), 7.91 (d, $J$ = 8.2 Hz, 1H), 7.88 (d, $J$ = 9.0 Hz, 1H), 7.77 (d, $J$ = 8.3 Hz, 1H), 7.48 (d, $J$ = 9.0 Hz, 1H), 7.41–7.31 (m, 2H), 7.25–7.13 (m, 6H), 6.99–6.95 (m, 3H), 3.77 (s, 2H), 2.27 (s, 3H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ = 155.0, 154.1, 137.7, 136.0, 134.3, 134.2, 129.3, 129.2, 129.0, 128.1, 127.9, 127.8, 127.8, 127.3, 126.7, 126.2, 125.5, 124.3, 124.2, 123.5, 120.2, 119.7, 115.2, 114.0, 71.2, 56.7, 22.0.

HRMS (ESI$^+$) C$_{29}$H$_{24}$O$_2$ [M+H]$^+$ requires 405.18491; found 405.18488, $\Delta$ −0.1 ppm.

Chiral HPLC: (Chiralpak OJH, 3% EtOH, 97% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 300 nm) $\tau_R$ (minor) = 9.4 min, $\tau_R$ (major) = 15.1 min.

$[\alpha]_{D}^{25}$ = −23.8 (c = 1.00, CHCl$_3$).

Data in agreement with literature reported.$^{11}$

(R)- 2'-methoxy-7-methyl-[1,1'-binaphthalen]-2-ol (15):

m.p. = 124-125 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 290 nm) $\tau_R$ (minor) = 12.8 min, $\tau_R$ (major) = 15.6 min.

$[\alpha]_{D}^{25}$ = −59.0 (c = 1.00, CHCl$_3$).
Following General procedure A, 2'-methoxy-7-phenyl-[1,1'-binaphthalen]-2-ol (16) (56.4 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:7 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2-(benzyloxy)-2'-methoxy-7-phenyl-1,1'-binaphthalene (Bn-16) as an off-white solid (35.1 mg, 50%, 90:10 e.r.) and recovered starting material (16) (23.6 mg, 42%, 97:3 e.r.).

(S)-2-(benzyloxy)-2'-methoxy-7-phenyl-1,1'-binaphthalene (Bn-16):
m.p. = 68-89 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν max/cm⁻¹: 3058, 3032, 2935, 2837, 1621, 1594, 1509, 1493, 1454, 1265, 1250, 1221, 1093, 1063, 974, 733, 697.

¹H NMR (400 MHz, CDCl₃) δ = 7.90 (d, J = 9.1 Hz, 1H), 7.83 (d, J = 8.7 Hz, 2H), 7.79 (d, J = 8.2 Hz, 1H), 7.50 (dd, J = 8.5, 1.8 Hz, 1H), 7.36 (d, J = 9.0 Hz, 1H), 7.33 (d, J = 9.0 Hz, 1H), 7.30–7.26 (m, 3H), 7.21 (m, 3H), 7.17–7.10 (m, 4H), 7.08–7.04 (m, 3H), 6.92–6.84 (m, 2H), 5.02–4.91 (m, 2H), 3.67 (s, 3H).

¹³C NMR (101 MHz, CDCl₃) δ = 155.0, 154.5, 141.5, 139.0, 137.6, 134.4, 134.2, 129.6, 129.2, 129.0, 128.7, 128.6, 128.5, 128.2, 127.9, 127.5, 127.3, 127.1, 126.8, 126.4, 125.4, 123.7, 123.5, 123.5, 121.2, 119.3, 116.3, 113.8, 71.3, 56.7.

HRMS (ESI⁺) C₃₄H₂₆O₂ [M+Na]⁺ requires 489.18250; found 489.18233, Δ -0.3 ppm.

Chiral HPLC: (Chiralpak IC, 2% iPrOH, 98% hexane, 1.0 mL min⁻¹, λ = 289 nm) τₕ (major) = 20.5 min, τₕ (minor) = 23.5 min.

[α]D²⁵ = +28.3 (c = 1.00, CHCl₃).

Data in agreement with literature reported.¹¹

(R)-2'-methoxy-7-phenyl-[1,1'-binaphthalen]-2-ol (16):
m.p. = 190-191 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, λ = 272 nm) τₕ (major) = 11.6 min, τₕ (minor) = 14.1 min.

[α]D²⁵ = −118.1 (c = 1.00, CHCl₃).
Kinetic resolution of 7-fluoro-2'-methoxy-[1,1'-binaphthalen]-2-ol (17)

Following General procedure A, 7-fluoro-2'-methoxy-[1,1'-binaphthalen]-2-ol (17) (47.7 mg, 0.150 mmol) was reacted for 36 h. Purification via flash column chromatography (3:7 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2-(benzyloxy)-7-fluoro-2'-methoxy-1,1'-binaphthalene (Bn-17) as an off-white solid (33.7 mg, 50%, 88:12 e.r.) and recovered starting material (17) (18.9 mg, 40%, 99:1 e.r.).

(S)- 2-(Benzyloxy)-7-fluoro-2'-methoxy-1,1'-binaphthalene (Bn-17):

m.p. = 88-90 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν_max/cm⁻¹: 3061, 2935, 2838, 1629, 1510, 1268, 1255, 1212, 811.

¹H NMR (500 MHz, CDCl₃) δ = 8.01 (d, J = 8.8 Hz, 1H), 7.93–7.87 (m, 2H), 7.83 (dd, J = 8.9, 5.8 Hz, 1H), 7.46 (d, J = 9.1 Hz, 1H), 7.37 (d, J = 9.2 Hz, 1H), 7.35–7.32 (m, 1H), 7.26–7.21 (m, 1H), 7.19–7.07 (m, 6H), 7.02–6.96 (m, 2H), 6.78 (dd, J = 11.4, 2.6 Hz, 1H), 5.09 (d, J = 12.7 Hz, 1H), 5.06 (d, J = 12.7 Hz, 1H), 3.78 (s, 4H).

¹³C NMR (126 MHz, CDCl₃) δ = 161.5 (d, J = 245.1 Hz), 155.0, 155.0, 137.5, 135.5 (d, J = 9.3 Hz), 134.0, 130.5, 130.4, 129.8, 129.3 (d, J = 1.5 Hz), 128.3, 128.1, 127.5, 126.8, 126.6, 126.5, 125.2, 123.7, 120.4 (d, J = 5.6 Hz), 118.9, 115.2 (d, J = 2.6 Hz), 114.3, 114.1, 113.9, 108.9, 108.7, 71.1, 56.7.

¹⁹F NMR: (471 MHz, CDCl₃) δ = -114.0

HRMS (ESI⁺) C₂₈H₂₁O₂F [M+Na]⁺ requires 431.14178; found 431.14145, Δ −0.8 ppm.

Chiral HPLC: (Chiralpak IC, 1% i-PrOH, 99% hexane, 1.0 mL min⁻¹, λ = 294 nm) τ_R (major) = 7.0 min, τ_R (minor) = 9.3 min.

[α]_D²⁵ = −58.0 (c = 1.00, CHCl₃).

Data in agreement with literature reported.¹¹

(R)- 7-Fluoro-2'-methoxy-[1,1'-binaphthalen]-2-ol (17):

m.p. = 118-119 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 10% i-PrOH, 90% hexane, 1.0 mL min⁻¹) τ_R (major) = 11.6 min, τ_R (minor) = 14.1 min.

[α]_D²⁵ = −13.5 (c = 1.00, CHCl₃).
Following **General procedure A**, 2',6-dimethoxy-[1,1'-binaphthalen]-2-ol (18) (49.6 mg, 0.150 mmol) was reacted for 27 h. Purification *via* flash column chromatography (1:1 petroleum ether 40-60 – CH$_2$Cl$_2$ to 1:3 petroleum ether 40-60 – CH$_2$Cl$_2$) afforded 2-(benzyloxy)-2',6-dimethoxy-1,1'-binaphthalene (Bn-18) as an off-white solid (35.8 mg, 57%, 87.5:12.5 e.r.) and recovered starting material (18) (20.8 mg, 42%, 99.5:0.5 e.r.).

(S)-2-(benzyloxy)-2',6-dimethoxy-1,1'-binaphthalene (Bn-18)

**m.p.** = 108-100 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

**IR** (film) $\nu_{\text{max}}$/cm$^{-1}$: 3061, 3004, 2935, 2836, 1624, 1594, 1506, 1462, 1433, 1376, 1351, 1332, 1267, 1251, 1239, 1222, 1168, 1148, 1130, 1090, 1061, 1024, 849, 808, 748, 696

$^1$H **NMR** (500 MHz, CDCl$_3$) $\delta$: 8.00 (d, $J = 9.05$ Hz, 1H), 7.89 (d, $J = 8.10$ Hz, 1H), 7.82 (d, $J = 8.95$ Hz, 1H), 7.46 (d, $J = 9.05$ Hz, 1H), 7.40 (d, $J = 9.05$ Hz, 1H), 7.37-7.31 (m, 1H), 7.26-7.21 (m, 1H), 7.21-7.13 (m, 4H), 7.11 (d, $J = 9.12$ Hz, 1H), 7.01-6.92 (m, 2H), 6.94 (dd, $J = 9.22$, 2.56 Hz, 1H), 5.06-4.96 (m, 2H), 3.91 (s, 3H), 3.77 (s, 3H).

$^{13}$C **NMR** (126 MHz, CDCl$_3$) $\delta$: 156.4, 155.1, 152.8, 137.9, 134.2, 130.6, 129.6, 129.5, 129.3, 128.2, 128.0, 127.9, 127.4, 127.2, 127.0, 126.5, 125.5, 123.6, 121.5, 119.6, 119.2, 117.3, 114.0, 106.1, 71.8, 56.8, 55.4.

**HRMS** (ESI$^+$) C$_{29}$H$_{25}$O$_3$ [M+H]$^+$ requires 421.17982; found 421.17975, $\Delta$ −0.2 ppm.

**Chiral HPLC**: (Chiralpak IC, 1% iPrOH, 99% hexane, 1.00 mL min$^{-1}$, $\lambda$ = 290 nm) $\tau_R$ (major) = 15.3 min, $\tau_R$ (minor) = 30.6 min

$[\alpha]^25_D = -34.9$ (c = 1.00, CHCl$_3$).

(R)-2',6-dimethoxy-[1,1'-binaphthalen]-2-ol (18)

**m.p.** = 160-162 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

**Chiral HPLC**: (Chiralpak ADH, 15% iPrOH, 85% hexane, 1.00 mL min$^{-1}$, $\lambda$ = 290 nm) $\tau_R$ (major) = 27.0 min, $\tau_R$ (minor) = 13.9 min

$[\alpha]^25_D = -38.6$ (c = 1.00, CHCl$_3$).
Kinetic resolution of 2'-methoxy-6-morpholino-[1,1'-binaphthalen]-2-ol (19)

Following General procedure A, 2'-methoxy-6-morpholino-[1,1'-binaphthalen]-2-ol (27) (57.8 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (4:1 petroleum ether 40-60 – EtOAc to 7:3 petroleum ether 40-60 – EtOAc) afforded 4-(2-(benzyloxy)-2'-methoxy-[1,1'-binaphthalen]-6-yl)morpholine (Bn-19) as an off-white solid (33.3 mg, 47%, 87:13 e.r.) and recovered starting material (19) (19.6 mg, 34%, 99:1 e.r.).

(S)- 4-(2-(benzyloxy)-2'-methoxy-[1,1'-binaphthalen]-6-yl)morpholine (Bn-19):

m.p. = 144-145 °C (EtOAc/petroleum ether 40-60).

IR (film) ν_{max}/cm^{-1}: 3059, 3031, 2954, 2928, 2853, 2837, 1592, 1506, 1266, 1250, 1227, 1120, 1092.

$^1$H NMR (400 MHz, CDCl$_3$) δ = 7.99 (d, $J$ = 9.0 Hz, 1H), 7.89 (d, $J$ = 8.2 Hz, 1H), 7.78 (d, $J$ = 9.0 Hz, 1H), 7.45 (d, $J$ = 9.0 Hz, 1H), 7.37 (d, $J$ = 9.0 Hz, 1H), 7.33 (app. t, $J$ = 8.0 Hz, 1H), 7.22 (m, 1H), 7.16 (m, 5H), 7.10 (d, $J$ = 9.4 Hz, 1H), 7.02 (dd, $J$ = 9.3, 2.5 Hz, 1H), 6.99–6.91 (m, 2H), 5.06–4.92 (m, 2H), 3.92–3.85 (m, 4H), 3.76 (s, 3H), 3.24–3.16 (m, 4H).

$^{13}$C NMR (101 MHz, CDCl$_3$) δ = 155.1, 152.8, 147.8, 137.9, 134.3, 130.6, 129.5, 129.4, 129.3, 128.2, 128.1, 128.0, 127.4, 127.0, 126.7, 126.4, 125.6, 123.6, 121.3, 119.8, 119.7, 117.3, 114.0, 110.6, 71.8, 67.1, 56.8, 50.1.

HRMS (ESI$^+$) C$_{31}$H$_{29}$O$_3$N [M+H]$^+$ requires 476.22202; found 476.22162, Δ −0.8 ppm.

Chiral HPLC: (Chiralpak IC, 3% iPrOH, 97% hexane, 1.0 mL min$^{-1}$, λ = 289 nm) τ$_R$ (major) = 23.3 min, τ$_R$ (minor) = 30.4 min.

[α]$_D^{25}$= −4.2 (c = 1.00, CHCl$_3$).

(R)- 2'-methoxy-6-morpholino-[1,1'-binaphthalen]-2-ol (19):

m.p. = 124-125 °C (EtOAc/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 15% iPrOH, 85% hexane, 1.0 mL min$^{-1}$, λ = 272 nm) τ$_R$ (minor) = 20.4 min, τ$_R$ (major) = 30.4 min.

[α]$_D^{25}$= −31.2 (c = 1.00, CHCl$_3$).
Kinetic resolution of [2'-methoxy-6-phenyl-[1,1'-binaphthalen]-2-ol] (20)

Following General procedure A, 2'-methoxy-6-phenyl-[1,1'-binaphthalen]-2-ol (20) (56.4 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:7 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2-(benzyloxy)-2'-methoxy-6-phenyl-1,1'-binaphthalene (Bn-20) as an off-white solid (39.1 mg, 56%, 86:14 e.r.) and recovered starting material (20) (22.0 mg, 39%, 99:1 e.r.).

(S)- 2-(benzyloxy)-2'-methoxy-6-phenyl-1,1'-binaphthalene (Bn-20):

m.p. = 78-79°C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν max/cm⁻¹: 3060, 3030, 2933, 2856, 2837, 1743, 1592, 1507, 1492, 1454, 1349, 1268, 1222, 1093, 1061, 1027, 1020, 806, 757, 750, 736, 696.

¹H NMR (400 MHz, CDCl₃) δ = 8.10 (d, J = 1.9 Hz, 1H), 8.05 (d, J = 9.1 Hz, 1H), 8.01 (d, J = 9.0 Hz, 1H), 7.94 (d, J = 8.1 Hz, 1H), 7.76–7.66 (m, 2H), 7.59 – 7.45 (m, 5H), 7.38 (ddd, J = 8.2, 6.5, 1.5 Hz, 2H), 7.32–7.25 (m, 2H), 7.25–7.16 (m, 4H), 7.08–6.99 (m, 2H), 5.18–5.03 (m, 2H), 3.82 (s, 3H).

¹³C NMR (126 MHz, CDCl₃) δ = 155.0, 154.2, 141.2, 137.6, 136.5, 134.7, 134.1, 133.4, 129.7, 129.6, 129.5, 129.2, 128.8, 128.2, 128.0, 127.4, 127.3, 127.1, 126.8, 126.4, 126.1, 126.0, 125.9, 125.4, 123.5, 120.7, 119.3, 116.6, 113.9, 71.3, 56.7.

Chiral HPLC: (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min⁻¹, λ = 259 nm) τR (major) = 10.2 min, τR (minor) = 19.7 min.

[α]D²⁵ = −77.0 (c = 1.00, CHCl₃).

Data in agreement with literature reported.

(R)- 2'-methoxy-6-phenyl-[1,1'-binaphthalen]-2-ol (20):

m.p. = 58-59 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, λ = 259 nm) τR (minor) = 13.2 min, τR (major) = 21.2 min.

[α]D²⁵ = −5.7 (c = 1.00, CHCl₃).
Kinetic resolution of 6-bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (21)

Following **General procedure A**, 6-bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (21) (56.9 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:7 CH$_2$Cl$_2$ – petroleum ether 40-60 to 4:1 CH$_2$Cl$_2$ – petroleum ether 40-60) afforded 2-(benzyloxy)-6-bromo-2'-methoxy-1,1'-binaphthalene (Bn-21) as an off-white solid (34.3 mg, 49%, 87:13 e.r.) and recovered starting material (21) (22.0 mg, 39%, 99:1 e.r.).

**(S)- 2-(Benzyloxy)-6-bromo-2'-methoxy-1,1'-binaphthalene (Bn-21):**

m.p. = 115-115 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

IR (film) ν$_{max}$/cm$^{-1}$: 3061, 3033, 2837, 1584, 1494, 1268, 1065, 734.

$^1$H NMR (400 MHz, CDCl$_3$) δ = 7.93–7.88 (m, 2H), 7.79 (d, $J$ = 8.2 Hz, 1H), 7.71 (d, $J$ = 9.0 Hz, 1H), 7.34 (app. t, $J$ = 9.4 Hz, 2H), 7.26–7.22 (m, 1H), 7.21–7.11 (m, 3H), 7.11–6.86 (m, 2H), 6.96 (d, $J$ = 9.0 Hz, 1H), 6.91–6.86 (m, 2H), 5.15–4.79 (m, 2H), 3.66 (s, 3H).

$^{13}$C NMR (101 MHz, CDCl$_3$) δ = 155.1, 154.4, 137.5, 134.1, 132.8, 130.6, 129.9, 129.8, 129.7, 129.3, 128.4, 128.3, 128.1, 127.5, 127.5, 126.8, 126.6, 125.3, 123.7, 121.2, 118.8, 117.7, 117.2, 113.8, 71.3, 56.7.

HRMS (ESI$^+$) C$_{28}$H$_{21}$O$_2$$^{79}$Br [M+Na]$^+$ requires 491.06171; found 491.06180, Δ +0.2 ppm.

Chiral HPLC: (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 295nm) τ$_R$ (major) = 6.2 min, τ$_R$ (minor) = 9.7 min.

