

Curriculum Vitae

James M. Moran, Jr.

Education: 1963 B.S., University of Notre Dame
1965 S.M., Massachusetts Institute of Technology
1968 Ph.D., Massachusetts Institute of Technology

Professional Experience

1964–1968 Research Assistant, Research Laboratory of Electronics, MIT
1968–1970 Staff Scientist, Group 31–Surveillance Techniques, Lincoln Laboratory, MIT
1970–1981 Radio Astronomer, Smithsonian Astrophysical Observatory (SAO)
1973–1979 Lecturer, Astronomy Department, Harvard University
1979–1989 Professor of the Practice of Astronomy, Harvard University
1981–2020 Senior Radio Astronomer, Smithsonian Astrophysical Observatory
1982–1983 Visiting Research Scientist, Radio Astronomy Lab, University of CA at Berkeley
1987–1992 Associate Director, Radio and Geoastronomy Division,
Harvard-Smithsonian Center for Astrophysics
1989–2000 Professor of Astronomy, Harvard University
1995–2005 Director, SAO Submillimeter Array (SMA)
2001–2016 Donald H. Menzel Professor of Astrophysics, Harvard University
2005– Concurrent Professor of Astronomy, Nanjing University
2006–2011 Chair, Department of Astronomy, Harvard University
2016– Donald H. Menzel Professor of Astrophysics, Emeritus, Harvard University
2020– Research Associate, Smithsonian Astrophysical Observatory

Awards

Rumford Prize (1971) (shared), American Academy of Arts and Sciences
Outstanding Publication Award (1975) (shared), Naval Research Laboratory
Newton Lacy Pierce Prize (1978), American Astronomical Society
Outstanding Publication Award (1979) (shared), Naval Research Laboratory
Senior Humboldt Award (1992), Alexander von Humboldt Stiftung
Jansky Lectureship (1996), National Radio Astronomy Observatory
Grote Reber Gold Medal (2013), Grote Reber Foundation
Diamond Achievement Award (2019), National Science Foundation (to 347 member EHT Collaboration)
Breakthrough Prize in Fundamental Physics (2019) Fundamental Physics Prize Foundation (to 347 member EHT Collaboration)
Bruno Rossi Prize (2020), American Astronomical Society (to 347 member EHT Collaboration)
Oort Professorship (2020), Leiden University

External Committees

1973–1982 Committee on Operations and Proposals, Haystack Observatory, Northeast Radio Observatory Corporation (NEROC)
1976–1982, 1985–1987 Users Committee, National Radio Astronomy Observatory (NRAO)

1976–1992 Network Users Group for the organization of Very Long Baseline Interferometry (Scheduler, 1976–1977; Chair, 1977–1981)

1978–1980 National Advisory Committee, Owens Valley Radio Observatory, California Institute of Technology

1978–1981 Visiting Committee, NRAO (Chair, 1981)

1978–1986 Haystack Scientific Advisory Committee, Haystack Observatory, NEROC

1981–1989 U.S. VLBI Consortium (Executive Officer, 1981–1983; Secretary, 1983–1986; Vice Chair, 1986–1989)

1982–1984 Arecibo Scientific Advisory Committee

1982–1987 Scientific Advisory Committee to NRAO for the Very Long Baseline Array

1982–1989 QUASAT Science Working Group

1982–2017 Board of Trustees, NEROC (Chair, 2009–2017)

1984–1987, 2005–2010, 2016–2019 Committee on Radio Frequencies (CORF), National Academy of Sciences, National Research Council (NAS/NRC)

1986–1987 Chair, Scientific Organizing Committee, International Astronomical Union (IAU) Symposium 129, “The Impact of VLBI on Astrophysics and Geophysics”

1987–1989 FCRAO Proposal Review Committee

1988 NRAO Long Range Planning Committee

1988–1990 Vice Chair, International Union of Radio–Science (URSI), Commission J (US)

