Table 1. Cited Journals — ADS and ISI Abbreviations

| Jour Name | Jour Name | Jour Name | Jour Name | Jour Name | Jour Name | Jour Name | Jour Name |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| AcA       | ANN GEOPH | ARA&A     | AJ        | AN        | A&AS      | A&G       |
| A&A       | A&Arv     | AstL      | ARep      | APh       | APJ       | ApJL      |
| ApJS      | ApLC      | Ap&SS     | BAICz     | CeMDA     | EM&P      | ExA       |
| GApFD     | Icar      | INT J MOD D | JApA     | J GEO R-PLA | J GEO R-S P | MNRAS     |
| Natur     | NewA      | NUOV CIM C | Obs      | P&SS      | PASA      | PASJ      | SvAL      |
| PASS      | QJRAS     | RMxAA     | Sei       | SoPh      | SSRv      | SVAL      |

**Space Science (SP)**

| Name | Name | Name | Name | Name | Name | Name | Name |
|------|------|------|------|------|------|------|------|
| AcOUST PHYS | ACOT MATER | ADV PHYSICS | ACSB | ANN CHIM-SC | AnrMS | ApOpt |
| ApPhA | APPhL | CR R SOLID | CURR OP SOL | DIAM RELAT | DIAM FILM T | EUR J MEB C |
| CHEM MATER | COMP MATR S | FizMM | HIGH TEMP | INTERMATT | INT J MOD B | JaJAP |
| FERROELECTR | FERROELEC L | INF PHYS T | INORG MATER | JAP | JEMat | JLTTP |
| ITM | J ALLOY COM | J MATER RES | JMAT S | J MATER S-M E | J OPT | J PHASE EQ |
| JAPL | J PHYSII | J MATH CHEM | J NuM | JACS | J CERAM S J |
| J LUMINESC | JMM | J NON-CRYST | J NONLIN OP | J SYNCHROTR | JAC | J EUR CERAM |
| J MOD OPT | J NON-CRYST | J NO-CNEWT | J Surp | J VISTA | JaLa | J EUR CERAM |
| JPCS | JPHD | JPHC | JPHC | J OptL | J LASER PHYS | J INF REC |
| J EUR CERAM | OSAJ | OSAJ | OSAJ | OptL | LASER PHYS | LOW TEMP PH |
| LOW TEMP PH | MATCH PH | MatL | MSEngR | MSEngB | MET MAT T A | MICROPMOR | MICROSC T |
| MICROPMOR | MICROSC T | MICROSC M | OPTICAL REV | PHYS LOW D | PHYS SOL ST | OPTICAL REV |
| Nanot | OptMa | PHIL MAG A | PHIL MAG B | PHYS A | PHYS A | OPTICAL REV |
| OPTIK | PHASE TRAN | PHYS STST B | PHYS ST ST B | PHYS A | PHYS A | OPTIONS REA |
| PHYS ST S-A | PHYS T SURF S | PHYS CS GLAS | PHYS LG | PHYS LG | PHYS LG | OPTIONS REA |
| PROG CRYSIT | PRS | SCR MATER | SuScT | SUPERLATT M | SURF REV L | TECH PHYS |
| RADIAT MEAS | ROL RHEL | SCI R TOH A | Scr MATER | Vac | Synth METAL | TECH PHYS |
| SSCom | SOL ST ION | SOL ST ION | SOL ST ION | ZMetl | Z PHYS B | TECH PHYS |

**Condensed Matter/Applied Physics (APP)**

| Name | Name | Name | Name | Name | Name | Name | Name |
|------|------|------|------|------|------|------|------|
| OPTICAL PHY | Acu | ApAc | ApOpt | EARTH OBS R | FIOpt | IEE P-OPTO |
| ITUFF | IMAGING S J | LHST | ISPRS J PH | J COMP ACOU | JEI | JIST |
| J INF REC | J LASER APP | JwT | JMO | J OPT | J OPT | J OPT |
| J ACCOUT A | JAES | J ILLUM E S | J OPT SOC A | J OPT SOC B | LASER FOC W | LASER PHYS |
| MIOTL | NCE | OPT APPL | OptQE | OptEn | OPT FIBER T | OPTICAL REV |
| OptLT | OptLE | OptCo | OptL | OPTIK | PgERS | PhoSp |
| PASoP | UltIm | Ultra | WaMot | Z PHYS B | Z PHYS B | Z PHYS B |

**Optical and Acoustics (O/A)**

| Name | Name | Name | Name | Name | Name | Name | Name |
|------|------|------|------|------|------|------|------|
| ACT PHY P & A | ACT PHY P B | ActPSn | AmJPh | ANN PHYSIK | ANN HEP AN | AnPh |
| AnPhys | ANN R NUCL | ATOM DATA N | AuJPh | CaJPh | CHAOS | CHIN J PHYS |
| CHIN PHYS L | CQGra | ComMP | COMM TY PHY | COMP PHYS C | COMPUT PHY | ConPh |
| CoPP | CzJPh | EL | FEW-BODY B | FORTSCHR PH | FoPh | FOUND PH L |
| GReGr | AcHPH | HIGH ENER P | HYHGR RES | Hynt | ITPS | I J PA PHYS |
| INT J MOD P | INT J MOD D | INT J MOD C | INT J MOD C | InvFr | IAN FIZ | JETT LETTER |
| JPHYS I | JPHYS IV | JCoPh | J EX PT PH TH | JFM | JMP | JNET |
| JPHa | JPB | JpG | JrHeo | JSP | J KOR PHYS | J PHYS JP N |
| J PHYS JP N | LETT MATH P | MOD PHY L A | NuCPh | NuPhA | NuPhB | NcimA |
| NCAIM | NCAIN | PART ACCEL | PhysA | PhysD | PhysS | PhysRva |
| PbHVC | PbHVC | PbHVC | PhRvL | PhyEs | PhLA | PhLB |
| PHYS ATOM N | PhI | PHY PART N | PHYS PLASMA | PhysR | PhysT | PHYS WORLD |
| PPCF | PLAS PHYS R | PSST | Prama | PTHPH | PTHPS | PPhPC |
| REP PR PHYS | REV MATH PH | RevMP | REV MEX SIS | RIV NUOV CI | RUS J MAT P | TbCFD |
| THEOR MATH | UsFIN | WaMot | WRM | Z PHYS A | Z PHYS C | Z PHYS D |

**General Physics (PHS)**

| Name | Name | Name | Name | Name | Name | Name | Name |
|------|------|------|------|------|------|------|------|
| ACT PHY P A | ACT PHY P B | AcPsn | AmJPh | ANN PHYSIK | ANN HEP AN | AnPh |
| AnPhys | ANN R NUCL | ATOM DATA N | AuJPh | CaJPh | CHAOS | CHIN J PHYS |
| CHIN PHYS L | CQGra | ComMP | COMM TY PHY | COMP PHYS C | COMPUT PHY | ConPh |
| CoPP | CzJPh | EL | FEW-BODY B | FORTSCHR PH | FoPh | FOUND PH L |
| GReGr | AcHPH | HIGH ENER P | HYHGR RES | Hynt | ITPS | I J PA PHYS |
| INT J MOD P | INT J MOD D | INT J MOD C | INT J MOD C | InvFr | IAN FIZ | JETT LETTER |
| JPHYS I | JPHYS IV | JCoPh | J EX PT PH TH | JFM | JMP | JNET |
| JPHa | JPB | JpG | JrHeo | JSP | J KOR PHYS | J PHYS JP N |
| J PHYS JP N | LETT MATH P | MOD PHY L A | NuCPh | NuPhA | NuPhB | NcimA |
| NCAIM | NCAIN | PART ACCEL | PhysA | PhysD | PhysS | PhysRva |
| PbHVC | PbHVC | PbHVC | PhRvL | PhyEs | PhLA | PhLB |
| PHYS ATOM N | PhI | PHY PART N | PHYS PLASMA | PhysR | PhysT | PHYS WORLD |
| PPCF | PLAS PHYS R | PSST | Prama | PTHPH | PTHPS | PPhPC |
| REP PR PHYS | REV MATH PH | RevMP | REV MEX SIS | RIV NUOV CI | RUS J MAT P | TbCFD |
| THEOR MATH | UsFIN | WaMot | WRM | Z PHYS A | Z PHYS C | Z PHYS D |
Table 3. Top 10 Cited Papers, By Year, 1981–1996

