

CURRICULUM VITAE AND BIBLIOGRAPHY
JOAN MARIE WROBEL
2011 SEPTEMBER 29

1 Personal

Date of birth: 1954 January 15

Place of birth: Edson, Alberta, Canada

Citizenship: Canadian

Marital status: Married to Robert Craig Walker

US INS status: Permanent US resident

2 Education

1983: Ph.D. (Astronomy), University of Toronto, Toronto, Ontario, Canada

1978: M.S. (Astronomy), University of Toronto, Toronto, Ontario, Canada

1976: B.S. (Honors Physics), University of Alberta, Edmonton, Alberta, Canada

1972: Matriculation, Parkland Composite High School, Edson, Alberta, Canada

3 Support, Research, and Teaching Positions

2011: Observatory Science Operations (OSO) Department Head for Observatory Time Allocation, National Radio Astronomy Observatory (NRAO), Socorro, NM, USA

2001-2011: Scientist and Scheduling Officer, NRAO, Socorro, NM, USA

2010-2011: Faculty Adjunct, New Mexico Institute of Mining and Technology, Socorro, NM, USA

2008-2013: Scientific Editor, The Astrophysical Journal, NRAO, Socorro, NM, USA

1997-2001: Scientist & Division Head for Array and Correlator Operations, NRAO, Socorro, NM, USA

1992-1997: Associate Scientist, NRAO, Socorro, NM, USA

1994: Science and Engineering Research Council Visiting Fellow, Jodrell Bank, UK

1989-1992: Assistant Scientist, NRAO, Socorro, NM, USA

1985-1989: Research Collaborator (unpaid), VLA, Socorro, NM, USA

1985-1989: Visiting Assistant Professor, Physics Department, New Mexico Institute of Mining and Technology, Socorro, NM, USA

1983-1985: Postdoctoral Research Fellow, Caltech, Pasadena, CA, USA

1980-1983: Predoctoral Research Fellow, NRAO, Charlottesville, VA, USA

1976-1977: Teaching Assistant, Department of Astronomy, University of Toronto, Toronto, Ontario, Canada

1975: Undergraduate Summer Student, Herzberg Institute of Astrophysics, National Research Council of Canada, Ottawa, Ontario, Canada

1974: Undergraduate Summer Student, TRIUMF Project, University of British Columbia, Vancouver, BC, Canada

4 Key Responsibilities

Proposal Evaluation, Time Allocation & Telescope Scheduling 2011: OSO Department Head for Observatory Time Allocation. Lead the implementation of a semester-based, community-driven process for proposal evaluation and time allocation for NRAO telescopes; support that process. Lead the implementation of a 24/7 process for handling Director's Discretionary proposals for NRAO telescopes; support that process. EVLA Scheduling Officer. EVLA Resident Shared Risk Observing Committee. EVLA Commissioning Review Committee. Optimize EVLA early science output. Optimize EVLA configuration durations. Dynamic scheduling of EVLA shared-risk observations. Dynamic scheduling of EVLA test observations. Documentation. Newsletters and news e-mails. OSO presentations. schedsoc account and homepage. Subsystem scientist for EVLA Observation Scheduling Tool. Subsystem scientist for EVLA Project Builder Tool. Proposal writing lecture at summer schools.

Proposal Evaluation, Time Allocation & Telescope Scheduling 2001-2010: EVLA Scheduling Officer. EVLA/VLBA Proposal Selection Committee. EVLA Resident Shared Risk Observing Committee. EVLA Commissioning Review Committee. Optimize EVLA early science output. Optimize EVLA configuration durations. Dynamic scheduling of EVLA shared-risk observations. Dynamic scheduling of EVLA test observations. Proposal handling, reviewing, selecting, disposition (both for three proposal calls per year and for 24/7 rapid response science). Documentation. Newsletters and news e-mails. schedsoc account and homepage. Subsystem scientist for EVLA Observation Scheduling Tool. Subsystem scientist for EVLA Project Builder Tool. Proposal writing lecture at summer schools.

EVLA Observer Support: Consultation. Documentation.

Scientific Editor, The Astrophysical Journal (ApJ)

Research. Collaborations. Mentoring.