1988–2000 IAU Commission 40 (Radio Astronomy) (Scientific Organizing Committee, 1988–1994; Vice President, 1994–1997; President, 1997–2000; also President, Division X, 1997–2000)

1989–1991 Radio Astronomy Panel of the Astronomy and Astrophysics Survey Committee, NAS (Decadal Review)

1990–1996 Scientific Working Group for the Green Bank Telescope

1991–1993 Chair, URSI, Commission J (US)

1995–1997, 2007–2010 Visiting Committee, National Astronomy and Ionosphere Center (Arecibo), (Chair, 1997, 2009)

1995–2004 Scientific Advisory Board (Fachbeirat), Max Planck Institute for Radio Astronomy (Chair, 2001)

1998–2000 Astronomy & Astrophysics Survey Committee, NAS (Decadal Review) (also Vice Chair, Radio Panel)

1998–2014 M.I.T. Barrett Prize Committee

2000–2003, 2006–2009 U.S. National Committee, IAU

2014–2017

2020–

- 2001–2004 Council Delegate, Astronomy Section, American Association for the Advancement of Science
- 2002 Visiting Committee, University of Maryland, Astronomy Department
- 2005 Nominator, MacArthur Fellowship Program
- 2005 Advisory Panel for Large Array HF/VHF Imaging Program, NRL
- 2005–2006 International SKA Site Selection Advisory Committee (ISSAC)
- 2005–2018 Board of Trustees, Associated Universities Inc. (AUI) (ALMA Oversight Committee, 2008–2014; Executive Committee, 2010–2018; NRAO Director Search Committee, 2011–2012; Audit Committee, 2015–2017; Nominating Committee, 2015–2018)
- 2006–2009 Committee on a Survey of the Scientific Uses of the Radio Spectrum, NAS/NRC
- 2007 Haystack Observatory Futures Committee
- 2008–2015 Board of Trustees, Murchison Widefield Array Project (Chair, 2009)
- 2009–2010 Vice Chair, NAS/NRC Panel on Radio Astronomy of the 2010 Decadal Review of Astronomy
- 2009–2011 Co-chair, Section 12 Membership Committee, NAS
- 2010–2015 Advisory Board, Partnership for International Research in Education (PIRE) for NanoGrav Project
- 2011–2012 Chair, Square Kilometer Array (SKA) Site Advisory Committee (SSAC)
- 2013 Hubble Fellowship Selection Panel, Space Telescope Science Institute
- 2013 Selection Committee, Henry Draper Medal, NAS
- 2013 Selection Committee, James Watson Medal, NAS
- 2013 Selection Committee, Grote Reber Medal
- 2014 Advisory Committee, NRL Space Sciences and Space Technology Division
- 2016 Review Panel for Cosmology and Gravity Program, Canadian Institute for Advanced Research

Professional Societies

- American Astronomical Society (1968)
- International Union of Radio Sciences (1968)
- American Association for the Advancement of Science (Fellow, 1982)
- Institute of Electrical and Electronic Engineers (Senior Member, 1983, Fellow, 2002, Life Member, 2010)
- International Astronomical Union (President of Division X and Commission 40, 1997–2000)
- National Academy of Sciences (1998)
- American Academy of Arts and Sciences (2010)
- American Philosophical Society (2020)

General Fields of Interest

Radio astronomy (star formation, masers, interstellar medium, active galactic nuclei, black holes); signal processing; interferometry

Teaching Experience (Harvard University)