| No. | Abs Rank | # in Yr | Authors | Year | Journal | Vol | Page |
|-----|----------|---------|---------|------|---------|-----|------|
| 627 | 13       | 1       | Pringle, JE | 1981 | ARA&A | 19 | 137  |
| 603 | 16       | 2       | Vernazza, JE, Avrett, EH, & Loeser, R | 1981 | ApJS | 45 | 635  |
| 473 | 30       | 3       | Renzini, A & Voli, M | 1981 | A&A | 94 | 175  |
| 466 | 33       | 4       | Kutner, ML & Ulrich, BL | 1981 | ApJ | 250 | 341  |
| 431 | 42       | 5       | Ostriker, JP & Cowie, LL | 1981 | ApJL | 243 | 127  |
| 398 | 51       | 6       | Larson, RB | 1981 | MNRS | 194 | 809  |
| 395 | 53       | 7       | Baldwin, JA, Phillips, MM, Terlevich, R | 1981 | PASP | 93 | 5    |
| 382 | 55       | 8       | Kwan, J & Krol, JH | 1981 | ApJ | 250 | 478  |
| 372 | 60       | 9       | Fisher, JR & Tully, RB | 1981 | ApJS | 47 | 139  |
| 370 | 62       | 10      | Vanderhucht, KA, Conti, PS, Lundstrom, I, & Stenholm, B | 1981 | SSRv | 28 | 227  |
| 1100 | 1       | 1       | Burstein, D & Heiles, C | 1982 | AJ | 87 | 1165 |
| 634 | 12       | 2       | Elias, JE, Frogel, JA, Matthews, K & Neugebauer, G. | 1982 | AJ | 87 | 1029 |
| 449 | 38       | 3       | Scargle, JD | 1982 | ApJ | 263 | 835  |
| 419 | 46       | 4       | Graham, JA | 1982 | PASP | 94 | 175  |
| 362 | 65       | 5       | Sandage, A | 1982 | ApJ | 252 | 553  |
| 338 | 74       | 6       | Malkan, MA & Sargent, WLW | 1982 | ApJ | 254 | 22   |
| 325 | 79       | 7       | Condon, JJ, Condon, MA, Gisler, G & Puschell, JJ | 1982 | ApJ | 252 | 102  |
| 314 | 85       | 8       | Blandford, RD & Payne, DG | 1982 | MNRS | 199 | 883  |
| 311 | 89       | 9       | Smith, BA, et al. | 1982 | Sci | 215 | 504  |
| 297 | 106      | 10      | Piccinotti, G, et al. | 1982 | ApJ | 253 | 485  |
| 826 | 4        | 1       | Landolt, AU | 1983 | AJ | 88 | 853  |
| 726 | 7        | 2       | Iben, I, Jr & Renzini, A | 1983 | ARA&A | 21 | 271  |
| 696 | 8        | 3       | Davis, M & Peebles, PJE | 1983 | ApJ | 267 | 465  |
| 682 | 9        | 4       | Morrison, R & McCammon, D | 1983 | ApJ | 270 | 119  |
| 474 | 28       | 5       | Bally, J & Lada, CJ | 1983 | ApJ | 265 | 824  |
| 468 | 32       | 6       | Schmidt, M & Green RF | 1983 | ApJ | 269 | 352  |
| 463 | 34       | 7       | Bahcall, NA & Soniera, RM | 1983 | ApJ | 270 | 20   |
| 457 | 37       | 8       | Kennicutt, RC, Jr | 1983 | ApJ | 272 | 54   |
| 445 | 39       | 9       | Huchra, JP, Davis, M, Latham, D, & Touny, J | 1983 | ApJ | 52 | 89   |
| 440 | 40       | 10      | Hildebrand, RH | 1983 | QRAS | 24 | 207  |
| 617 | 14       | 1       | Burstein, D & Heiles, C | 1984 | ApJS | 54 | 33   |
| 576 | 17       | 2       | Yang, J, Turner, MS, Schramm, DN, Steigman, G, & Olive, KA | 1984 | ApJ | 281 | 493  |
| 527 | 21       | 3       | Patterson, J | 1984 | ApJS | 54 | 443  |
| 516 | 22       | 4       | Leger, A & Puget, JL | 1984 | A&A | 137 | 5    |
| 462 | 35       | 5       | Zinn, R & West, MJ | 1984 | ApJS | 55 | 45   |
| 461 | 36       | 6       | Blumenthal, GR, Faber, SM, Primack, JR, Rees, MJ | 1984 | Natur | 311 | 517  |
| 434 | 41       | 7       | Jones, C & Forman, W | 1984 | ApJ | 276 | 38   |
| 408 | 48       | 8       | Bridle, AH, Perley, RA | 1984 | ARA&A | 22 | 319  |
| 405 | 49       | 9       | Rees, MJ | 1984 | ARA&A | 22 | 471  |
| 359 | 68       | 10      | Kaiser, N | 1984 | ApJL | 284 | 9    |
| 980 | 2        | 1       | Draine, BT & Lee, HM | 1985 | ApJ | 285 | 89   |
| 642 | 10       | 2       | Davis, M, Efstatthiou, G, Frenk, CS, & White, SDM | 1985 | ApJ | 292 | 371  |
| 547 | 18       | 3       | Rieke, GH & Lebofsky, MJ | 1985 | ApJ | 288 | 618  |
| 532 | 20       | 4       | Antonucci, RRJ & Miller, JS | 1985 | ApJ | 297 | 621  |
| 495 | 25       | 5       | Zinn, R | 1985 | ApJ | 292 | 424  |
| 474 | 28       | 6       | Lada, CJ | 1985 | ARA&A | 23 | 267  |
| 412 | 47       | 7       | VandenBerg, DA | 1985 | ApJS | 58 | 711  |
| 404 | 50       | 8       | Boesgaard, AM & Steigman, G | 1985 | ARA&A | 23 | 319  |
| 377 | 56       | 9       | VandenBerg, DA & Bell, RA | 1985 | ApJS | 58 | 501  |
| 371 | 61       | 10      | Knapp, GR & Morris, M | 1985 | ApJ | 292 | 640  |
| 769 | 6        | 1       | Bardeen, JM, Bond, JR, Kaiser, N, & Szalay, AS | 1986 | ApJ | 304 | 15   |
| 500 | 24       | 2       | deLapparent, V, Geller, MJ, Huchra, JP | 1986 | ApJL | 302 | 1    |
| 481 | 27       | 3       | Mikheyev, SP & Smirnov, AY | 1986 | NUOV CIM C | 9 | 17   |
| 376 | 57       | 4       | Woosley, SE & Weaver, TA | 1986 | ARA&A | 24 | 265  |
| No. | Cites | Abs # in | Journal | Year | Vol | Page |
|-----|-------|---------|---------|------|-----|------|
| 356 | 70    | 5       | Natur   | 1986 | 324 | 446  |
| 318 | 82    | 6       | ApJ     | 1986 | 303 | 39   |
| 291 | 113   | 7       | ApJS    | 1986 | 61  | 305  |
| 288 | 115   | 8       | ApJ     | 1986 | 304 | 1    |
| 282 | 120   | 9       | ApJ     | 1986 | 302 | 536  |
| 265 | 145   | 10      | PASP    | 1986 | 98  | 609  |
| 636 | 11    | 1       | J GEO R-S P | 1987 | 92 | 4649 |
| 606 | 15    | 2       | ApJ     | 1987 | 326 | 19   |
| 374 | 58    | 3       | ARA&A   | 1987 | 25  | 23   |
| 367 | 63    | 4       | ApJ     | 1987 | 322 | 706  |
| 309 | 92    | 5       | ApJ     | 1987 | 322 | 706  |
| 306 | 94    | 6       | ApJ     | 1987 | 63  | 295  |
| 283 | 119   | 7       | ApJ     | 1987 | 63  | 1    |
| 280 | 124   | 8       | PKSS    | 1987 | 35  | 1347 |
| 275 | 130   | 9       | ApJ     | 1987 | 315 | 621  |
| 274 | 132   | 10      | A&A     | 1987 | 182 | 243  |
| 825 | 5     | 1       | PASP    | 1988 | 99  | 191  |
| 428 | 43    | 2       | ApJ     | 1988 | 96  | 1    |
| 421 | 44    | 3       | ApJ     | 1988 | 326 | 19   |
| 420 | 45    | 4       | ApJ     | 1988 | 325 | 74   |
| 318 | 82    | 5       | A&A     | 1988 | 76  | 411  |
| 294 | 109   | 6       | MNRS    | 1988 | 232 | 431  |
| 271 | 137   | 7       | MNRS    | 1988 | 235 | 827  |
| 267 | 142   | 8       | ApJ     | 1988 | 330 | 350  |
| 260 | 154   | 9       | ApJ     | 1988 | 334 | 771  |
| 230 | 205   | 10      | ApJ     | 1988 | 335 | 57   |
| 485 | 26    | 1       | ApJ     | 1989 | 345 | 245  |
| 361 | 66    | 2       | ApJ     | 1989 | 336 | 606  |
| 352 | 72    | 3       | ApJ     | 1989 | 99  | 924  |
| 337 | 76    | 4       | ApJ     | 1989 | 343 | 726  |
| 314 | 85    | 5       | Sci     | 1989 | 246 | 897  |
| 305 | 95    | 6       | MNRS    | 1989 | 240 | 833  |
| 299 | 102   | 7       | ApJ     | 1989 | 344 | 685  |
| 298 | 103   | 8       | PASJ    | 1989 | 41  | 345  |
| 264 | 149   | 9       | ApJ     | 1989 | 345 | 434  |
| 263 | 151   | 10      | PKSS    | 1989 | 37  | 5    |
| 373 | 59    | 1       | AJ      | 1990 | 99  | 924  |
| 322 | 80    | 2       | Natur   | 1990 | 99  | 924  |
| 303 | 99    | 3       | MNRS    | 1990 | 242 | 43   |
| 293 | 110   | 4       | A&A     | 1990 | 28  | 37   |
| 273 | 135   | 5       | ApJL    | 1990 | 354 | 37   |
| 265 | 145   | 6       | A&A     | 1990 | 28  | 215  |
| 239 | 188   | 7       | Natur   | 1990 | 344 | 132  |
| 238 | 189   | 8       | ApJ     | 1990 | 72  | 567  |
| 217 | 243   | 9       | MNRS    | 1990 | 244 | 408  |
| 215 | 246   | 10      | A&A     | 1990 | 84  | 139  |
| 541 | 19    | 1       | ApJ     | 1991 | 376 | 51   |
| 281 | 122   | 2       | ApJ     | 1991 | 77  | 119  |
| 249 | 175   | 3       | Natur   | 1991 | 349 | 32   |
| 235 | 196   | 4       | ApJ     | 1991 | 76  | 813  |
| 227 | 213   | 5       | A&A     | 1991 | 248 | 485  |
| 227 | 213   | 5       | SoPh    | 1991 | 136 | 37   |
| 212 | 257   | 7       | ApJ     | 1991 | 369 | 79   |
| No. | Abs Cites | Rank | # in Yr | Authors | Year | Journal | Vol | Page |
|-----|-----------|------|---------|---------|------|---------|-----|------|
| 211 | 259       | 8    | 9       | Balbus, SA & Hawley, JF | 1991 | ApJ     | 376 | 214  |
| 179 | 378       | 9    | 9       | Clavel, J, et al. | 1991 | ApJ     | 366 | 64   |
| 173 | 413       | 10   | 6       | George, IM & Fabian, AC | 1991 | MNRAS   | 249 | 352  |
| 297 | 106       | 1    | 1       | Antonucci, R | 1993 | ARA&A   | 31  | 473  |
| 278 | 126       | 2    | 1       | Alcock, C, et al. | 1993 | Natur   | 365 | 621  |
| 275 | 130       | 3    | 1       | Edvardsson, B, et al. | 1993 | A&A     | 275 | 101  |
| 261 | 153       | 4    | 1       | Taylor, JH, Manchester, N, & Lyne, AG | 1993 | ApJS   | 88  | 529  |
| 215 | 246       | 5    | 1       | Bruzual, G & Charlot, S | 1993 | ApJ     | 405 | 538  |
| 190 | 319       | 6    | 1       | White, SDM, Navarro, JF, Evrard, AE, & Frenk, CA | 1993 | Natur   | 366 | 429  |
| 186 | 338       | 7    | 1       | Taylor, JH & Cordes, JM | 1993 | ApJ     | 411 | 674  |
| 172 | 416       | 8    | 1       | Pounds, KA, et al. | 1993 | MNRAS   | 260 | 77   |
| 164 | 469       | 9    | 1       | Klypin, A, Holtzman, J, Primack, J, & Regos, E | 1993 | ApJ     | 416 | 1    |
| 146 | 612       | 10   | 1       | White, SDM, Efstathiou, G, & Frenk, CA | 1993 | MNRAS   | 262 | 1023 |
| 242 | 184       | 1    | 1       | Freedman, WL, et al. | 1994 | Natur   | 371 | 757  |
| 241 | 185       | 2    | 1       | Tanaka, Y, Inoue, H, & Holt, SS | 1994 | PASL   | 46  | 37   |
| 186 | 338       | 3    | 1       | Lyne, AG & Lorimer, DR | 1994 | Natur   | 369 | 127  |
| 166 | 454       | 4    | 1       | Mathar, JC, et al. | 1994 | ApJ     | 420 | 439  |
| 158 | 512       | 5    | 1       | Fichtel, CE, et al. | 1994 | ApJS   | 94  | 551  |
| 153 | 545       | 6    | 1       | D’Antona, F & Mazzitelli, I | 1994 | ApJS   | 90  | 407  |
| 153 | 545       | 6    | 1       | Songaila, A, Cowie, LL, Hogan, CJ, & Rugers, M | 1994 | Natur   | 368 | 599  |
| 152 | 560       | 8    | 1       | Peacock, JA & Dodds, SJ | 1994 | MNRAS   | 267 | 1020 |
| 141 | 660       | 9    | 1       | Nandra, K & Pounds, KA | 1994 | MNRAS   | 268 | 405  |
| 139 | 693       | 10   | 1       | Bennett, CL, et al. | 1994 | ApJ     | 436 | 423  |
| 134 | 745       | 1    | 1       | Von Montigny, C, et al. | 1995 | ApJ     | 440 | 525  |
| 128 | 822       | 2    | 1       | Copi, CJ, Schramm, DN, & Turner, MS | 1995 | Sci     | 267 | 192  |
| 127 | 837       | 3    | 1       | Holtzman, JA, et al. | 1995 | PASL   | 107 | 1065 |
| 127 | 837       | 3    | 1       | Thompson, DJ, et al. | 1995 | ApJS   | 101 | 259  |
| 110 | 1189      | 5    | 1       | Miyoshi, M, et al. | 1995 | Natur   | 373 | 127  |
| 108 | 1239      | 6    | 1       | Leitherer, C & Heckman, TM | 1995 | ApJS   | 96  | 9    |
| 98  | 1484      | 7    | 1       | Mayor, M & Queloz, D | 1995 | Natur   | 378 | 355  |
| 93  | 1638      | 8    | 1       | Lilly, SJ, Tresse, L, Hammer, F, Crampton, D, & Le Fevre, O | 1995 | ApJ     | 455 | 108  |
| 92  | 1668      | 9    | 1       | Woosley, SE & Weaver, TA | 1995 | ApJS   | 101 | 181  |
| 87  | 838       | 10   | 1       | Timmes, FX, Woosley, SE, & Weaver, TA | 1995 | ApJS   | 98  | 617  |
| 80  | 986       | 1    | 1       | Steidel, CC, Giavalisco, M, Pettini, M, Dickinson, M, & Adelberger, KL | 1996 | ApJ     | 462 | 17   |
| 66  | 1068      | 2    | 1       | Tytler, D, Fan, X-M, & Burles, S | 1996 | Natur   | 381 | 207  |
| 47  | 1076      | 3    | 1       | Ellis, RS, Colless, M, Broadhurst, T, Heyl, J & Glazebrook, K | 1996 | MNRAS   | 280 | 235  |
| 47  | 1076      | 3    | 1       | Rogers, M & Hogan, CJ | 1996 | ApJ     | 459 | 1    |
| 45  | 1076      | 5    | 1       | Narayan, R, McClintock, J, & Yi, I | 1996 | ApJ     | 457 | 821  |
| 44  | 1076      | 6    | 1       | Babul, A & Ferguson, HC | 1996 | ApJ     | 458 | 100  |
| 43  | 1076      | 7    | 1       | Marcy, GW & Butler, RP | 1996 | ApJ     | 464 | 147  |
| 42  | 1076      | 8    | 1       | Navarro, JF, Frenk, CS, White, SDM | 1996 | ApJ     | 462 | 563  |
| 42  | 1076      | 8    | 1       | Williams, RE, et al. | 1996 | AJ     | 112 | 1335 |
| 40  | 1076      | 10   | 1       | Alcock, C, et al. | 1996 | ApJ     | 461 | 84   |
| 40  | 1076      | 10   | 1       | Chaboyer, B, DeMarque, P, & Sarajedini, A | 1996 | ApJ     | 459 | 558  |
| 40  | 1076      | 10   | 1       | Hernquist, L, Katz, N, Weinberg, DH, & Miralda-Escude’ | 1996 | ApJ     | 457 | 51   |
Astronomers and the Science Citation Index, 1981–1997

David Burstein

Received ..............................; accepted ..............................

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ABSTRACT

The Institute for Science Information (ISI) has generated two lists of citation information for astronomers that are restricted both as to the years surveyed for the cited papers, and the years surveyed for the citing papers. These databases are unique among the electronically-available citation data in their restrictions of both citing and cited years. The main list (P&A-100) gives citation data for 62,813 physicists and astronomers whose journal papers were cited 100 times or more from 1981.0 to 1997.5 by papers published during the same time interval. The second list (AST-top-papers) gives the 200 most-cited papers/year published in refereed astronomical journals from 1981–1996, as cited in papers in those same journals from 1981.0 to 1998.0. Astronomer names were selected from those given in the P&A-100 list using various sources, including the 1998 AAS Membership Directory, the 2000 list of the Astronomical Society of India, the names from the AST-top-papers list, the list of astronomers honored by the AAS, National Academy of Sciences and the Nobel Prize Committee, and the knowledge of this writer. From this work an Astronomy Citation Database has been constructed, containing citation data for 6458+ astronomers. Various problems, both substantial and subtle, of producing a reasonably fair citation database from either the data supplied by the ISI to this author, or from the Web, are detailed. Chief among these are whether to assign either partial or full credit for each author on a given paper.

