

Cambridge University Press & Assessment

978-1-107-03284-2 — Cosmic Masers – from OH to H₀ (IAU S287)

Edited by R. S. Booth , W. H. T. Vlemmings , E. M. L. Humphreys

Frontmatter

[More Information](#)

COSMIC MASERS - FROM OH TO H₀

IAU SYMPOSIUM 287

COVER ILLUSTRATION:

A picture of Table Mountain, Cape Town, taken from Robben Island.

This iconic symbol of South Africa was recently voted one of the ‘New 7 Wonders of the World’.

Cambridge University Press & Assessment

978-1-107-03284-2 — Cosmic Masers – from OH to Ho (IAU S287)

Edited by R. S. Booth, W. H. T. Vlemmings, E. M. L. Humphreys

Frontmatter

[More Information](#)

IAU SYMPOSIUM PROCEEDINGS SERIES

Chief Editor

IAN F. CORBETT, IAU General Secretary

icorbett@eso.org

Editor

THIERRY MONTMERLE, IAU Assistant General Secretary

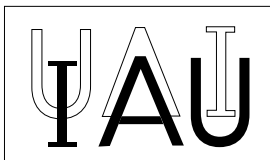
Institut d'Astrophysique de Paris,

98bis, Bd Arago, 75014 Paris, France

montmerle@iap.fr

INTERNATIONAL ASTRONOMICAL UNION
UNION ASTRONOMIQUE INTERNATIONALE

International Astronomical Union



COSMIC MASERS - FROM OH TO H₀

PROCEEDINGS OF THE 287th SYMPOSIUM OF THE
INTERNATIONAL ASTRONOMICAL UNION
HELD IN STELLENBOSCH, SOUTH AFRICA
JANUARY 29 - FEBRUARY 3, 2012

Edited by

ROY S. BOOTH

SA SKA Project, SOUTH AFRICA

ELIZABETH M. L. HUMPHREYS

ESO Garching, GERMANY

and

WOUTER H. T. VLEMMINGS

Onsala Space Observatory, Chalmers University of Technology, SWEDEN



CAMBRIDGE
UNIVERSITY PRESS

Cambridge University Press & Assessment

978-1-107-03284-2 — Cosmic Masers – from OH to Ho (IAU S287)

Edited by R. S. Booth, W. H. T. Vlemmings, E. M. L. Humphreys

Frontmatter

[More Information](#)

CAMBRIDGE UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314-321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi - 110025, India

103 Penang Road, #05-06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org

Information on this title: www.cambridge.org/9781107032842

© International Astronomical Union 2012

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2012

A catalogue record for this publication is available from the British Library

ISBN 978-1-107-03284-2 Hardback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication, and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.

Table of Contents

Preface xii

Organizing committee xiii

Conference photograph xiv

Conference participants xv

Tribute to Yolanda Gómez Castellano xvii

T1: Advances in Maser Theory *Chair: Roy Booth*

Advances in Maser Theory 3
 V. Strelitski

Modelling of Cosmic Molecular Masers: Introduction to a Computation Cookbook 13
 A. M. Sobolev & M. D. Gray

A detailed trace of the pump for 1720-MHz OH masers in SNRs 23
 M. D. Gray

T2: Polarization and magnetic fields *Chair: Athol Kemball*

Maser polarization and magnetic fields 31
 W. H. T. Vlemmings

Polarization of Class I methanol (CH₃OH) masers 41
 A. P. Sarma

Polarization of the Recombination Line Maser in MWC349..... 49
 C. Thum, D. Morris, & H. Wiesemeyer

VLBA SiO maser observations of the OH/IR star OH 44.8-2.3: magnetic field and morphology 54
 N. Amiri, W. H. T. Vlemmings, A. J. Kemball & H. J. van Langevelde

Linear polarization of hydroxyl masers in circumstellar envelope outer regions .. 59
 P. Wolak, M. Szymczak & E. Gérard

Maser polarization with ALMA 64
 A. F. Pérez-Sánchez & W. Vlemmings

High resolution magnetic field measurements in high-mass star-forming regions using masers 69
 G. Surcis, W. H. T. Vlemmings, H. J. van Langevelde & B. H. Kramer

The magnetic field of IRAS 16293-2422 as traced by shock-induced H₂O masers 74
 F. O. Alves, W. H. T. Vlemmings, J. M. Girart & J. M. Torrelles

Water Maser Emission Around Low/Intermediate Mass Evolved Stars 79
 M. L. Leal-Ferreira, W. H. T. Vlemmings, P. J. Diamond, A. Kemball, N. Amiri & J.-F. Desmurs

Observational tests of SiO maser polarisation models..... 81
 L. L. Richter, A. J. Kemball & J. L. Jonas

