A 610-MHz survey of the Lockman Hole with the Giant Metrewave Radio Telescope – I. Observations, data reduction and source catalogue for the central 5 deg²

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ABSTRACT
We present observations of the Lockman Hole taken at 610 MHz with the Giant Metrewave Radio Telescope (GMRT). Twelve pointings were observed, covering a total area of ∼5 deg², with a resolution of 6 × 5 arcsec², position angle +45°. The majority of the pointings have an rms noise of ∼60 µJy beam⁻¹ before correction for the attenuation of the GMRT primary beam. Techniques used for data reduction and production of a mosaicked image of the region are described, and the final mosaic is presented, along with a catalogue of 2845 sources detected above 6σ. Radio source counts are calculated at 610 MHz and combined with existing 1.4-GHz source counts, in order to show that pure luminosity evolution of the local radio luminosity functions for active galactic nuclei and starburst galaxies is sufficient to account for the two source counts simultaneously.

Key words: catalogues – surveys – radio continuum – galaxies

1 INTRODUCTION

The Lockman Hole [Lockman, Jahoda & McCammon 1986] is the region of lowest H I column density in the sky, with the low infrared background (0.38 MJy sr⁻¹ at 100 µm; Lonsdale et al. 2003) making this region particularly well suited for deep infrared observations. The Spitzer Space Telescope [Werner et al. 2004] observed ∼12 deg² of the region in 2004 as part of the Spitzer Wide-area Infrared Extragalactic survey (SWIRE; Lonsdale et al. 2003). Observations were centered on 10°45'00", +58°00'00" (J2000 coordinates, which are used throughout this work) using the Infrared Array Camera (IRAC; Fazio et al. 2004) operating at 3.6, 4.5, 5.8 and 8 µm, and the Multiband Imaging Photometer for Spitzer (MIPS; Reike et al. 2004) at 24, 70 and 160 µm.

A great deal of complementary data has been taken on the Lockman Hole at other wavelengths in order to exploit the availability of sensitive infrared observations. There have been deep optical observations in the U, g', r' and i' bands taken with the Mosaic-I camera at Kitt Peak National Observatory (KPNO), to 5σ Vega magnitude limits of 24.1, 25.1, 24.4 and 23.7 respectively [Surace et al. 2005]. There is existing near-infrared data across the region from the Two Micron All Sky Survey (2MASS; Beichman et al. 2003), to J, H and Ks band magnitudes of 17.8, 16.5 and 16.0, and a band-merged catalogue containing 323 044 sources from the IRAC, MIPS 24 µm, 2MASS and KPNO data has been produced [Surace et al. 2005]. A photometric redshift catalogue containing 229 238 galaxies and quasars within the Lockman Hole has been constructed from the band-merged data [Rowan-Robinson et al. 2008]. Data Release Six of the Sloan Digital Sky Survey (SDSS DR6; Adelman-Mccarthy et al. 2007) covers the whole region in the ugriz bands, with both photometric and spectroscopic observations available to a depth of ∼22 mag. Further deep infrared observations of the Lockman Hole are underway as part of the Deep Extragalactic Survey section of the UK Infrared Deep Sky Survey (UKIDSS; Lawrence et al. 2007) in the J, H and K bands, with a target sensitivity of J ~ 22 mag. There have been deep surveys of the Lockman Hole with the Submillimetre Common-User Bolometer Array (SCUBA; Holland et al. 1999) at 850 µm [Coppin et al. 2006], and with the X-ray satellites ROSAT [Hasinger et al. 1998], XMM-Newton [Haszinger et al. 2001], Chandra [Polletta et al. 2006] and and X-ray telescopes.

A variety of radio surveys cover areas within the Lockman Hole. The first of these was by [de Ruiter et al. 1997], who observed 149 1.4-GHz sources within an area of 0.35 deg², using the Very Large Array (VLA) in C-configuration, with an rms noise level of 30-55 µJy beam⁻¹. A similar deep observation was carried out by [Ciliegi et al. 2003], who observed 63 sources at 4.9 GHz within a 0.087 deg² region, using the VLA in C-configuration, with an rms noise level of 11 µJy beam⁻¹. More recently, [Biggs & Ivison 2006] found 506 sources within a 0.35 deg² area, using the VLA at 1.4 GHz operating in the A- and B-configurations, and with an rms noise level of 4.6 µJy beam⁻¹. The Faint Images of the Radio Sky at Twenty-cm (FIRST; Becker, White & Helfand 1995) and NRAO VLA Sky Survey (NVSS; Condon et al. 1998) surveys both cover the entire region at 1.4 GHz, but only to re-
At least shallow noise levels of 150 and 450 µJy beam\(^{-1}\) respectively.