Whether one is honored with one of the top lifetime-awards given to astronomers is a strong function of how well your work stands out as your own. In particular, we can negatively impact our citation statistics in two ways. First, because the ISI does not keep track of meeting proceedings/books/catalogs, per se, we do not get citation credit for meeting papers/books/catalogs in the ISI lists. Second, if we fuzz our identities on the papers, such as publishing papers with two or more first initials or through confusion with the names of other astronomers/physicists.

Name confusion affects this kind of analysis to the extent that that it would take an enormous effort to disentangle its effects and, even, then, not all name confusion would be settled. If sociologists, science historians and others (ourselves included?) feel that solving the name confusion problem is worthwhile, perhaps we, as a professional society, should take appropriate steps. A “modest proposal” is made that our professional field (and others) go to a system of uniquely associating an identification number to each author on each paper.
Subject headings: sociology of astronomy; astronomical databases: citations
1. INTRODUCTION

For the past several decades, we in astronomy have relied on the Science Citation Index, as compiled and published by the Institute for Science Information (ISI), as our source for citation statistics of our papers. At the dawn of the 21st Century, we in astronomy are becoming more and more reliant on electronic databases for the papers we read, and for the citation statistics on those papers. The two main internet sites we access for listings of our published papers (as opposed to preprints) are the Astrophysics Data System (ADS) (adsabs.harvard.edu) and the Institute for Science Information’s (ISI) Science Citation Index (www.webofscience.com).

Indeed, the Science Library at our University no longer subscribes to the ISI’s printed Science Citation Index; rather there is now complete reliance on the ISI’s web-accessible Web of Science. Yet, as this author has discovered during the research conducted for this paper, many of us do not clearly understand the constraints and limitations of either the hard-copy Science Citation Index and the new Web of Science.

However, what prompted the research done in this paper was the a new kind of citation analysis produced by the ISI research group over the past few years. At least two new citation lists were generated by the ISI research group before this author contacted them: A list of the chemists cited 500 times or more and a similar list for physicists/astronomers. Each list differs from what we can access either from the Web of Science or from the hard-copy Science Citation Index, in that time intervals for both citing and cited papers are specified.

A French chemist, Dr. Armel Le Bail (Laboratoire des Flouresces, CNRS, ESA) purchased the ISI’s most-cited chemist list (for $1000), and posted it on the Web (pcb4122.univ-lemans.fr/cgi-bin/physiciens.pl). Along with the most-cited chemist list, the ISI sent Dr. Le Bail the first 1120 names of physicists/astronomers on that most-cited list, which Dr. Le Bail scanned into his computer and posted on the web. One of the reasons Dr. Le Bail posted these lists on the web was given by Dr. David Pendlebury of the ISI, who points out that, of the 50 most-cited chemists, 7 have been awarded the Nobel Prize (cf. Garfield & Welljam-Dorof 1992).

The interest of the present author in this subject was piqued when one of his colleagues pointed out that his name was in the most-cited physicists/astronomers list on the web page of Dr. Le Bail. Thus began the journey of this author down the rabbit hole of web-accessible and web-generated paper and citation information. The present paper, with its lessons learned and data gathered, is the net result of that journey.
Aside from the not-inconsiderable curiosity factor (e.g., most of us would like to know where we stand relative to others in the number of times our papers have been cited) and job-related factors (my own promotion to professor was aided by such a list compiled by a colleague for one year of citations for our department), why would one do such a study? This author can think of several questions one would like to answer. First, at the very least, if citation information is to be used in connection with job-related decisions, should not the available data be of highest possible quality? Such data should be treated like any other data, and investigated as to random and systematic errors. Should it not also be clear what assumptions go into the data being used? Given that a relationship exists between being most-cited and winning a Nobel prize among chemists, does the same relationship exist for honors received by astronomers? As a guide to those scientists just entering our field of study, what do these data tell us about how the way we put our names on our papers, and where we publish our papers, influence how we are honored by our peers?

Previous papers which tried to assess citation information for astronomers (Abt 1981a,b, 1982, 1983, 1984a,b, 1985, 1987a,b, 1988a,b 1989, 1990a,b, 1992a,b, 1996, 1998a,b; Abt & Zhou 1996; Trimble 1985, 1986a,b, 1988, 1991, 1993a,b, 1996; White 1992; Girard & Davoust 1997; Davoust & Schmadel 1987, 1992) were limited by time and data access to asking statistical questions that are more restricted than those that now can be addressed electronically. The methodology employed by this paper are detailed in Section 2, where we address, in detail, what one can do, and what cannot do, with the present databases made available to this author by the ISI as well as those databases generally available on the web. The data we have generated from this study are discussed in Section 3. The statistical studies of citations for astronomers are discussed in Section 4, both among themselves and in comparison to the life-time honors bestowed to individuals. The main results of this paper are summarized in Section 5, where a “modest proposal” is made towards solving the ever-pervasive name confusion problem.

2. METHODOLOGY

2.1. The ISI Databases: Definition and Restrictions

The first list of most-cited physicists/astronomers generated by Dr. David Pendlebury and his collaborators and given to Dr. Le Bail, has a cutoff at 500 citations/name. When the “unique-two” issue was discovered (cf. Secs. 2.3, 3.1), this writer requested a new list be generated by the ISI that placed its cutoff at 100 citations/name. This new list, provided by Dr. Pendlebury to this writer, gives 62,813 astronomer and physicist “names” cited in the “usual” refereed journals at least 100 times or more during
the time period January, 1981 (1981.0) through June, 1997 (1997.5), for papers published in the same journals during the same time period (hereafter referred to as the “P&A-100” list). Note that what the ISI provides in its databases is literally a last name and first initial(s), without uniquely identifying that name, per se, with an actual individual.

Separately, Dr. Pendelbury’s group has generated a list of the top 200 papers cited in astronomy each year from 1981-1996 (“High Impact Papers in Astronomy, 1981–1996”; hereafter referred to as the “AST-top-papers” list) from a set of astronomer-used journals (see Table 1), for citations made up to 1998.0. Among the 3,200 papers in this database are 5,035 astronomer ISI “names.” For the purposes of this paper alone, the ISI has given this author access to these two databases, and it is from these datasets that this author has compiled the citation data in this paper for astronomers. In return, this author has communicated to the ISI the various issues one finds when one attempts to do a complete survey of citations for scientists in a relatively well-defined field of study, such as our own.

Abbreviations for the journals used for the ISI P&A-100 list are given in Table 1, divided into four classes (ISI code in parentheses): space science (SP), condensed matter and applied physics (APP), optical and acoustic (O/A) and general physics (PHS). Essentially all of the standard journals in which astronomers publish their papers are in the SP category. The journal abbreviations come from both the Astrophysical Data System (ADS) (generally mixed upper and lower case letters) and from the ISI (an 11-character code, all capital letters). Those SP journals whose abbreviations are given in bold letters in Table 1 are used for the AST-top-papers database. As is evident, the AST-top-papers list employs the “usual” astronomy journals, so the “names” in that database can be all considered as those of astronomers for this analysis. In contrast, the P&A-100 list includes all of the journals in Table 1, and thus includes far more physicists than astronomers (as is evident from the marked contrast in numbers of names in the two lists).

Both the ISI databases have limitations placed upon them in terms of how the ISI does its business in handling certain well-known “sticky” citation analysis issues:

First, no meeting papers or books are used for these compilations, either for the cited papers or the citing papers. Indeed, if you currently use the Web of Science’s “Cited Search” option, you have to specify at least the first author of any article for that search to bear fruit (more discussion on the issues of using this webpage in Secs. 2.4-2.7). The ISI is not alone in making apparently draconian decisions about meeting papers. The ADS also tends to list only a few authors on multi-authored meeting papers, as well as for many journal papers published pre-electronic submission (see Secs. 2.4-2.7). It is apparently difficult for
electronic databases to account for authorship of meeting papers/catalogs/books or multi-authored papers, in their citation statistics for scientists.

Second, while the authorship of a paper that is cited comes from the cited paper itself (minimizing spelling errors of authors’ names), the citation for that paper comes from the citing paper. Human error being as it is, citations in the citing papers can sometimes be in error. This leads to what is, in effect, a random error for the citations that is proportional to the number of citations for a given paper (i.e., more hands in the pot, more likely an error). An estimate of this random error will be made in Sec. 2.6.

Third, only the first 16 authors of a given journal paper are used in the two ISI databases used here. This decision was made by the ISI in the interests of economy, and from the fact that relatively few physics/astronomy papers have many authors. Fortunately, one can use the AST-top-papers list to make corrections to the P&A-100 list to account for this exclusion (Sec. 2.2) so that the resulting error in citation statistics is negligible.

Fourth, the long-standing decision of the ISI is that every author of a paper be given full credit for that paper. Whether or not one agrees with this decision, this is what you get when you access the Web of Science or the ADS for citation purposes. Whether or not this author (or a reader of this paper) agrees with this decision by ISI or not, this is what the ISI does to generate the Web of Science and the data lists used in the present analysis. It is also in keeping with the philosophy they used for the hard-copy Science Citation Index, but could not completely employ in that presentation mode. This important issue is discussed in detail in Sec. 2.4.

Fifth, the lists are not lists of individual astronomers and physicists, but, as stated above, the “names” as given on their papers. These “names” uniformly have a last name and first initial(s) only. In cross-correlating these two datasets with lists of actual astronomers, name confusion is inevitable if all we have for identification are the ISI names. Many people share the same last names and first initial(s).

2.2. A Step-by-Step Name Search Process

The two ISI databases provide citation data for astronomers in a complementary way. Comparison of the names of astronomers in the AST-top-papers list with those in the P&A-100 list shows that not all astronomers who have 100 or more citations are included in the P&A-100 list, owing to the multi-author problem (“sticky” issue 3, above). Comparison of the names of astronomers in the AST-top-papers list to
those in the AAS 1998 Membership Directory finds many astronomers not in the AAS Directory. Hence, by using the P&A-100 list as the primary data source, and the AST-top-papers list as the secondary data source, we can assemble a more complete citation database for astronomers than by using either ISI database alone. The assembly of the citation database for astronomers was done through five time-consuming steps, using all of the information, both written and electronic, available to this author.

Step 1. The names of astronomers in the 1998 AAS Membership Directory were compared with the last names, first initial(s) in the P&A-100 list. Those in common were noted. The AAS Directory was used as this is the only membership directory for astronomers generally available. Subsequent to placing a copy of this paper on the Web, this author did the same comparison for those astronomers in the 2000 directory of the Astronomical Society of India.

Step 2. For each of the found “names,” a web search was made using the ADS to see whether more than one person, physicist or astronomer, could have that “name.” The ADS was used for this search, as it gives, in many cases, first names for individuals. Depending on what was found on the ADS, the listed “name” was either uniquely assigned to an astronomer, or that “name” was marked as confused with other astronomers/physicists. At this point in the process, a preliminary Astronomy Citation Database (ACD) was assembled (∼3700 names).

Step 3. To further help to overcome the obvious AAS-driven, North American bias in the preliminary ACD, the “names” of astronomers in the AST-top-paper list were compared to the names in both the P&A-100 list and in the preliminary ACD. Those AST-top-papers “names” found in the P&A-100 list but not yet in the ACD were added to the ACD via the same Web search process as in Step 2 above (∼2500 names).

Step 4. To overcome the 16 author/paper limit of the ISI databases, a search was made of all papers (105) in the AST-top-papers list that had more than 16 authors. These included papers with as few as 15 citations and as many as 908 citations. The remaining authors on these papers were then found either by looking up the paper on the Web of Science or from the actual hardcopy of the journal. As before, the additional data for astronomers was added into the ACD via the process outlined in Step 2. The citation data for new astronomers (∼170) found by this process, and the citation data that was added to astronomers already on the ACD, are noted as “A16” in the ACD.

Step 5. We generated a list of astronomers (278) honored by the AAS since 1949, honored by the Nobel Committee and/or who are current members of the U.S. National Academy of Sciences. Any astronomer in
this list not already in the existing ACD (∼ 50) was added to that list if the astronomer’s name was also in the P&A-100 list.

The citation data from the two ISI databases were modified in just one way to handle the special cases of three well-used data catalogs that were published during the cited time period (1981.0 to 1997.5): the Third Reference Catalog of Bright Galaxies (de Vaucouleurs et al. 1991), the Revised Shapley Ames Catalog (Sandage & Tammann 1981, 1987) and the Bright Star Catalog (Hoffleit 1982). The printed Science Citation Index and the Web of Science were both used to estimate (±100) the number of citations to add for these catalogs for the individuals involved: 1000 citations for the Third Reference Catalog, 1250 citations for the Revised Shapley–Ames Catalogs, and 1395 citations for the Bright Star Catalog. Citation data for these catalogs follow the same rules as for the citation data in the ISI lists — only the those citations as given in papers in refereed journals during the stated citing time period.