$[\alpha]_D^{25} = -25.8$ (c = 1.00, CHCl$_3$).

**(R)- 6-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (21):**

m.p. = 71-72 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 1% iPrOH, 99% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 281 nm) τ$_R$ (major) = 19.1 min, τ$_R$ (minor) = 14.3 min.

$[\alpha]_D^{25} = -49.6$ (c = 1.00, CHCl$_3$).
Following General procedure A, 2'-methoxy-5-methyl-[1,1'-binaphthalen]-2-ol (21) (47.2 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:7 CH$_2$Cl$_2$ – petroleum ether 40-60 to 4:1 CH$_2$Cl$_2$ – petroleum ether 40-60) afforded 2-(benzyloxy)-2'-methoxy-5-methyl-1,1'-binaphthalene (Bn-21) as an off-white solid (33.8 mg, 56%, 89:11 e.r.) and recovered starting material (21) (18.9 mg, 40%, 99.5:0.5 e.r.).

(S)-2-(benzyloxy)-2'-methoxy-5-methyl-1,1'-binaphthalene (Bn-21):

m.p. = 84-85 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

IR (film) $\nu_{\text{max}}$/cm$^{-1}$: 3020, 3937, 1801, 1742, 1521, 1494, 1347, 1265, 1237, 1175, 1053, 749, 691, 666.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ = 8.10 (d, $J = 9.2$ Hz, 1H), 8.01 (d, $J = 9.0$ Hz, 1H), 7.90 (d, $J = 8.3$ Hz, 1H), 7.51–7.42 (m, 2H), 7.33 (t, $J = 7.4$ Hz, 1H), 7.24–7.04 (m, 8H), 7.03–6.97 (m, 2H), 5.15–5.02 (m, 2H), 3.77 (s, 3H), 2.75 (s, 3H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ = 155.1, 153.9, 137.8, 134.4, 134.3, 129.5, 129.3, 128.7, 128.3, 128.0, 127.4, 126.9, 126.4, 126.3, 125.6, 124.8, 124.1, 123.6, 121.4, 119.9, 115.8, 114.0, 71.2, 56.8, 19.8.

HRMS (ESI$^+$) C$_{29}$H$_{24}$O$_2$ [M+H]$^+$ requires 405.18491; found 405.18494, $\Delta +0.1$ ppm.

Chiral HPLC: (Chiralpak IC, 1% $i$PrOH, 99% hexane, 1.0 mL min$^{-1}$, $\lambda = 295$ nm) $\tau_R$ (major) = 6.9 min, $\tau_R$ (minor) = 13.6 min.

$[\alpha]_D^{25} = -41.4$ (c = 1.00, CHCl$_3$).

Data in agreement with literature reported.$^{11}$

(R)-2'-methoxy-5-methyl-[1,1'-binaphthalen]-2-ol (21):

m.p. = 74-75 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 10% $i$PrOH, 90% hexane, 1.0 mL min$^{-1}$, $\lambda = 295$ nm,) $\tau_R$ (major) = 20.0 min, $\tau_R$ (minor) = 12.8 min.

$[\alpha]_D^{25} = -13.3$ (c = 1.00, CHCl$_3$).
Kinetic resolution of 2',5-dimethoxy-[1,1'-binaphthalen]-2-ol (23)

Following General procedure A, 2',5-dimethoxy-[1,1'-binaphthalen]-2-ol (23) (49.6 mg, 0.150 mmol) was reacted for 30 h. Purification via flash column chromatography (3:7 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2-(benzyloxy)-2',5-dimethoxy-1,1'-binaphthalene (Bn-23) as an off-white solid (37.6 mg, 59%, 77:23 e.r.) and recovered starting material (23) (16.4 mg, 33%, 99.5:0.5 e.r.).

(S)- 2-(Benzyloxy)-2',5-dimethoxy-1,1'-binaphthalene (Bn-23):

m.p. = 151-152 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν max/cm⁻¹:

¹H NMR (400 MHz, CDCl₃) δ = 8.38 (d, J = 8.4 Hz, 1H), 7.99 (d, J = 9.0 Hz, 1H), 7.89 (d, J = 8.2 Hz, 1H), 7.46 (d, J = 9.0 Hz, 1H), 7.41 (d, J = 9.3 Hz, 1H), 7.33 (ddd, J = 8.1, 6.6, 1.3 Hz, 1H), 7.23 (m, 1.4 Hz, 1H), 7.16 (m, 5H), 7.00 (m, 2H), 6.77 (d, J = 8.6 Hz, 1H), 6.68 (d, J = 6.8 Hz, 1H), 5.15–4.95 (m, 2H), 4.02 (s, 3H), 3.76 (s, 3H).

¹³C NMR (101 MHz, CDCl₃) δ = 155.8, 155.1, 154.7, 137.7, 135.7, 134.2, 129.4, 129.3, 128.2, 128.0, 127.4, 126.9, 126.6, 126.4, 125.6, 123.6, 121.6, 120.5, 120.0, 118.0, 115.1, 114.1, 102.0, 71.1, 56.8, 55.6.

HRMS (ESI⁺) C₂₉H₂₄O₃ [M+H]⁺ requires 421.17982; found 421.17923, Δ –1.4 ppm.

Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, λ = 293 nm) τᵣ (minor) = 17.2 min, τᵣ (major) = 27.9 min.

[α]D²⁵ = –37.3 (c = 1.00, CHCl₃).

(R)- 2',5-Dimethoxy-[1,1'-binaphthalen]-2-ol (23):

m.p. = 165-167 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, λ = 293 nm) τᵣ (major) = 17.3 min, τᵣ (minor) = 28.0 min.

[α]D²⁵ = –35.7 (c = 1.00, CHCl₃).
Kinetic resolution of 5-bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (24)

Following **General procedure A**, 5-bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (24) (56.9 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:7 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2-(benzyloxy)-5-bromo-2'-methoxy-1,1'-binaphthalene (Bn-24) as an off-white solid (33.6 mg, 48%, 89:11 e.r.) and recovered starting material (24) (22.4 mg, 39%, 98:2 e.r.).

**(S)-2-(benzyloxy)-5-bromo-2'-methoxy-1,1'-binaphthalene (Bn-24):**

**IR** (film) $\nu_{max}$/cm⁻¹: 3077, 3063, 3019, 2941, 1802, 1747, 1521, 1495, 1347, 1267, 1233, 1176, 1053, 749.

**¹H NMR** (500 MHz, CDCl₃) $\delta$ = 8.35 (d, $J$ = 9.3 Hz, 1H), 8.02 (d, $J$ = 9.0 Hz, 1H), 7.90 (d, $J$ = 8.2 Hz, 1H), 7.62 (d, $J$ = 7.3 Hz, 1H), 7.52 (d, $J$ = 9.4 Hz, 1H), 7.47 (d, $J$ = 9.0 Hz, 1H), 7.35 (dd, $J$ = 8.1, 6.8 Hz, 1H), 7.25–7.21 (m, 1H), 7.20–7.15 (m, 4H), 7.12–7.04 (m, 2H), 7.04–6.93 (m, 2H), 5.35–4.88 (m, 2H), 3.77 (s, 3H).

**¹³C NMR** (126 MHz, CDCl₃) $\delta$ = 155.0, 154.6, 137.3, 135.4, 134.0, 129.7, 129.2, 128.6, 128.2, 128.0, 127.8, 127.4, 126.7, 126.7, 126.5, 125.5, 125.2, 123.6, 122.9, 121.0, 118.9, 116.9, 113.7, 70.9, 56.6.

**HRMS** (ESI⁺) $\text{C}_{28}\text{H}_{21}\text{O}_2\text{Br}$ [M+Na]⁺ requires 491.06171; found 491.06180, Δ +0.2 ppm.

**Chiral HPLC:** (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, $\lambda$ = 295 nm) $\tau_R$ (major) = 22.2 min, $\tau_H$ (minor) = 12.3 min.

$[\alpha]_{D}^{25}$ = −56.3 (c = 1.00, CHCl₃).

Data in agreement with literature reported.¹¹

**(R)-5-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (24):**

m.p. = 109-110 °C (CH₂Cl₂/petroleum ether 40-60).

**Chiral HPLC:** (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, $\lambda$ = 295 nm) $\tau_R$ (major) = 22.5 min, $\tau_H$ (minor) = 12.5 min.

$[\alpha]_{D}^{25}$ = +6.5 (c = 1.00, CHCl₃).
Kinetic resolution of 1-(2-methoxynaphthalen-1-yl)phenanthren-2-ol (25)

Following General procedure A, 1-(2-methoxynaphthalen-1-yl)phenanthren-2-ol (25) (52.6 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:7 CH$_2$Cl$_2$ – petroleum ether 40-60 to 4:1 CH$_2$Cl$_2$ – petroleum ether 40-60) afforded 2-(benzyloxy)-1-(2-methoxynaphthalen-1-yl)phenanthrene (Bn-25) as an off-white solid (33.0 mg, 50%, 87:13 e.r.) and recovered starting material (25) (21.0 mg, 40%, 99:1 e.r.).

Data in agreement with literature reported.$^{11}$

(S)- 2-(benzyloxy)-1-(2-methoxynaphthalen-1-yl)phenanthrene (Bn-25):

m.p. = 130-132 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

IR (film) $\nu_{\text{max}}$/cm$^{-1}$: 3036, 2934, 1592, 1460, 1301, 1269, 1251, 1086, 1060, 810, 749.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ = 8.77 (d, $J$ = 9.1 Hz, 1H), 8.69 (d, $J$ = 8.4 Hz, 1H), 8.03 (d, $J$ = 9.0 Hz, 1H), 7.92 (d, $J$ = 8.4 Hz, 1H), 7.80 (d, $J$ = 7.9 Hz, 1H), 7.71–7.59 (m, 1H), 7.56–7.45 (m, 4H), 7.38–7.32 (m, 1H), 7.26–7.21 (m, 1H), 7.20–7.14 (m, 5H), 7.06–6.99 (m, 2H), 5.21–5.05 (m, 2H), 3.78 (s, 3H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ = 155.1, 137.7, 134.3, 133.0, 131.1, 130.8, 129.6, 129.3, 128.6, 128.3, 128.1, 127.6, 127.4, 126.8, 126.7, 126.5, 125.9, 125.5, 125.4, 124.7, 123.9, 123.6, 122.4, 122.3, 119.8, 114.7, 114.0, 70.9, 56.8.

HRMS (ESI$^+$) C$_{32}$H$_{24}$O$_2$ [M+Na]$^+$ requires 463.16685; found 463.16660, $\Delta$ = 0.6 ppm.

Chiral HPLC: (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 222 nm) $\tau_R$ (major) = 20.8 min, $\tau_R$ (minor) = 33.0 min.

$[\alpha]_{D}^{25} = -31.3$ (c = 1.00, CHCl$_3$).

(R)- 1-(2-methoxynaphthalen-1-yl)phenanthren-2-ol (25):

m.p. = 62-64 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 15% iPrOH, 85% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 277 nm) $\tau_R$ (major) = 16.6 min, $\tau_R$ (minor) = 26.3 min.

$[\alpha]_{D}^{25} = -15.2$ (c = 0.50, CHCl$_3$).
Kinetic resolution of 2'-methoxy-4-methyl-[1,1'-binaphthalen]-2-ol (26)

Following General procedure A, 2'-methoxy-4-methyl-[1,1'-binaphthalen]-2-ol (26) (49.2 mg, 0.150 mmol) was reacted for 36 h. Purification via flash column chromatography (3:7 CH$_2$Cl$_2$ – petroleum ether 40-60 to 4:1 CH$_2$Cl$_2$ – petroleum ether 40-60) afforded 2-(benzyloxy)-2'-methoxy-4-methyl-1,1'-binaphthalene (Bn-26) as an off-white solid (37.4 mg, 61%, 81:19 e.r.) and recovered starting material (26) (16.4 mg, 33%, >99.5:0.5 e.r.).

Data in agreement with literature reported.$^{11}$

(S)- 2-(benzyloxy)-2'-methoxy-4-methyl-1,1'-binaphthalene (Bn-26):

m.p. = 54-55 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

IR (film) $\nu_{\text{max}}$/cm$^{-1}$: 3062, 3033, 2936, 2836, 1593, 1508, 1342, 1266, 1252, 1101, 754.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ = 8.06–7.97 (m, 2H), 7.90 (d, $J$ = 8.2 Hz, 1H), 7.47 (d, $J$ = 9.1 Hz, 1H), 7.43–7.30 (m, 3H), 7.29–7.11 (m, 7H), 7.03–6.94 (m, 2H), 5.10–5.01 (m, 3H), 3.77 (s, 3H), 2.80 (s, 1H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ = 155.2, 153.7, 137.8, 136.0, 134.4, 134.4, 129.4, 129.3, 128.9, 128.2, 128.0, 127.4, 126.9, 126.4, 126.2, 125.6, 124.3, 123.7, 123.5, 119.7, 119.0, 117.5, 117.5, 114.0, 71.5, 56.8, 20.1.

HRMS (ESI$^+$) C$_{29}$H$_{24}$O$_2$ [M+H]$^+$ requires 405.18491; found 405.18494, $\Delta$ +0.1 ppm.

Chiral HPLC: (Chiralpak IC, 2% tPrOH, 98% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 291 nm) $\tau_R$ (major) = 15.6 min, $\tau_R$ (minor) = 24.7.

$[\alpha]_D^{25} = -33.4$ (c = 1.00, CHCl$_3$).

(R)- 2'-methoxy-4-methyl-[1,1'-binaphthalen]-2-ol (26):

m.p. = 170-171 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 10% tPrOH, 90% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 291 nm) $\tau_R$ (major) = 15.6 min, $\tau_R$ (minor) = 20.7 min.

$[\alpha]_D^{25} = +37.8$ (c = 1.00, CHCl$_3$).
Kinetic resolution of 2'-methoxy-4-phenyl-[1,1'-binaphthalen]-2-ol (27)

Following General procedure A, 2'-methoxy-4-phenyl-[1,1'-binaphthalen]-2-ol (27) (56.4 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:7 CH$_2$Cl$_2$ – petroleum ether 40-60 to 4:1 CH$_2$Cl$_2$ – petroleum ether 40-60) afforded 2-(benzyloxy)-2'-methoxy-4-phenyl-1,1'-binaphthalene (Bn-27) as an off-white solid (35.4 mg, 51%, 91:9 e.r.) and recovered starting material (27) (26.0 mg, 46%, 95:5 e.r.).

(S)-2-(Benzyloxy)-2'-methoxy-4-phenyl-1,1'-binaphthalene (Bn-27):

m.p. = 120-121 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

IR (film) $\nu_{\text{max}}$/cm$^{-1}$: 3066, 1585, 1342, 1188, 1024, 911, 766, 731, 705.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ = 7.92 (d, $J = 9.1$ Hz, 1H), 7.86–7.77 (m, 2H), 7.49 (m, 2H), 7.46–7.41 (m, 2H), 7.40–7.34 (m, 2H), 7.31 (s, 1H), 7.24 (m, 1H), 7.20–7.11 (m, 5H), 7.04 (m, 3H), 6.86 (m, 2H), 5.02–4.91 (m, 2H), 3.69 (s, 3H).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ = 155.2, 153.5, 141.7, 140.9, 137.6, 134.7, 134.3, 130.3, 129.6, 129.3, 128.4, 128.2, 128.0, 127.9, 127.5, 127.4, 127.0, 126.5, 126.3, 126.3, 125.9, 125.6, 124.0, 123.6, 120.5, 119.5, 117.6, 114.0, 71.5, 56.8.

HRMS (ESI$^+$) C$_{34}$H$_{27}$O$_2$ [M+H]$^+$ requires 467.20056; found 467.20050, $\Delta$ −0.1 ppm.

Chiral HPLC: (Chiralpak ADH, 2% $^1$PrOH, 98% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 297 nm) $\tau_R$ (minor) = 14.8 min, $\tau_R$ (major) = 24.5 min.

$[\alpha]_D^{25}$ = −54.9 ($c = 1.00$, CHCl$_3$).

(R)- 2'-methoxy-4-phenyl-[1,1'-binaphthalen]-2-ol (27):

m.p. = 88-89 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 10% $^1$PrOH, 90% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 295 nm) $\tau_R$ (minor) = 18.8 min, $\tau_R$ (major) = 26.2 min.

$[\alpha]_D^{25}$ = −1.5 ($c = 1.00$, CHCl$_3$).
Kinetic resolution of 4-bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (28)

Following General procedure A, 4-bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (28) (56.9 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:7 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2-(benzyloxy)-4-bromo-2'-methoxy-1,1'-binaphthalene (Bn-28) as an off-white solid (38.0 mg, 54%, 86:14 e.r.) and recovered starting material (28) (23.0 mg, 40%, 99:1 e.r.).

(S)- 2-(Benzyloxy)-4-bromo-2'-methoxy-1,1'-binaphthalene (n-28):

m.p. = 54-55 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν_max/cm⁻¹: 3062, 3033, 2930, 2837, 1583, 1501, 1453, 1315, 1270, 1261, 1251.

¹H NMR (400 MHz, CDCl₃) δ = 8.15 (d, J = 7.2 Hz, 1H), 7.91 (d, J = 9.0 Hz, 1H), 7.80 (d, J = 8.2 Hz, 1H), 7.68 (s, 1H), 7.37–7.31 (m, 2H), 7.26–7.21 (m, 1H), 7.20–7.09 (m, 3H), 7.08–7.00 (m, 4H), 6.89–6.83 (m, 2H), 5.04–4.87 (m, 2H), 3.66 (s, 3H).

¹³C NMR (101 MHz, CDCl₃) δ = 154.9, 153.7, 137.0, 134.8, 133.9, 129.8, 129.1, 128.2, 128.1, 128.0, 127.5, 127.1, 127.1, 126.8, 126.5, 125.9, 125.2, 123.6, 123.2, 121.2, 120.6, 120.6, 118.5, 113.6, 71.6, 56.6.

HRMS (ESI⁺) C₂₈H₂₁O₂⁻⁷⁹Br [M+Na]⁺ requires 491.06171; found 491.06171, Δ 0.0 ppm.

Chiral HPLC: (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min⁻¹, λ = 232 nm) τ_R (major) = 15.0 min, τ_R (minor) = 18.0 min.

[α]D²⁵ = −39.6 (c = 1.00, CHCl₃).