1973/F Astronomy 160 (Radio Astronomy)
1975/F Astronomy 218 (Radio Astronomy)
1977/F Astronomy 218 (Radio Astronomy)
1979/F Astronomy 218 (Radio Astronomy)
1981/F Astronomy 150 (Radiation Processes in Astrophysics)
1983/F Astronomy 150 (Radiation Processes in Astrophysics)
1984/F Astronomy 150 (Radiation Processes in Astrophysics)
1986/S Astronomy 218 (Radio Astronomy) (with Mark Reid)
1987/S Astronomy 193 (Noise and Data Analysis in Astrophysics)
1988/S Astronomy 218 (Radio Astronomy)
1989/S Astronomy 193 (Noise and Data Analysis in Astrophysics)
1990/S Astronomy 218 (Radio Astronomy)
1990/F Astronomy 193 (Noise and Data Analysis in Astrophysics)
1992/S Astronomy 218 (Radio Astronomy)
1992/F Astronomy 193 (Noise and Data Analysis in Astrophysics)
1994/S Astronomy 218 (Radio Astronomy)
1994/F Astronomy 193 (Noise and Data Analysis in Astrophysics)
1995/F Astronomy 193 (Noise and Data Analysis in Astrophysics)
1996/S Astronomy 218 (Radio Astronomy)
1998/S Astronomy 218 (Radio Astronomy)
1999/S Astronomy 1 (The Astronomical Universe) (with Simon Steel)
2000/S Astronomy 218 (Radio Astronomy) (with Alyssa Goodman)
2000/F Astronomy 193 (Noise and Data Analysis in Astrophysics)
2001/F Astronomy 218 (Radio Astronomy)
2002/F Astronomy 193 (Noise and Data Analysis in Astrophysics)
2004/S Astronomy 218 (Radio Astronomy)
2005/S Astronomy 193 (Noise and Data Analysis in Astrophysics)
2005/F Astronomy 218 (Radio Astronomy)
2007/S Astronomy 193 (Noise and Data Analysis in Astrophysics)
2007/F Astronomy 218 (Radio Astronomy)
2009/S Astronomy 193 (Noise and Data Analysis in Astrophysics)
2009/F Astronomy 218 (Radio Astronomy)
2011/S Astronomy 193 (Noise and Data Analysis in Astrophysics)
2011/F Astronomy 218 (Radio Astronomy)
2012/F Astronomy 99 (Senior Thesis in Astrophysics)
2013/S Astronomy 99 (Senior Thesis in Astrophysics)
2013/S Astronomy 193 (Noise and Data Analysis in Astrophysics)
2013/F Astronomy 218 (Radio Astronomy)
2013/F Astronomy 99 (Senior Thesis in Astrophysics)
2014/S Astronomy 99 (Senior Thesis in Astrophysics)
1973–
2014 Frequent contributor to sophomore, junior, and senior tutorial program;
Department of Astronomy

Bibliography¹ for James M. Moran, Jr.