2.3. Name Search Leads to Name Confusion

The ISI procedure of taking the names of the authors from the papers cited, rather than from the citing papers eliminates most, but not quite all, spelling errors. Of the few specific instances of misspelling caught by this author in the two ISI databases, most have been fixed by the ISI. There still remain three individuals whose names that are likely mispelled in the journal proceedings (or mis-scanned by the ISI): RP Kirshner/Kirschner; A Dyachkov/Dyatchkov; H Luhr/Luehr. The case of RP Kirshner is curious, as in 1998, the ADS recognized that both spellings are associated with the same person. As such, while citations are added together for Kirshner/Kirschner, the numbers of papers cited is kept at the value listed for Kirshner. In the cases of A Dyachkov and H Luhr, the mispellings are quite evident, so the papers and citations for both spellings are added together.

The same person can also have different last names, owing to marriage. Four persons having two names in the databases were so identified (with kind aid from V. Trimble): J Bland–Hawthorn/Bland, MJ Rieke/Lebofsky, S Viegas-Aldrovandi/Aldrovandi and S Collin-Souffrin/Collin. The citation data for the first three of these astronomers were added together, as the different names are on different papers. The citation data for S Collin-Souffrin cannot be added together with those for S Collin, as the S Collin name is confused with that of another astronomer as well as with names of physicists.

In an attempt to disentangle as much of the name confusion as possible, this writer took advantage
of an aspect of the ADS website that is apparently not yet available on the Web of Science website: The ADS website will search all names using the string of letters it is given, and will do so for an exact name match even if you do not give the whole name. Moreover, the ADS will often give the first names of the individuals found. As such, it was possible to search both the astronomy and the physics ADS websites for each ISI “name” suspected to be name-confused. This search was eventually done for almost all “names” thought to be those of an astronomer. When an unambiguous first name is found for a last name having only one first initial, that first name is noted in the ACD. In addition, all last names that are in fairly common usage were searched for name confusion for all sets of first initials. Some name confusion was solved by comparing citation data for astronomers as obtained from the P&A-100 list with those obtained for the same astronomers in the AST-top-papers list. In the former list, astronomers and physicists can have their names confused; such is not the case in the latter list.

It was quickly found in this analysis that some astronomers are listed under two or more sets of initials in the ISI databases (e.g. JP Huchra also commonly has J Huchra on his papers). In the 357 cases currently in the ACD for which this writer could identify the author’s last name with two or more sets of first initials, and that set of initials/last name are all uniquely identified with an individual, the citations are summed for all sets of initials with the same last name. The number of papers is summed as well, as the ISI would find these as separate papers from those with another initial for the given last name.

Name confusion can occur for two reasons. First, many last names are common in each culture (e.g., Smith, Jones, Wang, Suzuki, Singh), so that those individuals with only one, or even two, first initials can have their names confused with those of other astronomers and, especially physicists. In certain cases, astronomers related to each other may have the same last name and first initials. Second, given that we find many astronomers using two sets of initials for their papers, we have to allow that other astronomers may do this, but that one or both sets of names they use can be confused with those of others (who also may or may not use two sets of initials). This then leads to all possible combinations of confused/unconfused names: one set of initials for a given last name uniquely identified with an individual, the other set confused; both sets of initials confused; a last name with one first initial having possible confusion with 2 or more (up to 6) names with that first initial plus different middle initials. In other words, far more than 357 astronomers publish using two or more sets of initials for their papers.

If this all sounds confusing, well, it is!
2.4. Methodology Summary

Investigating the citation data for astronomers is, indeed, a trip down the rabbit hole. To help make sense of this trip, here we answer seven questions one can ask about this kind of citation survey:

1. Which journals/meeting-proceedings/books does one choose from which to gather citations? The ISI has defined the answer. Only refereed journals as defined by the ISI (Table 1) are used here, both for papers cited and for papers doing the citations. Thus, papers published in meeting proceedings, and authorship of books and catalogs, are not used for citation statistics (Sec. 2.2).

2. The papers that do the citations are published during what time periods? The ISI defines these papers to be published between 1981.0 and 1997.5 in all of the journals in Table 1, including both physics and astronomy journals. The AST-top-papers list covers the citing papers during the period 1981.0 through 1998.0 (i.e., 1/2 year longer than the other list), using the astronomy journals whose abbreviations are in bold face in Table 1.

3. Papers during what time period are cited? The ISI defines this time period for each list slightly differently. For the P&A-100 list, it is from 1981.0 to 1997.5, same as the paper-citing time interval. For the AST-top-papers list, it is for papers published from 1981.0 to 1997.0, ending one year before the paper-citing period. In both cases, the cited papers are from the same journals as those that do the citing for each database. Again, it is stressed that meeting proceeding papers are neither cited nor are citations taken from them by the ISI. Hence, no meeting proceeding data are included in ACD.

4. Credit only the first author, or credit all authors on a given paper? The ISI standard practice for its Web of Science, and for its generation of citation lists is that all authors on a journal paper are credited for each paper. As stated earlier, this is not a change in ISI policy, but rather full expression the ISI policies given the freedom of the web.

5. Fractional, or unitary credit of citations for authors on multi-authored papers? The ISI gives each author of a journal paper full credit for that paper (i.e., unitary credit), up to 16 authors per paper.

6. How does one handle name confusion when only first initials and last names are available? This is handled in a complicated manner, using all available means available. The sobering fact is that even having full first names available does not completely remove the confusion issue, as many individuals also have the same first and last names.

7. What is the accuracy of the citation estimates? As discussed below (Sec. 2.6), the random error in
the ACD citations is proportional to the number of citations received, at about the 4% level. Other small, systematic effects exist as well, stemming from several different issues.

Of all of the choices that the ISI makes for its databases, the assignment of one paper credit to each author of a paper is the most-controversial. While this writer agrees with this choice, others with whom the author has discussed this paper do not. The plain fact is that any present or future study that uses the ISI citation database is using citation data which assigns each author of a paper all of the citations for that paper.

Given the lively controversy this decision by ISI has engendered among this authors colleagues, this writer feels it necessary to state why he agrees with ISI's choice in this matter. First, and foremost, this writer does not know of a universally-accepted fair way to give fractional credit. On the small sampling of astronomer colleagues, whether or not one votes for fractional credit seems to depend on whether or not one has been involved in a multi-authored paper. Those of us who have been involved in multi-astronomer projects tend to vote for giving full credit to each author of a paper. Those who have not been involved much with such projects tend to vote to give fractional credit.

Yet, if ISI, or any reader of this paper, decided to give fractional credit for the citations of a paper, how would such fractional credit be calculated? Would it be fairer to divide the number of citations strictly by numbers of authors, and give each author fractional credit? Or do we try to credit some authors (say, first author) more than others? As shown in Sec. 2.6, if we take the most straightforward way to calculate citations for individuals in a fractional sense — even division by numbers of authors — there would be substantial revision of names among the top-cited astronomer list.

2.5. Two ways we lessen the impact of our papers

In the compilation of the astronomer citation list, this author has found that getting credit for the papers you publish can be lessened in two ways.

Both the ISI databases and the ADS (Sec. 2.1) have problems in registering citations for papers published in meeting proceedings. While books and catalogs can be found in the Web of Science via a “cited reference” search of the correct first author name and year of publication, these citations come only from those made in journal papers. So, while meeting papers are cited there, these data are not incorporated into the main ISI databases. Meeting papers do not figure at all into the citations statistics for the Web of
Science, nor for the two ISI databases given this author to develop the ACD.

The other way credit for citations of your paper can be harmed is if your name is either confused, or if you use more than one first initial on your papers. For those of us with common last names, especially our Asian colleagues, solving name confusion will not easy (cf. Sec. 5). If you permit your papers to be published with two or more sets of first initials, the Web of Science will put you in two or more different places, fuzzing the credit you will get for your citations. This issue was one thing when we used the Science Citation Index hardcopy, as we could easily see the two different entries. Such is not the case when you access the same data electronically. Indeed, if using electronic databases, finding citations data for an individual who uses different first initials requires knowledge aforesought that this problem exists. While someone working in the field of study can sort this problem out with a lot of effort, it is impossible for people not working in that field of study (such as the ISI personnel) to do the correct sorting.

2.6. Citation Errors: “Random” and Systematic

A “random error” infects the ISI databases owing to the manner in which the ISI gets its citations per paper: the journal volume, page number of the cited papers are taken from the citing papers. Human error being what it is, a certain percentage of those cites give the wrong journal number, wrong page number (sometime switching one for the other), confuse ApJ with ApJL or ApJS, etc. One does not discover that this can lead to errors in the ISI databases until one accesses the Web of Science, pushes on the general search button, then opt for a “cited ref search.”

As opposed to the “general search” mode, “cited reference search” is best used by entering both the first author and the correct year of publication. What one then finds is a list of the citations for the papers of that author. Those that are underlined in blue you will also find in the general search. Those not highlighted either are misentered in a citing journal paper, or are referenced in citing journal papers to non-journal papers, private communications, books, catalogs, etc. In cited reference search mode you will see all of the misentered entries for a given cited paper.

This writer has accessed the cited reference search for 36 papers in Table 3 to estimate the misentry incidence as a function of journal. Note that statistics cannot be done for the citation data in the ACD per se, but rather for the current (2000.0) citation data for the papers involved. Citation data for individual papers is affected as much as 126 misentries for 989 1999.9 citations (for 1992 ApJ Letter paper of Smoot et
al.) to a low of 2 misentries for 532 1999.9 citations (the A&A paper of Renzini & Voli 1981). If we express these errors in terms of percentages, they range from a high of 19% to a low of 0.004%, with a mean of 4%. This error is strongly journal-dependent, being the most for the ApJL (with a relatively high percentage of papers not citing the journal as ApJL), and lowest for Nature and PASP.

Given that none of us publish our papers solely in one journal, a reasonable estimate for a one-sigma random error of citations in the ACD is 4%. While this random error can be corrected in principle, in practice it would be highly labor-intensive, requiring a scientist from our field to work directly with the ISI to make the corrections, paper-by-paper. As such, a one-sigma random error of 4% in the number of our citations can be viewed as the dues we pay for using the digital computers to do the citation calculations.

Several systematic errors also affect the citations in the ACD:

Omission of astronomers: Non-inclusion of astronomers at the low end of the ACD comes about in a somewhat convoluted manner. 173 astronomer names from the “A16” analysis were excluded from the ACD because the ISI names of those astronomers had fewer than 100 citations accredited to them in the A16-corrected AST-top-papers list. The AST-top-papers list references only a subset of the journals used for the P&A-100 list, of which only a subset of those papers are used. Hence, it is likely that the names of at least some of these astronomers would be in the ACD if all papers on which they are authors had been included in the P&A-100 accounting (i.e., their other papers could total up to 99 citations). As such, these 173 astronomer names are given in a separate “honorable mention” list that will be supplied electronically.

Separately, inclusion of people who became deceased during the sampled period is handled both from the memory of this writer, and through the comparison of the astronomer names in the AST-top-papers list to those in the P&A-100 list. It is not expected that many such astronomer have been omitted from the ACD. As an additional check, a scan of the full P&A-100 list by this writer of those ISI names with 3000 or more citations uncovered no other astronomer names than those given in the ACD.

Wrong papers: One can compare the authors on the papers in Table 3 to the astronomer names in Table 2, to see that papers that publish wrong results do not substantially contribute to the citations for these astronomers. Moreover, one can verify that very few of the 3000+ astronomers in the top half of the ACD have reputations built on the publication of wrong papers. The conclusion of this paper is that citation of wrong papers negligibly influences the citation statistics.

Self-citation: The present available websites make it difficult to quantitatively assess the effect of
self-citations on the citations for a given astronomer. What is important here is the variance around the percentage of our citations that are our own papers, as this is something we all do. On can most directly assess this for individual papers, which this writer has done for about a dozen, many-cited papers. The result of this non-statistical sampling is these papers self-cite in the range 3–15%, with a mean about 8%. Since it is variance about this mean that affects the citations of one astronomer vs. another, we can expect a variance of 5–7% in citations that can be ascribed to self-citation. Whether or not to assign a “self-citation” variance of ~6% to the ACD data (to then be added in quadrature to the random error estimate of 4%) is a matter of choice. As with giving/not giving full citation credit for each author of a paper, honest people can differ on whether or not to account for self-citation variance in the ACD.

Fractional or Full Credit: While a scientifically correct test of this issue cannot be made from either the Web of Science (no restriction on citing years) or from the two ISI databases. As such, compiling a list that is complete as the ACD that gives only fractional author credit is impossible without the full cooperation of the ISI. Nonetheless, an illustrative differential test can be made using the data in the AST-top-papers list. This writer took the top 13 individuals cited in the AST-top-papers list (which are not necessarily the same as the top-cited authors in the ACD), and counted the number of authors of each paper for each individual, as well as counted the number of papers that individual was first author, and the number of papers the name of that individual was placed in alphabetical order (for papers with 3 or more authors). To this list this writer added the same data for three other astronomers known to this writer to mainly publish significant, single-authored papers.

For a first test, fractional credit was given by dividing the number of citations for each paper by the number of authors on that paper, and then summing the fractional credit for each individual. The ratio of (fractional citations/full citations) so obtained ranged from 0.05 (for an individual publishing mainly with large groups) to 1.00 (for an individual with 2 sole-authored papers), with a median of 0.30. If these 15 individuals were the only ones in the database, a substantial reordering would be done from the full citation credit list. The net result would be to keep 7 of the 13 top-cited individuals in the top positions, but move 6 individuals from lower on the full credit list to near the top of the fractional credit list.