5 Recent Abstracts in Refereed Journals

- *A Kiloparsec-Scale Binary Active Galactic Nucleus Confirmed by the Expanded Very Large Array*, H. Fu, Z. Zhang, R.J. Assef, A. Stockton, A.D. Myers, L. Yan, S.G. Djorgovski, J.M. Wrobel & D.A. Riechers, 2011, *ApJ*, 740, L44: We report the confirmation of a kpc-scale binary active galactic nuclei (AGNs) with high-resolution radio images from the Expanded Very Large Array (EVLA). SDSS J150243.1+111557 is a double-peaked [OIII] AGN at $z = 0.39$ selected from the Sloan Digital Sky Survey. Our previous near-infrared adaptive optics imaging reveals two nuclei separated by 1.4 arcsec (7.4 kpc), and our optical integral-field spectroscopy suggests that they are a type-1–type-2 AGN pair. However, these data alone cannot rule out the single AGN scenario where the narrow emission-line region associated with the secondary is photoionized by the broad-line AGN in the primary. Our new EVLA images at 1.4,

5.0, and 8.5 GHz show two steep-spectrum compact radio sources spatially coincident with the optical nuclei. The radio power of the type-2 AGN is an order-of-magnitude in excess of star-forming galaxies with similar extinction-corrected [OII]3727 luminosities, indicating that the radio emission is powered by accretion. Therefore, SDSS J150243.1+111557 is one of the few confirmed kpc-scale binary AGN systems. Spectral-energy-distribution modeling shows that SDSS J150243.1+111557 is a merger of two $\sim 10^{11} M_{\odot}$ galaxies. With both black hole masses around $10^8 M_{\odot}$, the AGNs are accreting at ~ 10 times below the Eddington limit. *Key words: galaxies: active — galaxies: interactions — galaxies: nuclei — galaxies: individual (SDSS J150243.1+111557)*

- *The Candidate Intermediate-Mass Black Hole in the Globular Cluster M54, J.M. Wrobel, J.E. Greene & L.C. Ho, 2011, AJ, 142, 113:* Ibata et al. reported evidence for density and kinematic cusps in the Galactic globular cluster M54, possibly due to the presence of a $9400 M_{\odot}$ black hole. Radiative signatures of accretion onto M54’s candidate intermediate-mass black hole (IMBH) could bolster the case for its existence. Analysis of new *Chandra* and recent *Hubble Space Telescope* astrometry rules out the X-ray counterpart to the candidate IMBH suggested by Ibata et al. If an IMBH exists in M54, then it has an Eddington ratio of $L(0.3 - 8 \text{ keV})/L(\text{Edd}) < 1.4 \times 10^{-10}$, more similar to that of the candidate IMBH in M15 than that in G1. From new imaging with the NRAO Very Large Array, the luminosity of the candidate IMBH is $L(8.5 \text{ GHz}) < 3.6 \times 10^{29} \text{ ergs s}^{-1}$ (3σ). Two background active galaxies discovered toward M54 could serve as probes of its intracluster medium. *Key words: black hole physics — globular clusters: individual (M54) — radio continuum: general — X-rays: general*
- *The Expanded Very Large Array: A New Telescope for New Science, R.A. Perley, C.J. Chandler, B.J. Butler & J.M. Wrobel, 2011, ApJ, 739, L1 (Special Issue on Early Science with the EVLA):* Since its commissioning in 1980, the Very Large Array (VLA) has consistently demonstrated its scientific productivity. However, its fundamental capabilities have changed little since 1980, particularly in the key areas of sensitivity, frequency coverage, and velocity resolution. These limitations have been addressed by a major upgrade of the array, which began in 2001 and will be completed at the end of 2012. When completed, the Expanded VLA – the EVLA – will provide complete frequency coverage from 1 to 50 GHz, a continuum sensitivity of typically $1 \mu\text{Jy}/\text{beam}$ (in 9 hours with full bandwidth), and a modern correlator with vastly greater capabilities and flexibility than the VLA’s. In this paper we describe the goals of the EVLA project, its current status, and the anticipated expansion of capabilities over the next few years. User access to the array through the OSRO and RSRO programs is described. The following papers in this special issue, derived from observations in its early science period, demonstrate the astonishing breadth of this most flexible and powerful general-purpose telescope. *Key words: telescopes*
- *Parsec-Scale Localization of the Quasar SDSS J1536+0441A, a Candidate Binary Black Hole System, J.M. Wrobel & A. Laor, 2010, ApJ, 714, L29:* The radio quiet quasar (RQQ) SDSS J1536+0441A shows two broad-line emission systems, recently interpreted as a binary black hole (BBH) system with a subparsec separation; as a double-peaked emitter; or as both types of systems. The NRAO VLBA was used to search for 8.4 GHz emission from SDSS J1536+0441A, focusing on the optical localization region for the broad-line emission, of area 5400 mas^2 (0.15 kpc^2). One source was detected, with a diameter of less than 1.63 mas (8.5 pc) and a brightness temperature $T_b > 1.2 \times 10^7 \text{ K}$. New NRAO VLA photometry at 22.5 GHz, and earlier photometry at 8.5 GHz, gives a rising spectral slope of $\alpha = 0.35 \pm 0.08$. The