(R)- 4-Bromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (28):

Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, λ = 293 nm) τ_R (major) = 13.2 min, τ_R (minor) = 23.0 min.
Kinetic resolution of 2',4-dimethoxy-[1,1'-binaphthalen]-2-ol (29)

Following General procedure A, 2',4-dimethoxy-[1,1'-binaphthalen]-2-ol (29) (49.6 mg, 0.150 mmol) was reacted for 30 h. Purification via flash column chromatography (3:7 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2-(benzylxoy)-2',4-dimethoxy-1,1'-binaphthalene (Bn-29) as an off-white solid (34.0 mg, 54%, 85:15 e.r.) and recovered starting material (29) (17.0 mg, 34%, 99:1 e.r.).

(S)- 2-(Benzylxoy)-2',4-dimethoxy-1,1'-binaphthalene (Bn-29):

m.p. = 125-126 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) νmax/cm⁻¹: 2996, 2980, 2971, 2936, 1620, 1588, 1508, 1460, 1344, 1265, 1253, 1241, 1195, 1144, 1107, 1066, 1022, 906, 809, 764, 733, 697.

¹H NMR (400 MHz, CDCl₃) δ = 8.16 (d, J = 8.4 Hz, 1H), 7.89 (d, J = 9.0 Hz, 1H), 7.81–7.76 (m, 1H), 7.35 (d, J = 9.1 Hz, 1H), 7.22 (m, 2H), 7.17–7.10 (m, 3H), 7.09–7.01 (m, 4H), 6.91–6.86 (m, 2H), 6.70 (s, 1H), 4.90 (m, 2H), 3.92 (s, 3H).

¹³C NMR (101 MHz, CDCl₃) δ = 156.4, 155.3, 154.4, 137.7, 134.5, 129.3, 129.2, 128.2, 127.9, 127.4, 127.0, 127.0, 126.3, 125.6, 125.2, 123.4, 123.2, 122.0, 122.0, 119.6, 114.0, 113.3, 96.8, 72.0, 56.7, 55.6.

Chiral HPLC: (Chiralpak IC, 3% iPrOH, x% hexane, 1.0 mL min⁻¹, λ = 292 nm) τR (major) = 6.1 min, τR (minor) = 8.2 min.

[α]D²⁵ = −46.0 (c = 1.00, CHCl₃).

(R)- 2',4-Dimethoxy-[1,1'-binaphthalen]-2-ol (29):

m.p. = 161-162 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 15% iPrOH, 85% hexane, 1.0 mL min⁻¹, λ = 231 nm) τR (minor) = 8.7 min, τR (major) = 12.7 min.

[α]D²⁵ = −2.0 (c = 1.00, CHCl₃).
Kinetic resolution of 7,7'-dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (30)

Following **General procedure A**, 7,7'-dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (30) (68.7 mg, 0.150 mmol) was reacted for 48 h. Purification via flash column chromatography (3:1 petroleum ether 40-60/CH$_2$Cl$_2$ to 1:1 petroleum ether 40-60/CH$_2$Cl$_2$) afforded 2-(benzyloxy)-7,7'-dibromo-2'-methoxy-1,1'-binaphthalene (Bn-30) as an off-white solid (41.6 mg, 51%, 92.0:8.0 e.r.) and recovered starting material (30) (30.0 mg, 44%, 94.0:6.0 e.r.).

**(-)**-2-(benzyloxy)-7,7'-dibromo-2'-methoxy-1,1'-binaphthalene (Bn-30)

- **m.p.** = 66-68°C (CH$_2$Cl$_2$/petroleum ether 40-60).
- **IR** (film) $\nu_{\text{max}}$/cm$^{-1}$: 2935.6, 2360.5, 2341.5, 1612.9, 1583.0, 1496.4, 1456.2, 1343.2, 1321.1, 1256.3, 1343.2, 1321.1, 1256.3, 1221.9, 1171.5, 1151.9, 1095.9, 1067.1, 923.4, 872.5, 827.1, 796.2, 756.3, 695.7, 668.8.
- **$^1$H NMR** (500 MHz, CDCl$_3$) $\delta$: 7.96 (d, $J = 9.0$ Hz, 1H), 7.87 (d, $J = 9.0$ Hz, 1H), 7.75 (d, $J = 8.6$ Hz, 1H), 7.71 (d, $J = 8.8$ Hz), 7.45 (d, $J = 9.2$ Hz, 1H), 7.43-7.37 (m, 3H), 7.30-7.25 (m, 2H), 7.23-7.15 (m, 3H), 7.05-6.97 (m, 2H), 5.13-5.04 (m, 2H), 3.77 (s, 3H)
- **$^{13}$C NMR** (126 MHz, CDCl$_3$) $\delta$: 155.7, 154.7, 137.3, 135.4, 135.4, 129.9, 129.9, 129.7, 128.5, 127.9, 127.7, 127.6, 127.4, 127.2, 127.2, 126.8, 121.4, 121.3, 119.0, 118.0, 115.9, 114.0, 70.9, 56.6
- **HRMS** (MSS-ESI$^{+}$) C$_{30}$H$_{20}$O$_7$Br$_2$Na$^+$ [M+Na]$^+$ requires 568.97463; found: 568.97223, $\Delta$ -4.2 ppm.
- **Chiral HPLC**: (Chiralpak ADH, 5%/PrOH, 95% hexane, 1.00 mL min$^{-1}$, $\lambda$ = 290 nm) $\tau_R$ (major) = 7.6 min, $\tau_R$ (minor) = 6.6 min
  - $[\alpha]_{D}^{25} = +13.9^\circ$ ($c = 1.00$, CHCl$_3$).

**(R)-7,7'-dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (30)**

- **m.p.** = 116-118°C (CH$_2$Cl$_2$/petroleum ether 40-60).
- **Chiral HPLC**: (Chiralpak ADH, 5%/PrOH, 95% hexane, 1.00 mL min$^{-1}$, $\lambda$ = 290 nm) $\tau_R$ (major) = 26.7 min, $\tau_R$ (minor) = 21.7 min
  - $[\alpha]_{D}^{25} = -156.2^\circ$ ($c = 1.00$, CHCl$_3$).
Following General procedure A, 2',7,7'-trimethoxy-[1,1'-binaphthalen]-2-ol (31) (54.1 mg, 0.150 mmol) was reacted for 27 h. Purification via flash column chromatography (2:1 petroleum ether 40-60 – CH$_2$Cl$_2$ to 1:2 petroleum ether 40-60 – CH$_2$Cl$_2$) afforded 2-(benzyloxy)-2',7,7'-trimethoxy-[1,1'-binaphthalen]-2-ol (Bn-31) as an off-white solid (35.1 mg, 52%, 89.5:10.5 e.r.) and recovered starting material (31) (24.2 mg, 45%, 94.0:6.0 e.r.).

(S)-2-(benzyloxy)-2',7,7'-trimethoxy-[1,1'-binaphthalen]-2-ol (Bn-31)

**m.p.** = 61-63 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

**IR** (film) $\nu_{max}$/cm$^{-1}$: 2924, 1621, 1509, 1458, 1261, 1220, 1029, 826, 734.

**$^1$H NMR** (500 MHz, CDCl$_3$) $\delta$H: 7.93 (d, $J = 8.9$ Hz, 1H), 7.85 (d, $J = 8.9$ Hz, 1H), 7.80 (d, $J = 8.9$ Hz, 1H), 7.77 (d, $J = 8.9$ Hz, 1H), 7.32 (d, $J = 9.0$ Hz, 1H), 7.29 (d, $J = 9.6$ Hz, 1H), 7.20-7.15 (m, 3H), 7.05-7.00 (m, 4H), 6.54 (d, $J = 2.4$ Hz, 1H), 6.47 (d, $J = 2.4$ Hz, 1H), 5.13-5.05 (m, 2H), 3.78 (s, 3H), 3.55 (s, 3H), 3.49 (s, 3H).

**$^{13}$C NMR** (126 MHz, CDCl$_3$) $\delta$C: 158.2, 158.2, 155.7, 154.7, 137.8, 135.4, 129.6, 129.6, 129.2, 129.1, 128.2, 127.4, 126.8, 125.2, 124.9, 119.9, 118.7, 116.3, 116.1, 113.6, 114.4, 104.1, 104.0, 71.2, 56.7, 55.2, 55.1

**HRMS** (ESI$^+$) C$_{30}$H$_{26}$O$_4$Na$^+$ [M+Na]$^+$ requires 473.17233; found: 473.17258, $\Delta +0.5$ ppm.

**Chiral HPLC:** (Chiralpak ADH, 5% iPrOH, 95% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 27.4 min, $\tau_R$ (minor) = 11.6 min

$[\alpha]^{25}_D = +32.9$ (c = 1.00, CHCl$_3$).

(R)-2',7,7'-trimethoxy-[1,1'-binaphthalen]-2-ol (31)

**m.p.** = 73-75 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

**Chiral HPLC:** (Chiralpak ADH, 5% iPrOH, 95% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 47.8 min, $\tau_R$ (minor) = 40.7 min

$[\alpha]^{25}_D = -179.1$ (c = 1.00, CHCl$_3$).
Kinetic resolution of 2′-methoxy-7,7′-dimethyl-[1,1′-binaphthalen]-2-ol (32)

Following General procedure A, 2′-methoxy-7,7′-dimethyl-[1,1′-binaphthalen]-2-ol (32) (49.3 mg, 0.150 mmol) was reacted for 39 h. Purification via flash column chromatography (3:1 petroleum ether 40-60 – CH₂Cl₂ to 1:1 petroleum ether 40-60 – CH₂Cl₂) afforded 2-(benzyloxy)-2′-methoxy-7,7′-dimethyl-1,1′-binaphthalene (Bn-32) as an off-white solid (32.0 mg, 51%, 84.0:16.0 e.r.) and recovered starting material (32) (21.0 mg, 43%, 95.5:4.5 e.r.).

(S)-2-(benzyloxy)-2′-methoxy-7,7′-dimethyl-1,1′-binaphthalene (Bn-32)

m.p. = 55-57 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν_max/cm⁻¹: 3044, 2935, 2837, 1626, 1597, 1509, 1454, 1353, 1320, 1262, 1223, 1152, 1094, 1065, 826, 737, 696

¹H NMR (500 MHz, CDCl₃) δ_H: 7.96 (d, J = 8.9 Hz, 1H), 7.87 (d, J = 9.1 Hz, 1H), 7.81 (d, J = 8.3 Hz, 1H), 7.77 (d, J = 8.3 Hz, 1H), 7.40 (d, J = 8.9 Hz, 1H), 7.36 (d, J = 8.9 Hz, 1H), 7.22-7.13 (m, 5H), 7.05-6.90 (m, 4H), 5.10-4.99 (m, 2H), 3.75 (s, 3H), 2.28 (s, 3H), 2.26 (s, 3H)

¹³C NMR (126 MHz, CDCl₃) δ_C: 155.2, 154.2, 137.9, 136.0, 136.0, 134.5, 129.1, 128.9, 128.2, 127.9, 127.8, 127.8, 127.6, 126.3, 126.3, 126.0, 124.5, 124.4, 120.6, 119.3, 115.4, 113.1, 71.3, 56.8, 22.1, 22.1

HRMS (ESI⁺) C₃₀H₂₇O₂⁺ [M+H]⁺ requires 419.20056; found: 419.20062 Δ +0.2 ppm.

Chiral HPLC: (Chiralpak ADH, 5% iPrOH, 95% hexane, 1.00 mL min⁻¹, λ = 290 nm) τ_R (major) = 8.4 min, τ_R (minor) = 5.5 min

[α]D⁰ = −17.9 (c = 1.00, CHCl₃).

(R)-2′-methoxy-7,7′-dimethyl-[1,1′-binaphthalen]-2-ol (32)

m.p. = 76-78 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 5% iPrOH, 95% hexane, 1.00 mL min⁻¹, λ = 290 nm) τ_R (major) = 19.5 min, τ_R (minor) = 22.1 min

[α]D⁰ = −84.0 (c = 1.00, CHCl₃).
Following General procedure A, 6,6'-dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (33) (68.7 mg, 0.150 mmol) was reacted for 42 h. Purification via flash column chromatography (3:1 petroleum ether 40-60/CH₂Cl₂ to 1:1 petroleum ether 40-60/CH₂Cl₂) afforded 2-(benzyloxy)-6,6'-dibromo-2'-methoxy-1,1'-binaphthalene (Bn-33) as an off-white solid (45.1 mg, 55%, 88.5:11.5 e.r.) and recovered starting material (33) (29.6 mg, 43%, 99.0:1.0 e.r.).

(S)-2-(benzyloxy)-6,6'-dibromo-2'-methoxy-1,1'-binaphthalene (Bn-33)

m.p. = 61-63 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) νmax/cm⁻¹: 2917, 1584, 1494, 1327, 1268, 1069, 906, 730.

¹H NMR (500 MHz, CDCl₃) δH: 8.06 (d, J = 1.8 Hz, 1H, H₆), 8.03 (d, J = 1.7 Hz, 1H, H₁₇), 7.93 (d, J = 9.1 Hz, 1H, H₄), 7.84 (d, J = 9.0 Hz, 1H, H₁₃), 7.48 (d, J = 9.1 Hz, 1H, H₃), 7.46 (d, J = 9.1 Hz, 1H, H₁₄), 7.33-7.27 (m, 2H, H₈ and H₁₉), 7.22-7.17 (m, 3H, H₂₄ and H₂₆), 7.03-6.96 (m, 4H, H₉, H₂₀ and H₂₅), 5.09 (s, 2H, H₂₂), 3.78 (s, 3H, H₁₁).

¹³C NMR (126 MHz, CDCl₃) δC: 155.2, 154.3, 137.2, 132.51, 132.48, 130.5, 130.2, 129.92, 129.87, 129.8, 128.8, 128.6, 128.3, 127.5, 127.0, 126.7, 120.3, 119.0, 117.7, 117.3, 116.9, 114.7, 71.1, 56.6.

HRMS (APCI-) C₂₈H₂₁⁷⁹Br₂O₂⁻ [M-H]⁻ requires 546.9914; found: 546.9907, Δ -1.10 ppm.

Chiral HPLC: (Chiralpak ADH, 7.5% iPrOH, 92.5% hexane, 1.00 mL min⁻¹, λ = 290 nm) τR (major) = 13.3 min, τR (minor) = 10.8 min. 
[α]D²⁵ ≈ -9.5° (c = 1.00, CHCl₃)

(R)-6,6'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (33)

m.p. = 61-63 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 7.5% iPrOH, 92.5% hexane, 1.00 mL min⁻¹, λ = 290nm) τR (major) = 25.4 min, τR (minor) = 20.2 min. 
[α]D²⁵ ≈ -103.3 (c = 1.00, CHCl₃).
Kinetic resolution of 2'-Methoxy-6,6'-diphenyl-[1,1'-binaphthalen]-2-ol

Following General procedure A, 2'-Methoxy-6,6'-diphenyl-[1,1'-binaphthalen]-2-ol (34) (67.9 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:1 petroleum ether 40-60/CH₂Cl₂ to 1:1 petroleum ether 40-60/CH₂Cl₂) afforded 2-(Benzyloxy)-2'-methoxy-6,6'-diphenyl-1,1'-binaphthalene (Bn-34) as an off-white solid (36.8 mg, 45%, 93.0:7.0 e.r.) and recovered starting material (34) (32.2 mg, 47%, 95.0:5.0 e.r.)

(S)-2-(Benzyloxy)-2'-methoxy-6,6'-diphenyl-1,1'-binaphthalene (Bn-34)

m.p. = 98-100 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν_max/cm⁻¹: 3028, 2917, 1622, 1592, 1491, 1454, 1251, 1223, 1176, 1096, 1061, 1028, 757, 732, 695.

¹H NMR (500 MHz, CDCl₃) δ_H: 8.15 (s, 1H), 8.13-8.09 (m, 2H), 8.02 (d, J = 9.0 Hz, 1H), 7.76-7.69 (m, 4H), 7.58 – 7.53 (m, 3H), 7.52-7.46 (m, 5H), 7.40-7.28 (m, 4H), 7.23-7.18 (m, 3H), 7.10-7.05 (m, 2H), 5.14 (s, 2H), 3.83 (s, 3H)

¹³C NMR (126 MHz, CDCl₃) δ_C: 155.2, 154.2, 141.3, 141.2, 137.6, 136.5, 136.2, 133.4, 129.9, 129.73, 129.67, 129.4, 128.8, 128.2, 127.4, 127.27, 127.25, 127.08, 127.06, 126.8, 126.2, 126.0, 125.93, 125.88, 120.6, 119.3, 116.6, 114.3, 71.3, 56.7.

HRMS (ESI⁺) C₄₀H₃₀O₂Na⁺ [M+Na]⁺ requires 565.21380, found: 565.21381, Δ +0.0 ppm.

Chiral HPLC: (Chiralpak ADH, 12.5% iPrOH, 87.5% hexane, 1.00 mL min⁻¹, λ = 290 nm) τ_R (major) = 12.3 min, τ_R (minor) = 19.5 min

[α]D²⁵ = +70.5 (c = 1.00, CHCl₃).

(R)-2'-Methoxy-6,6'-diphenyl-[1,1'-binaphthalen]-2-ol (34)

m.p. = 120-122 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 12.5% iPrOH, 87.5% hexane, 1.00 mL min⁻¹, λ = 290 nm) τ_R (major) = 25.6 min, τ_R (minor) = 17.7 min

[α]D²⁵ = −189.4 (c = 1.00, CHCl₃).
Kinetic resolution of 6,6'-bis(4-fluorophenyl)-2'-methoxy-1,1'-binaphthalen-2-ol (35)

Following General procedure A, 6,6'-bis(4-fluorophenyl)-2'-methoxy-1,1'-binaphthalen-2-ol (35) (73.3 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:1 petroleum ether 40-60 – CH$_2$Cl$_2$ to 1:1 petroleum ether 40-60 – CH$_2$Cl$_2$) afforded 2-(Benzyloxy)-6,6'-bis(4-fluorophenyl)-2'-methoxy-1,1'-binaphthalene (Bn-35) as an off-white solid (49.7 mg, 57%, 85.0:15.0 e.r.) and recovered starting material (35) (30.6 mg, 42%, 99.5:0.5 e.r.).

(S)-2-(Benzyloxy)-6,6'-bis(4-fluorophenyl)-2'-methoxy-1,1'-binaphthalene (Bn-35)

m.p. = 185-187 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

IR (film) $\nu_{\text{max}}$/cm$^{-1}$: 2918, 1602, 1514, 1496, 1251, 1224, 1159, 1096, 1061, 820, 735.