For a second test, we find the ratio of papers for which the author is first or sole, to the number of individual’s papers included in the AST-top-papers list. This ratio varies from a high of 1.00 to a low of 0.067, with a median of 0.27. If we then would calculate fractional credit by giving more credit to the first author of a paper, the order of listing of individuals would be different from that of either full credit or
strict fractional credit lists.

The bottom line here is that there is simply no way one can calculate the number of citations for individuals that everyone can agree with. Depending on which way one chooses, the result will be different. Rather, given the now wide-spread use of the Web of Science, it seems most logical to accept the practices of the ISI in this regard in giving full citation credit to each author on a given paper.

Interestingly, how the ISI has presented its database has been a product of technology. From the start, for the the printed Science Citation Index, ISI obviously had to make hard choices of how to present data, both in number of letters for names and number of authors per paper used. One choice that was made for the printed version was to list papers under only first authors in the Author part of the Index. All authors of a paper (up to an author limit given in the Index explanations of that year/summary list) would then be referenced to the each paper in the Source part of the Index. As such, previous investigations of citation-related issues would, indeed, have just found first-authored papers if only the Author part of the Index was used.

In contrast, the Web of Science now permits the ISI to show all of its data for each author. This means that when one accesses a given author name, one gets the full citations for each paper that author is on, not just the ones for which that author is first. The ISI notes such other papers by preferencing the Web-cited reference with several dots.

In summary, errors in data lists are introduced due to human error or human choice, whether using a computer or not. When data lists are of numbers, errors or choices are one thing; when data lists are of the accomplishments of real people, errors or choices are quite another thing. It is likely that human errors of omission and comission in ACD exist. Unfortunately, there is no easy way for this writer to find all of them. The most serious of the likely systematic errors in the ACD concern exclusion of astronomers from the list, while the random errors of citations in the list are at about the 4% level (modulo accounting/non-accounting for 6% self-citation variance). The most intractable issue is to whether or not give full citation credit to each author. Whether or not one views this as an error in the data base depends on ones opinion. Interestingly, if one had only used the Author section of the hard-copy Science Citation Index in past years, one would have only found those papers for which the author was first.

While the current version of the ACD has been constructed to be as complete as possible, it is the ongoing aim of this writer to make this list as complete and accurate as is reasonably possible. Given that the time periods of citing and cited papers are fixed, this is doable. Towards this end, the reader is
encouraged to contact this writer if the reader feels a name should be in the ACD that is not, or if one feels the data entered for a person is badly in error. All such cases will be addressed individually by this author and corrections to the ACD made, if warranted.

2.7. Are the ISI Lists the Best We Can Do?

The ISI lists do something important that this writer has not yet found among the available websites or in written form: Specify both a time interval for *when* the papers are published and a time interval for *when* the papers citing those papers are published, and sum all of the found citations per author name. This permits “snapshots” in time of citations to be assembled, of which the current ACD is just the first.

The Web of Science gives the number of citations per paper, but not per author for that year. This latter number is something one would have to manually extract from the information given. The Web of Science also does not currently permit the citing years to be restricted. As such, when checking for the random error problem (Sec. 2.4), one could only assess the errant citations against ISI-registered citations at the current time. However, a specific interval for the years the papers of an astronomer were published can be specified. Hence, what one gets is a running number of all citations of a given paper up until the date you access the citation information. In absence of a world-wide directory for astronomers, It is essentially impossible to predefine all astronomer names to do the kind of analysis with the Web of Science that one can do with the P&A-100 and AST-top-papers databases.

The ADS website has a button one can push which will give the total citations per astronomer from their database (such a button is not available for the physicist webpage, though). By pushing this button you get a summary total of citations for that astronomer, and a list of the citing papers, but not the number of citations per paper, nor the number of cited papers, nor a list of cited journals/meetings/etc. A perusal of citing papers for several individuals indicates that papers in meeting proceedings are only included in the ADS list if those proceedings could be accessed electronically. Combine this with the problems the ADS has in listing authors for multi-authored, pre-electronic submission papers, the citation information one gathers from the ADS website has more systematic problems within it than that we can get from the ISI website. As with the current ISI website, the current ADS does not permit defining a specific range of years for citing papers.

Comparing numbers of citations for astronomers between the P&A-100 and AST-top-papers lists shows
that the P&A-100 list always has more citations, with comparable citations for the most-cited individuals. This indicates that the half-year sampling advantage of the AST-top-papers list is more than compensated by the greater completeness of the P&A-100 list in terms of journals covered. Surprisingly, it is also found that the ADS citations are generally less than those of the P&A-100 list for the same astronomer (at least in late 1999). This difference could be a result of referencing only a restricted number of journals (the ADS currently accesses only astronomy journals for astronomers, as does the AST-top-papers list).

3. THE DATA PRODUCTS

3.1. The Astronomy Citation Database (ACD)

The Astronomy Citation Database (ACD) is comprised of the names of actual astronomers that are associated with the “names” in the P&A-100 and AST-top-papers. For each associated astronomer name we give the “name” as given in the ISI databases: last name used (ISI format without hyphens), first initial(s); the total number of citations received, the total number of papers cited, and the average citation/paper (cite/pap). Each author of a paper is given full credit for the citations of that paper. First names are given for those astronomers for which first names are known/could be found. The citation data are adjusted for the “A16” issue, the three specified data catalogs (Sec. 2.2), the changed/mispelled names, and for those individuals who use two or more first initials. All additions to the citation data from the P&A-100 list are noted for the P&A-100 “name” commonly used for that astronomer. Note that when the P&A-100 citation data has been modified for a given “name,” the added data are specified as well. If one wishes to see the original P&A-100 data for a given person, subtract the number of citations and number of papers that were added.

For statistical purposes we divide the ACD into three subsets, owing to the degree to which each ISI “name” can be associated with a unique astronomer:

“Unique-One:” These are the astronomers whose last names and first initial(s) are unambiguously associated with a single, identifiable person. These are most often authors whose names have two or more first initials and those with uncommon last names. The term “unique” here refers to the fact that a unique person is identified with a unique last name and first set of initial(s). There are 4617 “unique-one” astronomers in the ACD.

“Unique-Two:” These are the astronomers whose last names are unambiguously associated with two
or more sets of first initials. Again, the use of the word “unique” here denotes association with a unique, identifiable person. While there are 357 “unique-two” astronomers the ACD, the number of astronomers using two or more first initials for their papers is likely much more.

“Confused- Named:” These are the 1484 cases for which unique ownership of a given last name and first initial(s) is intrinsically confused. Here the term “name” literally means a “name,” not a unique person. As stated earlier, name confusion occurs both because a particular last name is confused for the first initial(s) used, or because one set of initials for an individual is confused, but another set is not (the other side of the “unique-two” issue). Of the names that are confused among astronomers and/or physicists, 398 combine one version of the name confused, and the other version uniquely-identified. Hence the same person might be found in two places in the ACD. In addition, there are 94 others pairs of names that have the same last name, two sets of first initials, and both sets of initials/names are confused among those of astronomers and/or physicists. Finally, there are 40 sets in which one name with one first initial can combine with 2 or more names with the same first initial but different middle initials, and all sets of this name are confused among astronomers and/or physicists. Hence, nearly half of the confused-named cases in the ACD could involve confusion among “unique-two”–related issues. (Again, sorting through confused names is confusing!)

To the main ACD we add an “honorable mention” list comprised of the available AST-top-papers citation data for 173 astronomer names from the “A16” analysis whose names were not found in the P&A-100 list (cf. Sec. 2.6).

The full ACD is provided in electronic form from this writer, and will be made available through the Astrophysics Data Center. For the purposes of further statistics, in Table 2 we publish those unique-named and confused-name astronomers cited 3000 times or more. It is possible to separate out those names least-confused for top-cited astronomers in two ways. First, compare the number of citations between the P&A-100 list and the AST-top-papers list. Second, in the case of physicist-related name confusion, use the ADS and the P&A-100 list to check for citations of co-authors on physics papers. These tests have only been applied for those “names” with 3000 or more citations. Astronomers with confused names who have a large ratio of AST-top-papers citations to P&A-100 citations, and are not found to have much physics confusion, are designated as “Cg.” The Cg designation indicates that while the astronomer’s name is confused, a substantial number of citations, if not the vast majority, are for the identified astronomer.

In addition, there are also several possible persons that could be among those with 3000 or more citations, but are not owing to name confusion. These include B/BA Brown, J/JH Lee, J/JW Lee, J/JM
Stone, J/JC Wang and R/RW Wilson. The multi-faceted properties of name confusion also affects the number of citations for individuals/confused names already in Table 2, with one confused version of the name qualifying for the list, while the other does not: CL Bennett has C Bennett with 108 citations, MC Cohen has MH Cohen with 1862 citations, RF Green has R Green with 740 citations, RH Koch has R Koch with 1494 citations, and DW Murphy has D Murphy with 110 citations.

The data in Table 2 are divided by ACD subset, in descending order of number of citations/name: Column (1) – the last name of the astronomer, no spaces/hyphens, in the ISI standard format for last names; (2) – the first initial(s) of that name (most commonly cited in the case of names in the “unique-two” subset); (3) – the citation/paper ratio (cite/pap); (4) – the number of papers cited, including all papers that can be attributed to the individual or name; (5) – the total number of citations for these papers; (6) – Typ is the sample into which author is placed (1 = “unique-one,” 2 = “unique-two,” C = “confused-named”, and Cg as explained above); (7) – life-time honor awards: Nobel prize, National Academy membership, Russell prize, Heineman Prize, with the last two digits of the year awarded given with the code; (8) – country of citizenship, other than U.S.A., coded as given in Section 4; (9) – comments, including: for astronomers in the “unique-two” subset, the other initial(s) used by the author (including mispellings), and for two names (N/NZ Scoville and R/RS Ellis, the fact they were put into the Unique-2 category is based on comparison of P&A-100 to AST-top-papers citations); for astronomers in the “unique-one” subset, first names and middle initials (if any) for those astronomers using just one first initial, papers added due to mispelling of last name (+sp); added catalog citations (+ca:); and corrections for the “A16” flaw in the original ISI databases. The “confused-named” subsets give the first names of the astronomers having this/these initial(s) (if the names easily fit into the table), as well as an indication (“+ others”) if there are physicists with the same last name and set of first initial(s).

3.2. Top Ten Astronomy Papers Cited, 1981–1996

While the full list of 3200 papers in the AST-top-papers list is an item the ISI has made available for purchase only ($1995), the ISI has given this author permission to print the top 10 papers cited for each year. Table 3 does so for the years 1981–1996 in standard reference format: Column (1) given the number of citations for that paper; (2) the absolute ranking of the paper in the full list of 3200 top–200 cited papers of each year sampled (if number of citations/paper is 90 or over, this is an absolute ranking; if less than this number, no absolute ranking is given, as the AST-top-papers list is not complete for papers with 89
citations or less); (3) the ranking within a given year; (4) the standard astronomical reference for the paper, using the “et al.” for other authors when the number of authors exceeds five (NCC is NUOV CIM C = Nuovo Cimento della Soc. Italiana di Fisica C, Geophysics); (5) the year of publication; (6) the journal in which the paper was published; (7) the journal volume; and (8) the starting page number.

3.3. The Honored Few

We in the U.S.A. astronomical community have developed a large number of ways to honor those among us who we feel have done outstanding work in their scientific fields. These awards are separate from that considered the ultimate of our profession — the Nobel Prize. As such, we can go further in our comparison of citations to honors than can likely be done in other fields (cf. the Nobel prize comparison for chemist made by Garfield & Welljams-Dorof 1992). While honors are not awarded solely on the basis of numbers of citations, it is certainly the case that the more our papers are cited, the more likely our work is known to others. As such, one expects a good correlation between the names of those astronomers who have been honored and those most cited. The ACD was partly assembled to test this hypothesis.

All nine astrophysicists to whom the Physics Nobel Prize has been awarded since 1964 are included among the 6458 names in the ACD: CH Townes (1964); HA Bethe (1967); A Hewish (1974); AA Penzias, RW Wilson (1978); S Chandrasekhar, WA Fowler (1983); JH Taylor, RA Hulse (1993). That their Nobel prizes do not correspond to their positions in the ACD owes much more to the fact that for all but the 1993 Nobel prize, the work for which the prize was given well pre-dates the time interval sampled here. Additionally, name confusion affects the citations for JH Taylor and RW Wilson, both of whose names are found in the “confused-named” subset of the ACD, illustrating well that problem.

A total of 278 astrophysicists have been honored either by the Nobel Prize committee (since 1964), and/or the American Astronomical Society and its scientific divisions (since 1949), and/or by current membership in the National Academy of Sciences (in either the Astronomy, Physics or Geophysics sections). While only the lifetime awards are given in Table 2 for individuals so-honored by them, the electronically-available ACD lists all of the awards given by the AAS and its divisions.

Of the 278 individuals honored by the AAS, NAS memberships or Nobel Prizes, 41 are not in the ACD. Of these 41 individuals, 29 received their last honor before 1980, hence most of their papers are likely published before 1981. Three other honored astronomers not in the ACD received only one honor that is
more related to public service than to science, per se. Of the remaining nine honored astronomers not in the ACD, it is likely that most of their distinguished work was published before 1981.