Thesis and Reports

- Moran, J.M., “Observations of the Moon Near One Centimeter Wavelength,” S.M. thesis, Massachusetts Institute of Technology, Cambridge, Massachusetts (1965).
- Moran, J.M., “Interferometer Observations of Galactic OH Emission,” Ph.D. thesis, Massachusetts Institute of Technology, Cambridge, Massachusetts (1968). [4]
- Moran, J.M., “Calibration of the Millstone Antenna’s Pointing,” Lincoln Laboratory Technical Memorandum No. 31L-0048 (1969).
- Moran, J.M., “Program to Solve a Magnetic Geometry Problem for Auroral Backscatter,” Lincoln Laboratory Technical Memorandum No. 31L-0047 (1969).
- Rogers, A.E.E., and Moran, J.M., “Very Long Baseline Interferometry as a Means of Worldwide Time Synchronization,” Lincoln Laboratory Technical Report 478 (1970).
- Moran, J.M., and Penfield, H., “Test and Evaluation of Water Vapor Radiometers and Determination of Their Capability to Measure Tropospheric Path Length,” NASA Contract Report NAS5-20975 (1976).
- Moran, J.M., “Notes on Using the VLA for VLBI,” VLA Test Memorandum 128, National Radio Astronomy Observatory, Socorro, New Mexico (1980).
- Moran, J.M., “Program Summary of the U.S. VLBI Network,” 1976–1981 (1981).
- Moran, J.M., “Phased Arrays as VLBA Elements,” NRAO VLBA memo 178 (1983).
- Moran, J.M., Elvis, M.S., Fazio, G.G., Ho, P.T.P., Myers, P.C., Reid, M.J., and Willner, S.P., “A Submillimeter-Wavelength Telescope Array: Scientific, Technical, and Strategic Issues,” SAO Report (1984).
- Division X, Radio Astronomy, “Triennial Summary (1996–1999),” in *Reports on Astronomy*, ed. J. Anderson (ASP, San Francisco), Vol. XXIVA, pp. 347–356 (1999).
- National Research Council, *Handbook of Frequency Allocations and Spectrum Protection for Scientific Uses* (National Academies Press, Washington, DC), 118 pages (2007). K. St. Germain, D. DeBoer, S.W. Ellingson, D.G. Long, J.M. Moran, J. Piepmeier, M. Picket-May, S.C. Reising, D. Smythe, P.A. Vanden Bout, and L. Ziurys.
- National Research Council, *Spectrum Management for Science in the 21st Century* (National Academies Press, Washington, DC), 230 pages (2010). M.H. Cohen, A.J. Gasiewski, D.C. Backer, R. Balstad, S.W. Ellingson, D. Emerson, A.S. Evans, J.T. Johnson, P. Kolodzy, D.B. Kunkee, M.K. Macauley, J.M. Moran, L.G. Mundy, T.J. Pearson, C.S. Ruf, F.S. Solheim, D.H. Staelin, and A.B. Tanner.
- National Research Council, *Views of the U.S. NAS and NAE on Agenda Items at Issue at the World Radiocommunication Conference 2012* (National Academies Press, Washington, DC) (2010). J.R. Piepmeier, M. Davis, S.W. Ellingson, K. Kellermann, D.G. Long, D. McKague, J.M. Moran, M. Picket-May, A.E.E. Rogers, S.C. Reising, A.R. Thompson, L. Van Zee, and L. Ziurys.

¹ Bracketed numbers indicate the number of citations to the work in the ADS survey of astronomy journals as of 10/1/20.

Books

- Thompson, A.R., Moran, J.M., and Swenson, G.W., *Interferometry and Synthesis in Radio Astronomy* (Wiley–Interscience, New York), 1986, 528 pages. [496] Russian edition, 1989. Reprinted by Krieger (Melbourne, FL), 1992.
- Thompson, A.R., Moran, J.M., and Swenson, G.W., *Interferometry and Synthesis in Radio Astronomy* (Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany), 2001, second edition, 692 pages. [487] Chinese edition, 2018.
- Thompson, A.R., Moran, J.M., and Swenson, G.W., *Interferometry and Synthesis in Radio Astronomy* (Springer International Publishing AG, Switzerland), 2017, third edition, 917 pages. [158]