$^1$H NMR (500 MHz, CDCl$_3$) $\delta_H$: 8.11-8.06 (m, 2H), 8.04 (d, $J = 1.7$ Hz, 1H), 8.00 (d, $J = 9.0$ Hz, 1H), 7.69-7.61 (m, 4H), 7.53 (d, $J = 9.0$ Hz, 1H), 7.51-7.44 (m, 3H), 7.32-7.24 (m, 2H), 7.21-7.13 (m, 7H), 7.08-7.03 (m, 2H), 5.13 (s, 2H), 3.82 (s, 3H).

$^{13}$C NMR (126 MHz, CDCl$_3$) $\delta_C$: 162.3 (d, $J = 246$ Hz), 155.2, 154.3, 137.5, 137.3 (app t, $J = 4$ Hz), 135.5, 135.2, 133.3, 129.8, 129.65, 129.60, 129.3, 128.7 (app dd, $J = 8.0$, 2.5 Hz), 128.2, 127.4, 126.8, 126.1, 126.0, 125.8, 125.7, 120.6, 119.2, 116.7, 115.7 (d, $J = 21.3$ Hz), 114.3, 71.3, 56.7.

$^{19}$F NMR (470 MHz, CDCl$_3$, $^1$H decoupled) $\delta_F$: -116.0 (s), -116.1 (s).

HRMS (ESI$^+$) C$_{40}$H$_{28}$F$_2$O$_2$Na$^+$ [M+Na]$^+$: requires 601.19496, found: 601.19489, $\Delta$ -0.1 ppm.

Chiral HPLC: (Chiralpak ADH, 12.5% i-PrOH, 87.5% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 16.6 min, $\tau_R$ (minor) = 26.6 min

$[\alpha]_{D}^{25}$ = +48.4 (c = 1.00, CHCl$_3$).

(R)-2'-Methoxy-6,6'-bis(4-(trifluoromethoxy)phenyl)-1,1'-binaphthalen-2-ol (35)

m.p. = 113-115 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 12.5% i-PrOH, 87.5% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 41.2 min, $\tau_R$ (minor) = 24.3 min

$[\alpha]_{D}^{25}$ = -231.6 (c = 1.00, CHCl$_3$).
Kinetic resolution of 1,1'-(2-hydroxy-2'-methoxy-[1,1'-binaphthalene]-6,6'-diyl)bis(4,1-phenylene))bis(ethan-1-one) (36)

Following **General procedure A**, 1,1'-(2-hydroxy-2'-methoxy-[1,1'-binaphthalene]-6,6'-diyl)bis(4,1-phenylene))bis(ethan-1-one) (36) (80.5 mg, 0.150 mmol) was reacted for 30 h. Purification via flash column chromatography (19:1 CH₂Cl₂ – diethyl ether to 9:1 CH₂Cl₂ – diethyl ether) afforded 1,1'-(2-(benzyloxy)-2'-methoxy-[1,1'-binaphthalene]-6,6'-diyl)bis(4,1-phenylene))bis(ethan-1-one) (Bn-36) as an off-white solid (50.0 mg, 53%, 90.5:9.5 e.r.) and recovered starting material (36) (34.3 mg, 43%, 97.0:3.0 e.r.)

**{(S)}-1,1'-(2-(benzyloxy)-2'-methoxy-[1,1'-binaphthalene]-6,6'-diyl)bis(4,1-phenylene))bis(ethan-1-one) (Bn-36)**

m.p. = 128-130 °C (CH₂Cl₂/diethyl ether).

IR (film) ν max/cm⁻¹: 2923, 2851, 1677, 1599, 1493, 1268, 1250, 1059, 818, 732.

¹H NMR (500 MHz, CDCl₃) δ H: 8.19 (s, 1H), 8.16 (s, 1H), 8.12 (d, J = 9.0 Hz), 8.10-8.00 (m, 5H), 7.84-7.76 (m, 4H), 7.58-7.49 (m, 4H), 7.35-7.25 (m, 2H), 7.24-7.15 (m, 3H), 7.10-7.02 (m, 2H), 5.15 (s, 2H), 3.83 (s, 3H), 2.67 (s, 3H), 2.66 (s, 3H).

¹³C NMR (126 MHz, CDCl₃) δ C: 197.8, 155.6, 154.6, 145.8, 145.7, 137.4, 135.7, 135.6, 135.0, 134.8, 133.8, 130.2, 130.0, 129.6, 129.3, 129.0, 128.2, 127.5, 127.20, 126.7, 126.6, 126.5, 126.2, 125.7, 120.4, 119.1, 116.6, 114.4, 71.2, 56.6, 26.7.

HRMS (ESI⁺) C₄₄H₃₄O₄Na⁺ [M+Na]⁺: requires 649.23493, found: 649.23499, Δ +0.1 ppm

Chiral HPLC: (Chiralpak ADH, 50% i-PrOH, 50% hexane, 1.00 mL min⁻¹, λ = 290 nm) τᵣ (major) = 37.6 min, τᵣ (minor) = 42.0 min

[α]D²⁵ = +135.3 (c = 1.00, CHCl₃).

**(R)-1,1'-(2-hydroxy-2'-methoxy-[1,1'-binaphthalene]-6,6'-diyl)bis(4,1-phenylene))bis(ethan-1-one) (36)**

m.p. = 161-163 °C (CH₂Cl₂/diethyl ether).

Chiral HPLC: (Chiralpak ADH, 50% i-PrOH, 50% hexane, 1.00 mL min⁻¹, λ = 290 nm) τᵣ (major) = 27.8 min, τᵣ (minor) = 17.7 min

[α]D²⁵ = −316.1 (c = 1.00, CHCl₃).
Kinetic resolution of 2'-methoxy-6,6'-bis(4-(trifluoromethoxy)phenyl)-1,1'-binaphthalen-2-ol (37)

Following **General procedure A**, 2'-methoxy-6,6'-bis(4-(trifluoromethoxy)phenyl)-1,1'-binaphthalen-2-ol (37) (93.1 mg, 0.150 mmol) was reacted for 24 h. Purification via flash column chromatography (3:1 petroleum ether 40-60 – CH$_2$Cl$_2$ to 1:1 petroleum ether 40-60 – CH$_2$Cl$_2$) afforded 2-(Benzyloxy)-2'-methoxy-6,6'-bis(4-(trifluoromethoxy)phenyl)-1,1'-binaphthalene (Bn-37) as an off-white solid (61.2 mg, 57%, 85:15 e.r.) and recovered starting material (37) (37.9 mg, 41%, 99.5:0.5 e.r.).

**(S)-2-(Benzyloxy)-2'-methoxy-6,6'-bis(4-(trifluoromethoxy)phenyl)-1,1'-binaphthalene (Bn-37)

m.p. = 85-87 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

**IR** (film) $\nu_{max}$/cm$^{-1}$: 2917, 1597, 1514, 1496, 1252, 1222, 1167, 907, 730.

$^1$H NMR (500 MHz, CDCl$_3$) $\delta_H$: 8.12-8.08 (m, 2H), 8.06 (d, $J = 1.6$ Hz, 1H), 8.01 (d, $J = 9.0$ Hz, 1H), 7.74-7.66 (m, 4H), 7.54 (d, $J = 9.1$ Hz, 1H), 7.52-7.44 (m, 3H), 7.36-7.24 (m, 6H), 7.22-7.15 (m, 3H), 7.09-7.02 (m, 2H), 5.13 (s, 2H), 3.83 (s, 3H).

$^{13}$C NMR (126 MHz, CDCl$_3$) $\delta_C$: 155.4, 154.4, 148.5, 140.0, 139.9, 137.4, 135.1, 134.8, 133.4, 129.9, 129.7, 129.6, 129.3, 128.49, 128.47, 128.2, 127.4, 126.7, 126.11, 126.08, 126.03, 125.8, 121.3, 120.6 (q, $J = 257.1$ Hz), 120.5, 119.5, 119.1, 116.7, 114.4, 71.2, 56.6.

$^{19}$F NMR (470 MHz, CDCl$_3$) $\delta_F$: -57.79 (s).

**HRMS** (ESI$^+$) C$_{42}$H$_{28}$F$_6$O$_4$Na$^+$ [M+Na]$^+$: requires 744.17840, found: 744.17834, $\Delta$ -0.1 ppm.

**Chiral HPLC**: (Chiralpak IC, 1% iPrOH, 99% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 6.9 min, $\tau_R$ (minor) = 9.6 min

$[\alpha]_D^{25} = +49.0$ ($c = 1.00$, CHCl$_3$).

**(R)-2'-methoxy-6,6'-bis(4-(trifluoromethoxy)phenyl)-1,1'-binaphthalen-2-ol (37)

m.p. = 93-95 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

**Chiral HPLC**: (Chiralpak ADH, 12.5% iPrOH, 87.5% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 16.6 min, $\tau_R$ (minor) = 12.4 min

$[\alpha]_D^{25} = -172.8$ ($c = 1.00$, CHCl$_3$).
Kinetic resolution of 5,5'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (38)

Following General procedure A, 5,5'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (38) (68.7 mg, 0.150 mmol) was reacted for 48 h. Purification via flash column chromatography (3:1 petroleum ether 40-60/CH₂Cl₂ to 1:1 petroleum ether 40-60/CH₂Cl₂) afforded 2-(benzyloxy)-5,5'-dibromo-2'-methoxy-1,1'-binaphthalene (Bn-38) as an off-white solid (43.4 mg, 53%, 87.5:12.5 e.r.) and recovered starting material (38) (29.4 mg, 43%, 98.0:2.0 e.r.).

(S)-2-(benzyloxy)-5,5'-dibromo-2'-methoxy-1,1'-binaphthalene (Bn-38)

m.p. = 62-64 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν_max/cm⁻¹: 2935.9, 2360.2, 2341.5, 1611.3, 1588.1, 1560.7, 1497.2, 1454.9, 1394.1, 1347.2, 1324.7, 1264.5, 1216.4, 1200.4, 1140.0, 1100.5, 1072.5, 1049.6, 965.1, 798.7, 753.8, 693.0, 655.7

¹H NMR (500 MHz, CDCl₃) δ_H: 8.44 (d, J = 9.4 Hz, 1H), 8.35 (d, J = 9.4 Hz), 7.64-7.60 (m, 2H), 7.54 (d, J = 9.4 Hz, 1H), 7.50 (d, J = 9.4 Hz, 1H), 7.20-7.16 (m, 3H), 7.10-6.99 (m, 6H), 5.15-5.06 (m, 2H), 3.78 (s, 3H).

¹³C NMR (126 MHz, CDCl₃) δ_C: 155.7, 154.7, 135.4, 135.3, 129.2, 129.0, 128.4, 128.0, 127.9, 127.8, 127.7, 127.6, 126.9, 126.8, 125.4, 125.3, 123.1, 123.1, 120.5, 119.3, 116.8, 114.7, 71.0, 56.6.

HRMS (APCI⁻) C₃₀H₂₀⁷Br₂O₂Na⁺ [M+Na]⁺ requires 568.97463; found: 568.97223, Δ -4.2 ppm.

Chiral HPLC: (Chiralpak IC, 2% iPrOH, 98% hexane, 1.00 mL min⁻¹, λ = 290 nm) t_R (major) = 5.2 min, t_R (minor) = 6.9 min

[α]D²⁵ = -103.3 (c = 1.00, CHCl₃).

(R)-5,5'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (38)

m.p. = 94-96 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak IC, 2% iPrOH, 98% hexane, 1.00 mL min⁻¹, λ = 290 nm) t_R (major) = 11.8 min, t_R (minor) = 23.1 min

[α]D²⁵ = +48.1 (c = 1.00, CHCl₃).
Kinetic resolution of 2'-methoxy-5,5'-dimethyl-[1,1'-binaphthalen]-2-ol (39)

Following **General procedure A**, 2'-methoxy-5,5'-dimethyl-[1,1'-binaphthalen]-2-ol (39) (49.3 mg, 0.150 mmol) was reacted for 21 h. Purification via flash column chromatography (3:1 petroleum ether 40-60/CH$_2$Cl$_2$ to 1:1 petroleum ether 40-60/CH$_2$Cl$_2$) afforded 2-(benzyloxy)-2'-methoxy-5,5'-dimethyl-1,1'-binaphthalene (Bn-39) as an off-white solid (30.0 mg, 48%, 93.0:7.0 e.r.) and recovered starting material (39) (25.5 mg, 52%, 93.0:7.0 e.r.).

**(S)-2-(benzyloxy)-2'-methoxy-5,5'-dimethyl-1,1'-binaphthalene (Bn-39)**

m.p. = 60-62 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

IR (film) $\nu_{\text{max}}$/cm$^{-1}$: 3062, 3031, 2935, 2837, 1614, 1594, 1511, 1454, 1401, 1325, 1265, 1223, 1091, 1077, 1063, 1038, 800, 758, 696

$^1$H NMR (500 MHz, CDCl$_3$) $\delta$: 8.19 (d, $J = 9.22$ Hz, 1H), 8.10 (d, $J = 9.22$ Hz, 1H), 7.51 (d, $J = 9.22$ Hz, 1H), 7.45 (d, $J = 9.22$ Hz, 1H), 7.22-7.17 (m, 5H), 7.16-7.10 (m, 2H), 7.09-7.01 (m, 4H), 5.14-5.04 (m, 2H), 3.79 (s, 3H), 2.80 (s, 3H), 2.76 (s, 3H).

$^{13}$C NMR (126 MHz, CDCl$_3$) $\delta$: 154.9, 153.9, 137.9, 134.5, 134.3, 134.3, 128.7, 128.4, 128.2, 127.4, 126.9, 126.3, 125.6, 125.5, 124.8, 124.5, 124.2, 124.1, 121.7, 120.4, 115.8, 113.4, 71.2, 56.7, 19.8, 19.8.

HRMS (ESI$^+$) C$_{30}$H$_{27}$O$_2$ $^+$ [M+H]$^+$ requires 419.20056, found: 419.20060, $\Delta +0.10$ ppm.

**Chiral HPLC:** (Chiralpak ADH, 12.5% iPrOH, 87.5% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 8.9 min, $\tau_R$ (minor) = 8.2 min.

$[\alpha]_D^{25} = -53.0$ (c = 1.00, CHCl$_3$).

**(R)-2'-methoxy-5,5'-dimethyl-[1,1'-binaphthalen]-2-ol (39)**

m.p. = 76-78 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

**Chiral HPLC:** (Chiralpak ADH, 12.5% iPrOH, 87.5% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 29.1 min, $\tau_R$ (minor) = 9.7 min.

$[\alpha]_D^{25} = +2.6$ (c = 1.00, CHCl$_3$).
Kinetic resolution of 2'-methoxy-5,5'-diphenyl-[1,1'-binaphthalen]-2-ol (40)

Following **General procedure A**, 2'-methoxy-5,5'-diphenyl-[1,1'-binaphthalen]-2-ol (40) (67.9 mg, 0.150 mmol) was reacted for 36 h. Purification via flash column chromatography (3:1 petroleum ether 40-60/CH$_2$Cl$_2$ to 1:1 petroleum ether 40-60/CH$_2$Cl$_2$) afforded 2-(benzyloxy)-2'-methoxy-5,5'-diphenyl-1,1'-binaphthalene (Bn-40) as an off-white solid (39.8 mg, 49%, 81.5:18.5 e.r.) and recovered starting material (40) (25.3 mg, 37%, 95.0:5.0 e.r.).

**[(S)-2-(benzyloxy)-2'-methoxy-5,5'-diphenyl-1,1'-binaphthalene (Bn-40)]**

m.p. = 97-99 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

**IR** (film) $\nu_{max}$/cm$^{-1}$: 3058, 3030, 2838, 2359, 2336, 2211, 2155, 1947, 1890, 1726, 1609, 1590, 1511, 1491, 1475, 1461, 1454, 1444, 1402, 1371, 1360, 1322, 1263, 1226, 1179, 1156, 1121, 1089, 1044, 1028, 971, 922, 906, 847, 806, 759, 702, 667, 647, 620

**$^1$H NMR** (500 MHz, CDCl$_3$) $\delta_H$: 8.09 (d, $J = 9.44$ Hz, 1H), 8.01 (d, $J = 9.18$ Hz, 1H), 7.66-7.44 (m, 10H), 7.43 (d, $J = 9.44$ Hz, 1H), 7.38 (d, $J = 9.18$ Hz, 1H), 7.34-7.27 (m, 5H), 7.26-7.23 (m, 1H), 7.20-7.15 (m, 3H), 7.06-7.00 (m, 2H), 5.15-5.05 (m, 2H), 3.80 (s, 3H).

**$^{13}$C NMR** (126 MHz, CDCl$_3$) $\delta_C$: 155.0, 154.0, 141.4, 141.3, 140.4, 140.4, 137.8, 134.7, 134.7, 130.4, 130.3, 128.4, 128.3, 128.3, 127.9, 127.8, 127.7, 127.5, 127.5, 127.3, 127.3, 126.8, 126.1, 125.3, 125.1, 124.8, 121.1, 119.8, 116.0, 113.7, 71.2, 56.7.

**HRMS** (ESI$^+$) C$_{40}$H$_{30}$O$_2$Na$^+$ [M+Na]$^+$ requires 565.21380; found: 565.21362, $\Delta$ -0.3 ppm.

**Chiral HPLC:** (Chiralpak IC, 2% iPrOH, 99% hexane, 1.00 mL min$^{-1}$, $\lambda$ = 290 nm) $\tau_R$ (major) = 5.0 min, $\tau_R$ (minor) = 6.2 min

$[\alpha]_{D}^{25}$ = −69.7 (c = 1.00, CHCl$_3$).

**[(R)-2'-methoxy-5,5'-diphenyl-[1,1'-binaphthalen]-2-ol (40)]**

m.p. = 117-119 °C (CH$_2$Cl$_2$/petroleum ether 40-60).

**Chiral HPLC:** (Chiralpak IC, 2% iPrOH, 98% hexane, 1.00 mL min$^{-1}$, $\lambda$ = 290 nm) $\tau_R$ (major) = 8.0 min, $\tau_R$ (minor) = 14.9 min

$[\alpha]_{D}^{25}$ = +73.2 (c = 0.50, CHCl$_3$).
Kinetic resolution of 4,4'-dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (41)

Following General procedure A, 4,4'-dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (41) (68.7 mg, 0.150 mmol) was reacted for 36 h. Purification via flash column chromatography (3:7 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2-(benzyloxy)-4,4'-dibromo-2'-methoxy-1,1'-binaphthalene (Bn-41) as an off-white solid (30.7 mg, 45%, 88:12 e.r.) and recovered starting material (41) (41.4 mg, 50%, 93:7 e.r.).