slope implies an optically thick synchrotron source, with a radius of about 0.04 pc, and thus T_b 5×10^{10} K. The implied radio sphere at the rest frequency 31.2 GHz has a radius of 800 gravitational radii, just below the size of the broad line region in this object. Observations at higher frequencies can probe whether or not the radio sphere is as compact as expected from the coronal framework for the radio emission of RRQ. *Key words: black hole physics — quasars: individual (SDSS J153636.22+044127.0) — radio continuum: general*

- *SDSS J1254+0846: A Binary Quasar Caught in the Act of Merging*, P.J. Green, A.D. Myers, W.A. Barkhouse, J.S. Mulchaey, V.N. Bennert, T.J. Cox, T.L. Aldcroft, & J.M. Wrobel, 2010, *ApJ*, 710, 1578; *press releases by Chandra, Carnegie, NOAO; YouTube video*: We present the first luminous, spatially resolved binary quasar that clearly inhabits an ongoing galaxy merger. SDSS J125455.09+084653.9 and SDSS J125454.87+084652.1 (SDSS J1254+0846 hereafter) are two luminous $z = 0.44$ radio-quiet quasars, with a radial velocity difference of just 215 km s^{-1} , separated on the sky by 21 kpc in a disturbed host galaxy merger showing obvious tidal tails. The pair was targeted as part of a complete sample of binary quasar candidates with small transverse separations drawn from SDSS DR6 photometry. We present follow-up optical imaging which shows broad, symmetrical tidal arm features spanning some 75 kpc at the quasars' redshift. Previously, the triggering of two quasars during a merger had only been hypothesized but our observations provide strong evidence of such an event. SDSS J1254+0846, as a face-on, pre-coalescence merger hosting two luminous quasars separated by a few dozen kpc, provides a unique opportunity to probe quasar activity in an ongoing gas-rich merger. Numerical modeling suggests that the system consists of two massive disk galaxies prograde to their mutual orbit, caught during the first passage of an active merger. This demonstrates rapid black hole growth during the early stages of a merger between galaxies with pre-existing bulges. Neither of the two luminous nuclei show significant intrinsic absorption by gas or dust in our optical or X-ray observations, illustrating that not all merging quasars will be in an obscured, ultraluminous phase. We find that the Eddington ratio for the fainter component B is rather normal, while for the A component L/L_{Edd} is quite (≈ 3) high compared to quasars of similar luminosity and redshift, possibly evidence for strong merger-triggered accretion. More such mergers should be identifiable at higher redshifts using binary quasars as tracers. *Key words: black hole physics; galaxies: active; galaxies: interactions; galaxies: nuclei; quasars: emission lines*
- *VLBA Observations of Sub-Parsec Structure in Mrk 231: Interaction between a Relativistic Jet and a BAL Wind*, C. Reynolds, B. Punsly, P. Kharb, C.P. O'Dea & J.M. Wrobel, 2009, *ApJ*, 706, 851: We report on the first high frequency VLBI observations of the nearby broad absorption line quasar (BALQSO), Mrk 231. Three epochs of observations were achieved at 15 GHz and 22 GHz, two of these included 43 GHz observations as well. The nuclear radio source is resolved as a compact double. The core component experienced a strong flare in which the flux density at 22 GHz increased by $> 150\%$ (45 mJy) in three months. Theoretical models of the flare imply that the emission is likely enhanced by very strong Doppler boosting of a highly relativistic ejecta with a kinetic energy flux, $Q \sim 3 \times 10^{43}$ ergs/s. Combining our data with two previous epochs of 15 GHz data shows marginal evidence for the slow advance of the secondary component (located ≈ 0.97 pc from the core) over a 9.4 year span. We estimate that the long term time averaged kinetic energy flux of the secondary at $\bar{Q} \approx 10^{42}$ ergs/s. Low frequency VLBA observations indicate that the secondary is seen through a shroud of free-free absorbing gas with an emission measure of $\approx 10^8 \text{ cm}^{-6} \text{ pc}$. The steep spectrum secondary component appears to be a compact radio lobe that is associated with a

working surface between the ram - pressure confined jet, and a dense medium that is likely to be the source of the free-free absorption. The properties of the dense gas are consistent with the temperatures, displacement from the nucleus and the column density of total hydrogen commonly associated with the BAL wind. *Key words: quasars: absorption lines — galaxies: active — accretion disks — black holes*