Book Chapters

- Moran, J.M., “Very Long Baseline Interferometer Systems,” in *Methods of Experimental Physics*, **12**, Part C, ed. M.L. Meeks (Academic Press, New York), 174–197 (1976). [11]
- Moran, J.M., “Very Long Baseline Interferometric Observations and Data Reduction,” in *Methods of Experimental Physics*, **12**, Part C, ed. M.L. Meeks (Academic Press, New York), 228–260 (1976). [43]
- Moran, J.M., “Radio Observations of Galactic Masers,” in *Frontiers of Astrophysics*, ed. E.H. Avrett (Harvard University Press, Cambridge, MA), 385–437 (1976). [7]
- Reid, M.J., and Moran, J.M., “Masers,” in *Annual Review of Astronomy and Astrophysics*, **19**, 231–276 (1981). [313]
- Moran, J.M., “Maser Action in Nature,” in *CRC Handbook on Laser Science and Technology*, **1**, Lasers and Masers, ed. M.J. Weber (CRC Press, Boca Raton), 483–506 (1982).
- Ames, H., Bolton, S., Burke, B., ..., Moran, J. (61 authors), “Quasat: Technical Aspects of the Proposed Mission,” in *Quasat: A VLBI Observatory in Space*, Proceedings of a Workshop Held in Gross Enzersdorf, Austria, on June 18–22, 1984, ESA Special Publication, ESA SP-213 (European Space Agency), 27–99 (1984). [2]
- Reid, M.J., and Moran, J.M., “Astronomical Masers,” in *Galactic and Extra Galactic Radio Astronomy*, second edition, eds. K. Kellermann and G. Verschuur (Springer-Verlag, Berlin), 255–293 (1988). [68]
- Moran, J.M., “Masers in the Envelopes of Young and Old Stars,” in *Molecular Astrophysics*, ed. T. Hartquist (Cambridge University Press, Cambridge, UK), 397–423 (1990). [6]
- Moran, J.M., “Progress in the Study of Maser Action in Nature,” in *CRC Handbook on Laser Science and Technology*, ed. M.J. Weber (CRC Press, Boca Raton), 579–588 (1990).
- Moran, J.M., and Dhawan, V., “An Introduction to Calibration Techniques for VLBI,” eds. A. Zensus, P. Diamond, and P. Napier (ASP, San Francisco), ASP Conference Series, **82**, 161–188 (1995).
- Kellermann, K.I. and Moran, J.M., “The Development of High-Resolution Imaging in Radio Astronomy,” in *Annual Reviews of Astronomy and Astrophysics* **39**, 457–509 (2001). [27]

Books Edited

- Reid, M.J., and Moran, J.M., *The Impact of VLBI on Astrophysics and Geophysics*, Proceedings of IAU Symposium 129 (D. Reidel, Dordrecht), 1988, 599 pages. [4]

- Moran, J.M., and Ho, P.T.P., *Interstellar Matter*, Proceedings of a Symposium on Interstellar Molecules and Grains in Honor of Alan H. Barrett (Gordon and Breach, New York), 1988, 418 pages.
- Moran, J.M., Hewitt, J.N., and Lo, K.-Y., *Gravitational Lenses* (Springer-Verlag, Berlin), 1989, 238 pages. [20]
- Backer, D.C., Turner, J.L., and Moran, J.M., *Revealing the Molecular Universe: One Antenna Is Never Enough*, Proceedings of a Symposium in Honor of the Academic Retirement of Jack Welch, held at University of California, Berkeley, September 9–10, 2005, ASP Conference Series, **356** (ASP, San Francisco), 2006, 314 pages.

Book Reviews

- Moran, J., “The Golden Age of Australian Radio Astronomy,” book review of *Four Pillars of Radio Astronomy: Mills, Christiansen, Wild, and Bracewell*, R.H. Frater, W.M. Goss, and H.W. Wendt (Springer, 2017), *Physics Today*, **71**, 59 (2018). doi: 10.1063/PT.3.4024.

Popular Articles

- Moran, J.M., “Interstellar Hydroxyl Clouds,” *Science Journal*, **5A**, 60 (1969).
- Moran, J.M., “Black Holes”, in *McGraw-Hill Yearbook of Science and Technology*, ed. S.P. Parker (McGraw-Hill, New York), 51–54 (1996).
- Moran, J.M., “Nanjing’s Historic Refractor,” *Sky & Telescope*, **105:2**, 86, Feb. 2003.
- Moran, J., “The Submillimeter Array,” *The Magellanic Times*, Day Seven, IAU General Assembly 25 (2003).
- Kondratko, P.T., Greenhill, L.J., and Moran, J.M., “Thick, Flared, Disorganized, and Clumpy Accretion Disk in NGC 3079,” *NRAO Newsletter*, **97** (Oct. 2003).