(S)-2-(Benzyloxy)-4,4'-dibromo-2'-methoxy-1,1'-binaphthalene (Bn-41):

m.p. = 148-150 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν_max/cm⁻¹: 3064, 2934, 1582, 1497, 1314, 1259, 1243, 1025, 907, 756, 733.

¹H NMR (400 MHz, CDCl₃) δ = 8.35–8.19 (m, 3H), 7.79–7.76 (m, 2H), 7.52–7.39 (m, 2H), 7.32–7.22 (m, 2H), 7.21–7.11 (m, 5H), 7.05–6.92 (m, 2H), 5.12–4.92 (m, 2H), 3.75 (s, 3H).

¹³C NMR (101 MHz, CDCl₃) δ = 154.7, 153.8, 136.9, 134.7, 128.4, 128.2, 127.9, 127.8, 127.4, 127.3, 126.9, 125.8, 125.8, 125.4, 125.1, 123.9, 123.7, 120.4, 120.2, 118.9, 118.2, 71.6, 56.9.

HRMS (ESI⁺) C₸H₂₀O₂⁷⁹Br [M+Na⁺] requires 568.97223; found 568.97217, Δ -0.1 ppm.

Chiral HPLC: (Chiralpak ADH, 1% iPrOH, 99% hexane, 1.0 mL min⁻¹, λ = 295 nm) τ_R (major) = 16.2 min, τ_R (minor) = 11.1 min.

[α]_D⁰ = −47.2 (c = 0.50, CHCl₃).

(R)-4,4'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (41):

m.p. = 178-180 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, λ = 293 nm) τ_R (major) = 15.3 min, τ_R (minor) = 31.2 min.

[α]_D⁰ = +23.4 (c = 0.50, CHCl₃).
Kinetic resolution of [2'-methoxy-4,4'-diphenyl-[1,1'-binaphthalen]-2-ol] (42)

Following General procedure A, 2'-methoxy-4,4'-diphenyl-[1,1'-binaphthalen]-2-ol (42) (67.9 mg, 0.150 mmol) for 30 h. Purification via flash column chromatography (3:7 CH$_2$Cl$_2$ – petroleum ether 40-60 to 4:1 CH$_2$Cl$_2$ – petroleum ether 40-60) afforded 2-(benzyloxy)-2'-methoxy-4,4'-diphenyl-1,1'-binaphthalene (Bn-42) as an off-white solid (50.3 mg, 62%, 80:20 e.r.) and recovered starting material (42) (22.2 mg, 33%, 99:1 e.r.).

(S)- 2-(Benzyloxy)-2'-methoxy-4,4'-diphenyl-1,1'-binaphthalene (Bn-42):

- **m.p.** = 117-119 °C (CH$_2$Cl$_2$/petroleum ether 40-60).
- **IR** (film) $\nu_{\text{max}}$/cm$^{-1}$: 3060, 3029, 2935, 1586, 1342, 1224, 764, 703.
- **$^1$H NMR** (500 MHz, CDCl$_3$) $\delta$ = 7.94 (m, 2H), 7.71–7.65 (m, 2H), 7.63–7.47 (m, 8H), 7.44 (m, 2H), 7.39 (m, 1H), 7.35–7.22 (m, 5H), 7.17 (m, 2H), 7.00 (m, 3H), 5.42–4.89 (m, 2H), 3.81 (s, 3H).
- **$^{13}$C NMR** (126 MHz, CDCl$_3$) $\delta$ = 154.4, 153.5, 141.9, 141.6, 141.1, 140.8, 137.6, 134.6, 134.6, 130.2, 128.4, 128.3, 128.1, 127.9, 127.5, 127.5, 127.4, 127.4, 126.9, 126.3, 126.3, 126.2, 126.2, 125.9, 125.9, 123.9, 123.6, 120.5, 118.9, 117.6, 115.0, 71.5, 56.7.
- **HRMS** (ESI$^+$) $C_{40}H_{30}O_2$ [M+H]$^+$ requires 543.23186; found 543.23132, $\Delta$ = 0.1 ppm.
- **Chiral HPLC**: (Chiralpak ODH, 2% $^i$PrOH, 98% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 295 nm) $\tau_R$ (minor) = 9.0 min, $\tau_R$ (major) = 10.7 min.

[$\alpha$]$^D_{25}$ = −31.1 ($c$ = 1.00, CHCl$_3$).

(R)-[2'-methoxy-4,4'-diphenyl-[1,1'-binaphthalen]-2-ol] (42):

- **m.p.** = 125-127 °C (CH$_2$Cl$_2$/petroleum ether 40-60).
- **Chiral HPLC**: (Chiralpak ADH, 20% $^i$PrOH, 80% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 300 nm) $\tau_R$ (major) = 20.8 min, $\tau_R$ (minor) = 36.0 min..

[$\alpha$]$^D_{25}$ = +16.9 ($c$ = 1.00, CHCl$_3$).
Kinetic resolution of 2'-methoxy-4,4'-dimethyl-[1,1'-binaphthalen]-2-ol (43)

Following General procedure A, 2'-methoxy-4,4'-dimethyl-[1,1'-binaphthalen]-2-ol (43) (49.3 mg, 0.150 mmol) was reacted for 30 h. Purification via flash column chromatography (3:7 CH₂Cl₂ – petroleum ether 40-60 to 4:1 CH₂Cl₂ – petroleum ether 40-60) afforded 2-(benzyloxy)-2'-methoxy-4,4'-dimethyl-1,1'-binaphthalene (Bn-43) as an off-white solid (33.8 mg, 54%, 88:12 e.r.) and recovered starting material (43) (19.4 mg, 39%, 99:1 e.r.).

(S)- 2-(Benzyloxy)-2'-methoxy-4,4'-dimethyl-1,1'-binaphthalene (Bn-43):

m.p. = 155-157 °C (CH₂Cl₂/petroleum ether 40-60).

IR (film) ν max/cm⁻¹: 3063, 2937, 2911, 1593, 1342, 757.

¹H NMR (500 MHz, CDCl₃) δ = 8.06 (d, J = 8.5, 1H), 8.03 (d, J = 8.5, 1H), 7.42–7.36 (m, 2H), 7.35 (s, 1H), 7.33 (s, 1H), 7.28–7.21 (m, 4H), 7.22–7.15 (m, 3H), 7.06–6.98 (m, 2H), 5.09 (d, J = 12.5 Hz, 1H), 5.05 (d, J = 12.6 Hz, 1H), 5.05 (d, J = 12.6 Hz, 1H), 5.05 (d, J = 12.6 Hz, 1H), 5.05 (d, J = 12.6 Hz, 1H), 5.05 (d, J = 12.6 Hz, 1H), 5.05 (d, J = 12.6 Hz, 1H), 5.05 (d, J = 12.6 Hz, 1H), 5.05 (d, J = 12.6 Hz, 1H), 5.05 (d, J = 12.6 Hz, 1H), 5.05 (d, J = 12.6 Hz, 1H), 5.05 (d, J = 12.6 Hz, 1H).

¹³C NMR (126 MHz, CDCl₃) δ = 154.5, 153.7, 137.8, 135.9, 135.8, 134.5, 128.8, 128.4, 128.1, 127.2, 126.8, 126.2, 126.2, 126.0, 126.0, 124.2, 124.1, 123.6, 123.3, 119.2, 117.7, 117.5, 115.1, 71.3, 56.7, 20.0, 20.0.

HRMS (ESI⁺) C₃₀H₂₆O [M+Na]⁺ requires 441.18250; found 441.18280, Δ +0.7 ppm.

Chiral HPLC: (Chiralpak ADH, 3% iPrOH, 99% hexane, 1.0 mL min⁻¹, λ = 250 nm) τᵣ (major) = 19.7 min, τᵣ (minor) = 12.0 min.

[α]D²⁵ = −36.0 (c = 1.00, CHCl₃).

(R)- 2'-Methoxy-4,4'-dimethyl-[1,1'-binaphthalen]-2-ol (43):

m.p. = 201-202 °C (CH₂Cl₂/petroleum ether 40-60).

Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, λ = 293 nm) τᵣ (major) = 20.9 min, τᵣ (minor) = 23.3 min.

[α]D²⁵ = −31.7 (c = 1.00, CHCl₃).
### 7. 10 g Scale Kinetic Resolution

6,6'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (33) (10.1 g, 22.0 mmol, 1.00 equiv.), benzyl tosylate (8.66 g, 33.0 mmol, 1.50 equiv.) and N-(2,3,4-trifluorobenzyl)hydrocinchoninium bromide (1.15 g, 2.20 mmol, 1.00 equiv.) were added to a 2 L 3 necked round bottom flask fitted with an overhead stirrer (pictured below). 9:1 PhH-Et₂O (880 mL) was added followed by K₂CO₃ (saturated aq., 30.4 mL) and stirring was commenced (1100 RPM). After 36 hours piperidine (44.0 mL) was added and stirring was continued for a further 30 minutes. NH₄Cl (saturated aq., 300 mL) was added and the mixture was transferred to a separating funnel. The phases were separated and the aqueous phase was extracted with EtOAc (2 × 300 mL). The combined organic layers were washed with water (200 mL), dried over anhydrous sodium sulfate, concentrated \textit{in vacuo} and purified by flash column chromatography (3:7 CH₂Cl₂–petroleum ether 40-60 to 3:2 CH₂Cl₂–petroleum ether 40-60) to give 2-(benzyloxy)-6,6'-dibromo-2'-methoxy-1,1'-binaphthalene (Bn-33) (6.32 g, 52%, 90:10 e.r.) and recovered starting material (33) (4.32 g, 43%, 99:1 e.r.).

#### 2-(Benzyloxy)-6,6'-dibromo-2'-methoxy-1,1'-binaphthalene (Bn-33):

m.p. = 54-55 °C (CH₂Cl₂/petroleum ether 40-60).

[α]₀[D] = −9.8 (c = 1.00, CHCl₃)

#### 6,6'-Dibromo-2'-methoxy-[1,1'-binaphthalen]-2-ol (33):

m.p. = 71-73 °C (CH₂Cl₂/petroleum ether 40-60).

[α]₀[D] = −106.0 (c = 1.00, CHCl₃)
8. Determination of Absolute Stereochemistry

The absolute stereochemistry of MeBINOL (1) and MeBnBINOL (Bn-1) were determined by chiral HPLC comparison with authentic samples prepared from commercially available (R)-BINOL and (S)-BINOL respectively. The optical rotation of MeBINOL (1) is consistent with the value reported in the literature.\(^\text{17}\)
Chiral HPLC: (Chiralpak ADH, 7.5% i-PrOH, 99% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\text{nm}\)) \(\tau_R\) (major) = 25.7 min, \(\tau_R\) (minor) = 16.6 min

(R)-MeBINOL prepared by kinetic resolution

![CHIRAL HPLC GRAPH]

| No. | Peak Name | Retention Time | Area (mAU*min) | Height (mAU) | Relative Area |
|-----|-----------|----------------|----------------|--------------|---------------|
| 1   |           | 16.647         | 0.622          | 1.677        | 2.41          |
| 2   |           | 25.670         | 25.162         | 43.915       | 97.59         |
| Total: |         | 25.784         | 45.591         | 100.00       |

(R)-MeBINOL prepared from commercially available (R)-BINOL

![CHIRAL HPLC GRAPH]

| No. | Peak Name | Retention Time | Area (mAU*min) | Height (mAU) | Relative Area |
|-----|-----------|----------------|----------------|--------------|---------------|
| 1   |           | 16.667         | 0.518          | 1.402        | 0.36          |
| 2   |           | 25.847         | 143.619        | 249.436      | 99.64         |
| Total: |         | 144.137        | 250.838        | 100.00       |
Chiral HPLC: (Chiralpak IC, 1% PrOH, 99% hexane, 1.00 mL min⁻¹, λ = 290 nm) \( \tau_R \) (major) = 7.6 min, \( \tau_R \) (minor) = 11.0 min

**(S)-MeBnBINOL prepared by kinetic resolution**

![Chiral HPLC graph](image)

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 7.607          | 28.297 | 34.615  | 89.96         |
| 2   |           | 11.020         | 3.156  | 3.356   | 10.04         |
| **Total:** | | **31.454** | **37.971** | **100.00** | |

**(S)-MeBnBINOL prepared from commercially available (S)-BINOL**

![Chemical structure](image)

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 7.237          | 85.670 | 103.034 | 99.89         |
| 2   |           | 10.573         | 0.098  | 0.026   | 0.11          |
| **Total:** | | **85.767** | **103.060** | **100.00** | |
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9. NMR Spectra and HPLC traces
4-AcC₆H₄

O

Bn

4-AcC₆H₄

4-AcC₆H₄

OBn

O

OMe

Bn-36
**Chiral HPLC**: (Chiralpak ADH, 7.5% iPrOH, 90% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 25.7 min, \(\tau_R\) (minor) = 16.6 min.

### Racemic

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 16.757         | 229.643| 630.007 | 49.92         |
| 2   |           | 25.887         | 230.356| 403.502 | 50.08         |
| **Total:** |     |                | **459.998** | **1033.509** | **100.00** |

### Asymmetric

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 16.600         | 2.041  | 5.668   | 2.29          |
| 2   |           | 25.727         | 87.190 | 156.082 | 97.71         |
| **Total:** |     |                | **89.231** | **161.750** | **100.00** |
Chiral HPLC: (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min$^{-1}$, $\lambda = 289$ nm) $\tau_R$ (major) = 8.0 min, $\tau_R$ (minor) = 11.8 min.

### Racemic

- **Bn-1**

| No. | Peak Name | Retention Time (min) | Area (mAU*min) | Height (mAU) | Relative Area (%) |
|-----|-----------|----------------------|----------------|--------------|-------------------|
| 1   |           | 7.653                | 42.993         | 70.452       | 49.98             |
| 2   |           | 11.003               | 43.028         | 66.431       | 50.02             |
| **Total:** | | **86.021** | **136.883** | **100.00** |

### Asymmetric

- **Bn-1**

| No. | Peak Name | Retention Time (min) | Area (mAU*min) | Height (mAU) | Relative Area (%) |
|-----|-----------|----------------------|----------------|--------------|-------------------|
| 1   |           | 8.033                | 60.986         | 90.364       | 90.38             |
| 2   |           | 11.813               | 6.489          | 8.991        | 9.62              |
| **Total:** | | **67.475** | **99.356** | **100.00** |

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**S191**
**Chiral HPLC:** (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.00 mL min⁻¹, \(\lambda = 290\) nm) \(\tau_R\) (major) = 21.1 min, \(\tau_R\) (minor) = 6.7 min

### Racemic

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|----------------|--------|--------|---------------|
|     |           | min            | mAU*min| mAU   | %             |
| 1   |           | 6.713          | 124.143| 777.568| 49.89         |
| 2   |           | 21.100         | 124.675| 259.424| 50.11         |
| **Total:** | | **248.818** | **1036.992** | 100.00 |

### Asymmetric

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|----------------|--------|--------|---------------|
|     |           | min            | mAU*min| mAU   | %             |
| 1   |           | 6.737          | 2.135  | 10.927 | 4.05          |
| 2   |           | 21.153         | 50.573 | 103.997| 95.95         |
| **Total:** | | **52.708** | **114.924** | 100.00 |
**Chiral HPLC:** (Chiralpak ADH, 5% /PrOH, 95% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\text{nm}\)) \(\tau_R\) (major) = 5.1 min, \(\tau_R\) (minor) = 5.6 min

### Racemic

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min mAU*min | mAU   | %      |               |
| 1   |           | 5.067 | 13.320 | 94.479 | 49.93         |
| 2   |           | 5.580 | 13.360 | 89.123 | 50.07         |
| **Total:** | | | **26.679** | **183.602** | **100.00** |

### Asymmetric

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min mAU*min | mAU   | %      |               |
| 1   |           | 5.073 | 212.451 | 1178.404 | 89.27        |
| 2   |           | 5.593 | 25.530  | 130.811 | 10.73        |
| **Total:** | | | **237.982** | **1309.215** | **100.00** |
**Chiral HPLC:** (Chiralpak ADH, 20% t-PrOH, 80% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 35.2 min, $\tau_R$ (minor) = 19.5 min

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**Racemic**

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 19.007         | 241.636 | 506.321 | 49.94         |
| 2   |           | 34.847         | 242.227 | 240.120 | 50.06         |
| **Total:** | | **483.863** | **746.442** | **100.00** |              |

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**Asymmetric**

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 19.540         | 1.000  | 2.161  | 5.39          |
| 2   |           | 35.250         | 17.563 | 20.072 | 94.61         |
| **Total:** | | **18.563** | **22.233** | **100.00** |              |
**Chiral HPLC:** (Chiralpak ADH, 10% PrOH, 90% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 7.3 min, $\tau_R$ (minor) = 8.7 min

### Racemic

![Bn-10](attachment:image1.png)

| No. | Peak Name | Retention Time | Area  | Height  | Relative Area |
|-----|-----------|----------------|-------|---------|--------------|
|     |           | min            | mAU*min | mAU | %            |
| 1   |           | 7.133          | 199.858 | 1121.306 | 50.00        |
| 2   |           | 8.430          | 199.884 | 997.805  | 50.00        |
| **Total:** | | **399.743** | **2119.111** | | 100.00 |

### Asymmetric

![Bn-10](attachment:image2.png)

| No. | Peak Name | Retention Time | Area  | Height  | Relative Area |
|-----|-----------|----------------|-------|---------|--------------|
|     |           | min            | mAU*min | mAU | %            |
| 1   |           | 7.347          | 13.264  | 74.661  | 90.81        |
| 2   |           | 8.723          | 1.343   | 7.004   | 9.19         |
| **Total:** | | **14.607** | **81.665** | | **100.00** |
Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 277\) nm) \(\tau_R\) (major) = 27.4 min, \(\tau_R\) (minor) = 29.8 min.

### Racemic

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | % |
| 1   |           | 27.380         | 92.599 | 131.404 | 49.94 |
| 2   |           | 29.783         | 92.812 | 125.627 | 50.06 |
| Total: | | | 185.411 | 257.030 | 100.00 |

### Asymmetric

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | % |
| 1   |           | 26.420         | 5.501 | 6.095 | 0.51 |
| 2   |           | 29.037         | 1081.495 | 1163.649 | 99.49 |
| Total: | | | 1086.996 | 1169.744 | 100.00 |
**Chiral HPLC:** (Chiralpak ADH, 10% 
PrOH, 90% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 279 nm) $\tau_R$ (major) = 14.2 min, $\tau_R$ (minor) = 26.1 min.