- *Discovery of Radio Emission from the Quasar SDSS J1536+0441, a Candidate Binary Black Hole System, J.M. Wrobel & A. Laor, 2009, ApJ, 699, L22:* The radio-quiet quasar SDSS J1536+0441 shows two broad-line emission systems that Boroson & Lauer interpret as a candidate binary black hole system with a separation of 0.1 pc (0.02 mas). From new VLA imaging at 8.5 GHz, two faint sources, separated by 0.97 arcsec (5.1 kpc), have been discovered within the quasar’s optical localization region. Each radio source is unresolved, with a diameter of less than 0.37 arcsec (1.9 kpc). A double radio structure is seen in some other radio-quiet quasars, and the double may be energized here by the candidate 0.1 pc binary black hole system. Alternatively, the radio emission may arise from a binary system of quasars with a projected separation of 5.1 kpc, and the two quasars may produce the two observed broad-line emission systems. Binary active galactic nuclei with a kpc scale separation are known from radio and X-ray observations, and a few such system are expected in the Boroson & Lauer sample based on the observed clustering of quasars down to the 10 kpc scale. Future observations designed to distinguish between the 0.1 pc and 5 kpc scales for the binary system are suggested. *Key words: quasars: individual (SDSS J1536+0441) — radio continuum: general — X-rays: general*
- *Steep-Spectrum Radio Emission from the Low-Mass Active Galactic Nucleus GH 10, J.M. Wrobel, J.E. Greene, & L.C. Ho, 2008, ApJ, 686, 838:* GH 10 is a broad-lined active galactic nucleus (AGN) energized by a black hole of mass $800,000 M_{\odot}$. It was the only object detected by Greene et al. in their Very Large Array (VLA) survey of 19 low-mass AGNs discovered by Greene & Ho. New VLA imaging at 1.4, 4.9, and 8.5 GHz reveals that GH 10’s emission has an extent of less than 320 pc, has an optically-thin synchrotron spectrum with a spectral index $\alpha = -0.76 \pm 0.05$ ($S_{\nu} \propto \nu^{+\alpha}$), is less than 11% linearly polarized, and is steady - although poorly sampled - on timescales of weeks and years. Circumnuclear star formation cannot dominate the radio emission, because the high inferred star formation rate, $18 M_{\odot} \text{ yr}^{-1}$, is inconsistent with the rate of less than $2 M_{\odot} \text{ yr}^{-1}$ derived from narrow H α and [O II] $\lambda 3727$ emission. Instead, the radio emission must be mainly energized by the low-mass black hole. GH 10’s radio properties match those of the steep-spectrum cores of Palomar Seyfert galaxies, suggesting that, like those Seyferts, the emission is outflow-driven. Because GH 10 is radiating close to its Eddington limit, it may be a local analog of the starting conditions, or seeds, for supermassive black holes. Future imaging of GH 10 at higher linear resolution thus offers an opportunity to study the relative roles of radiative versus kinetic feedback during black-hole growth. *Key words: galaxies: active — galaxies: individual (GH 10) — galaxies: nuclei — galaxies: Seyfert — radio continuum: galaxies*
- *Outflow-Dominated Emission from the Quiescent Massive Black Holes in NGC4621 and NGC4697, J.M. Wrobel, Y. Terashima, & L.C. Ho, 2008, ApJ, 675, 1041:* The nearby elliptical galaxies NGC4621 and NGC4697 each host a supermassive black hole with $M_{\bullet} > 10^8 M_{\odot}$. Analysis of archival *Chandra* data and new NRAO VLA data shows that each galaxy contains a low-luminosity active galactic nucleus (LLAGN), identified as a faint, hard X-ray source that is astrometrically coincident with a faint 8.5-GHz source. The latter has a diameter less than 0.3” (26 pc for NGC4621, 17 pc for NGC4697). The black holes energizing these