There is a clear need for deep radio observations over a significant area within the Lockman Hole, in order to extend the multi-wavelength information presently available for a large number of sources. In this paper, we present observations of the Lockman Hole taken at 610 MHz with the Giant Metre-wavelength Radio Telescope (GMRT; Ananthakrishnan 2005), covering \( \sim 5 \) deg\(^2\) of sky with a resolution of \( 6 \times 5 \) arcsec\(^2\), position angle (PA) \( +45^\circ \) and centred on \( 10^h45^m00^s, +58^\circ 00'00'' \) to match the SWIRE coverage. This is the third in a series of 610-MHz GMRT surveys targeting the Spitzer deep legacy survey regions, following the Spitzer extragalactic First Look Survey (xFLS; Garn et al. 2007) and the European Large Area ISO Survey-North 1 (ELAIS-N1) survey (EN1; Garn et al. 2008). This work, in combination with the deep optical and infrared data, will be used to study the infrared / radio correlation for star-forming galaxies (e.g. Helou, Soifer & Rowan-Robinson 1985; Condon 1992; Garrett 2002; Appleton et al. 2004; Murphy et al. 2006; Vlahakis, Eales & Dunne 2007; Ibar et al. 2008; Garn, Ford & Alexander 2008), and the link between star formation and Active Galactic Nuclei (AGN) activity (e.g. Richards et al. 2007; Bundy et al. 2007), as well as the properties of the faint radio source population at 610 MHz (Bondi et al. 2007; Moss et al. 2007; Tasse et al. 2007; Garn et al. 2008).

In Section 2 we describe the observations and data reduction techniques used in the creation of the survey. Section 3 presents the mosaic and a source catalogue containing 2845 sources above 6σ.

Throughout this work a flat cosmology with \( \Omega_m = 0.7 \) and \( H_0 = 70 \) km s\(^{-1}\) Mpc\(^{-1}\) is assumed.
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Figure 3. The rms noise of the final mosaic, calculated using SExtractor (see Section 3). The grey-scale ranges between 60 and 300 µJy beam\(^{-1}\), and the contours are at 100 and 200 µJy beam\(^{-1}\) respectively. The increased noise for pointings 10 and 11 (top right and centre-right) is due to a very bright radio source located at 10\(^{h}30^{m}33^{s}.2\,58^\circ15'02''\).

3 SOURCE CATALOGUE

Source Extractor (SExtractor; Bertin & Arnouts 1996) was used to calculate the rms noise \(\sigma\) across the mosaic. A grid of 16 x 16 pixels was used in order to track changes in the local noise level, which varies significantly near the brightest sources. Fig. 3 illustrates the local noise, with the grey-scale varying between 60 µJy beam\(^{-1}\) (the approximate noise level in the centre of the pointings) and 300 µJy beam\(^{-1}\) (the expected noise level at the distance where the GMRT primary beam gain was 20 per cent of its central value). The 100 and 200 µJy beam\(^{-1}\) contours are plotted on Fig. 3 to guide the eye. Our GMRT data suffer from dynamic range issues near the brightest sources, and the final mosaic has increased noise and residual sidelobes in these regions, as for the XFLS and EN1 surveys. While the local noise calculated by SExtractor increases due to these residuals, some of them still have an apparent signal-to-noise level that is greater than 6\(\sigma\). We therefore opted for a two-stage selection process for our final catalogue.

3.1 Catalogue creation

An initial catalogue of 5223 sources was created using SExtractor. The mosaic was cut off at the point where the primary beam correction dropped to 20 per cent of its central value, but only sources inside the 30 per cent region were included in the catalogue to avoid the mosaic edges from affecting the local noise estimation. The requirements for a source to be included in the initial catalogue were that it had at least 5 connected pixels with brightness greater than 3 times the local noise \(\sigma\), and a peak brightness greater than 6\(\sigma\). The image pixel size meant that the beam was reasonably oversampled, so the source peak was taken to be the value of the brightest pixel within a source. The integrated flux density was calculated using the FLUXAUTO option within SExtractor, which creates an elliptical aperture around each object (as described in Kron 1980), and integrates the flux contained within the ellipse.