4. The Statistics of Citations

4.1. Unique-One vs. Unique-Two vs. Confused-Named

Three data products are produced from this analysis: the number of citations per astronomer or astronomer “name;” the number of papers cited for these citations; and the ratio of the number of citations to number of papers (cite/pap). Figures 1a,b,c show the histogram distribution for the unique-one, unique-two and confused-name lists for each of these parameters. The data that go into these figures are given in Table 4.

The adopted procedure of handling the number of papers for the unique-two astronomers is verified by the fact that the unique-two authors have a statistically higher cite/pap ratio than do the unique-one authors. This confirms the choice of adding together both papers and citations for unique-two astronomers. In contrast, it is to be expected that the confused-named subset have a significantly lower cite/pap ratio than the subset of unique-one astronomers.

As shown in Figure 1b, the distribution of the number of citations is nearly identical for the astronomers in the unique-one and confused-named subsets, but skews to significantly higher values for those in the unique-two subset. In Figure 1c we see that the numbers of papers cited have the lowest distribution for unique-one astronomers, but are of comparable higher values for the confused-named and unique-two astronomers (note the relatively large number of confused names with 300 or more papers).

Confused-named astronomers have a systematically lower cite/pap ratio than either of the unique-listed astronomers, while having a similar distribution of numbers of citations as those in the unique-one list. This difference was noted early in the analysis and was used to help seek out confused names by investigating the ownership of those names with low cite/pap ratios. The most cited names in the ACD are those astronomers with asian names whose ISI names are multiply-confused, even among astronomers.

The big surprise of this analysis is the finding that the statistics for the unique-two astronomers exceed those for the unique-one astronomers in all three categories. This difference is also seen when median values for these parameters are compared: The median values for number of citations are 381, 425 and 863 for unique-one, confused-named, and unique-two astronomers, respectively. Similarly, the median values for
papers cited are 24, 40 and 38, and for cite/pap are 18.3, 11.5 and 24.2.

Part of the difference in the citation pattern for unique-one authors vs. unique-two authors is consistent with the idea that the median value of citations is likely be twice for people cited in two places in the original list, compared to that for people cited only once. This is true for the numbers of citations, as the median value for unique-two authors (863) is a bit over twice the median value for unique-one authors (381). This, however, does not explain the difference in cite/pap ratio between unique-one and unique-two astronomers. Moreover, examination of the astronomer names in the unique-two subset shows that many are well-known astronomers whose papers are generally highly regarded.

We are forced to conclude that real differences exist between the citation patterns for unique-two astronomers versus those for unique-one astronomers. Why this is so is open to speculation. Is it possible the confidence a person has in giving two sets of initials for her/his papers is related to how useful the papers are for astronomy? Or is this more a product that a person collaborating with other individuals puts his/her on the paper without verifying how her/his name is given? Explaining this result is beyond the scope of this paper, and likely would involve sociologists more than astronomers.

### 4.2. Honors versus Citations

As enumerated earlier (Section 3.3), 237 of the 278 astrophysicists in the honored list are also included in the citation list. Following what was done for the chemist list by Dr. Pendlebury, we concentrate on how the most-cited people in each subset of the ACD (unique-one, unique-two, confused-named) have been honored; i.e., those astronomers listed in Table 2. This list includes 54 astronomers in the unique-one category (top 1.2%); 22 astronomers in the unique-two category (top 6.2%) and 54 astronomers in the confused-name category (top 3.6%), of which 12 can be placed in the Cg category.

The honors received by each person are coded after the citation information by letter code with the last two digits of the date awarded by the code (many of which are seen in Table 2, all of which are used in the full table of honored individuals that will be made electronically available): International: NOB = Nobel Prize; National, NAS = member of the National Academy of Sciences; R = Henry Norris Russell Prize, H = Heinemann Prize.

We will view the relationship between honors and citations from the direction of first selecting on citations. This is because name-confusion fuzzes the numbers to which we might compare for unique-two
astronomers versus the other two categories. Until such name confusion is settled, the only valid statistics go from citations to honors, not the other way around. A glance at Table 2 pretty much tells the whole story. While only 1 of 22 Unique-Two astronomers (4.6%), and only 2 of 42 full-confused-named astronomers (4.9%) have been given lifetime honors, 17 of 54 unique-one astronomers (31.5%) and four of 12 Cg astronomers (33.3%) have been so-honored. Similarly, of 59 non-U.S. astronomers, 3 (5.1%) have been so-honored, compared to 21 of 71 U.S. astronomers (29.6%) so-honored. Finally, while 24 of the 130 astronomers/names cited 3000 times or more are so-honored (18.5%), only 78 of the 6328 astronomers/names (1.2%) are so-honored.

The data in Table 2 and in the ACD tell the following story: To first order, the number of citations your papers receive are, indeed, reasonably correlated with whether you are honored by your peers. To second order, whether or not an individual with high numbers of citations has been honored to date is a function of several variables: into which citation subset (unique-one, unique-two or confused) her/his name falls; how many citations that person has; and from what country that person mostly does his/her work. This last effect is understandable, as most of the honors listed in Table 2 are given by the American Astronomical Society and the U.S. National Academy of Sciences.

5. Summary and A Modest Proposal

An Astronomy Citation Database (ACD) has been assembled, which gives the number of citations, papers cited and the cite/pap ratio for 6331+ astronomers for a 16.5 year snapshot of time. These data correspond to citation information assembled by the Institute for Science Information (ISI) for astronomers and physicists for papers published in the years 1981-1997.0, as cited in papers published in 1981-1997.5. The data for the astronomy list was assembled from two databases given to this writer by the ISI. One list (P&A-100) contains citation data for 62,813 physics and astronomy ISI “names” cited 100 or more times during the specific intervals. The other list (AST-top-papers) contains both citation data for the 200 most-cited papers published each year in astronomy during 1981-1996, as well as for the astronomy-related citations for 5,035 astronomer names from those papers.

The databases given to this author by the ISI give full citation credit to each author for each of her/his papers, whether first author or not, whether multi-authored or not. This is also the methodology used for ISI’s Web of Science. While the methodology of the ISI in this regard has not changed over the years, how it presents its data has. In particular, users familiar with the hard-copy Science Citation Index will note
that only papers on which you are a first author are listed in the Author section, while all papers on which
you were an author (first or not) are given the Source section. As such, readers should be aware that the
ISI Web of Science now gives full credit for the citations for all papers on which each of us is an author, but
only for refereed journals listed from their list of sampled journals (cf. Table 1).

In order to make sense of these citation data, this writer had to engage in a series of laborious,
time-consuming tasks. These tasks also involved discovering and correcting for a number of biases in the
original data lists, some of which are inherent to any electronically-assembled database.

The main file for ACD is divided into three subsets: 4617 “unique-one” astronomers (those whose
names are uniquely identified with individuals); 357 “unique-two” astronomers (those whose last names are
cited with two or more sets of first initials); and 1484 “confused-named” astronomers (those with names
and initials that are confused with those of other astronomers and/or physicists). The use of the word
“unique” to name two of the subsets refers to the fact that these are names singly assigned to an individual
astronomer. Such is not the case for the “confused” ISI names, which are associated with two or more
individuals in astronomy and/or physics. Due to name confusion, it is likely than many astronomers are
listed twice in the ACD, either two times in the confused-named list, or once in the unique-one list and
once in the confused-named list.

Two other files are provided with the ACD. One is an “honorable mention” list of 173 names for those
astronomers whose names are in the AST-top-papers list but not in the P&A-100 list, and which have
less than 100 citations from the AST-top-papers list. The other is the “honors” list, which correlates the
citation data information from the main database with the honors 278 individuals have received for their
astronomical work.

A list of the 10 most-cited papers per year, from 1981 to 1996 is provided in this paper (but not in the
electronic database). Comparison of the authors’ names on the 10 most-cited papers to those names most
cited overall shows a good correspondence. Moreover, the papers in the 10 most-cited-per-year list are of a
wide range of paper type (e.g., review, data, theory, observation) and are all known to be of high quality.
Hence, the old shibboleth that one can get many citations from publishing papers with wrong results is
shown to be the myth that it is.

The errors for citations for individuals in the ACD are both random and systematic. Random errors
exist in proportion (estimated to be 4%) to the number of citations, owing to the way in which the ISI
compiles citations. Systematic errors include errors of omission and comission. Errors in citations owing to
variance in self-citations among astronomers can also affect the statistics at the $\sim 6\%$ level, if one chooses to apply such a criterion to these data. The likely most-egregious error in this database in the eyes of some of the readers of this paper is the use of full citations for each author of a paper. Tests using the papers of top-cited authors in the AST-top-papers database shows that no way we can think of to calculate citations for authors will give the same results. The plain fact is, however, whether one agrees with using full citations or not for astronomers, this is what the ISI gives us in the Web of Science, as well as in the P&A-100 and AST-top-papers lists.

We show that, due to the manner in which citations are assembled by the Institute for Science Information, which maintains the science citations for our field of study, we hurt the impact of our papers if we publish many papers in meeting proceedings, or if our name is confused with those of others.

Two more of our findings are of specific sociological interest. The first is that astronomers who divide their papers among two or more first sets of initials on average publish more papers, have more citations, and have a significantly higher citations/paper ratio than astronomers who publish under just one set of initials.

The second is that there is a very good, but not perfect, correspondence of a person being near the top of the citation list and the chance that person has been honored by her/his peers in U.S. astronomy for life-time achievement. Closer examination of this good correlation reveals that assigning honors to our peers is as human an enterprise as any that we do. The evidence suggests that anything we do, intended or not, to blur the focus of our papers to our peers has a measurable effect on how we are honored by them. Such blurring effects can come in several forms: authoring papers using two or more sets of initials; having a name confused with those of others; publishing your papers predominantly in non–U.S.–based journals or meeting proceedings. Other means of blurring the focus of our papers (having high citations, but low cite/pap ratio; mostly publishing in large groups or with more well-known authors; publishing in several different scientific fields) also likely exist.

In a paper devoted to analyzing the citation data for astronomers, it is relevant to note that citation statistics give us but one view of the impact of individuals on our science. This is best evidenced by the most recent Nobel Prize awarded to astronomers, that to JH Taylor and RA Hulse in 1993. Where these two individuals stand in the citation list has little relationship to their scientific impact on our field.

The two ISI databases used in this paper were generated with ISI software and given to this author expressly for the analysis done in this paper. These databases are different from those we can access via
the Web in three ways: ability to specify specific ranges of years for cited and citing papers; kinds of papers cited, and number of citations attributed to each author. The idiosyncrasies discovered in the course of this survey of the use of current web-based database for the bibliography of astronomers are detailed.

The full ACD (all three files) will be made available via anonymous ftp from samuri.la.asu.edu, as well as through the Astrophysics Data Center. The top ten papers cited for each year between 1981-1996 are given in this paper. The full top-200 cited papers database produced by the ISI is proprietary (termed “High-Impact Papers in Astronomy”) and is available for a fee separately from the ISI.

Since the ACD is a database about the accomplishments of people, any error in the ACD is a serious error. As such, readers are encouraged to contact this writer if errors of omission or commission are found in the ACD. Those appropriate modifications to the ACD that should be made, will be made. It is hoped that with the help of readers, a full unconfused, ACD can be eventually made of cited papers during 1981–1997.5. Such a list can then act as a baseline against which future investigations of this kind may be made. It also hoped that the lessons learned in this paper about the idiosyncracies of the various electronic databases will aid others in their own searches.

Towards this end, I end this paper by unashamedly borrowing from Jonathan Swift in putting forward a “modest proposal” for eliminating name confusion in our field. We are used to having social security numbers, university ID numbers, shopper ID numbers; each of us is now various numbers in various databases. If this is so, why do we not assign a “publishing ID number” (PID for short) for each person who publishes a paper in our journals? I suggest that this be done, and we start by assigning PIDs to all astronomers who have published papers in the journals in the past. The ACD could be a start, but only a start, as to solve name confusion the process must work iteratively among the ISI, the individuals involved and the ACD. The PID number would then be carried by each journal in the author list (but not necessarily printed out for each paper).

If we, and other scientists in other fields of study, are interested in having a true, honest assessment of citation data for astronomers as a function of time, then the problem of name confusion should be, and can be, solved.