T3a: Star formation: maser variability *Chair: Philip Diamond*

Variability of Class II methanol masers in massive star forming regions.	85
<i>S. Goedhart, M. Gaylard, & J. van der Walt</i>	
Binary systems: implications for outflows & periodicities relevant to masers . . .	93
<i>N. K. Singh & A. A. Deshpande</i>	
Intermittent maser flare around the high-mass young stellar object G353.273+0.641	98
<i>K. Motogi, K. Sorai, K. Fujisawa, K. Sugiyama & M. Honma</i>	
VERA Observations of the H ₂ O Maser Burst in Orion KL	103
<i>T. Hirota, M. Tsuboi, K. Fujisawa, M. Honma, N. Kawaguchi, M. K. Kim, H. Kobayashi, H. Imai, T. Omodaka, K. M. Shibata, T. Shimoikura, & Y. Yonekura</i>	
The variability of cosmic methanol masers in massive star-forming regions	108
<i>J. P. Maswanganye & M. J. Gaylard</i>	
Chasing the flare in Orion KL: Observations of the 22 GHz H ₂ O Masers at HartRAO.	110
<i>S. Otto & M. J. Gaylard</i>	
On the Methanol masers in G9.62+0.20E: Preliminary colliding-wind binary (CWB) calculations	112
<i>S. P. van den Heever, D. J. van der Walt, J. M. Pittard & M. G. Hoare</i>	

T3b: Star formation masers *Chair: Crystal Brogan*

Masers in star forming regions	117
<i>A. Bartkiewicz & H. J. van Langevelde</i>	
Masers in GLIMPSE Extended Green Objects (EGOs)	127
<i>C. J. Cyganowski, C. L. Brogan, T. R. Hunter, E. Churchwell, J. Koda, E. Rosolowsky, S. Towers, B. Whitney, & Q. Zhang</i>	
44 GHz Methanol Maser Surveys	133
<i>S. E. Kurtz</i>	
A Highly-collimated Water Maser Bipolar Outflow in the Cepheus A HW3d Massive Protostellar Object.	141
<i>J. O. Chibueze, H. Imai, D. Tafoya, T. Omodaka, O. Kameya, T. Hirota, S.-N. Chong, & J. M. Torrelles</i>	
Methanol masers and millimetre lines: a common origin in protostellar envelopes	146
<i>K. J. E. Torstensson, H. J. van Langevelde, F. F. S. van der Tak, W. H. T. Vlemmings, L. E. Kristensen, S. Bourke & A. Bartkiewicz</i>	
The infrared environment of methanol maser rings at high spatial resolution . .	151
<i>J. M. De Buizer, A. Bartkiewicz & M. Szymczak</i>	
Masers as evolutionary tracers of high-mass star formation.	156
<i>S. L. Breen & S. P. Ellingsen</i>	
Class I methanol masers in low-mass star formation regions	161
<i>S. V. Kalenskii, V. I. Slysh, L. E. B. Johansson, P. Bergman, S. Kurtz, P. Hofner, & C. M. Walmsley</i>	

<i>Contents</i>	vii
Dynamical detection of a magnetocentrifugal wind driven by a 20 M _⊙ YSO <i>L. J. Greenhill, C. Goddi, C. J. Chandler, E. M. L. Humphreys, & L. D. Matthews</i>	166
The W51 Main/South SFR complex seen through 6-GHz OH and methanol masers <i>S. Etoka, M. D. Gray & G. A. Fuller</i>	171
What is happening in G357.96-0.16? <i>T. R. Britton, M. A. Voronkov, & V. A. Moss</i>	176
Infrared characteristics of sources associated with OH, H ₂ O, SiO and CH ₃ OH masers <i>J. Esimbek, J. J. Zhou, G. Wu & X. D. Tang</i>	178
Massive star-formation toward G28.87+0.07 <i>J. J. Li, L. Moscadelli, R. Cesaroni, R. S. Furuya, Y. Xu, T. Usuda, K. M. Menten, M. Pestalozzi, D. Eliav, & E. Schisano</i>	180
High-mass Star Formation in the Regions IRAS 19217+1651 and 23151+5912 . . <i>V. Migenes, I. T. Rodríguez & M. A. Trinidad</i>	182
325 GHz Water Masers in Orion Source I <i>F. Niederhofer, E. Humphreys, C. Goddi & L. J. Greenhill</i>	184
10 years of 12.2 GHz methanol maser VLBI observations towards NGC 7538 IRS1 N: proper motions and maser saturation <i>M. Pestalozzi, A. Jerkstrand & J. Conway</i>	186
Internal Proper Motion of 6.7 GHz Methanol Masers in Ultra Compact HII Region S269 <i>S. Sawada-Satoh, K. Fujisawa, K. Sugiyama, K. Wajima & M. Honma</i>	188
The radial velocity acceleration of the 6.7 GHz methanol maser in Mon R2 IRS3 <i>K. Sugiyama, K. Fujisawa, N. Shino, & A. Doi</i>	190
A Circumstellar Disk toward the High-mass Star-forming Region IRAS 23033+5951 <i>M. A. Trinidad, T. Rodríguez & V. Migenes</i>	192
Molecular outflows toward methanol masers: detection techniques and their prop- erties <i>H. M. de Villiers, M. A. Thompson, A. Chrysostomou & D. J. van der Walt</i>	194
T4: Stellar Masers <i>Chair: Elizabeth Humphreys</i>	
Masers in evolved star winds <i>A. M. S. Richards</i>	199
Radio and IR interferometry of SiO maser stars <i>M. Wittkowski, D. A. Boboltz, M. D. Gray, E. M. L. Humphreys, I. Karovicova, & M. Scholz</i>	209
Maser emission during post-AGB evolution <i>J.-F. Desmurs</i>	217
Water Fountains in Pre-Planetary Nebulae: The Case of IRAS16342–3814 <i>M. Claussen, R. Sahai, M. Morris, & H. Rogers</i>	225
The first water fountain in a planetary nebula <i>O. Suárez, J. F. Gómez, P. Bendjoya, L. F. Miranda, M. A. Guerrero, G. Ramos-Larios, J. R. Rizzo, & L. Uscanga</i>	230