Obituaries

- Myers, P.C., Moran, J.M., and Ho, P.T.P., “Alan H. Barrett—Obituary,” *Physics Today*, **45**, 97–98 (1992).
- Moran, J.M., Kirby, K., Chance, K., and Brown, J., “Harrison Radford—Obituary,” *Bull. A.A.S.*, **35**, 1470–72 (2003).
- Dalgarno, A., Moran, J., Sasselov, D., Thaddeus, P., Thielemann, F., Wasserburg, G., Wood, J., and Field, G., “Alastair Graham Walter Cameron,” Faculty of Arts and Sciences—Memorial Minute, *Harvard Gazette* (Dec. 17, 2009).
- Moran, J.M., “Donald Charles Backer—Obituary,” *Physics Today*, **64(7)**, 61–62 (2011).
- Moran, J.M., “John Peter Huchra—Obituary,” *Physics Today*, **64(10)**, 66 (2011).
- McElroy, M., Moran, J., Sadeghpour, H., and Shapiro, I., “Alexander Dalgarno—Memorial Minute,” *Harvard Gazette* (Nov. 2, 2016).
- Dinger Dickinson, A., and Moran, J., “Dale Flint Dickinson—Obituary,” *Bull. A.A.S.*, **49(1)** (Dec. 1, 2017).
- Moran, J., “George W. Swenson Jr.—Obituary,” *Bull. A.A.S.*, **49(1)** (Dec. 1, 2017).
- Dame, T., Grindlay, Wilson, R., and Moran, J., “Patrick Thaddeus—Memorial Minute,” *Harvard Gazette* (May 9, 2019).

Nature News and Views

- Moran, J.M., “Masers in the Nuclei of Galaxies,” *Nature*, **310**, 270–271 (1984). [12]
- Moran, J.M., “Astronomical Masers—Violent Motions in Galactic Core,” *Nature*, **361**, 17–18 (1993).
- Moran, J.M., “Astrophysics: More Light on a Peculiar Galaxy,” *Nature*, **370**, 98–99 (1994).

Articles in Refereed Journals

1966

- 1 Rogers, A.E.E., Moran, J.M., Crowther, P.P., Burke, B.F., Ball, J.A., Meeks, M.L., and Hyde, G.M., “Interferometric Study of Cosmic Line Emission at OH Frequencies,” *Phys. Rev. Letters*, **17**, 450–451 (1966). [24]

1967

- 2 Rogers, A.E.E., Moran, J.M., Crowther, P.P., Burke, B.F., Meeks, M.L., Ball, J.A., and Hyde, G.M., “The Positions and Angular Extent of OH Emission Associated with the H II Regions in W3, W24, W49, and NGC6334,” *ApJ*, **147**, 369–377 (1967). [24]
- 3 Moran, J.M., Barrett, A.H., Rogers, A.E.E., Burke, B.F., Zuckerman, B., Penfield, H., and Meeks, M.L., “Observations of OH Emission in the H II Region W3 with a 74400-Wavelength Interferometer,” *ApJL*, **148**, L69–L72 (1967). [13]
- 4 Moran, J.M., Crowther, P.P., Burke, B.F., Barrett, A.H., Rogers, A.E.E., Ball, J.A., Carter, J.C., and Bare, C., “Spectral Line Interferometry with Independent Time Standards at Stations Separated by 845 Kilometers,” *Science*, **157**, 676–677 (1967). [26]

1968

- 5 Moran, J.M., Burke, B.F., Barrett, A.H., Rogers, A.E.E., Carter, J.C., Ball, J.A., and Cudaback, D.D., “The 18-cm Flux of the Unresolved Component of 3C273,” *ApJL*, **151**, L99–L101 (1968). [4]
- 6 Moran, J.M., Burke, B.F., Barrett, A.H., Rogers, A.E.E., Carter, J.C., Ball, J.A., and Cudaback, D.D., “The Structure of the OH Source in W3,” *ApJL*, **152**, L97–L101 (1968). [81]