LLAGNs have Eddington ratios $L(2 - 10 \text{ keV})/L(\text{Edd}) \sim 10^{-9}$, placing them in the so-called quiescent regime. The emission from these quiescent black holes is radio-loud, with $\log R_X = \log \nu L_\nu(8.5 \text{ GHz})/L(2 - 10 \text{ keV}) \sim -2$, suggesting the presence of a radio outflow. Also, application of the radio–X-ray–mass relation from Yuan & Cui for quiescent black holes predicts the observed radio luminosities $\nu L_\nu(8.5 \text{ GHz})$ to within a factor of a few. Significantly, that relation invokes X-ray emission from the outflow rather than from an accretion flow. The faint, but detectable, emission from these two massive black holes is therefore consistent with being outflow-dominated. Observational tests of this finding are suggested. *Key words:* galaxies: active — galaxies: individual (NGC4621, NGC4697) — galaxies: nuclei — radio continuum: galaxies — X-rays: galaxies

6 Scholarships, Fellowships, and Prizes

2011: NRAO Star Award

1994: Science and Engineering Research Council Visiting Fellowship, Jodrell Bank

1985: Research Fellowship, Caltech

1983-1985: Natural Sciences and Engineering Research Council of Canada Postdoctoral Fellowship, Caltech

1981-1982: NRAO Junior Research Associateship, NRAO

1980-1981: Amelia Earhart Fellowship Award, NRAO

1979-1980: Natural Sciences and Engineering Research Council of Canada Postgraduate Scholarship, University of Toronto

1977-1979: National Research Council of Canada Postgraduate Scholarship, University of Toronto

1976-1977: Walter Helm Fellowship in Astronomy, University of Toronto

1973-1976: Province of Alberta Undergraduate Scholarship, University of Alberta

1973-1974: Interprovincial Pipe Line Company Bursary, University of Alberta

1973-1974: Cyril G. Wates Memorial Prize in Astronomy, University of Alberta

1972-1973: Friends of the University Bursary, University of Alberta

1972-1973: Province of Alberta Matriculation Scholarship, University of Alberta

1972-1973: Prizes in English and Mathematics from Parkland Composite High School

7 Research Grants

2008-2013: Start-Up Grant (\$5,500) and Annual Research Grant (\$10,000) from AAS for Scientific Editorship, The Astrophysical Journal. Held at NRAO.

1986-1990: Studies of Radio Sources in E/S0 Galaxies and Polarization Properties of Compact Radio Sources. National Science Foundation. Requested \$71,000 US and awarded \$71,000 US. Held at New Mexico Institute of Mining and Technology. Two graduate students supported. Two undergraduate students supported.

8 Professional Society Memberships

1991: International Astronomical Union (IAU), Commissions 28 and 40

1985: American Association for the Advancement of Science

1983: American Astronomical Society (AAS)