viii	<i>Contents</i>	
Polarization properties of R Cas SiO masers	235	
<i>K. A. Assaf, P. J. Diamond, A. M. S. Richards & M. D. Gray</i>		
The final 112-frame movie of the 43 GHz SiO masers around the Mira Variable TX Cam	240	
<i>I. Gonidakis, P. J. Diamond & A. J. Kemball</i>		
High Resolution Radio and IR Observations of AGB Stars	245	
<i>W. Cotton, G. Perrin, R. Millan-Gabet, O. Delaa, & B. Mennesson</i>		
OH mainline maser polarisation properties of post-AGB stars	250	
<i>J. M. Chapman, I. Gonidakis, R. M. Deacon & A. Green</i>		
Preliminary results on SiO $v=3$ $J=1-0$ maser emission from AGB stars	252	
<i>J.-F. Desmurs, V. Bujarrabal, M. Lindqvist, J. Alcolea, R. Soria-Ruiz, & P. Bergman</i>		
1612 MHz OH maser monitoring with the Nançay Radio Telescope	254	
<i>D. Engels, E. Gérard, & N. Hallet</i>		
The Hamburg Database of Circumstellar OH Masers	256	
<i>D. Engels</i>		
Imaging the water masers toward the H ₂ O-PN IRAS 18061–2505	258	
<i>Y. Gómez, D. Tafuya, O. Suárez, J. F. Gómez, L. F. Miranda, G. Anglada, J. M. Torrelles, & R. Vázquez</i>		
TWINKLING STARS The disappearing SiO masers of W Aql	260	
<i>S. Ramstedt, W. Vlemmings, S. Mohamed, Y. K. Choi & H. Olofsson</i>		
T5: Maser Surveys <i>Chair: Jessica Chapman</i>		
SiO Maser Surveys of Nearby Miras and their Kinematics in the Galaxy	265	
<i>S. Deguchi</i>		
Water maser follow-up of the Methanol Multi-Beam Survey	275	
<i>A. Titmarsh, S. Ellingsen, S. Breen, J. Caswell & M. Voronkov</i>		
Identification of Class I Methanol Masers with Objects of Near and Mid-Infrared Bands and the Third Version of the Class I Methanol Maser (MMI) Catalog	280	
<i>O. Bayandina, I. Val'tts & G. Larionov</i>		
25 GHz methanol masers in regions of massive star formation	282	
<i>T. R. Britton & M. A. Voronkov</i>		
44-GHz class I methanol maser survey towards 6.7-GHz class II methanol masers	284	
<i>D.-Y. Byun, K.-T. Kim & J.-H. Bae</i>		
Water Masers Toward Star-Forming Regions in the Bolocam Galactic Plane Survey	286	
<i>M. K. Dunham & The BGPS Team</i>		
The VLBI mapping survey of the 6.7 GHz methanol masers with the JVN/EAVN	288	
<i>K. Fujisawa, K. Hachisuka, K. Sugiyama, A. Doi, M. Honma, Y. Yonekura, T. Hirota, S. Sawada-Satoh, Y. Murata, K. Motogi, H. Ogawa, X. Chen, K.-T. Kim & Z.-Q. Shen</i>		