 Artefacts are seen near bright sources which may be included in the initial catalogue. We used the technique described...
Figure 4. A 0.2 deg$^2$ region of the 610-MHz mosaic, illustrating the image quality. The grey-scale ranges between $-0.2$ and 1.0 mJy beam$^{-1}$, and the noise is relatively uniform and around 70 $\mu$Jy beam$^{-1}$, apart from small regions near bright sources where the noise increases. The brightest source in the field is GMRTLH J105043.2+575231, with a peak brightness of 50.4 mJy beam$^{-1}$.

In Garn et al. (2008) in order to identify regions that are affected by these artefacts, and within these areas required sources to have a peak brightness greater than $12 \sigma$ in order to be included in the final catalogue. All sources with peaks greater than 10 mJy beam$^{-1}$ were examined for artefacts. The final catalogue contains 2845 sources – we have erred on the side of caution in order to produce a catalogue with little contamination from spurious sources.

Table 1 presents a sample of 10 entries in the catalogue, which is sorted by RA. The full table is available as Supplementary Material to the online version of this article, and via http://www.mrao.cam.ac.uk/surveys/. Column 1 gives the IAU designation of the source, in the form GMRTLH Jhhmmss.s+ddmmss, where J represents J2000.0 coordinates, hhmms.s represents RA in hours, minutes and truncated tenths of seconds, and ddmms represents the Dec. in degrees, arcminutes and truncated arcseconds. Columns 2 and 3 give the RA and Dec. of the source, calculated using first moments of the relevant pixel brightnesses to give a centroid position. Column 4 gives the brightness of the peak pixel in each source, in mJy beam$^{-1}$, and column 5 gives the local rms noise in $\mu$Jy beam$^{-1}$. Columns 6 and 7 give the integrated flux density and error, calculated from the local noise level and source size. Columns 8 and 9 give the $X$, $Y$ pixel coordinates from the mosaic image of the source centroid. Column 10 is the SExtractor deblended object flag – 1: where a nearby bright source may be affecting the calculated flux, 2: where a source has been deblended into two or more components from a single initial island of flux, and 3: when both of the above criteria apply. There are 77 sources present in our catalogue with non-zero deblend flags, and it is necessary to examine the images to distinguish between the case where one extended object has been represented by two or more entries, and where two astronomically distinct objects are present.

Figure 5. Radio spectral index $\alpha$ between 610 MHz and 1.4 GHz, for sources in the FIRST catalogue.

3.2 Comparison with the FIRST survey

In order to test the positional accuracy of our catalogue, we paired it with sources in the FIRST survey (Becker et al. 1995). The whole of our 610-MHz survey region is covered by FIRST, and 340 sources are found with positions within 6 arcsec in the two surveys. The difference in source positions in the GMRT catalogue relative to the VLA FIRST survey is approximately Gaussian, with mean offset of 0.01 arcsec in RA and $-0.1$ arcsec in Dec. The standard deviations of the distribution are 0.3 and 0.5 arcsec respectively. We make no alteration to the coordinates of sources in our survey due to the good agreement in positions.

The spectral index distribution of the matched sources is shown in Fig. 5 using the integrated flux density measurements. The distribution peaks around $\alpha = 0.8$, where $\alpha$ is defined so that the flux density $S$ scales with frequency $\nu$ as $S = S_0 \nu^{-\alpha}$. There are significant biases in this distribution due to the differing sensitivity levels of the two surveys – Fig. 6 shows the variation in spectral
SMG06, SMG10 and SMG11 with 1.4-GHz flux densities of 246, 88 and 538 µJy, respectively, are undetected at 610 MHz. The 610-MHz noise level at the location of the two undetected bright SMGs is approximately 100 µJy beam\(^{-1}\), leading to an upper limit on the spectral index of these sources of α = 1.05.