1983: American Institute of Physics

9 Professional Meetings and Workshops Attended

2011 May: ApJ Editorial Board, Toronto, ON, Canada

2011 Mar: Building on New Worlds, New Horizons, Santa Fe, NM, USA

2011 Jan: 217th Meeting of the AAS, Seattle, WA, USA

2010 Nov: New Mexico Local Symposium, Socorro, NM, USA

2010 Oct: Chandra Users' Committee, Boston, MA, USA

2010 Apr: Chandra Users' Committee, Boston, MA, USA

2010 Feb: Formation and Evolution of Black Holes, Aspen, CO, USA

2010 Jan: New Mexico Local Symposium, Socorro, NM, USA

2009 Oct: Chandra Users' Committee, Boston, MA, USA

2009 Jul: New Science Enabled by Microarcsecond Astrometry, Socorro, NM, USA

2009 Jun: Chandra Cycle 11 Peer Review, Boston, MA, USA

2009 May: ApJ Editorial Board, Hamilton, ON, Canada

2009 Apr: Intermediate-Mass Black Holes: from First Light to Galactic Nuclei, Irvine, CA, USA

2009 Jan: 213th Meeting of the AAS, Long Beach, CA, USA

2008 Dec: The EVLA Vision: Galaxies Through Cosmic Time, Socorro, NM, USA

2008 Nov: Black Hole Astrophysics with Radio and Gravitational Wave Observations, Charlottesville, VA, USA

2008 Oct: New Mexico Local Symposium, Socorro, NM, USA

2008 May: ApJ Editorial Board, Bristol, UK

2008 Apr: NRAO Staff Retreat, Socorro, NM, USA

2008 Feb: NRAO New Mexico Staff Retreat, Socorro, NM, USA

2008 Jan: 211th Meeting of the AAS, Austin, TX, USA

2007 Oct: New Mexico Local Symposium, Socorro, NM, USA

2007 Jan: 209th Meeting of the AAS, Seattle, WA, USA
2006 Jul: Physics and Astrophysics of Supermassive Black Holes, Santa Fe, NM, USA
2006 May: Legacy Projects Workshop, Socorro, NM, USA
2004 Dec: New Opportunities for NRAO, Socorro, NM, USA
2004 Nov: New Mexico Local Symposium, Socorro, NM, USA
2004 Jan: 203rd Meeting of the AAS, Atlanta, GA, USA
2003 Oct: New Mexico Local Symposium, Socorro, NM, USA
2003 Jun: Future Directions in High Resolution Astronomy, Socorro, NM, USA
2003 Jan: 201st Meeting of the AAS, Seattle, WA, USA
2002 Nov: New Mexico Local Symposium, Socorro, NM, USA
2002 Oct: Radio Astronomy at the Fringe, Green Bank, WV, USA
2002 Jun: 200th Meeting of the AAS, Albuquerque, NM, USA
2002 Jan: 199th Meeting of the AAS, Washington, DC, USA
2001 Nov: New Mexico Local Symposium, Socorro, NM, USA
2001 Aug: EVLA Planning Workshop, Socorro, NM, USA
2001 Jun: 198th Meeting of the AAS, Pasadena, CA, USA
2000 Oct: New Mexico Local Symposium, Socorro, NM, USA
2000 Oct: Deep Fields, Garching, Germany
1999 Oct: New Mexico Local Symposium, Socorro, NM, USA
1999 Jun: 194th Meeting of the AAS, Chicago, IL, USA
1999 Jan: 193rd Meeting of the AAS, Austin, TX, USA
1998 Nov: New Mexico Local Symposium, Socorro, NM, USA
1998 Oct: OVRO 40th Anniversary Celebration, Big Pine, CA, USA
1998 Jun: The VLA Upgrade Review, Socorro, NM, USA
1998 Jun: Interferometry and Imaging, Socorro, NM, USA
1997 Oct: New Mexico Local Symposium, Socorro, NM, USA
1997 Jul: How to Supervise People, National Seminars Group, Albuquerque, NM, USA
1997 Apr: Radio Emission from Galactic and Extragalactic Compact Sources, Socorro, NM, USA
1996 Oct: New Mexico Local Symposium, Socorro, NM, USA

1995 Oct: New Mexico Local Symposium, Socorro, NM, USA
1995 Oct: Extragalactic Radio Sources, Bologna, Italy
1995 Jun: Proposer Workshop for the VSOP Space VLBI Mission, Pasadena, CA, USA
1995 Mar: Quasars and AGN: High Resolution Imaging, Irvine, CA, USA
1995 Jan: The First VLA Upgrade Science Workshop, Socorro, NM, USA
1995 Jan: 185th Meeting of the AAS, Tucson, AZ, USA
1994 Nov: New Mexico Local Symposium, Socorro, NM, USA
1994 Feb: Compact Extragalactic Radio Sources, Socorro, NM, USA
1992 Sep: Sky Surveys: Protostars to Protogalaxies, Pasadena, CA, USA
1992 Aug: Galactic Bulges, Ghent, Belgium
1992 Jul: Sub-Arcsecond Radio Astronomy, Manchester, UK
1992 Jun: NRAO Internal Symp., Green Bank, WV, USA
1991 Dec: Extragalactic Radio Astronomy - Issues and Prospects, Charlottesville, VA, USA
1991 Jul: IAU 21st General Assembly, Buenos Aires, Argentina
1991 Jan: 177th Meeting of the AAS, Philadelphia, PA, USA
1990 Oct: Radio Interferometry - Theory, Techniques, and Applications, Socorro, NM, USA
1990 Jun: 176th Meeting of the AAS, Albuquerque, NM, USA
1990 Mar: The Interpretation of Modern Synthesis Observations of Spiral Galaxies, Albuquerque, NM, USA
1989 Nov: The Millimeter Sky at High Resolution: Present and Future, Socorro, NM, USA
1989 Oct: New Mexico Local Symposium, Socorro, NM, USA
1989 Oct: Parsec-Scale Radio Jets, Socorro, NM, USA
1989 Jul: The Interstellar Medium in External Galaxies, Jackson Lake Lodge, WY, USA
1989 Jan: 173th Meeting of the AAS, Boston, MA, USA
1988 Nov: New Mexico Local Symposium, Socorro, NM, USA
1988 Aug: Active Galactic Nuclei, Santa Cruz, CA, USA
1988 Jan: 171th Meeting of the AAS, Austin, TX, USA
1987 Nov: New Mexico Local Symposium, Socorro, NM, USA
1987 May: The Impact of VLBI on Astrophysics and Geophysics, Cambridge, MA, USA
1987 Jan: 169th Meeting of the AAS, Pasadena, CA, USA