<i>Contents</i>	ix
Simultaneous observations of SiO and H ₂ O masers toward known stellar SiO and/or H ₂ O maser sources	290
<i>J. Kim, S.-H. Cho & S. J. Kim</i>	
SHOOTING STARS Masers from red giants	292
<i>S. Ramstedt, W. Vlemmings, E. Humphreys & F. Alves</i>	
New OH Observations toward Northern Class I Methanol Masers	294
<i>I. E. Val'tts, I. D. Litovchenko , O. S. Bayandina, A. V. Alakoz, G. M. Larionov, D. V. Mukha, A. S. Nabatov, A. A. Konvalenko, V. V. Zakharenko, E. V. Alekseev, V. S. Nikolaenko, V. F. Kulishenko & S. A. Odincov</i>	
22 GHz Water Maser Survey of the Xinjiang Astronomical Observatory	296
<i>J.-J. Zhou, J. Esimbek & G. Wu</i>	
T6: Cosmology and the Hubble constant <i>Chair: Willem Baan</i>	
Cosmology and the Hubble Constant: On the Megamaser Cosmology Project (MCP)	301
<i>C. Henkel, J. A. Braatz, M. J. Reid, J. J. Condon, K. Y. Lo, C. M. V. Impellizzeri & C. Y. Kuo</i>	
Mrk 1419 - a new distance determination	311
<i>C. M. V. Impellizzeri, J. A. Braatz, C.-Y. Kuo, M. J. Reid, K. Y. Lo, C. Henkel & J. J. Condon</i>	
Optical Properties of the Host Galaxies of Extragalactic Nuclear H ₂ O Masers . .	316
<i>I. Zaw, G. Zhu, M. Blanton, & L. J. Greenhill</i>	
T7: AGN and megamasers <i>Chair: Lincoln Greenhill</i>	
AGN and Megamasers	323
<i>A. Tarchi</i>	
Masers in Starburst Galaxies	333
<i>J. Darling</i>	
Long term Arecibo monitoring of the water megamaser in MG J0414+0534 . . .	340
<i>P. Castangia, C. M. V. Impellizzeri, J. P. McKean, C. Henkel, A. Brunthaler, A. L. Roy, & O. Wucknitz</i>	
Searching for new OH megamasers out to redshifts $z > 1$	345
<i>K. W. Willett</i>	
Expectations of maser studies with FAST	350
<i>J. S. Zhang, D. Li & J. Z. Wang</i>	
The origin of Keplerian megamaser disks.	354
<i>M. Wardle & F. Yusef-Zadeh</i>	
T8: Maser Astrometry <i>Chair: Huib Jan van Langevelde</i>	
Maser Astrometry: from Galactic Structure to Local Group Cosmology	359
<i>M. J. Reid</i>	

x	<i>Contents</i>	
Methanol Maser Parallaxes and Proper Motions.....	368	
<i>Y. Xu, M. J. Reid, L. Moscadelli, K. M. Menten, X. W. Zheng, A. Brunthaler, B. Zhang, K. L. J. Rygl, J. J. Li, & A. Sanna</i>		
VLBI multi-epoch water maser observations toward massive protostars.....	377	
<i>J. M. Torrelles, J. F. Gómez, N. A. Patel, S. Curiel, G. Anglada, & R. Estalella</i>		
Maser astrometry with VERA and Galactic structure	386	
<i>M. Honma, T. Nagayama, T. Hirota, N. Matsumoto, N. Sakai, N. Kawaguchi & VERA project members</i>		
Astrometry of Galactic Star-Forming Regions ON1 and ON2N with VERA	391	
<i>T. Nagayama & VERA project members</i>		
VLBI maser kinematics in high-mass SFRs: G23.01–0.41.....	396	
<i>A. Sanna, L. Moscadelli, R. Cesaroni & C. Goddi</i>		
3D velocity fields from methanol and water masers in an intermediate-mass proto- star	401	
<i>C. Goddi, L. Moscadelli & A. Sanna</i>		
Trigonometric Parallax of the Protoplanetary Nebula OH 231.8+4.2.....	407	
<i>Y. K. Choi, A. Brunthaler, K. M. Menten & M. J. Reid</i>		
Astrometry of water masers in post-AGB stars.....	411	
<i>H. Imai & VERA collaboration</i>		
Relative parallaxes in the massive star forming region W33	413	
<i>K. Immer, M. J. Reid & K. M. Menten</i>		
3-Dimensional kinematics of water/SiO masers in Orion-KL.....	415	
<i>M. K. Kim, T. Hirota, K. Hideyuki & VERA project team members</i>		
Annual Parallax Measurements of an Infrared Dark Cloud MSXDC G034.43+00.24	417	
<i>T. Kurayama</i>		
The bar effect in the galactic gas motions traced by 6.7 GHz methanol maser sources with VERA	419	
<i>N. Matsumoto, M. Honma & VERA project members</i>		
Mass distribution of the Galaxy with VERA.....	421	
<i>N. Sakai, M. Honma, H. Nakanishi, H. Sakanoue, T. Kurayama & VERA project members</i>		
Distance and Maser Outflows of the Galactic Star-forming Region W51 Main/South	423	
<i>M. Sato, M. J. Reid, A. Brunthaler & K. M. Menten</i>		
Trigonometric Parallax of RCW 122	425	
<i>Y. W. Wu, Y. Xu, K. M. Menten, X. W. Zheng & M. J. Reid</i>		
Distance and Size of the Red Hypergiant NML Cyg.....	427	
<i>B. Zhang, M. J. Reid, K. M. Menten, X. W. Zheng & A. Brunthaler</i>		
T9: New masers and further developments in maser physics		
<i>Chair: Mark Reid</i>		