### 4 DIFFERENTIAL SOURCE COUNTS

We calculated source counts for the Lockman Hole using a method similar to the one used for the ELAIS-N1 field (Garn et al. 2008), by deriving faint and bright source counts from two separate regions of the mosaic. In order to calculate source counts below 10 mJy, we chose a 75 × 75 arcmin\(^2\) region that was relatively free from bright sources above 10 mJy (and consequently from the errors resulting from those sources). For reliability, source counts were constructed from all sources with a signal-to-noise ratio greater than 7, and binned by their integrated flux density, using the same flux density bins as in Garn et al. (2008). The lowest flux bin went down to 556 µJy, corresponding to the approximate noise of 80 µJy beam\(^{-1}\) within the selected region. We calculated the differential source count for sources with flux densities above 10 mJy by considering the central ~3.3 deg\(^2\) of the map, excluding the region near pointing 10 which had significantly greater noise. Within this area, residual sidelobes are seen from several bright sources, but inspection of the residuals found them to have a typical flux density of below 1 mJy, which will not affect the source counts. The differential source counts dN/dS were corrected for the fraction of the image over which they could be detected, taking into account the increase in noise near the bright sources. In order to correct for resolution bias, we applied a correction factor of 3 per cent for source counts below 1 mJy (Moss et al. 2007). No correction for resolution bias was made for brighter sources. Table 2 gives the source counts, mean flux density (⟨S⟩) of sources in each bin, dN/dS and dN/dS normalised by ⟨S⟩, the value expected from a static Euclidean universe, along with Poisson error estimates calculated from the number of sources detected in each flux density bin. The source counts are consistent with our results from the Spitzer extragalactic First Look Survey and ELAIS-N1 fields (Garn et al. 2007; Garn et al. 2008), and in Table 3 we give the source counts found by combining data from the three fields.

Figure 7 shows the normalised differential source counts from our three survey fields, along with 610-MHz source counts from two other GMRT surveys (Moss et al. 2007; Bondi et al. 2007), and a collection of shallow surveys made with the Westerbork Synthesis Radio Telescope (WSRT; Valenti 1979; Valenta 1980; Katgert-Merkelijn et al. 1985). The turnover

### Table 1. A sample of 10 entries from the 610-MHz Lockman Hole catalogue, sorted by ascending RA.

| Name          | RA J2000.0 | Dec. J2000.0 | Peak mJy beam\(^{-1}\) | Local Noise mJy beam\(^{-1}\) | Int. Flux Density mJy | Error µJy | X    | Y    | Flags |
|---------------|------------|-------------|------------------------|-----------------------------|----------------------|-----------|------|------|-------|
| GMRTLH J104237.0+583759 | 10:42:37.04 | +58:37:59.1  | 0.564                  | 82                          | 1.666                | 0.136     | 3994 | 4773 | 0     |
| GMRTLH J104237.1+572634 | 10:42:37.10 | +57:26:34.7  | 0.539                  | 88                          | 0.473                | 0.072     | 4018 | 1917 | 0     |
| GMRTLH J104237.4+574652 | 10:42:37.41 | +57:46:52.1  | 0.445                  | 68                          | 0.412                | 0.056     | 4010 | 2729 | 3     |
| GMRTLH J104238.3+572630 | 10:42:38.36 | +57:26:30.7  | 0.698                  | 88                          | 0.586                | 0.082     | 4012 | 1914 | 0     |
| GMRTLH J104239.2+585011 | 10:42:39.27 | +58:50:11.5  | 0.536                  | 73                          | 0.626                | 0.085     | 3978 | 5261 | 0     |
| GMRTLH J104239.3+572752 | 10:42:39.35 | +57:27:52.1  | 0.545                  | 78                          | 0.643                | 0.081     | 4006 | 1969 | 0     |
| GMRTLH J104240.6+580353 | 10:42:40.62 | +58:03:53.6  | 0.438                  | 71                          | 0.786                | 0.083     | 3987 | 3409 | 0     |
| GMRTLH J104240.6+573836 | 10:42:40.65 | +57:38:36.5  | 0.410                  | 60                          | 0.331                | 0.054     | 3995 | 2398 | 0     |
| GMRTLH J104241.4+580505 | 10:42:41.46 | +58:05:05.9  | 0.648                  | 77                          | 0.710                | 0.082     | 3982 | 3458 | 0     |
| GMRTLH J104241.6+573259 | 10:42:41.63 | +57:32:59.6  | 0.547                  | 78                          | 0.518                | 0.078     | 3992 | 2173 | 0     |
Table 2. 610-MHz differential source counts for the Lockman Hole survey.