1986 Oct: Superluminal Radio Sources, Big Bear, CA, USA
1986 Oct: New Mexico Local Symposium, Socorro, NM, USA
1986 Jun: Star Formation in Galaxies, Pasadena, CA, USA
1986 Jan: 167th Meeting of the AAS, Houston, TX, USA
1985 Oct: New Mexico Local Symposium, Socorro, NM, USA
1985 Aug: Plasma Processes in Astrophysical Jets, Taos, NM, USA
1985 Jan: 165rd Meeting of the AAS, Tucson, AZ, USA
1984 Jul: Astrophysics of Active Galaxies and QSOs, Santa Cruz, CA, USA
1984 Jan: 163rd Meeting of the AAS, Las Vegas, NV, USA
1983 Jun: VLBI and Compact Radio Sources, Bologna, Italy
1982 Jun: NRAO-VLA Workshop on Synthesis Mapping, Socorro, NM, USA
1981 Aug: Extragalactic Radio Sources, Albuquerque, NM, USA
1980 Jun: 156th Meeting of the AAS, College Park, MD, USA

10 Talks Presented

2011 Apr: NRAO, Socorro, NM, USA
2011 Mar: NRAO, Socorro, NM, USA
2011 Mar: Santa Fe, NM, USA
2010 Jun: NRAO, Socorro, NM, USA
2010 Jun: NRAO, Socorro, NM, USA
2009 Apr: University of California, Irvine, CA, USA
2008 Nov: NRAO, Socorro, NM, USA
2008 Nov: NRAO, Charlottesville, VA, USA
2008 Oct: University of British Columbia, British Columbia, Canada
2008 Oct: Herzberg Institute of Astrophysics, Victoria, British Columbia, Canada
2008 Jun: NRAO, Socorro, NM, USA
2008 May: University of Bristol, UK
2008 Feb: NRAO, Socorro, NM, USA
2006 Nov: NRAO, Socorro, NM, USA
2006 Jul: Santa Fe, NM, USA

2006 Jun: University of New Mexico, Albuquerque, NM, USA
2004 Jun: NRAO, Socorro, NM, USA
2003 Jun: NRAO, Socorro, NM, USA
2002 Jun: NRAO, Socorro, NM, USA
2001 Jul: NRAO, Green Bank, WV, USA
2001 Jun: NRAO, Socorro, NM, USA
2001 May: NRAO, Socorro, NM, USA
2000 Jun: NRAO, Socorro, NM, USA
2000 Apr: NRAO, Socorro, NM, USA
1999 Jul: NRAO, Socorro, NM, USA
1999 Jun: 194th Meeting of the AAS, Chicago, IL, USA
1999 Jan: NRAO, Socorro, NM, USA
1998 Jun: NRAO, Socorro, NM, USA
1996 Oct: University of Toronto, Toronto, Ontario, Canada
1996 Apr: NRAO, Socorro, NM, USA
1996 Jan: NRAO, Charlottesville, VA, USA
1995 Oct: TRAO, Torun, Poland
1995 Jun: NRAO, Socorro, NM, USA
1994 Jul: IRA, Bologna, Italy
1994 Jun: MPIfR, Bonn, Germany
1994 Jun: NFRA, Dwingeloo, The Netherlands
1994 Apr: Jodrell Bank, UK
1993 Dec: NRAO, Charlottesville, VA, USA
1993 Nov: NMSU, Las Cruces, NM, USA
1993 Jun: NRAO, Socorro, NM, USA
1992 Jun: NRAO, Green Bank, WV, USA
1991 Dec: NRAO, Charlottesville, VA, USA
1991 Oct: HIA, NRC of Canada, Ottawa, Ontario, Canada
1991 Oct: University of Toronto, Toronto, Ontario, Canada