<i>Contents</i>	xi
New class I methanol masers.	433
<i>M. A. Voronkov, J. L. Caswell, S. P. Ellingsen, S. L. Breen, T. R. Britton, J. A. Green, A. M. Sobolev & A. J. Walsh</i>	
OH Masers and Supernova Remnants	441
<i>M. Wardle & K. McDonnell</i>	
Class I Methanol Masers in the Galactic Center	449
<i>L. O. Sjouwerman & Y. M. Pihlström</i>	
Radio Recombination Line Maser Objects: New Detections with the SMA	455
<i>I. Jiménez-Serra</i>	
Unveiling the kinematics of the disk and the ionized stellar wind of the massive star MWC349A through RRL masers.	460
<i>A. Báez-Rubio & J. Martín-Pintado</i>	
Intrinsic Sizes of the W3 (OH) Masers via Short Time Scale Variability	465
<i>T. Laskar, W. M. Goss & B. A. Zauderer</i>	
OH Maser sources in W49N: probing differential anisotropic scattering with Zeeman pairs.	470
<i>A. A. Deshpande, W. M. Goss & J. E. Mendoza-Torres</i>	
T10: Masers and the impact of new facilities <i>Chair: Wouter Vlemmings</i>	
Maser observations with new instruments	477
<i>A. Wootten</i>	
MeerKAT and its potential for Cosmic MASER Research	483
<i>R. Booth, S. Goedhart & J. Jonas</i>	
KVN Single-dish Water and Methanol Maser Line Surveys of Galactic YSOs	488
<i>K.-T. Kim, D.-Y. Byun, J.-H. Bae, W.-J. Kim, H.-W. Kang, C. S. Oh, & S.-Y. Youn</i>	
Methanol masers in the Herschel era Putting them in the star formation context	492
<i>M. Pestalozzi</i>	
Early results from a diagnostic 1.3 cm survey of massive young protostars	497
<i>C. L. Brogan, T. R. Hunter, C. J. Cyganowski, R. Indebetouw, R. Friesen & C. Chandler</i>	
EVLA imaging of the water masers in the massive protostellar cluster NGC6334I	502
<i>T. R. Hunter & C. L. Brogan</i>	
OH maser observations using the Russian interferometric network “Quasar” in preparation for scientific observations with the space mission RadioAstron.	504
<i>I. D. Litovchenko, A. V. Alakoz, V. I. Kostenko, S. F. Lihachev, A. M. Finkelstein & A. V. Ipatov</i>	
IAU (Maser) Symposium 287 Summary.	506
<i>Karl M. Menten</i>	
Author index	516

Preface

The fourth IAU Symposium on Astronomical *masers*, IAUS 287, entitled *Cosmic Masers from OH to H₀* was held in South Africa from January 29 February 3. The venue was the excellent Wallenberg Conference Centre in the beautiful old town of Stellenbosch nestling in the foothills of one of the countrys foremost wine districts.

The meeting was opened by Dr. Bernie Fanaroff, Director of the South African SKA Project, who pointed out that human-kind had its origins in Africa and learned basic skills before migration and continental drift led to the population of the rest of the World.

Despite a strenuous programme with lively discussions, the participants found time to visit the Cape Town Water Front and take a boat trip to historical Robben Island, where the present political structure was formulated in the mid 90s. They also enjoyed an African evening at a local hospice, where they sampled truly African food, song and dance.