This work could not have been done without the active participation and cooperation of Dr. David Pendlebury of the ISI, who supplied the two ISI datasets used in this study, and who also did a very careful reading of the first draft of this paper. This author owes Dr. Pendlebury much thanks. Conversations with
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This manuscript was prepared with the AAS \LaTeX\ macros v4.0.
Figure Caption

Figure 1: The histograms for the average citations/paper (cite/pap) for the unique-one (4617 names), unique-two (357 names) and confused-named (1484 names) subsets in the Astronomy Citation Database. a) The cite/pap ratio is binned by 5, and the histogram values are in terms of the fraction of the astronomers in each subset, falling in each cite/pap bin. Note the higher median value of cite/pap, and longer tail towards higher values of cite/pap for the unique-two astronomers as opposed to the unique-one astronomers. b) Numbers of citations are binned by 100. Histogram values as in Figure 1a. Note, as with Figure 1a, the higher median value of citations, and longer tail towards higher numbers of citations for the unique-two astronomers as opposed to the unique-one astronomers. c) Numbers of papers cited for the unique-one, unique-two, and confused names in our astronomer sample. The number of papers cited is binned by 10, and the histogram values are in terms of the fraction of the astronomers in each list, falling in each paper-cited bin. Note the higher median value of numbers of papers cited for the unique-two astronomers relative to those for the unique-one astronomers, and the longer tails towards high values of papers cited for both unique-two and confused-named astronomers.
Table 2. Citation and Honor Data for Astronomers Cited 3000+ Times

| Last Name     | First Init | Cite/ Pap | No. Pap | No. Cites | Typ | Hon | Cty | Comments |
|---------------|------------|-----------|---------|-----------|-----|-----|-----|----------|
| HUCHRA        | JP         | 51.17     | 160     | 8187      | 2   | NAS93|     |          |
| EFSTATHIOU    | G          | 77.21     | 95      | 7335      | 2   | UK  | GP  | +151    |
| OLIVE         | KA         | 32.39     | 162     | 5247      | 2   | K   | +530|          |
| SCOVILLE      | NZ         | 44.87     | 113     | 5070      | 2   | N   | +1099|          |
| LINDE         | AD         | 57.55     | 86      | 4949      | 2   | Ru  | A   | +1136   |
| MOULD         | JR         | 28.82     | 164     | 4726      | 2   | Au  | J   | +2084   |
| MUSHOTZKY     | RF         | 31.46     | 138     | 4342      | 2   | R   | +539 |          |
| LIEBERT       | J          | 26.48     | 159     | 4211      | 2   | JW  | +253|          |
| ELLIS         | RS         | 35.34     | 119     | 4206      | 2   | UK  | R   | +653    |
| HECKMAN       | TM         | 37.44     | 110     | 4518      | 2   | T   | +1168|          |
| SCHRAMM       | DN         | 30.00     | 137     | 4110      | 2   | D   | +100 |          |
| FREK          | CS         | 59.96     | 68      | 4077      | 2   | UK  | C   | +360    |
| SMOOT         | GF         | 37.26     | 105     | 3912      | 2   | G   | +310 | A16 +643|
| MATNICUTT     | RC         | 37.32     | 104     | 3881      | 2   | R   | +147 | A16 +32 |
| BOTHUN        | GD         | 28.19     | 127     | 3580      | 2   | G   | +561 |          |
| WEGNER        | G          | 23.33     | 143     | 3336      | 2   | GA  | +138 |          |
| TERLEVICH     | R          | 35.89     | 91      | 3266      | 2   | UK  | RJ  | +1766   |
| BOGGESS       | NW         | 127.48    | 25      | 3187      | 2   | N   | +1027| A16 +128|
| STOKE         | JT         | 32.76     | 96      | 3145      | 2   | J   | +1018|          |
| MILEY         | GK         | 33.30     | 94      | 3130      | 2   | G   | A16 +274|          |
| LUBIN         | PM         | 75.12     | 41      | 3080      | 2   | P   | +802 | A16 +1035|
| MAYERHASSELWANDER | HA      | 38.10    | 79      | 3010      | 2   | Ge  | HA A16 | +235 3 H A16 +160 1 |

Unique-One Astronomers

| Last Name     | First Init | Cite/ Pap | No. Pap | No. Cites | Typ | Hon | Cty | Comments |
|---------------|------------|-----------|---------|-----------|-----|-----|-----|----------|
| FABIAN        | AC         | 25.38     | 258     | 6549      | 1   | UK  |     |          |
| SANDAGE       | A          | 59.36     | 106     | 6292      | 1   | R72 | NAS(decl) +ca: +1250 1 for RSA |
| SOIFER        | BT         | 44.67     | 135     | 6030      | 1   |     |     |          |
| BAHCALL       | JN         | 36.34     | 163     | 5923      | 1   | NAS76, H94, R99 |          |
| TURNER        | MS         | 32.44     | 171     | 5547      | 1   | NAS97 |          |
| STEINHARDT    | PJ         | 72.84     | 76      | 5536      | 1   | NAS98 |          |
| RUSSELL       | CT         | 20.50     | 264     | 5413      | 1   |     |     |          |
| BURSTEIN      | D          | 76.03     | 71      | 5398      | 1   |     |     |          |
| VILENKIN      | A          | 50.32     | 96      | 4831      | 1   |     |     | Alexander |
| WHITE         | SDM        | 51.06     | 94      | 4800      | 1   |     |     |          |
| REES          | MJ         | 36.50     | 131     | 4782      | 1   |     |     |          |
| LAMBERT       | DL         | 25.41     | 182     | 4625      | 1   |     |     |          |
| OSTRIKER      | JP         | 42.19     | 108     | 4557      | 1   |     |     |          |
| BROWN         | GE         | 27.40     | 165     | 4521      | 1   |     |     |          |
| FABER         | SM         | 56.36     | 80      | 4500      | 1   |     |     |          |
| ROWANROBINSON | M          | 41.82     | 105     | 4391      | 1   |     |     |          |
| GUNN          | JE         | 48.74     | 88      | 4289      | 1   |     |     |          |
| MAEDEER       | A          | 60.91     | 70      | 4264      | 1   |     |     | Sw Andre |
| SANDERS       | DB         | 48.43     | 82      | 3971      | 1   |     |     |          |
| HAWKING       | SW         | 72.16     | 55      | 3969      | 1   |     |     |          |
| SILK          | J          | 19.90     | 199     | 3961      | 1   |     |     |          |
| GELLER        | MJ         | 41.95     | 92      | 3882      | 1   |     |     |          |
| IBEN          | K          | 47.47     | 79      | 3750      | 1   |     |     |          |
| MATTHEWS      | K          | 30.22     | 124     | 3747      | 1   |     |     |          |
| BAME          | SJ         | 29.75     | 125     | 3719      | 1   |     |     |          |
| DRESSLER      | A          | 54.63     | 68      | 3715      | 1   |     |     |          |
| SARGENT       | LWL        | 38.97     | 94      | 3663      | 1   |     |     |          |
| HEILES        | C          | 58.23     | 161     | 3552      | 1   |     |     |          |
| LADA          | CJ         | 51.42     | 69      | 3548      | 1   |     |     |          |
| HAUSER        | MG         | 81.79     | 43      | 3517      | 1   |     |     |          |
| THADDEUS      | P          | 38.60     | 91      | 3513      | 1   |     |     |          |
| LINSKY        | JL         | 29.67     | 118     | 3501      | 1   |     |     |          |
| TIELENS       | AGGM       | 34.42     | 101     | 3476      | 1   |     |     |          |

atXiv:astro-ph/0005277v2 11 Jun 2000.
| Last Name | First Name | Cite/ Pop | No. Pap | No. Cites | Typ | Hon | Cty | Comments |
|-----------|------------|-----------|---------|-----------|-----|-----|-----|----------|
| WOOSLEY SE | 46.01 | 75 | 3451 | 1 | | | | |
| TAMMANN GA | 79.81 | 43 | 3432 | 1 | | | | |
| ROSNER R | 28.26 | 121 | 3419 | 1 | | | | |
| STEIGMAN G | 50.55 | 67 | 3387 | 1 | | | | |
| GENZEL R | 31.65 | 107 | 3387 | 1 | | | | |
| SNELL RL | 35.33 | 95 | 3375 | 1 | | | | |
| GOSLING JT | 21.80 | 136 | 3373 | 1 | | | | |
| GURNETT DA | 22.73 | 145 | 3296 | 1 | | | | |
| WRIGHT EL | 50.70 | 64 | 3245 | 1 | | | | |
| KIRSHNER RP | 33.24 | 97 | 3224 | 1 | | | | |
| BOKSENBERG A | 30.40 | 105 | 3192 | 1 | | | | |
| KANBACH G | 31.65 | 100 | 3165 | 1 | | | | |
| WHITE NE | 26.15 | 121 | 3164 | 1 | | | | |
| DRAINE BT | 68.76 | 46 | 3163 | 1 | | | | |
| SAVAGE BD | 31.05 | 101 | 3136 | 1 | | | | |
| MARSHALL K | 21.18 | 147 | 3128 | 1 | | | | |
| BALLY J | 38.10 | 82 | 3124 | 1 | | | | |
| WEYMANN RJ | 41.64 | 74 | 3081 | 1 | | | | |
| GEBALLE TR | 18.98 | 161 | 3056 | 1 | | | | |
| BOND JR | 76.30 | 40 | 3052 | 1 | | | | |
| VANDENBERG DA | 63.46 | 48 | 3046 | 1 | | | | |
| DAVIS M | 70.52 | 95 | 6699 | Cg | | | NAS91 | mostly Marc, also Michael M, + others |
| NEUGEBAUER G | 40.32 | 166 | 6693 | Cg | | | NAS73, R96 | Gerry, Greg (p), GT (p) |
| KAISER N | 32.19 | 136 | 4378 | Cg | | | | UK Nick + N (p) |
| SCHMIDT M | 21.02 | 174 | 3657 | Cg | | | R78, NAS78 | Maarten, + others |
| INOUE H | 14.66 | 248 | 3635 | Cg | | | | Ja Hajime, Hiroyuki, + others |
| KOYAMA K | 12.43 | 287 | 3568 | Cg | | | | Ja Katsui, Kazuya, Kouichi, + others |
| HARTMANN L | 38.43 | 89 | 3420 | Cg | | | | Lee W, Lawrence (p) |
| TAYLOR JH | 46.33 | 73 | 3382 | Cg | | | Nov93, H80, NAS81 | Joseph H, + others A16 +185 3 Joseph H |
| BENNETT CL | 40.30 | 83 | 3345 | Cg | | | | Charles L, Charles L (p) |
| GREEN RF | 34.30 | 92 | 3156 | Cg | | | | Richard F, RF (p) A16 +44 1 Richard F |
| NOMOTO K | 27.15 | 116 | 3149 | Cg | | | | Ja Ken-Ichi, Kuninori (p) |
| BECHTOLD J | 44.82 | 68 | 3048 | Cg | | | | Jill, Jeffery J (p) |

Confused–g Astronomers

| Last Name | First Name | Cite/ Pop | No. Pap | No. Cites | Typ | Hon | Cty | Comments |
|-----------|------------|-----------|---------|-----------|-----|-----|-----|----------|
| SUZUKI T | 7.58 | 1401 | 10617 | C | | | | Ja Takao, Tomoharu, Toshhiro, + others |
| ANDERSON PW | 80.30 | 130 | 10439 | C | | | | PW, + others |
| MURPHY DW | 111.04 | 76 | 8439 | C | | | | David W, DW (p) |
| TANAKA K | 7.96 | 1020 | 8122 | C | | | | Ja 4 names, + others A16 +77 1 |
| WISE MB | 57.44 | 138 | 7927 | C | | | | Mark B, Mark B (phys) |
| TAKASHI K | 12.05 | 637 | 7675 | C | | | | Ja many names, + others |
| TANAKA Y | 13.97 | 535 | 7474 | C | | | NAS98 | Ja Yasuo,Yoshio,Yutaka, + others A16 +39 1 Yasuo |
| SATO M | 10.88 | 607 | 6606 | C | | | | Ja Makoto, Massae, + 12 others |
| MURAKAMI T | 22.46 | 291 | 6537 | C | | | | Ja Tadayoshi, Toshih, + others A16 +210 1 |
| SUZUKI K | 7.29 | 791 | 5769 | C | | | | Ja many names, + others |
| TAKASHI T | 9.00 | 628 | 5650 | C | | | | Ja Takamasa,Toru,Toshikazu, + other A16 +66 1 Tadayuki |
| SATO K | 7.69 | 655 | 5636 | C | | | | Ja Ken-Ichi, + others |
| SAITO S | 13.42 | 365 | 4900 | C | | | | Ja Sumisaburo, Shuji, + others |
| GUPTA A | 16.88 | 275 | 4642 | C | | | | In Anjana, Ajay, Alakanda, Alka, Anshu, + others |
| SCHWARZ JH | 79.78 | 55 | 4388 | C | | | | Joseph H, John H (p) |
| TANAKA H | 7.87 | 548 | 4314 | C | | | | Ja Hidekazu, Haruo, + others |
| SATO N | 14.12 | 301 | 4251 | C | | | | Ja Naohiro,Naohisa,Nobuaki, + others A16 +60 2 |
| SHIMIZU T | 10.12 | 409 | 4140 | C | | | | Ja 4 names, + others |
| WANG Y | 8.94 | 456 | 4077 | C | | | | Ch Yi-Ming, Yun, + others |
| ALLEN JW | 31.29 | 130 | 4068 | C | | | | John W, James W (p) |
| SEN A | 19.37 | 202 | 3913 | C | | | | In AK, + others |
| Last Name | First Init | Cite/ No. | No. Pap | No. Cites | Typ | Hon | Cty | Comments                        |
|-----------|------------|-----------|--------|----------|-----|-----|-----|---------------------------------|
| STONE  | AD         | 80.48     | 48     | 3863     |     | C   |     | Abraham D, Alfred D (p)         |
| SAKURAI | T          | 10.43     | 370    | 3858     |     | Ja  |     | many names, + others           |
| KOCH    | RH         | 29.97     | 127    | 3806     |     | C   |     | Robert H, Roger H (p)           |
| WATANABE| T          | 6.02      | 618    | 3722     |     | Ja  |     | 4 names, + others               |
| SUZUKI  | S          | 8.13      | 452    | 3675     |     | Ja  |     | many names, + others           |
| INOUE   | M          | 7.37      | 490    | 3610     |     | Ja  |     | many names, + others           |
| STEWART | GR         | 21.12     | 169    | 3569     |     | C   |     | Glen R, Gregory R (p)           |
| KOYAMA  | K          | 12.43     | 287    | 3568     |     | Ja  |     | Katsui, Kazuya, Kuichi, + others |
| MATSUOKA| M          | 14.37     | 240    | 3449     |     | Ja  |     | Masaru, + others A16 +132 1    |
| SUZUKI  | H          | 6.83      | 504    | 3442     |     | Ja  |     | many names, + others           |
| CHEN    | J          | 8.29      | 415    | 3442     |     | C   |     | Chian-sheng, James, Jun, + other |
| HARTMANN| L          | 38.43     | 89     | 3420     |     | C   |     | Lee W, Lawrence(p)              |
| COHEN   | M          | 19.44     | 174    | 3383     | NAS84|     |     | Marshall H, Martin, + others    |
| KATO    | M          | 8.36      | 393    | 3285     |     | Ja  |     | Mariko, + others                |
| SINGH   | J          | 8.16      | 402    | 3280     |     | In  |     | Jagdev, Jagjit, Jyoti, Jagadish, + others |
| ODA     | M          | 25.90     | 126    | 3263     |     | Ja  |     | Minoru, Mitsuhige, + others     |
| PINES   | D          | 39.80     | 81     | 3224     |     |     |     | David, + Darryl J(p)           |
| HASEGAWA| T          | 11.27     | 286    | 3224     |     | Ja  |     | Takshuito, + others             |
| ITOH    | N          | 13.28     | 242    | 3214     |     | Ja  |     | Naoki, Noboru, Nobunari         |
| YAMAZAKI| T          | 9.00      | 328    | 3148     |     | Ja  |     | Takaehi, Takaki, Toshitsugu, + others |
| KUBO    | Y          | 18.75     | 160    | 3000     |     | Ja  |     | Yoshio, + others                |