1991 Aug: NRAO, Socorro, NM, USA
1991 Jul: IAU 21st General Assembly, Buenos Aires, Argentina
1991 Jun: NRAO, Socorro, NM, USA
1990 Jul: Caltech, Pasadena, CA, USA
1990 Mar: The Interpretation of Modern Synthesis Observations of Spiral Galaxies, Albuquerque, NM, USA
1989 Oct: Parsec-Scale Radio Jets, Socorro, NM, USA
1988 Nov: New Mexico Local Symp., Socorro, NM, USA
1988 Oct: UCLA, Los Angeles, CA, USA
1988 Sep: NRAO, VLA Site, NM, USA
1988 Apr: NMIMT, Socorro, NM, USA
1987 Nov: New Mexico Local Symp., Socorro, NM, USA
1987 Jun: NRAO, VLA Site, NM, USA
1986 Nov: NRAO, VLA Site, NM, USA
1986 Oct: Superluminal Radio Sources, Big Bear, CA, USA
1986 Oct: NRAO Local Symp., Socorro, NM, USA
1986 Apr: University of Toronto, Toronto, Ontario, Canada
1986 Feb: NRAO, VLA Site, NM, USA
1985 Oct: NRAO Local Symp., Socorro, NM, USA
1985 Aug: Workshop on Plasma Processes in Astrophysical Jets, Taos, NM, USA
1985 May: Caltech, Pasadena, CA, USA
1985 Mar: NRAO, VLA Site, NM, USA
1985 Mar: NMIMT, Socorro, NM, USA
1984 Dec: HIA, NRC of Canada, Ottawa, Ontario, Canada
1984 Dec: CfA, Cambridge, MA, USA
1984 Aug: NRL, Washington, DC, USA
1984 Aug: NRAO, Charlottesville, VA, USA
1984 Jul: Workshop on Astrophysics of Active Galaxies and QSOs, Santa Cruz, CA, USA
1984 Jun: University of New Mexico, Albuquerque, NM, USA
1983 Jun: VLBI and Compact Radio Sources, Bologna, Italy

1983 Jun: MPIfR, Bonn, Federal Republic of Germany

1983 Jun: RGO, Herstmonceux Castle, Hailsham, East Sussex, UK

1983 Jan: University of Toronto, Toronto, Ontario, Canada

11 Bibliography

11.1 Papers in Refereed Journals

- A Kiloparsec-Scale Binary Active Galactic Nucleus Confirmed by the Expanded Very Large Array, H. Fu, Z. Zhang, R.J. Assef, A. Stockton, A.D. Myers, L. Yan, S.G. Djorgovski, J.M. Wrobel & D.A. Riechers, 2011, ApJ, 740, L44
- The Candidate Intermediate-Mass Black Hole in the Globular Cluster M54, J.M. Wrobel, J.E. Greene & L.C. Ho, 2011, AJ, 142, 113
- The Expanded Very Large Array: A New Telescope for New Science, R.A. Perley, C.J. Chandler, B.J. Butler & J.M. Wrobel, 2011, ApJ, 739, L1 (Special Issue on Early Science with the EVLA)
- Parsec-Scale Localization of the Quasar SDSS J1536+0441A, a Candidate Binary Black Hole System, J.M. Wrobel & A. Laor, 2010, ApJ, 714, L295
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- Mapping the Future of VLBI Science in the U.S., G.B. Taylor & C.J. Lonsdale (co-chairs), 2004
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- Strategies for Phase Referencing with the VLBA, J.M. Wrobel, R.C. Walker, J.M. Benson, & A.J. Beasley, 2000, VLBA Scientific Memo 24
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- Gain Curves for 1.3cm VLBI with a Single VLA Antenna, J.M. Wrobel, 1992, VLA Test Memo 164
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11.4 Public Outreach

2010 Feb: Merging Galaxies Create a Binary Quasar, press releases by Chandra, Carnegie, NOAO; YouTube video

2009 Jul: Binary Black Hole Surprizes, A. Laor & J.M. Wrobel, NRAO eNews

2007 Jan: Radio Telescopes Provide Key Clue on Black Hole Growth, invited press release at 209th Meeting of the AAS, Seattle, WA, USA

2007 Jan: Three submissions to the NRAO Image Gallery

11.5 Books

- IAU Colloquium 164: Radio Emission from Galactic and Extragalactic Compact Sources, J.A. Zensus, G.B. Taylor, & J.M. Wrobel, 1998, ASP Conference Series, Volume 144, (ASP: San Francisco)