Interstellar hydroxyl *masers* were first reported in 1965, at the beginning of an avalanche of detections of interstellar molecules and the emergence of the science of Cosmo-chemistry. Many molecules are now found to exhibit polarized (circular and linear) stimulated emission in a variety of astrophysical environments and the hierarchy extends from the interstellar medium and regions of stellar formation through winds around evolved stars and even the compressed gas surrounding Supernova remnants. *masers* are also detected in other galaxies as analogues of Galactic *masers*, and in the dense molecular regions near AGN. Most recently, *masers* have been detected in Comets and other regions of the Solar System. In all cases they have proved to be important diagnostics of their associated regions, pinpointing dense gas, its motions and the local magnetic field structure in great detail.

This phenomenon has proved to be invaluable in astrometry and the details of Galactic structure and rotation have been refined through precise observation of *masers*. The same properties of *masers* have been used to great effect to measure the study of Galactic nuclei and because of the precise measurement of position and velocity, water *masers* have enabled the unambiguous determination of the Hubble Constant at small red-shifts.

Recent *maser* surveys, and measurements of the above phenomena were discussed at the Stellenbosch meeting along with new detections of known *masers* and detections of new *maser* species. Discussion extended from reviews of the theory of the phenomenon, *maser* properties such as variability and polarisation, to its use in astrometry and in cosmology.

More than 110 participants, including some 25 students (many securing IAU grants) attended the meeting. There were 68 oral contributions, including 8 by students and many posters, displayed all week and discussed in 3 separate poster sessions. In general the meeting followed its predecessor with 10 different scientific themes, each with a review talk, one or two invited talks and contributed talks.

Finally we thank our sponsors the South African SKA project and the Natural Science Research Council, NRF.

Roy Booth, Liz Humphreys & Wouter Vlemmings

THE ORGANIZING COMMITTEE

Scientific

- | | |
|----------------------------------|--------------------------------------|
| A. Bartkiewicz (Poland) | M. Honma (Japan) |
| R.S. Booth (Chair, South Africa) | E.M.L. Humphreys (co-Chair, Germany) |
| V. Bujarrabal (Spain) | A.J. Kemball (USA) |
| J.M. Chapman (Australia) | K.-T. Kim (Taiwan) |
| M. Elitzur (USA) | H.J. van Langevelde (Netherlands) |
| S.P. Ellingsen (Australia) | J.M. Moran (USA) |
| Y. Gómez (Mexico) | W.H.T. Vlemmings (co-Chair, Sweden) |
| M.D. Gray (UK) | |

Local

- | | |
|------------------------|-------------------|
| K. de Boer | M. Oozeer |
| R.S. Booth (Chair) | S. Passmoor |
| S. Fishley | A. Schroeder |
| M.J. Gaylard | D.J. van der Walt |
| S. Goedhart (co-Chair) | P.A. Whitelock |
| R. Hames | |

Acknowledgements

The symposium was sponsored and supported by the IAU Divisions I (Fundamental Astronomy), VI (Interstellar Matter), VII (Galactic System), and X (Radio Astronomy); and by the IAU Commission No. 40 (Radio Astronomy).

Funding by the
National Research Foundation (NRF),
and
the South African SKA project
are gratefully acknowledged.

Cambridge University Press & Assessment
978-1-107-03284-2 — Cosmic Masers – from OH to Ho (IAU S287)
Edited by R. S. Booth , W. H. T. Vlemmings , E. M. L. Humphreys
Frontmatter
[More Information](#)