Table 2. (continued)
### Table 4. Citation Statistics for 6336 Astronomers

| Interval Ctr/Lim | No. Names in interval | % Names in interval | No. Names in interval | % Names in interval | No. Names in interval | % Names in interval |
|------------------|-----------------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|
|                  |                       |                     |                       |                     |                       |                     |
| Citations/Paper Ratio | Unique-One | Unique-Two | Confused |
| 2.5              | 70                    | 1.52                | 1                     | 0.28                | 127                   | 8.56                |
| 7.5              | 601                   | 13.02               | 7                     | 1.96                | 477                   | 32.14               |
| 12.5             | 1011                  | 21.90               | 45                    | 12.61               | 373                   | 25.13               |
| 17.5             | 928                   | 20.10               | 61                    | 17.09               | 216                   | 14.56               |
| 22.5             | 638                   | 13.82               | 77                    | 21.56               | 101                   | 6.81                |
| 27.5             | 406                   | 8.79                | 56                    | 15.69               | 62                    | 4.18                |
| 32.5             | 223                   | 4.83                | 37                    | 10.36               | 33                    | 2.22                |
| 37.5             | 138                   | 2.99                | 21                    | 5.88                | 27                    | 1.82                |
| 42.5             | 117                   | 2.53                | 13                    | 3.64                | 16                    | 1.08                |
| 47.5             | 65                    | 1.41                | 10                    | 2.80                | 11                    | 0.74                |
| 52.5             | 56                    | 1.21                | 5                     | 1.40                | 7                     | 0.47                |
| 57.5             | 43                    | 0.93                | 6                     | 1.68                | 6                     | 0.40                |
| 62.5             | 36                    | 0.78                | 4                     | 1.12                | 4                     | 0.27                |
| 67.5             | 19                    | 0.41                | 2                     | 0.56                | 3                     | 0.20                |
| 72.5             | 25                    | 0.54                | 3                     | 0.84                | 4                     | 0.27                |
| 77.5             | 20                    | 0.43                | 2                     | 0.56                | 1                     | 0.07                |
| 82.5             | 7                     | 0.15                | 0                     | 0.00                | 3                     | 0.20                |
| 87.5             | 15                    | 0.32                | 0                     | 0.00                | 0                     | 0.00                |
| 92.5             | 5                     | 0.11                | 1                     | 0.28                | 1                     | 0.07                |
| 97.5             | 8                     | 0.17                | 0                     | 0.00                | 0                     | 0.00                |
| 102.5            | 34                    | 0.74                | 0                     | 0.00                | 1                     | 0.07                |
| 107.5            | 7                     | 0.15                | 0                     | 0.00                | 0                     | 0.00                |
| 112.5            | 11                    | 0.24                | 2                     | 0.56                | 1                     | 0.07                |
| 117.5            | 21                    | 0.45                | 0                     | 0.00                | 1                     | 0.07                |
| 122.5            | 8                     | 0.18                | 0                     | 0.00                | 0                     | 0.00                |
| 127.5            | 12                    | 0.26                | 2                     | 0.56                | 0                     | 0.00                |
| 132.5            | 3                     | 0.06                | 0                     | 0.00                | 1                     | 0.07                |
| 137.5            | 4                     | 0.09                | 0                     | 0.00                | 0                     | 0.00                |
| 142.5            | 3                     | 0.06                | 0                     | 0.00                | 0                     | 0.00                |
| 147.5            | 10                    | 0.22                | 0                     | 0.00                | 0                     | 0.00                |
| 152.5            | 6                     | 0.13                | 0                     | 0.00                | 0                     | 0.00                |
| 157.5            | 3                     | 0.06                | 0                     | 0.00                | 0                     | 0.00                |
| 162.5            | 4                     | 0.09                | 1                     | 0.28                | 1                     | 0.07                |
| 167.5            | 5                     | 0.11                | 0                     | 0.00                | 0                     | 0.00                |
| 172.5            | 12                    | 0.26                | 0                     | 0.00                | 1                     | 0.07                |
| 177.5            | 3                     | 0.06                | 0                     | 0.00                | 0                     | 0.00                |
| 182.5            | 3                     | 0.06                | 0                     | 0.00                | 0                     | 0.00                |
| 187.5            | 1                     | 0.02                | 0                     | 0.00                | 2                     | 0.13                |
| 192.5            | 8                     | 0.17                | 0                     | 0.00                | 0                     | 0.00                |
| >200.0           | 28                    | 0.60                | 1                     | 0.28                | 4                     | 0.27                |

### Number of Papers Cited

| Interval Ctr/Lim | No. Names in interval | % Names in interval | No. Names in interval | % Names in interval | No. Names in interval | % Names in interval |
|------------------|-----------------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|
|                  |                       |                     |                       |                     |                       |                     |
| Citations/Paper Ratio | Unique-One | Unique-Two | Confused |
| 5.0              | 762                   | 16.50               | 10                    | 2.80                | 127                   | 8.56                |
| 15.0             | 1116                  | 24.17               | 58                    | 16.25               | 236                   | 15.90               |
| 25.0             | 926                   | 20.06               | 61                    | 17.09               | 199                   | 13.41               |
| 35.0             | 599                   | 12.97               | 57                    | 15.97               | 166                   | 11.19               |
| 45.0             | 433                   | 9.38                | 44                    | 12.32               | 151                   | 10.18               |
| 55.0             | 261                   | 5.65                | 28                    | 7.84                | 113                   | 7.61                |
| 65.0             | 168                   | 3.64                | 35                    | 9.80                | 90                    | 6.06                |
| 75.0             | 126                   | 2.78                | 16                    | 4.48                | 63                    | 4.25                |
| 85.0             | 81                    | 1.75                | 11                    | 3.08                | 54                    | 3.64                |
| 95.0             | 44                    | 0.95                | 12                    | 3.36                | 38                    | 2.56                |
| 105.0            | 39                    | 0.84                | 5                     | 1.40                | 34                    | 2.29                |
| 115.0            | 10                    | 0.22                | 5                     | 1.40                | 19                    | 1.28                |
| 125.0            | 14                    | 0.30                | 6                     | 1.68                | 27                    | 1.82                |
| 135.0            | 13                    | 0.28                | 8                     | 0.84                | 19                    | 1.28                |
| 145.0            | 5                     | 0.11                | 3                     | 0.84                | 2                     | 0.13                |
| Interval Ctr/Lim | No. Names in interval | % Names in interval | No. Names in interval | % Names in interval | No. Names in interval | % Names in interval |
|----------------|-----------------------|--------------------|-----------------------|--------------------|-----------------------|--------------------|
| 155.0          | 3                     | 0.06               | 1                     | 0.28               | 12                    | 0.81               |
| 165.0          | 6                     | 0.13               | 3                     | 0.84               | 18                    | 1.21               |
| 175.0          | 3                     | 0.06               | 0                     | 0.00               | 16                    | 1.08               |
| 185.0          | 3                     | 0.06               | 0                     | 0.00               | 11                    | 0.74               |
| 195.0          | 1                     | 0.02               | 0                     | 0.00               | 5                     | 0.34               |
| 205.0          | 0                     | 0.00               | 0                     | 0.00               | 7                     | 0.47               |
| 215.0          | 0                     | 0.00               | 0                     | 0.00               | 5                     | 0.34               |
| 225.0          | 0                     | 0.00               | 0                     | 0.00               | 4                     | 0.27               |
| 235.0          | 0                     | 0.00               | 0                     | 0.00               | 2                     | 0.13               |
| 245.0          | 1                     | 0.02               | 0                     | 0.00               | 4                     | 0.27               |
| 255.0          | 1                     | 0.02               | 0                     | 0.00               | 4                     | 0.27               |
| 265.0          | 1                     | 0.02               | 0                     | 0.00               | 4                     | 0.27               |
| 275.0          | 0                     | 0.00               | 0                     | 0.00               | 1                     | 0.07               |
| 285.0          | 0                     | 0.00               | 0                     | 0.00               | 2                     | 0.14               |
| 295.0          | 0                     | 0.00               | 0                     | 0.00               | 6                     | 0.40               |
| 305.0          | 0                     | 0.00               | 0                     | 0.00               | 4                     | 0.27               |
| >320.0         | 1                     | 0.02               | 0                     | 0.00               | 36                    | 2.42               |

| Total Citations | Unique-One | Unique-Two | Confused |
|-----------------|------------|------------|----------|
| 125.0           | 1559       | 33.77      | 9        | 2.52 | 460 | 31.00 |
| 375.0           | 1226       | 26.55      | 76       | 21.29 | 372 | 25.07 |
| 625.0           | 676        | 14.64      | 57       | 15.97 | 207 | 13.95 |
| 875.0           | 408        | 8.84       | 56       | 15.69 | 121 | 8.15  |
| 1125.0          | 225        | 4.87       | 34       | 9.52  | 86  | 5.80  |
| 1375.0          | 154        | 3.34       | 34       | 9.52  | 65  | 4.38  |
| 1625.0          | 114        | 2.47       | 22       | 6.16  | 34  | 2.29  |
| 1875.0          | 70         | 1.52       | 13       | 3.64  | 27  | 1.82  |
| 2125.0          | 38         | 0.82       | 11       | 3.08  | 21  | 1.42  |
| 2375.0          | 42         | 0.91       | 12       | 3.36  | 21  | 1.42  |
| 2625.0          | 24         | 0.52       | 7        | 1.96  | 8   | 0.54  |
| 2875.0          | 27         | 0.58       | 4        | 1.12  | 9   | 0.61  |
| 3125.0          | 13         | 0.28       | 5        | 1.40  | 8   | 0.54  |
| 3375.0          | 9          | 0.19       | 2        | 0.56  | 10  | 0.67  |
| 3625.0          | 9          | 0.19       | 1        | 0.28  | 7   | 0.47  |
| 3875.0          | 5          | 0.11       | 2        | 0.56  | 4   | 0.27  |
| 4125.0          | 0          | 0.00       | 5        | 1.40  | 3   | 0.20  |
| 4375.0          | 3          | 0.06       | 1        | 0.28  | 5   | 0.34  |
| 4625.0          | 4          | 0.09       | 1        | 0.28  | 1   | 0.07  |
| 4875.0          | 3          | 0.06       | 1        | 0.28  | 1   | 0.07  |
| 5125.0          | 0          | 0.00       | 2        | 0.56  | 1   | 0.07  |
| 5375.0          | 2          | 0.04       | 0        | 0.00  | 0   | 0.00  |
| 5625.0          | 2          | 0.04       | 0        | 0.00  | 1   | 0.07  |
| 5875.0          | 1          | 0.02       | 0        | 0.00  | 1   | 0.07  |
| 6125.0          | 1          | 0.02       | 0        | 0.00  | 0   | 0.00  |
| 6375.0          | 1          | 0.02       | 0        | 0.00  | 0   | 0.00  |
| 6625.0          | 1          | 0.02       | 0        | 0.00  | 4   | 0.27  |
| 6875.0          | 0          | 0.00       | 0        | 0.00  | 0   | 0.00  |
| 7125.0          | 0          | 0.00       | 0        | 0.00  | 0   | 0.00  |
| 7375.0          | 0          | 0.00       | 1        | 0.28  | 1   | 0.07  |
| 7625.0          | 0          | 0.00       | 0        | 0.00  | 1   | 0.07  |
| 7875.0          | 0          | 0.00       | 0        | 0.00  | 1   | 0.07  |
| 8125.0          | 0          | 0.00       | 1        | 0.28  | 1   | 0.07  |
| 8375.0          | 0          | 0.00       | 0        | 0.00  | 1   | 0.07  |
| >8500.0         | 0          | 0.00       | 0        | 0.00  | 2   | 0.13  |