**Racemic.**

| No. | Peak Name | Retention Time | Area      | Height   | Relative Area |
|-----|-----------|----------------|-----------|----------|---------------|
|     |           | min            | mAU*min   | mAU      | %             |
| 1   |           | 14.167         | 225.271   | 695.13   | 49.95         |
| 2   |           | 26.133         | 225.718   | 365.93   | 50.05         |
| Total: |           |                | 450.988   | 1061.06  | 100.00        |

**Asymmetric.**

| No. | Peak Name | Retention Time | Area      | Height   | Relative Area |
|-----|-----------|----------------|-----------|----------|---------------|
|     |           | min            | mAU*min   | mAU      | %             |
| 1   |           | 14.553         | 640.989   | 1953.881 | 89.95         |
| 2   |           | 26.710         | 71.593    | 114.481  | 10.05         |
| Total: |           |                | 712.582   | 2068.363 | 100.00        |
Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, λ = 341 nm) \( \tau_R \) (minor) = 11.5 min, \( \tau_R \) (major) = 12.9 min.

### Racemic

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 11.510         | 69.672 | 269.374 | 49.95         |
| 2   |           | 12.887         | 69.824 | 243.978 | 50.05         |
| Total: |           |                | **139.496** | **513.353** | **100.00** |

### Asymmetric

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 11.567         | 1.060 | 4.097  | 1.40          |
| 2   |           | 12.947         | 74.538 | 256.883 | 98.60         |
| Total: |           |                | **75.598** | **260.980** | **100.00** |
**Chiral HPLC**: (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min⁻¹, λ = 295 nm) \( \tau_R \) (major) = 7.8 min, \( \tau_R \) (minor) = 12.2 min.

### Racemic

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|---------------|--------|--------|---------------|
| 1   |           | 7.833         | 58.952 | 80.479 | 49.98         |
| 2   |           | 12.213        | 59.000 | 77.484 | 50.02         |
| Total: | |               | 117.952 | 157.963 | 100.00       |

### Asymmetric

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|---------------|--------|--------|---------------|
| 1   |           | 7.653         | 134.553| 191.393| 89.83         |
| 2   |           | 11.980        | 15.241 | 19.212 | 10.17         |
| Total: | |               | 149.794 | 210.605 | 100.00       |
Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min$^{-1}$, $\lambda = 295$ nm) $\tau_R$ (major) = 13.7 min, $\tau_R$ (minor) = 11.6 min.

Racemic.

Asymmetric
Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 98% hexane, 1.0 mL min⁻¹, $\lambda = 295$ nm) $\tau_R$ (major) = 8.7 min, $\tau_R$ (minor) = 7.5 min.

**Racemic**

| No. | Peak Name | Retention Time | Area     | Height  | Relative Area |
|-----|-----------|----------------|----------|---------|---------------|
|     |           | min mAU*min    | mAU      | %       |
| 1   |           | 7.517 180.898  | 855.996  | 49.84   |
| 2   |           | 8.697 182.024  | 871.941  | 50.16   |
| Total|           |                | 362.922  | 1727.937| 100.00        |

**Asymmetric**

| No. | Peak Name | Retention Time | Area     | Height  | Relative Area |
|-----|-----------|----------------|----------|---------|---------------|
|     |           | min mAU*min    | mAU      | %       |
| 1   |           | 7.580 45.946   | 274.209  | 14.70   |
| 2   |           | 8.687 266.507  | 1289.281 | 85.30   |
| Total|           |                | 312.453  | 1563.489| 100.00        |
Chiral HPLC: (Chiralpak ADH, 15% PrOH, 85% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 17.9 min, \(\tau_R\) (minor) = 13.5 min

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 13.350         | 100.173 | 327.807 | 50.05        |
| 2   |           | 17.770         | 99.983  | 245.506 | 49.95        |
| Total: |           |                | 200.156 | 573.312 | 100.00       |

Asymmetric

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 13.520         | 0.259  | 0.859  | 1.10          |
| 2   |           | 17.987         | 23.386 | 57.120 | 98.90         |
| Total: |           |                | 23.645 | 57.979 | 100.00        |
**Chiral HPLC:** (Chiralpak ODH, 5% *i*PrOH, 95% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 8.8 min, $\tau_R$ (minor) = 9.9 min

![Chiral HPLC Chromatogram](image)

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|----------------|--------|--------|---------------|
| 1   |           | 8.917          | 77.872 | 275.748| 49.98         |
| 2   |           | 9.883          | 77.938 | 245.714| 50.02         |
| Total: |        |                | 155.810| 521.461| 100.00        |

**Asymmetric**

![Asymmetric HPLC Chromatogram](image)

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|----------------|--------|--------|---------------|
| 1   |           | 8.830          | 54.413 | 192.706| 88.54         |
| 2   |           | 9.883          | 7.043  | 21.473 | 11.46         |
| Total: |        |                | 61.456 | 214.179| 100.00        |
**Chiral HPLC:** (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (minor) = 12.8 min, \(\tau_R\) (major) = 15.6 min.

### Racemic

![Racemic Peaks](image)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|---------------|------|--------|---------------|
|     |           | min           | mAU*min | mAU | % |
| 1   |           | 13.580        | 21.684 | 80.363 | 49.92 |
| 2   |           | 16.413        | 21.752 | 65.098 | 50.08 |
| Total|           | 43.436        | 145.461 | 100.00 |

### Asymmetric

![Asymmetric Peaks](image)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|---------------|------|--------|---------------|
|     |           | min           | mAU*min | mAU | % |
| 1   |           | 12.813        | 0.089 | 0.340 | 0.68 |
| 2   |           | 15.597        | 13.044 | 38.365 | 99.32 |
| Total|           | 13.133        | 38.705 | 100.00 |

S204
Chiral HPLC: (Chiralpak OJH, 3% EtOH, 97% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 300\) nm) \(t_R\) (minor) = 9.4 min, \(t_R\) (major) = 15.1 min.

| No. | Peak Name | Retention Time | Area       | Height   | Relative Area |
|-----|-----------|----------------|------------|----------|---------------|
|     |           | min            | mAU*min    | mAU      | %             |
| 1   |           | 9.418          | 174.663    | 41.530   | 50.48         |
| 2   |           | 15.053         | 171.314    | 20.380   | 49.52         |
| Total: |           |                | 345.977    | 61.910   | 100.00        |

Asymmetric

| No. | Peak Name | Retention Time | Area       | Height   | Relative Area |
|-----|-----------|----------------|------------|----------|---------------|
|     |           | min            | mAU*min    | mAU      | %             |
| 1   |           | 9.425          | 21.003     | 5.046    | 13.94         |
| 2   |           | 15.047         | 129.697    | 15.351   | 86.06         |
| Total: |           |                | 150.700    | 20397    | 100.00        |
**Chiral HPLC:** (Chiralpak AD, 10% PrOH, 90% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 272\) nm) \(\tau_R\) (major) = 11.6 min, \(\tau_R\) (minor) = 14.1 min.

**Racemic.**

![Racemic Chromatogram](image)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU* min | mAU | %           |
| 1   |           | 12.687         | 463.864 | 1485.694 | 49.45        |
| 2   |           | 16.840         | 474.176 | 1133.273 | 50.55        |
| **Total:** | | **938.040** | **2618.967** | **100.00** |  |

**Asymmetric.**

![Asymmetric Chromatogram](image)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU* min | mAU | %           |
| 1   |           | 12.750         | 5.253 | 16.970 | 3.45        |
| 2   |           | 16.893         | 146.800 | 345.780 | 96.55        |
| **Total:** | | **152.053** | **362.750** | **100.00** |  |
**Chiral HPLC:** (Chiralpak ADH, 2% iPrOH, 98% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 259\) nm) \(\tau_R\) (major) = 20.5 min, \(\tau_R\) (minor) = 23.5 min.

### Racemic

| No. | Peak Name | Retention Time | Area     | Height   | Relative Area |
|-----|-----------|----------------|----------|----------|---------------|
| 1   |           | 20.460         | 137.453  | 274.675  | 49.94         |
| 2   |           | 23.523         | 137.773  | 238.214  | 50.06         |
| **Total:** |           | **275.226**    | **512.889** |          | **100.00**    |

### Asymmetric

| No. | Peak Name | Retention Time | Area     | Height   | Relative Area |
|-----|-----------|----------------|----------|----------|---------------|
| 1   |           | 20.763         | 1770.358 | 2998.801 | 89.81         |
| 2   |           | 23.983         | 200.781  | 324.122  | 10.19         |
| **Total:** |           | **1971.139**   | **3322.924** |          | **100.00**    |
Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min\(^{-1}\)) \(\tau_R\) (major) = 11.6 min, \(\tau_R\) (minor) = 14.1 min.

### Racemic

| No. | Peak Name | Retention Time | Area  | Height  | Relative Area |
|-----|-----------|----------------|-------|---------|---------------|
|     |           | min            | mAU*min | mAU    | %            |
| 1   |           | 11.593         | 307.179 | 1170.227 | 50.05        |
| 2   |           | 14.143         | 306.510 | 940.471 | 49.95        |
| **Total:** | | **613.689** | **2110.699** | **100.00** | |

### Asymmetric

| No. | Peak Name | Retention Time | Area  | Height  | Relative Area |
|-----|-----------|----------------|-------|---------|---------------|
|     |           | min            | mAU*min | mAU    | %            |
| 1   |           | 11.570         | 1.329  | 5.385   | 0.98          |
| 2   |           | 14.103         | 133.970 | 420.660 | 99.02        |
| **Total:** | | **135.299** | **426.045** | **100.00** | |
Chiral HPLC: (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 294\) nm) \(\tau_R\) (major) = 7.0 min, \(\tau_R\) (minor) = 9.3 min.

Racemic.

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 7.020          | 14.521 | 19.701 | 50.00         |
| 2   |           | 9.257          | 14.523 | 21.939 | 50.00         |
| Total: | |                | 29.044 | 41.64  | 100.00        |

Asymmetric

| No. | Peak Name | Retention Time | Area    | Height    | Relative Area |
|-----|-----------|----------------|---------|-----------|---------------|
|     |           | min            | mAU*min | mAU       | %             |
| 1   |           | 6.770          | 349.536 | 530.540   | 88.16         |
| 2   |           | 8.967          | 46.933  | 76.590    | 11.84         |
| Total: | |                | 396.469 | 607.130  | 100.00        |
**Chiral HPLC:** (Chiralpak ADH, 15% PrOH, 85% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 27.0 min, $\tau_R$ (minor) = 13.9 min

### Racemic

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|----------------|--------|--------|---------------|
| 1   |           | 13.647         | 46.109 | 144.635| 50.08         |
| 2   |           | 26.683         | 45.955 | 72.062 | 49.92         |
| Total: |          |                | 92.064 | 216.697| 100.00        |

### Asymmetric

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|----------------|--------|--------|---------------|
| 1   |           | 13.867         | 0.168  | 0.526  | 0.60          |
| 2   |           | 27.040         | 28.042 | 44.326 | 99.40         |
| Total: |          |                | 28.210 | 44.852 | 100.00        |
**Chiral HPLC:** (Chiralpak IC, 1% iPrOH, 99% hexane, 1.00 mL min$^{-1}$, $\lambda$ = 290 nm) $\tau_R$ (major) = 15.3 min, $\tau_R$ (minor) = 30.6 min

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
| 1   |           | 14.727         | 11.743 | 16.950 | 49.94%        |
| 2   |           | 29.643         | 11.773 | 9.536  | 50.06%        |
| Total: |              |                 | 23.516 | 26.485 | 100.00%       |

**Asymmetric**

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
| 1   |           | 15.267         | 20.306 | 28.706 | 88.19%        |
| 2   |           | 30.593         | 2.719  | 2.214  | 11.81%        |
| Total: |              |                 | 23.025 | 30.920 | 100.00%       |
Chiral HPLC: (Chiralpak ADH, 15% PrOH, 85% hexane, 1.0 mL min^{-1}, \lambda = 272 nm) \tau_R (minor) = 20.4 \text{ min}, \tau_R (major) = 30.4 \text{ min}.

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|----------------|--------|--------|---------------|
|     |           | min            | mAU*min| mAU    | %             |
| 1   |           | 20.360         | 39.036 | 74.401 | 49.78         |
| 2   |           | 30.357         | 39.382 | 48.037 | 50.22         |
| **Total:** |         | **78.419**    | **122.439** |        | **100.00**   |

Asymmetric

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 20.803         | 1.270  | 2.451   | 1.49          |
| 2   |           | 30.903         | 83.750 | 101.373 | 98.51         |
| **Total:** |       | **85.020**    | **103.825** |     | **100.00**   |
Chiral HPLC: (Chiralpak IC, 3% /PrOH, 97% hexane, 1.0 mL min$^{-1}$, $\lambda = 289$ nm) $\tau_R$ (major) = 23.3 min, $\tau_R$ (minor) = 30.4 min.

Racemic.

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU | %      |
| 1   |           | 23.290         | 59.430 | 70.863 | 49.99 |
| 2   |           | 30.447         | 59.446 | 81.033 | 50.01 |
| Total: | | | 118.875 | 151.896 | 100.00 |

Asymmetric

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU | %      |
| 1   |           | 23.627         | 180.787 | 215.076 | 86.61 |
| 2   |           | 31.157         | 27.957 | 23.444 | 13.39 |
| Total: | | | 208.744 | 238.520 | 100.00 |
Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min⁻¹, λ = 259 nm) τ_R (major) = 21.2 min, τ_R (minor) = 13.2 min.

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|--------------|
|     |           | min | mAU*min | mAU | % |
| 1   |           | 13.203 | 221.030 | 693.723 | 50.08 |
| 2   |           | 21.193 | 220.318 | 423.552 | 49.92 |
| Total: | | | 441.348 | 1117.274 | 100.00 |

Asymmetric

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|--------------|
|     |           | min | mAU*min | mAU | % |
| 1   |           | 13.257 | 26.512 | 83.777 | 1.14 |
| 2   |           | 21.513 | 2290.501 | 3263.822 | 98.86 |
| Total: | | | 2317.013 | 3347.599 | 100.00 |
**Chiral HPLC:** (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 259 \text{ nm}\)) \(\tau_R\) (major) = 10.2 min, \(\tau_R\) (minor) = 19.7 min.

### Racemic

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 10.037         | 8.170  | 18.163 | 50.61         |
| 2   |           | 17.867         | 7.972  | 10.034 | 49.39         |
| **Total:** |       | **16.142**     | **28.197** | **100.00** |

### Asymmetric

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 9.960          | 46.267 | 109.470 | 86.48         |
| 2   |           | 17.740         | 7.234  | 9.382  | 13.52         |
| **Total:** |       | **53.501**     | **118.852** | **100.00** |

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S215
**Chiral HPLC:** (Chiralpak ADH, 1% PrOH, 99% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 281\ nm\)) \(\tau_R\) (major) = 19.1 min, \(\tau_R\) (minor) = 14.3 min.

### Racemic

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU    | %             |
| 1   |           | 14.227         | 35.322 | 105.259| 49.95         |
| 2   |           | 18.883         | 35.392 | 80.883 | 50.05         |
| **Total:** | | **70.714** | **186.142** | **100.00** | |

### Asymmetric

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU    | %             |
| 1   |           | 14.337         | 1.109  | 3.591  | 0.64          |
| 2   |           | 19.107         | 172.680| 390.569| 99.36         |
| **Total:** | | **173.788** | **394.161** | **100.00** | |
Chiral HPLC: (Chiralpak IC, 1% \text{PrOH}, 99% hexane, 1.0 \text{ mL min}^{-1}, \lambda = 340 \text{ nm}) \tau_R \text{ (major)} = 6.3 \text{ min}, \tau_R \text{ (minor)} = 9.8 \text{ min.}

![Graph of Racemic Peaks](image1)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min | mAU*min | mAU | % |
| 1   |           | 6.217 | 38.203 | 70.265 | 50.31 |
| 2   |           | 9.750 | 37.736 | 62.005 | 49.69 |
| Total: |           |         | 75.939 | 132.270 | 100.00 |

![Graph of Asymmetric Peaks](image2)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min | mAU*min | mAU | % |
| 1   |           | 6.300 | 174.680 | 305.925 | 87.25 |
| 2   |           | 9.820 | 25.517 | 38.856 | 12.75 |
| Total: |           |         | 200.197 | 344.781 | 100.00 |
**Chiral HPLC:** (Chiralpak ADH, 10% PrOH, 90% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 295 nm,) $\tau_R$ (major) = 20.0 min, $\tau_R$ (minor) = 12.8 min.

![Graph showing chromatogram](image)

### Racemic

| No. | Peak Name | Retention Time | Area  | Height  | Relative Area |
|-----|-----------|----------------|-------|---------|---------------|
|     |           | min            | mAU*min | mAU     | %             |
| 1   |           | 11.627         | 109.329 | 416.648 | 50.36         |
| 2   |           | 18.430         | 107.746 | 259.463 | 49.64         |
| **Total:** | | **217.075** | **676.111** | **100.00** | |

### Asymmetric

![Graph showing chromatogram](image)

| No. | Peak Name | Retention Time | Area  | Height  | Relative Area |
|-----|-----------|----------------|-------|---------|---------------|
|     |           | min            | mAU*min | mAU     | %             |
| 1   |           | 12.787         | 0.969  | 3.979   | 0.31          |
| 2   |           | 19.960         | 312.986| 734.010 | 99.69         |
| **Total:** | | **313.954** | **737.988** | **100.00** | |
Chiral HPLC: (Chiralpak ADH, 4% iPrOH, 96% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 295\) nm) \(\tau_R\) (major) = 14.2 min, \(\tau_R\) (minor) = 10.4 min.

Racemic.

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|--------------|
|     |           | min            | mAU*min | mAU   | %            |
| 1   |           | 10.327         | 52.602 | 227.997 | 49.13        |
| 2   |           | 14.137         | 54.463 | 175.937 | 50.87        |
| **Total:** | | **107.064** | **403.934** | **100.00** |

Asymmetric.