| Flux Bin (mJy) | \(\langle S \rangle\) (mJy) | \(N\) | \(N_c\) | \(dN/dS\) (sr\(^{-1}\) Jy\(^{-1}\)) | \(dN/dS \langle S \rangle^{2.5}\) (sr\(^{-1}\) Jy\(^{1.5}\)) |
|----------------|------------------------|------|------|---------------------|---------------------|
| 0.556–7.978    | 0.674                  | 94   | 108.8 | 9.4 ± 1.0 × 10\(^8\) | 11.1 ± 1.2          |
| 0.798–1.145    | 0.951                  | 61   | 61.3  | 3.7 ± 0.5 × 10\(^8\) | 10.4 ± 1.3          |
| 1.145–1.634    | 1.381                  | 31   | 31.0  | 1.3 ± 0.2 × 10\(^7\) | 9.3 ± 1.7           |
| 1.643–2.358    | 1.992                  | 27   | 27.0  | 7.9 ± 1.5 × 10\(^7\) | 14.0 ± 2.7          |
| 2.358–3.384    | 2.909                  | 26   | 26.0  | 5.3 ± 1.0 × 10\(^7\) | 24.3 ± 4.8          |
| 3.384–4.856    | 3.981                  | 14   | 14.0  | 2.0 ± 0.5 × 10\(^7\) | 20.0 ± 5.3          |
| 4.856–6.968    | 5.700                  | 9    | 9.0   | 8.9 ± 3.0 × 10\(^6\) | 21.9 ± 7.3          |
| 6.968–10.00    | 8.429                  | 6    | 6.0   | 4.2 ± 1.7 × 10\(^6\) | 27.1 ± 11.1         |
| 10.00–13.49    | 11.70                  | 14   | 14.0  | 4.0 ± 1.1 × 10\(^6\) | 59.3 ± 15.9         |
| 13.49–18.20    | 15.70                  | 8    | 8.0   | 1.7 ± 0.6 × 10\(^6\) | 52.5 ± 18.6         |
| 18.20–24.56    | 20.71                  | 17   | 17.0  | 2.7 ± 0.7 × 10\(^6\) | 165 ± 40.0          |
| 24.56–33.14    | 27.65                  | 11   | 11.0  | 1.3 ± 0.4 × 10\(^6\) | 163 ± 49.2          |
| 33.14–44.72    | 37.70                  | 7    | 7.0   | 6.0 ± 2.3 × 10\(^5\) | 167 ± 63.1          |
| 44.72–60.34    | 57.47                  | 2    | 2.0   | 1.9 ± 0.9 × 10\(^5\) | 101 ± 7.1           |
| 60.34–81.41    | 74.23                  | 4    | 4.0   | 1.9 ± 1.0 × 10\(^5\) | 285 ± 14.2          |
| 81.41–109.8    | 94.89                  | 4    | 4.0   | 1.4 ± 0.7 × 10\(^5\) | 390 ± 19.5          |
| 109.8–148.2    | 120.5                  | 3    | 3.0   | 7.8 ± 4.5 × 10\(^4\) | 395 ± 22.8          |
| 148.2–200.0    | 160.3                  | 1    | 1.0   | 1.9 ± 1.9 × 10\(^4\) | 199 ± 19.9          |

\[ dN/dS \propto S^{2.5}\frac{dN}{dS} \propto S^{1.5} \int_0^\infty \phi(z) h(z)(1+z)^P dz \]  

(1)

where \(\phi(z)\) has been separated into luminosity evolution \(\phi(z)\) and density evolution \((1+z)^P\) terms, and the change in comoving volume with redshift is given by \(h(z)\) – for more details, see Section 4.3 of Seymour et al. (2004).

The three populations of radio sources consist of a ‘steep’ spectrum AGN population with assumed spectral index of \(\alpha = 0.8\), a ‘flat’ spectrum AGN population with spectral index of 0 and a ‘starburst’ population, also assumed to have spectral index of 0.8. Following Seymour et al. (2004) we consider no density evolution (\(P = 0\)), and use the 1.4-GHz AGN luminosity functions and luminosity evolution from Rowan-Robinson et al. (1993), which is based on earlier work at 2.7 GHz by Dunlop & Peacock (1990). The AGN contribution to the radio source counts is therefore fixed at the same values found by previous authors, and dominates the source counts above a few mJy.

We obtain a local RLF for starburst galaxies from Mauch & Sadler (2007), measured from 4006 local radio sources present in the 6dF Galaxy Survey (Jones et al. 2005) and NVSS surveys, classified as starburst galaxies through their optical spectra. Following Hopkins et al. (1998) the starburst luminosity evolution is parameterised as \((1+z)^{Q}\), where we assume evolution takes place between \(z = 0\) and 2, based on measurements of the change in cosmic star formation rate across this redshift range (Madau et al. 1996; Hopkins & Beacom 2006). The star formation rate is assumed to remain constant for \(z > 2\). An M82-type galaxy at \(z = 2\) would have a flux density below 1 \(\mu\)Jy at 1.4 GHz, and would therefore not contribute to the observed source counts, making this assumption valid.