1970

- 7 Wilson, W.J., Barrett, A.H., and Moran, J.M., “OH Radio Emission Associated with Infrared Stars,” *ApJ*, **160**, 545–571 (1970). [114]
- 8 Burke, B.F., Papa, D.C., Papadopoulos, G.D., Schwartz, P.R., Knowles, S.H., Sullivan, W.T., Meeks, M.L., and Moran, J.M., “Studies of H₂O Sources by Means of a Very-Long-Baseline Interferometer,” *ApJL*, **160**, L63–L68 (1970). [32]
- 9 Hagfors, T., and Moran, J.M., “Detection and Estimation Practices in Radio and Radar Astronomy,” *Proc. of I.E.E.E.*, **58:5**, 743–759 (1970).
- 10 Rönnäng, B.O., Rydbeck, O.E.H., and Moran, J.M., “Very Long Baseline Interferometry of Galactic OH Sources,” *Radio Science*, **5**, 1227–1231 (1970). [2]

1971

- 11 Johnston, K.J., Knowles, S.H., Sullivan, W.T., Moran, J.M., Burke, B.F., Lo, K.-Y., Papa, D.C., Papadopoulos, G.D., Knight, C.A., Shapiro, I.I., and Welch, W.J., “An Interferometer Map of the Water Vapor Sources in W49,” *ApJL*, **166**, L21–L26 (1971). [30]
- 12 Evenson, K.M., Radford, H.E., and Moran, J.M., “CH Free Radicals Detected by Infrared Laser Magnetic Resonance,” *Applied Phys. Letters*, **18**, 426–429 (1971). [50]

1972

- 13 Hinteregger, H.F., Shapiro, I.I., Robertson, D.S., Knight, C.A., Ergas, R.A., Whitney, A.R., Rogers, A.E.E., Moran, J.M., Clark, T.A., and Burke, B.F., “Precision Geodesy via Radio Interferometry,” *Science*, **178**, 396–398 (1972). [31]
- 14 Burke, B.F., Johnston, K.J., Efanov, V.A., Clark, B.G., Kogan, L.R., Kostenko, V.I., Lo, K.-Y., Matveyenko, L.I., Moiseev, I.G., Moran, J.M., Knowles, S.H., Papa, D.C., Papadopoulos, G.D., Rogers, A.E.E., and Schwartz, P.R., “Observations of Maser Radio Sources with an Angular Resolution of $0^{\circ}.0002$,” *Soviet Astronomy*, **16**, 379–382 (1972). [15] *Astron. Zh.*, **49**, 465–469 (1972). [10]

1973

- 15 Knowles, S.H., Johnston, K.J., Moran, J.M., and Ball, J.A., “Interferometric Observations of the $2\text{II}_{3/2} J = 5/2$ State of Interstellar OH,” *ApJL*, **180**, L117–L121 (1973). [17]
- 16 Moran, J.M., “Spectral-Line Analysis of Very Long Baseline Interferometric Data,” *Proc. of I.E.E.E.*, **61:9**, 1236–1242 (1973). [26]
- 17 Moran, J.M., Papadopoulos, G.D., Burke, B.F., Lo, K.-Y., Schwartz, P.R., Thacker, D.L., Johnston, K.J., Knowles, S.H., Reisz, A.C., and Shapiro, I.I., “Very Long Baseline Interferometric Observations of the H_2O Sources in W49N, W3(OH), Orion A, and VY Canis Majoris,” *ApJ*, **185**, 535–567 (1973). [93]
- 18 Reisz, A.C., Shapiro, I.I., Moran, J.M., Papadopoulos, G.D., Burke, B.F., Lo, K.-Y., and Schwartz, P.R., “W3(OH): Accurate Relative Positions of Water Vapor Emission Features,” *ApJ*, **186**, 537–544 (1973). [7]

1974

- 19 Knowles, S.H., Johnston, K.J., Moran, J.M., Burke, B.F., Lo, K.-Y., and Papadopoulos, G.D., “Further Interferometer Observations of the Water Vapor Sources in W49,” *Astron. J.*, **79**, 925–932 (1974). [29]