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|--------------|
|     |           | min            | mAU*min | mAU   | %            |
| 1   |           | 10.420         | 26.627 | 115.948 | 10.89        |
| 2   |           | 14.247         | 217.768 | 694.190 | 89.11        |
| **Total:** | | **244.394** | **810.138** | **100.00** |

Bn-22
Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min$^{-1}$, $\lambda$ = 293 nm) $\tau_R$ (minor) = 17.2 min, $\tau_R$ (major) = 27.9 min.

**Racemic**

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|--------------|
|     |           | min            | mAU*min | mAU    | %            |
| 1   |           | 17.217         | 9.284 | 23.810 | 50.12        |
| 2   |           | 27.907         | 9.238 | 14.499 | 49.88        |
| **Total:** | | **18.522** | **38.309** | **100.00** |  |

**Asymmetric**

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|--------------|
|     |           | min            | mAU*min | mAU    | %            |
| 1   |           | 17.213         | 0.221 | 0.540  | 0.40         |
| 2   |           | 27.943         | 54.686 | 85.922 | 99.60        |
| **Total:** | | **54.907** | **86.462** | **100.00** |  |
Chiral HPLC: (Chiralpak IC, 2% iPrOH, 98% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 295\) nm) \(\tau_R\) (major) = 10.7 min, \(\tau_R\) (minor) = 17.3 min.

### Racemic

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | %       |
| 1   |           | 10.713         | 97.421 | 200.969 | 50.06 |
| 2   |           | 17.307         | 97.204 | 130.684 | 49.94 |
| **Total:** | | **194.624** | **331.653** | **100.00** |
Chiral HPLC: (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 295\) nm) \(t_R\) (major) = 22.2 min, \(t_R\) (minor) = 12.3 min.

### Racemic

| No. | Peak Name | Retention Time | Area    | Height  | Relative Area |
|-----|-----------|----------------|---------|---------|---------------|
|     |           | min            | mAU*min | mAU     |               |
| 1   |           | 12.323         | 10.030  | 36.653  | 49.67         |
| 2   |           | 22.197         | 10.164  | 20.045  | 50.33         |
| Total |          |                | 20.194  | 56.698  | 100.00        |

### Asymmetric

| No. | Peak Name | Retention Time | Area    | Height  | Relative Area |
|-----|-----------|----------------|---------|---------|---------------|
|     |           | min            | mAU*min | mAU     |               |
| 1   |           | 12.317         | 0.246   | 0.906   | 1.79          |
| 2   |           | 22.197         | 13.555  | 26.513  | 98.21         |
| Total |          |                | 13.801  | 27.419  | 100.00        |
Chiral HPLC: (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 295\, \text{nm}\)) \(\tau_R\) (major) = 5.6 min, \(\tau_R\) (minor) = 8.5 min.

### Racemic

![Graph](image1.png)

| No. | Peak Name | Retention Time | Area     | Height   | Relative Area |
|-----|-----------|----------------|----------|----------|---------------|
|     |           | min            | mAU*min  | mAU      | %             |
| 1   |           | 5.580          | 15.222   | 29.196   | 50.38         |
| 2   |           | 8.503          | 14.992   | 20.360   | 49.62         |
| Total: |           |                | **30.214** | **49.556** | **100.00**     |

### Asymmetric

![Graph](image2.png)

| No. | Peak Name | Retention Time | Area     | Height   | Relative Area |
|-----|-----------|----------------|----------|----------|---------------|
|     |           | min            | mAU*min  | mAU      | %             |
| 1   |           | 6.117          | 278.615  | 444.988  | 88.87         |
| 2   |           | 9.137          | 34.893   | 55.055   | 11.13         |
| Total: |           |                | **313.508** | **500.043** | **100.00**     |
**Chiral HPLC:** (Chiralpak ADH, 15% iPrOH, 85% hexane, 1.0 mL min$^{-1}$, $\lambda = 277$ nm) $\tau_R$ (major) = 16.6 min, $\tau_R$ (minor) = 26.3 min.

### Racemic

| No. | Peak Name | Retention Time | Area   | Height   | Relative Area |
|-----|-----------|----------------|--------|----------|---------------|
|     |           | min            | mAU*min | mAU      | %             |
| 1   |           | 16.623         | 757.925 | 1861.162 | 49.58         |
| 2   |           | 26.260         | 770.901 | 1205.848 | 50.42         |
| **Total:** |       |                | 1528.826 | 3067.010 | 100.00       |

### Asymmetric

| No. | Peak Name | Retention Time | Area   | Height   | Relative Area |
|-----|-----------|----------------|--------|----------|---------------|
|     |           | min            | mAU*min | mAU      | %             |
| 1   |           | 16.877         | 5.163  | 12.640   | 0.91          |
| 2   |           | 26.613         | 565.014 | 880.060  | 99.09         |
| **Total:** |       |                | 570.177 | 892.700  | 100.00       |
**Chiral HPLC:** (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min$^{-1}$, $\lambda = 222$ nm) $\tau_R$ (major) = 20.8 min, $\tau_R$ (minor) = 33.0 min.

### Racemic

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | % |
| 1   |           | 20.987         | 24.316 | 27.954 | 50.51 |
| 2   |           | 32.813         | 23.825 | 15.997 | 49.49 |
| **Total:** | | **48.142** | **43.950** | | **100.00** |

### Asymmetric

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | % |
| 1   |           | 20.820         | 204.797 | 244.870 | 86.96 |
| 2   |           | 32.980         | 30.698 | 19.873 | 13.04 |
| **Total:** | | **235.495** | **264.743** | | **100.00** |
**Chiral HPLC:** (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 291\) nm) \(\tau_R\) (major) = 15.6 min, \(\tau_R\) (minor) = 20.7 min.

| No. | Peak Name | Retention Time | Area      | Height   | Relative Area |
|-----|-----------|---------------|-----------|----------|---------------|
| 1   |           | 15.590        | 42.921    | 120.812  | 49.88         |
| 2   |           | 20.717        | 43.132    | 90.228   | 50.12         |
| **Total:** | | **86.053** | **211.039** | **100.00** | 

**Asymmetric**

| No. | Peak Name | Retention Time | Area      | Height   | Relative Area |
|-----|-----------|---------------|-----------|----------|---------------|
| 1   |           | 15.887        | 0.408     | 1.133    | 0.11          |
| 2   |           | 21.203        | 366.901   | 774.809  | 99.89         |
| **Total:** | | **367.309** | **775.942** | **100.00** |
**Chiral HPLC:** (Chiralpak IC, 2\% PrOH, 98\% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 291\) nm) \(\tau_R\) (major) = 15.6 min, \(\tau_R\) (minor) = 24.7.

### Racemic

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | % |
| 1   |           | 5.103          | 52.787 | 240.479 | 50.31 |
| 2   |           | 7.823          | 52.132 | 176.684 | 49.69 |
| **Total:** | | 104.919 | 417.164 | | **100.00** |

### Asymmetric

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | % |
| 1   |           | 5.050          | 283.626 | 1325.859 | 80.55 |
| 2   |           | 7.647          | 68.469 | 234.308 | 19.45 |
| **Total:** | | 352.095 | 1560.167 | | **100.00** |
Chiral HPLC: (Chiralpak ADH, 10 % PrOH, 90 % hexane, 1.0 mL min\(^{-1}\), \(\lambda = 295\) nm) \(\tau_R\) (major) = 26.2 min, \(\tau_R\) (minor) = 18.8 min.

### Racemic

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 18.813         | 130.803| 282.953 | 50.03         |
| 2   |           | 26.203         | 130.657| 193.909 | 49.97         |
| **Total:** |           |                | 261.460| 476.862 | 100.00        |

### Asymmetric

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 19.040         | 7.102  | 15.479  | 4.76          |
| 2   |           | 26.480         | 142.192| 210.317 | 95.24         |
| **Total:** |           |                | 149.294| 225.795 | 100.00        |
**Chiral HPLC:** (Chiralpak ADH, 2% iPrOH, 98% hexane, 1.0 mL min⁻¹, λ = 297 nm) \( \tau_R \) (major) = 24.5 min, \( \tau_R \) (minor) = 14.8 min.

![Racemic HPLC](image)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
| 1   |           | 14.777         | 70.775 | 165.263 | 50.10         |
| 2   |           | 24.943         | 70.501 | 101.085 | 49.90         |
| **Total:** | | **141.276** | **266.348** | **100.00** |

![Asymmetric HPLC](image)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
| 1   |           | 15.260         | 20.614 | 48.811 | 9.38          |
| 2   |           | 25.123         | 199.080 | 246.262 | 90.62         |
| **Total:** | | **219.694** | **295.073** | **100.00** |
**Chiral HPLC:** (Chiralpak ADH, 10% ¹PrOH, 90% hexane, 1.0 mL min⁻¹, λ = 293 nm) \( \tau_R \) (major) = 13.2 min, \( \tau_R \) (minor) = 23.0 min.

### Racemic

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 13.150         | 150.027| 484.912 | 49.93         |
| 2   |           | 23.047         | 150.418| 277.508 | 50.07         |
| Total: |          |                | 300.445| 762.420 | 100.00        |

### Asymmetric

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 13.387         | 2.927  | 9.496   | 1.23          |
| 2   |           | 23.423         | 234.693| 433.790 | 98.77         |
| Total: |          |                | 237.620| 443.285 | 100.00        |
**Chiral HPLC:** (Chiralpak IC, 1% iPrOH, 99% hexane, 1.0 mL min$^{-1}$, $\lambda = 232$ nm) $\tau_R$ (major) = 15.0 min, $\tau_R$ (minor) = 18.0 min.

### Racemic

| No. | Peak Name | Retention Time | Area  | Height    | Relative Area |
|-----|-----------|----------------|-------|-----------|---------------|
|     |           | min            | mAU*min | mAU       | %             |
| 1   |           | 15.03          | 564.591 | 1049.961  | 49.96         |
| 2   |           | 18.00          | 565.473 | 966.211   | 50.04         |
| Total: |   |                | **1130.065** | **2016.171** | **100.00**   |

### Asymmetric

| No. | Peak Name | Retention Time | Area  | Height    | Relative Area |
|-----|-----------|----------------|-------|-----------|---------------|
|     |           | min            | mAU*min | mAU       | %             |
| 1   |           | 15.023         | 319.318 | 596.470   | 86.01         |
| 2   |           | 18.097         | 51.944    | 89.643   | 13.99         |
| Total: |   |                | **371.262** | **686.113** | **100.00**   |
**Chiral HPLC:** (Chiralpak ADH, 15% iPrOH, 85% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 231\) nm) \(\tau_R\) (minor) = 8.7 min, \(\tau_R\) (major) = 12.7 min.

| No. | Peak Name | Retention Time | Area  | Height  | Relative Area |
|-----|-----------|----------------|-------|---------|---------------|
|     |           | min            | mAU*min | mAU     | %             |
| 1   |           | 8.690          | 205.251 | 986.114 | 49.98         |
| 2   |           | 12.710         | 205.385 | 687.335 | 50.02         |
| Total: | | | 410.636 | 1673.448 | 100.00       |

**Asymmetric**

| No. | Peak Name | Retention Time | Area  | Height  | Relative Area |
|-----|-----------|----------------|-------|---------|---------------|
|     |           | min            | mAU*min | mAU     | %             |
| 1   |           | 8.843          | 4.719  | 23.320  | 0.85          |
| 2   |           | 13.050         | 548.083 | 1783.682 | 99.15         |
| Total: | | | 552.802 | 1807.002 | 100.00       |
Chiral HPLC: (Chiralpak IC, 3% /PrOH, 97% hexane, 1.0 mL min⁻¹, λ = 292 nm) \( \tau_R \) (major) = 6.1 min, \( \tau_R \) (minor) = 8.2 min.

### Racemic

| No. | Peak Name | Retention Time | Area    | Height   | Relative Area |
|-----|-----------|----------------|---------|----------|---------------|
|     |           | min            | mAU*min | mAU      | %             |
| 1   |           | 6.097          | 144.632 | 629.007  | 49.99         |
| 2   |           | 8.197          | 144.708 | 497.911  | 50.01         |
| Total: |          |                | 289.339 | 1126.917 | 100.00        |

### Asymmetric

| No. | Peak Name | Retention Time | Area    | Height   | Relative Area |
|-----|-----------|----------------|---------|----------|---------------|
|     |           | min            | mAU*min | mAU      | %             |
| 1   |           | 6.103          | 312.866 | 1564.775 | 85.03         |
| 2   |           | 8.200          | 55.087  | 217.401  | 14.97         |
| Total: |          |                | 367.953 | 1782.176 | 100.00        |
**Chiral HPLC:** (Chiralpak ADH, 5% iPrOH, 95% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 26.7 min, \(\tau_R\) (minor) = 21.7 min

![Chiral HPLC Chromatogram](image)

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 21.583         | 85.348 | 167.794| 49.86         |
| 2   |           | 26.463         | 85.823 | 134.988| 50.14         |
| **Total:** | | **171.172** | **302.782** | **100.00** |

### Asymmetric

![Asymmetric HPLC Chromatogram](image)

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU  | %             |
| 1   |           | 21.733         | 1.167 | 1.883  | 6.18          |
| 2   |           | 26.683         | 17.708 | 23.878| 93.82         |
| **Total:** | | **18.875** | **25.760** | **100.00** |
Chiral HPLC: (Chiralpak ADH, 5% iPrOH, 95% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm, 15 \(\mu\)L injection) \(\tau_R\) (major) = 7.6 min, \(\tau_R\) (minor) = 6.6 min

**Racemic**

![Graph of Racemic peaks](image)

| No. | Peak Name | Retention Time | Area    | Height  | Relative Area |
|-----|-----------|----------------|---------|---------|---------------|
|     |           | min            | mAU*min | mAU     | %             |
| 1   |           | 6.577          | 5.250   | 28.193  | 49.97         |
| 2   |           | 7.593          | 5.257   | 25.556  | 50.03         |
| **Total:** | | **10.507** | **53.749** | **100.00** |               |

**Asymmetric**

![Graph of Asymmetric peaks](image)

| No. | Peak Name | Retention Time | Area    | Height  | Relative Area |
|-----|-----------|----------------|---------|---------|---------------|
|     |           | min            | mAU*min | mAU     | %             |
| 1   |           | 6.603          | 1.632   | 8.073   | 8.08          |
| 2   |           | 7.633          | 18.574  | 81.266  | 91.92         |
| **Total:** | | **20.206** | **89.339** | **100.00** |               |
Chiral HPLC: (Chiralpak ADH, 5% iPrOH, 95% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 47.8 min, \(\tau_R\) (minor) = 40.7 min

Racemic

| No. | Peak Name | Retention Time | Area     | Height  | Relative Area |
|-----|-----------|----------------|----------|---------|---------------|
|     |           | min            | mAU*min  | mAU     | %             |
| 1   |           | 40.250         | 69.130   | 76.397  | 49.94         |
| 2   |           | 47.233         | 69.285   | 63.653  | 50.06         |
| Total: |        |                | 138.414  | 140.050 | 100.00        |

Asymmetric

| No. | Peak Name | Retention Time | Area   | Height   | Relative Area |
|-----|-----------|----------------|--------|----------|---------------|
|     |           | min            | mAU*min| mAU      | %             |
| 1   |           | 40.710         | 2.527  | 2.827    | 6.07          |
| 2   |           | 47.853         | 39.143 | 35.658   | 93.93         |
| Total: |        |                | 41.670 | 38.485   | 100.00        |
Chiral HPLC: (Chiralpak ADH, 5% iPrOH, 95% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(t_R\) (major) = 27.4 min, \(t_R\) (minor) = 11.6 min

### Racemic

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU  | %            |
| 1   |           | 11.370         | 106.766 | 340.371 | 50.11        |
| 2   |           | 27.163         | 106.286 | 154.589 | 49.89        |
| Total: | | | 213.053 | 494.960 | 100.00 |

### Asymmetric

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU  | %            |
| 1   |           | 11.567         | 16.670  | 50.640 | 10.64        |
| 2   |           | 27.370         | 140.042 | 195.476 | 89.36        |
| Total: | | | 156.712 | 246.116 | 100.00 |
Chiral HPLC: (Chiralpak ADH, 5% iPrOH, 95% hexane, 1.00 mL min⁻¹, λ = 290 nm) \( \tau_r \) (major) = 19.5 min, \( \tau_r \) (minor) = 22.1 min

**Racemic**

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
| 1   |           | 18.823         | 24.144| 51.676 | 48.46         |
| 2   |           | 21.467         | 25.683| 48.561 | 51.54         |
| **Total:** | | **49.827** | **100.237** | **100.00** | |

**Asymmetric**

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
| 1   |           | 19.453         | 21.026| 48.052 | 95.59         |
| 2   |           | 22.103         | 0.970 | 2.003  | 4.41          |
| **Total:** | | **21.996** | **50.055** | **100.00** | |
**Chiral HPLC:** (Chiralpak ADH, 5% iPrOH, 95% hexane, 1.00 mL min⁻¹, λ = 290 nm) \( t_R \) (major) = 8.4 min, \( t_R \) (minor) = 5.5 min

### Racemic

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU    | %             |
| 1   |           | 5.290          | 16.034 | 86.890 | 50.01         |
| 2   |           | 8.197          | 16.025 | 71.741 | 49.99         |
| Total: |          |                | 32.060 | 158.631 | 100.00       |

### Asymmetric

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU    | %             |
| 1   |           | 5.463          | 4.831  | 30.360 | 15.96         |
| 2   |           | 8.427          | 25.435 | 126.259 | 84.04        |
| Total: |          |                | 30.266 | 156.619 | 100.00       |
Chiral HPLC: (Chiralpak ADH, 7.5% iPrOH, 92.5% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 25.4 min, $\tau_R$ (minor) = 20.2 min

Racemic

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|----------------|--------|--------|---------------|
|     |           | min            | mAU*min| mAU    | %             |
| 1   |           | 20.003         | 126.546| 244.803| 49.99         |
| 2   |           | 25.207         | 126.597| 199.952| 50.01         |
| Total|           |                | 253.144| 444.755| 100.00        |

Asymmetric

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|----------------|--------|--------|---------------|
|     |           | min            | mAU*min| mAU    | %             |
| 1   |           | 20.213         | 1.379  | 2.636  | 1.12          |
| 2   |           | 25.390         | 121.390| 186.520| 98.88         |
| Total|           |                | 122.769| 189.156| 100.00        |
**Chiral HPLC:** (Chiralpak ADH, 7.5% iPrOH, 92.5% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 13.3 min, $\tau_R$ (minor) = 10.8 min

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | %  |
| 1   |           | 10.720         | 46.477 | 187.937 | 50.03 |
| 2   |           | 13.170         | 46.425 | 148.219 | 49.97 |
| Total: |     | 92.902         | 336.156 |   | 100.00 |