xiv

Conference photograph



Participants

Khudhair Abbas Assaf	Al-Muntafki , School of Physics & Astronomy, Manchester University, UK	kam@jb.man.ac.uk
Alexey	Alakoz , Astro Space Center of the P.N. Lebedev Physical Institute, Moscow, Russia	l-sha@yandex.ru
Felipe	Alves , Argelander Institut fur Astronomie, Bonn, Germany	falves@astro.uni-bonn.de
Nikta	Amiri , Leiden Observatory/JIVE, Leiden, Netherlands	amiri@strw.leidenuniv.nl
Tao	An , Shanghai Astronomical Observatory, Shanghai, China	antao@shao.ac.cn
Bernard Duah	Asabere , Physics Department, University of Johannesburg, South Africa	b.asabere@rocketmail.com
Willem	Baan , ASTRON, Dwingeloo, Netherlands	baan@astron.nl
Alejandro	Baez Rubio , Centro de Astrobiologia (CSIC-INTA), Madrid, Spain	baezra@cab.inta-csic.es
Olga	Bayandina , Astro Space Center of the Lebedev Physical Institute of RAS, Moscow, Russia	Bayandix@yandex.ru
Per	Bergman , Onsala Space Observatory, Chalmers University, Sweden	per.bergman@chalmers.se
Roy S.	Booth , SA SKA, Cape Town, South Africa	rbooth@ska.ac.za
Shari	Breen , CSIRO Astronomy and Space science, NSW, Australia	Shari.Breen@csiro.au
Tui Rose	Britton , Dept. of Physics and Astronomy, Macquarie University, NSW, Australia	tui.britton@csiro.au
Crystal	Brogan , NRAO, Charlottesville, VA, USA	cbrogan@nrao.edu
Do-Young	Byun , Korean Astronomy and Space Science Institute, Seoul, South Korea	bdy@kasi.re.kr
Jessica	Chapman , CSIRO Astronomy & Space Science, NSW, Australia	Jessica.Chapman@csiro.au
James Okwe	Chibueze , Kagoshima University, Kagoshima, Japan	james.chibueze@gmail.com
Se-Hyung	Cho , Korea Astronomy and Space Science Institute, Seoul, South Korea	cho@kasi.re.kr
Yoon Kyung	Choi , Max-Planck-Institut fuer Radioastronomie, Bonn, Germany	ykchoi@mpifr.de
Mark	Claussen , NRAO, Socorro, NM, USA	mclausse@nrao.edu
William	Cotton , NRAO, Charlottesville, VA, USA	bcotton@nrao.edu
Claudia	Cyganowski , Harvard/SAO CfA, Cambridge, MA, USA	ccyganow@cfa.harvard.edu
Jeremy	Darling , University of Colorado, Boulder, CO, USA	jdarling@colorado.edu
James	De Buizer , SOFIA/USRA, NASA Ames Research Center, CA, USA	jdebuizer@sofia.usra.edu
Eduardo de la	Fuente , CUCEI, Universidad de Guadalajara, Mexico	edfuente@gmail.com
Lientjie de	Villiers , Centre for Astrophysics Research, University of Hertfordshire, UK	lientjiedv@gmail.com
Shuji	Deguchi , NRO/NAOJ, Nagano, Japan	deguchi@nro.nao.ac.jp
Avinash	Deshpande , Raman Research Institute, Bangalore, India	desh@rri.res.in
Jean-Francois	Desmurs , OAN, Madrid, Spain	desmurs@oan.es
Phil	Diamond , CSIRO Astronomy and Space Science, NSW, Australia	phil.diamond@csiro.au
Miranda	Dunham , Yale University, New Haven, CT, USA	miranda.dunham@yale.edu
Dieter	Engels , Hamburger Sternwarte, Hamburg, Germany	dengels@hs.uni-hamburg.de
Jarken	Esimbek , Xinjiang Astronomical Observatory, Xinjiang, China	jarken@xao.ac.cn
Sandra	Etoka , JBCA, University of Manchester, UK	sandra.etoka@googlemail.com
Michael	Feast , SAAO/UCT, University of Cape Town, South Africa	mwf@ast.uct.ac.za
Kenta	Fujisawa , Yamaguchi University, Yamaguchi, Japan	kenta@yamaguchi-u.ac.jp
Michael J.	Gaylard , HartRAO, Krugersdorp, South Africa	mike@hartao.ac.za
Ciriaco	Goddi , ESO, Garching, Germany	cgoddi@eso.org
Sharmila	Goedhart , SKA SA, Cape Town, South Africa	sharmila@ska.ac.za
Ioannis	Gonidakis , CSIRO, NSW, Australia	ioannis.gonidakis@csiro.au
Malcolm	Gray , JBCA, University of Manchester, UK	Malcolm.Gray@manchester.ac.uk
Lincoln	Greenhill , Harvard/Smithsonian CfA, Cambridge, MA, USA	greenhill@cfa.harvard.edu
Daniel	Harris , SAO, Cambridge, MA, USA	harris.d.e.42@gmail.com
Christian	Henkel , MPIFR, Bonn, Germany	chenkel@mpifr-bonn.mpg.de
Tomoya	Hirota , National Astronomical Observatory of Japan, Tokyo, Japan	tomoya.hirota@nao.ac.jp
Mareki	Honma , NAOJ, Japan	mareki.honma@nao.ac.jp