We construct models for the source counts at 610 MHz and 1.4 GHz, with the 1.4-GHz RLFs converted to 610 MHz through the use of the spectral indices chosen above. Fig. 9 shows the predicted 610-MHz source counts from three models of pure luminosity evolution, with the starburst evolution parameter \(Q\) taking the values 2, 2.5 and 3, in order to compare to previous works. The source count measurements at 1.4 GHz are taken from a wide range of surveys (White et al. 1997; Citri et al. 1998; Grappioni et al. 1999; Prandoni et al. 2001; Bondi et al. 2003; Hopkins et al. 2003; Seymour et al. 2004; Huynh et al. 2005; Biggs & Ivison 2006; Simpson et al. 2008), and are shown in Fig. 8 along with the same three luminosity evolution models.

We find that a value of \(Q\) between 2.5 and 3 agrees well with the data. From 1.4-GHz source counts, Rowan-Robinson et al. (1993) found \(Q = 3.1\), Condon, Cotton & Broderick (2002) found \(Q = 3 \pm 1\), Seymour et al. (2004) found \(Q = 2.5 \pm 0.5\) and Huynh et al. (2005) found \(Q = 2.7\). Using 1.4-GHz information and a range of other star formation indicators, Hopkins (2004) find \(Q = 2.7 \pm 0.6\) and \(P = 0.15 \pm 0.6\). Moss et al. (2007) use their 610-MHz source counts to fit a value of \(Q = 2.45^{+0.23}_{-0.33}\). Our results are therefore consistent with previous findings, and demonstrate that both sets of source counts can be modelled simultaneously with the same radio luminosity functions and evolutionary dependence.

5 CONCLUSIONS

We have observed ~5 deg\(^2\) of the Lockman Hole with the GMRT at 610 MHz. The majority of the observations have a rms noise of ~60 \(\mu\)Jy beam\(^{-1}\) before primary beam correction, with the noise level increasing in the direction of a bright FIRST source outside of our image. A catalogue of 2845 radio source components detected in source counts is clearly visible below ~2 mJy, due to the emergence of a new population of radio sources (see e.g. Simpson et al. 2006).

4.1 Source count models

Radio source counts have been used to understand the evolution of radio sources for many years (e.g. Longair 1969). We model the source counts as being due to three distinct populations of radio sources, following Seymour, McHardy & Gunn (2004). The normalised differential source counts for a population with radio luminosity function (RLF) given by \(\phi_z(L)\) can be calculated using

\[ \langle S \rangle = \frac{1}{A} \int S \phi_z(S) dS \]
We calculate differential source counts at 610 MHz by considering two separate regions of the mosaic. The source counts are calculated between 556 µJy and 200 mJy, and are shown to agree with previous 610-MHz source counts in other regions. We present average source counts calculated from this work and two previous surveys of the Spitzer extragalactic First Look Survey field and ELAIS-N1 field. The turnover in differential source counts is clearly visible below 2 mJy, and we show that a three-component population containing steep spectrum AGN, flat spectrum AGN and starburst galaxies which undergo pure luminosity evolution is sufficient to model the 610-MHz and 1.4-GHz source counts simultaneously.

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Figure 7. Differential source counts at 610 MHz (Valentijn et al. 1977; Katgert 1979; Valentijn 1980; Katgert-Merkelijn et al. 1985; Bondi et al. 2007; Moss et al. 2007; Garn et al. 2007; Garn et al. 2008), normalised by the value expected in a static Euclidean universe. Model source counts calculated with pure luminosity evolution with \( Q = 2 \) (dotted line), 2.5 (dashed line) and 3 (solid line) are shown – see Section 4.1 for more details.

Figure 8. Differential source counts at 1.4 GHz (White et al. 1997; Ciliegi et al. 1999; Gruppioni et al. 1999; Prandoni et al. 2001; Bondi et al. 2003; Hopkins et al. 2003; Seymour et al. 2004; Huynh et al. 2005; Biggs & Ivison 2006; Simpson et al. 2006), normalised by the value expected in a static Euclidean universe. Model source counts calculated with pure luminosity evolution with \( Q = 2 \) (dotted line), 2.5 (dashed line) and 3 (solid line) are shown – see Section 4.1 for more details.
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