1975

- 20 Mader, G.L., Johnston, K.J., Moran, J.M., Knowles, S.H., Mango, S.A., Schwartz, P.R., and Waltman, W.B., “The Relative Positions of the OH and H_2O Masers in W49N and W3(OH),” *ApJL*, **200**, L111–L114 (1975). [26]
- 21 Lo, K.-Y., Walker, R.C., Burke, B.F., Moran, J.M., Johnston, K.J., and Ewing, M.S., “Evidence for Zeeman Splitting in 1720 MHz OH Line Emission,” *ApJ*, **202**, 650–654 (1975). [55]

1976

- 22 Lo, K.-Y., Morris, M., Moran, J.M., and Haschick, A.D., “The Unusual H_2O Maser Source Near Herbig-Haro Object 11,” *ApJL*, **204**, L21–L24 (1976). [29]
- 23 Walker, R.C., Lo, K.-Y., Burke, B.F., Johnston, K.J., and Moran, J.M., “6-Centimeter Observations of Radio Galaxies Over a 228-Kilometer Baseline,” *ApJ*, **208**, 296–297 (1976). [6]
- 24 Barrett, A.H., Bologna, J.M., Cheung, A.C., Chui, M.F., Ho, P.T.P., Johnston, K.J., Martin, R.N., Matsakis, D., Moran, J.M., and Schwartz, P.R., “A Lower Limit to the Angular Size of the Methanol Source in Orion,” *AstrophysJ*, **18**, L13–L14 (1976). [5]

1977

- 25 Johnston, K.J., Knowles, S.H., Moran, J.M., Burke, B.F., Lo, K.-Y., Papadopoulos, G.D., Read, R.B., and Hardebeck, E.G., “Observations of H₂O Masers with a Resolution of 0.0008 Arcsec,” *Astron. J.*, **82**, 403–407 (1977). [13]
- 26 Moran, J.M., Ball, J.A., Yen, J.L., Schwartz, P.R., Johnston, K.J., and Knowles, S.H., “Very Long Baseline Interferometric Observations of OH Masers Associated with Infrared Stars,” *ApJ*, **211**, 160–169 (1977). [32]
- 27 Reid, M.J., Muhleman, D.O., Moran, J.M., Johnston, K.J., and Schwartz, P.R., “The Structure of the Stellar Hydroxyl Masers,” *ApJ*, **214**, 60–77 (1977). [144]
- 28 Moran, J.M., Johnston, K.J., Spencer, J.H., and Schwartz, P.R., “Observations of the SiO and H₂O Masers in Orion A,” *ApJ*, **217**, 434–441 (1977). [23]
- 29 Hansen, S.S., Moran, J.M., Reid, M.J., Johnston, K.J., Spencer, J.H., and Walker, R.C., “The Hydroxyl Masers in the Orion Nebula,” *ApJL*, **218**, L65–L69 (1977). [22]

1978

- 30 Rosen, B.R., Moran, J.M., Reid, M.J., Walker, R.C., Burke, B.F., Johnston, K.J., and Spencer, J.H., “Observations of OH and H₂O Microwave Maser Emission from VY Canis Majoris,” *ApJ*, **222**, 132–139 (1978). [43]
- 31 Genzel, R., Downes, D., Moran, J.M., Johnston, K.J., Spencer, J.H., Walker, R.C., Haschick, A., Matveyenko, L.I., Kogan, L.R., Kostenko, V.I., Rönnäng, B., Rydbeck, O.E.H., and Moiseev, I.G., “Structure and Kinematics of H₂O Sources in Clusters of Newly Formed OB Stars,” *Astron&Astrophys.*, **66**, 13–29 (1978). [130]
- 32 Mader, G.L., Johnston, K.J., and Moran, J.M., “The Spatial Distribution of the OH and H₂O Masers Associated with W3(OH), W49N, and W51,” *ApJ*, **224**, 115–124 (1978). [30]
- 33 Moran, J.M., Reid, M.J., Lada, C.J., Johnston, K.J., Spencer, J.H., and Yen, J.L., “Evidence for the Zeeman Effect in the OH Emission from W3(OH),” *ApJL*, **224**, L67–L71 (1978). [102]
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