**Asymmetric**

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | %  |
| 1   |           | 10.823         | 92.028 | 356.972 | 88.64 |
| 2   |           | 13.320         | 11.789 | 36.737 | 11.36 |
| Total: |     | 103.816        | 393.709 |   | 100.00 |
Chiral HPLC: (Chiralpak ADH, 12.5% iPrOH, 87.5% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 25.6 min, $\tau_R$ (minor) = 17.7 min

### Racemic

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 17.137         | 15.226 | 31.639 | 51.50         |
| 2   |           | 24.990         | 14.338 | 21.545 | 48.50         |
| **Total:** |           | **29.565** | **53.183** | **100.00** |     |

### Asymmetric

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 17.670         | 4.308 | 7.605  | 4.95         |
| 2   |           | 25.627         | 82.806 | 121.263 | 95.05        |
| **Total:** |           | **87.114** | **128.868** | **100.00** |     |
Chiral HPLC: (Chiralpak ADH, 12.5% iPrOH, 87.5% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 12.3 min, \(\tau_R\) (minor) = 19.5 min

**Racemic**

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
| 1   |           | 12.040         | 112.038 | 360.412 | 50.04         |
| 2   |           | 18.970         | 111.864 | 196.950  | 49.96         |
| **Total:** | | **223.902** | **557.362** | **100.00** | **100.00** |

**Asymmetric**

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
| 1   |           | 12.343         | 191.597 | 593.832 | 92.78         |
| 2   |           | 19.490         | 14.906  | 25.527  | 7.22          |
| **Total:** | | **206.504** | **619.359** | **100.00** | **100.00** |
Chiral HPLC: (Chiralpak ADH, 12.5% iPrOH, 87.5% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 41.2 min, $\tau_R$ (minor) = 24.3 min

### Racemic

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 24.050         | 160.639| 242.200 | 49.94         |
| 2   |           | 40.840         | 161.038| 143.426 | 50.06         |
| Total: | | 321.677       | 385.626|         | 100.00       |

### Asymmetric

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 24.293         | 0.435  | 0.673   | 0.34          |
| 2   |           | 41.233         | 127.384| 112.925 | 99.66         |
| Total: | | 127.819       | 113.598|         | 100.00       |
Chiral HPLC: (Chiralpak ADH, 12.5% iPrOH, 87.5% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 16.6 min, \(\tau_R\) (minor) = 26.6 min

### Racemic

| No. | Peak Name | Retention Time | Area    | Height  | Relative Area |
|-----|-----------|----------------|---------|---------|---------------|
|     |           | min            | mAU*min | mAU     | %             |
| 1   |           | 16.400         | 24.662  | 58.657  | 49.86         |
| 2   |           | 26.243         | 24.799  | 32.337  | 50.14         |
| Total: |       | 49.460         | 90.994  | 100.00  |               |

### Asymmetric

| No. | Peak Name | Retention Time | Area     | Height   | Relative Area |
|-----|-----------|----------------|----------|----------|---------------|
|     |           | min            | mAU*min  | mAU      | %             |
| 1   |           | 16.597         | 302.471  | 696.897  | 84.77         |
| 2   |           | 26.613         | 54.325   | 65.720   | 15.23         |
| Total: |       | 356.796        | 762.617  | 100.00   |               |
Chiral HPLC: (Chiralpak ADH, 50% PrOH, 50% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 27.8 min, $\tau_R$ (minor) = 17.7 min

**Racemic**

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 17.723         | 205.884 | 292.089 | 49.99         |
| 2   |           | 27.913         | 205.966 | 179.368 | 50.01         |
| Total: |     |               | 411.850 | 471.457 | 100.00        |

**Asymmetric**

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU   | %             |
| 1   |           | 17.673         | 4.365  | 6.183  | 2.86          |
| 2   |           | 27.767         | 148.109 | 129.083 | 97.14         |
| Total: |     |               | 152.475 | 135.266 | 100.00        |

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Chiral HPLC: (Chiralpak ADH, 50% iPrOH, 50% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 37.6 min, \(\tau_R\) (minor) = 42.0 min

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
| 1   |           | 37.747         | 127.339 | 89.946 | 49.97         |
| 2   |           | 42.000         | 127.500 | 75.692 | 50.03         |
| Total: |       | 254.840        |       | 165.639 | 100.00        |

Asymmetric

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
| 1   |           | 37.607         | 47.923 | 33.724 | 90.42         |
| 2   |           | 42.050         | 5.078  | 3.014  | 9.58          |
| Total: |       | 53.001         | 36.738 |       | 100.00        |
Chiral HPLC: (Chiralpak ADH, 12.5% iPrOH, 87.5% hexane, 1.00 mL min⁻¹, λ = 290 nm) τ<sub>R</sub> (major) = 16.6 min, τ<sub>R</sub> (minor) = 12.4 min

### Racemic

![Racemic graph]

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU    | %             |
| 1   |           | 12.217         | 301.003 | 797.855 | 49.97         |
| 2   |           | 16.403         | 301.365 | 607.620 | 50.03         |
| Total|           |                | 602.368 | 1405.475 | 100.00        |

### Asymmetric

![Asymmetric graph]

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU    | %             |
| 1   |           | 12.353         | 0.943  | 2.195  | 0.48          |
| 2   |           | 16.570         | 196.598 | 390.760 | 99.52         |
| Total|           |                | 197.541 | 392.955 | 100.00        |
Chiral HPLC: (Chiralpak IC, 1% iPrOH, 99% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 6.9 min, \(\tau_R\) (minor) = 9.6 min

**Racemic**

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
| 1   |           | 6.550          | 8.010| 14.108 | 50.14         |
| 2   |           | 8.693          | 7.964| 11.173 | 49.86         |
| **Total:** | | **15.974** | **25.281** | | **100.00** |

**Asymmetric**

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
| 1   |           | 6.910          | 90.822| 137.452 | 84.75         |
| 2   |           | 9.620          | 16.346| 18.123 | 15.25         |
| **Total:** | | **107.168** | **155.575** | | **100.00** |
Chiral HPLC: (Chiralpak IC, 2%/PrOH, 98% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 11.8 min, \(\tau_R\) (minor) = 23.1 min

### Racemic

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU     | %             |
| 1   |           | 11.607         | 47.416 | 120.001 | 50.12         |
| 2   |           | 22.180         | 47.196 | 53.912 | 49.88         |
| Total: |           |                | **94.612** | **173.913** | **100.00** |

### Asymmetric

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU     | %             |
| 1   |           | 11.813         | 14.869 | 24.797 | 98.05         |
| 2   |           | 23.127         | 0.296  | 0.315  | 1.95          |
| Total: |           |                | **15.165** | **25.112** | **100.00** |
Chiral HPLC: (Chiralpak IC, 2% iPrOH, 98% hexane, 1.00 mL min⁻¹, λ = 290 nm) \( \tau_R \) (major) = 5.2 min, \( \tau_R \) (minor) = 6.9 min

### Racemic

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
| 1   |            | 5.067          | 46.703 | 195.952 | 50.09         |
| 2   |            | 6.560          | 46.529 | 112.317 | 49.91         |
| Total: |            |                | 93.233 | 308.269 | 100.00        |

### Asymmetric

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
| 1   |            | 5.163          | 41.437 | 199.111 | 87.44         |
| 2   |            | 6.887          | 5.953  | 16.313  | 12.56         |
| Total: |            |                | 47.390 | 215.424 | 100.00        |
**Chiral HPLC:** (Chiralpak ADH, 12.5% iPrOH, 87.5% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 29.1 min, \(\tau_R\) (minor) = 9.7 min

![Chiral HPLC](image)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|--------------|
|     |           | min            | mAU*min | mAU    | %            |
| 1   |           | 9.690          | 92.702 | 405.688| 49.89        |
| 2   |           | 28.983         | 93.066 | 133.845| 50.11        |
| **Total:** | | **185.798** | **539.533** | **100.00** |

### Asymmetric

![Asymmetric HPLC](image)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|--------------|
|     |           | min            | mAU*min | mAU    | %            |
| 1   |           | 9.723          | 3.752 | 17.032 | 6.75         |
| 2   |           | 29.117         | 51.815| 75.284 | 93.25        |
| **Total:** | | **55.567** | **92.315** | **100.00** |
**Chiral HPLC**: (Chiralpak ADH, 12.5% iPrOH, 87.5% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 8.9 min, \(\tau_R\) (minor) = 8.2 min

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU    | %             |
| 1   |           | 7.913          | 6.794 | 36.266 | 48.21         |
| 2   |           | 8.640          | 7.297 | 34.084 | 51.79         |
| **Total:** |           | **14.091** | **70.350** | 100.00 |

**Asymmetric**

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU    | %             |
| 1   |           | 8.180          | 7.654 | 39.810 | 6.75          |
| 2   |           | 8.953          | 105.665 | 484.432 | 93.25        |
| **Total:** |           | **113.319** | **524.242** | 100.00 |

Bn-39
**Chiral HPLC:** (Chiralpak IC, 2% /PrOH, 98% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 8.0 min, \(\tau_R\) (minor) = 14.9 min

| No. | Peak Name | Retention Time | Area     | Height   | Relative Area |
|-----|-----------|----------------|----------|----------|---------------|
|     |           | min            | mAU/min  | mAU      | %             |
| 1   |           | 7.993          | 182.144  | 343.636  | 49.88         |
| 2   |           | 14.893         | 183.044  | 184.034  | 50.12         |
| Total|           |                | **365.188** | **527.670** | 100.00        |

**Asymmetric**

| No. | Peak Name | Retention Time | Area     | Height   | Relative Area |
|-----|-----------|----------------|----------|----------|---------------|
|     |           | min            | mAU/min  | mAU      | %             |
| 1   |           | 7.967          | 77.306   | 192.685  | 94.85         |
| 2   |           | 14.967         | 4.200    | 5.412    | 5.15          |
| Total|           |                | **81.506** | **198.096** | 100.00        |
**Chiral HPLC:** (Chiralpak IC, 2% iPrOH, 99% hexane, 1.00 mL min\(^{-1}\), \(\lambda = 290\) nm) \(\tau_R\) (major) = 5.0 min, \(\tau_R\) (minor) = 6.2 min

![Phenyl ring structure](image1)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | % |
| 1   |           | 5.013          | 7.563 | 29.270 | 50.09         |
| 2   |           | 6.317          | 7.537 | 19.964 | 49.91         |
| **Total:** |               | **15.101** | **49.234** | **100.00** | **100.00** |

![Asymmetric peak](image2)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | % |
| 1   |           | 4.957          | 293.416 | 986.273 | 81.31         |
| 2   |           | 6.203          | 67.455 | 152.329 | 18.69         |
| **Total:** |               | **360.872** | **1138.602** | **100.00** | **100.00** |

![Phenyl ring structure](image3)

**Bn-40**
**Chiral HPLC:** (Chiralpak ADH, 10% iPrOH, 90% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 293\) nm) \(\tau_R\) (major) = 15.3 min, \(\tau_R\) (minor) = 31.2 min.

Racemic

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU | %          |
| 1   |           | 15.300         | 104.995 | 277.734 | 50.00         |
| 2   |           | 31.237         | 105.008 | 131.069 | 50.00         |
| **Total:** | | **210.003** | **408.803** | | **100.00** |

Asymmetric

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU | %          |
| 1   |           | 15.127         | 13.901  | 37.364 | 6.82         |
| 2   |           | 31.023         | 190.039 | 237.212 | 93.18        |
| **Total:** | | **203.940** | **274.577** | | **100.00** |
**Chiral HPLC:** (Chiralpak ADH, 1% iPrOH, 99% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 295\) nm) \(\tau_R\) (major) = 16.2 min, \(\tau_R\) (minor) = 11.1 min.

![Chiral HPLC graph](image)

### Racemic

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU | %            |
| 1   |           | 11.067         | 8.283 | 25.645 | 49.91         |
| 2   |           | 16.220         | 8.313 | 21.432 | 50.09         |
| **Total:** | | **16.596** | **47.077** | | **100.00** |

### Asymmetric

| No. | Peak Name | Retention Time | Area  | Height | Relative Area |
|-----|-----------|----------------|-------|--------|---------------|
|     |           | min            | mAU*min | mAU | %            |
| 1   |           | 11.077         | 7.479 | 23.833 | 11.90         |
| 2   |           | 16.227         | 55.370 | 143.458 | 88.10         |
| **Total:** | | **62.850** | **167.290** | | **100.00** |
Chiral HPLC: (Chiralpak ADH, 20% 1PrOH, 80% hexane, 1.0 mL min$^{-1}$, $\lambda = 300$ nm) $\tau_R$ (major) = 20.8 min, $\tau_R$ (minor) = 36.0 min.

### Racemic

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|----------------|--------|--------|--------------|
|     |           | min            | mAU*min| mAU    | %            |
| 1   |           | 21.383         | 32.337 | 50.408 | 49.95        |
| 2   |           | 36.807         | 32.404 | 25.195 | 50.05        |
| Total: | | | 64.742 | 75.602 | 100.00 |

### Asymmetric

| No. | Peak Name | Retention Time | Area   | Height | Relative Area |
|-----|-----------|----------------|--------|--------|--------------|
|     |           | min            | mAU*min| mAU    | %            |
| 1   |           | 20.847         | 69.276 | 106.129| 98.50        |
| 2   |           | 36.343         | 1.055  | 1.005  | 1.50         |
| Total: | | | 70.331 | 107.134| 100.00   |
Chiral HPLC: (Chiralpak ODH, 2% iPrOH, 98% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 295\) nm) \(\tau_R\) (major) = 10.7 min, \(\tau_R\) (minor) = 9.0 min.

### Racemic

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min \(\text{min}\) | mAU*min | mAU | % |
| 1   |           | 9.027          | 78.521 | 223.291 | 51.04 |
| 2   |           | 10.880         | 75.320 | 132.306 | 48.96 |
| **Total:** | | | **153.841** | **355.597** | **100.00** |

### Asymmetric

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min \(\text{min}\) | mAU*min | mAU | % |
| 1   |           | 9.023          | 41.910 | 117.882 | 19.81 |
| 2   |           | 10.740         | 169.701 | 317.325 | 80.19 |
| **Total:** | | | **211.611** | **435.206** | **100.00** |
Chiral HPLC: (Chiralpak ADH, 10% PrOH, 90% hexane, 1.0 mL min\(^{-1}\), \(\lambda = 293\) nm) \(\tau_R\) (major) = 20.2 min, \(\tau_R\) (minor) = 23.5 min.

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 20.937         | 37.991 | 75.721  | 50.14         |
| 2   |           | 23.287         | 37.785 | 68.805  | 49.86         |
| Total: |          |                | 75.776 | 144.526 | 100.00        |

Asymmetric

| No. | Peak Name | Retention Time | Area   | Height  | Relative Area |
|-----|-----------|----------------|--------|---------|---------------|
|     |           | min            | mAU*min| mAU     | %             |
| 1   |           | 20.157         | 5.697  | 13.510  | 0.94          |
| 2   |           | 22.460         | 601.624| 1158.301| 99.06         |
| Total: |          |                | 607.322| 1171.811| 100.00        |
Chiral HPLC: (Chiralpak ADH, 3% iPrOH, 99% hexane, 1.0 mL min$^{-1}$, $\lambda = 250$ nm) $\tau_R$ (major) = 19.7 min, $\tau_R$ (minor) = 12.0 min.

### Racemic

![Chiral HPLC Racemic](image)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | %          |
| 1   |           | 11.623         | 18.740 | 64.096 | 50.04        |
| 2   |           | 19.937         | 18.707 | 45.935 | 49.96        |
| Total: | | 37.448 | 110.031 | 100.00 |

### Asymmetric

![Chiral HPLC Asymmetric](image)

| No. | Peak Name | Retention Time | Area | Height | Relative Area |
|-----|-----------|----------------|------|--------|---------------|
|     |           | min            | mAU*min | mAU | %          |
| 1   |           | 12.010         | 20.000 | 41.920 | 11.83        |
| 2   |           | 19.693         | 149.017 | 245.426 | 88.17        |
| Total: | | 169.017 | 287.346 | 100.00 |
Chiral HPLC: (Chiralpak ADH, 7.5% iPrOH, 92.5% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 25.4 min, $\tau_R$ (minor) = 20.2 min

**Racemic**

![Graph showing racemic peaks](image)

| No. | Peak Name | Retention Time | Area     | Height    | Relative Area |
|-----|-----------|----------------|----------|-----------|---------------|
|     |           | min            | mAU*min  | mAU       | %             |
| 1   |           | 20.003         | 126.546  | 244.803   | 49.99         |
| 2   |           | 25.207         | 126.597  | 199.952   | 50.01         |
| Total: |         |                | **253.144** | **444.755** | **100.00** |

**Asymmetric**

![Graph showing asymmetric peaks](image)

| No. | Peak Name | Retention Time | Area     | Height    | Relative Area |
|-----|-----------|----------------|----------|-----------|---------------|
|     |           | min            | mAU*min  | mAU       | %             |
| 1   |           | 20.383         | 7.395    | 15.728    | 1.12          |
| 2   |           | 25.670         | 653.285  | 1062.077  | 98.88         |
| Total: |         |                | **660.680** | **1077.805** | **100.00** |
Chiral HPLC: (Chiralpak ADH, 7.5% iPrOH, 92.5% hexane, 1.00 mL min$^{-1}$, $\lambda = 290$ nm) $\tau_R$ (major) = 13.3 min, $\tau_R$ (minor) = 10.8 min

![Chiral HPLC Chart]

| No. | Peak Name | Retention Time | Area     | Height   | Relative Area |
|-----|-----------|----------------|----------|----------|---------------|
|     |           | min            | mAU*min  | mAU      | %             |
| 1   |           | 10.720         | 46.477   | 187.937  | 50.03         |
| 2   |           | 13.170         | 46.425   | 148.219  | 49.97         |
| Total: |         |                | 92.902   | 336.156  | 100.00        |

Asymmetric

![Asymmetric Chart]

| No. | Peak Name | Retention Time | Area     | Height   | Relative Area |
|-----|-----------|----------------|----------|----------|---------------|
|     |           | min            | mAU*min  | mAU      | %             |
| 1   |           | 10.927         | 240.504  | 970.447  | 90.22         |
| 2   |           | 13.450         | 26.069   | 84.658   | 9.78          |
| Total: |         |                | 266.573  | 1055.105 | 100.00        |