Liz	Humphreys , ESO, Garching, Germany	chumphre@eso.org
Todd	Hunter , NRAO, Charlottesville, VA, USA	thunter@nrao.edu
Hiroshi	Imai , Kagoshima University, Kagoshima, Japan	hiroimai@sci.kagoshima-u.ac.jp
Katharina	Immer , MPIFR, Bonn, Germany	kimmer@mpifr-bonn.mpg.de
Violette	Impellizzeri , ALMA, Santiago, Chile	vimpelli@alma.cl
Izaskun	Jimenez-Serra , Harvard-Smithsonian Center for Astrophysics, MA, USA	ijimenez-serra@cfa.harvard.edu
Norio	Kaifu , NAOJ, Japan	noriokaifu@aol.com
Sergei	Kalenskii , Lebedev Physical Institute, Astro Space Center, Russia	kalensky@asc.rssi.ru
Athol	Kemball , University of Illinois at Urbana-Champaign, IL, USA	akemball@illinois.edu
Jaehoon	Kim , Yonsei University Observatory/KASI/Kyung Hee University, South Korea	jhkim@kasi.re.kr
Mikyoun	Kim , NAOJ, Japan	mikyoun.kim@nao.ac.jp
Kee-Tae	Kim , Korea Astronomy & Space Science Institute (KASI), South Korea	ktkim@kasi.re.kr
Tomoharu	Kurayama , Kagoshima University, Japan	kurayama@sci.kagoshima-u.ac.jp
Stan	Kurtz , UNAM, Mexico	s.kurtz@crya.unam.mx
Tanmoy	Laskar , Harvard University, Cambridge, MA, USA	tanmoylaskar@gmail.com
Marcelo	Leal-Ferreira , Argelander-Institut fur Astronomie, Germany	ferreira@astro.uni-bonn.de
Jingjing	Li , Purple Mountain Observatory, China	jjli@pmo.ac.cn
Michael	Lindqvist , Onsala Space Observatory, Chalmers University, Sweden	Michael.Lindqvist@chalmers.se
Ivan	Litovchenko , AstroSpace Center of Lebedev Physical Institute, Moscow, Russia	grosh@asc.rssi.ru
Jabulani Paul	Maswanganye , HartRAO/ Wits University, Krugersdorp, South Africa	pop7paul@gmail.com
Naoko	Matsumoto , National Astronomical Observatory of Japan, Japan	naoko.matsumoto@nao.ac.jp
Karl	Menten , MPIFR, Bonn, Germany	kmenten@mpifr.de
Victor	Migenes , Brigham Young University, UT, USA	vmigenes@byu.edu
David	Morris , IRAM, France	morris@iram.fr
Kazuhiro	Motogi , Hokkaido University, Japan	motogi@astrol.sci.hokudai.ac.jp
Takumi	Nagayama , NAOJ, Japan	takumi.nagayama@nao.ac.jp
Liudmila	Nazarova , EAAS, Moscow, Russia	lsnazarova@rambler.ru
Florian	Niederhofer , ESO, Garching, Germany	fniederhofer@gmx.de
Hans	Olofsson , Onsala Space Observatory, Chalmers University, Sweden	hans.olofsson@chalmers.se
Nadeem	Oozeer , SKA SA, South Africa	nadeem@ska.ac.za
Sunelle	Otto , HartRAO, Krugersdorp, South Africa	sunelle@hartao.ac.za
Tomooki	Oyama , National Astronomical Observatory of Japan, Japan	t.oyama@nao.ac.jp
Sean	Passmoor , SKA SA, South Africa	sean@ska.ac.za
Andres	Perez Sanchez , AIfA, Bonn, Germany	aperez@astro.uni-bonn.de
Michele	Pestalozzi , IFSI-INAf, Rome, Italy	michele.pestalozzi@gmail.com
Nurur	Raman , University of Johannesburg, Johannesburg, South Africa	nrahman@uj.ac.za
Sofia	Ramstedt , Argelander Institute for Astronomy, Bonn, Germany	sofia@astro.uni-bonn.de
Mark	Reid , Harvard-Smithsonian CfA, Cambridge, MA, USA	reid@cfa.harvard.edu
Anita M. S.	Richards , UK ARC Node, JBCA, University of Manchester, UK	amsr@jb.man.ac.uk
Laura	Richter , Rhodes University, South Africa	lrrichter@gmail.com

Nobuyuki Sakai, Graduate University for Advanced Studies, Japan	nobuyuki.sakai@nao.ac.jp
Alberto Sanna, MPIfR, Bonn, Germany	asanna@mpifr-bonn.mpg.de
Anuj Sarma, DePaul University, Chicago, IL, USA	asarma@depaul.edu
Mayumi Sato, MPIfR, Bonn, Germany	msato@mpifr-bonn.mpg.de
Satoko Sawada-Satoh, Mizusawa VLBI Observatory, NAOJ Japan	satoko.ss@nao.ac.jp
Nishant Singh, Raman Research Institute, Bangalore, India	nishant@rri.res.in
Lorant Sjouwerman, NRAO, Socorro, NM, USA	lsjouwer@nrao.edu
Rupert Spann, SKA SA, South Africa	rupert.spann@ska.ac.za
Vladimir Strel'nitski, Maria Mitchell Observatory, Nantucket, MA, USA	vladimir@mmo.org
Olga Suarez, Observatoire de la Cote d'Azur, Nice, France	olga.suarez@oca.eu
Koichiro Sugiyama, Yamaguchi University, Yamaguchi, Japan	koichiro@yamaguchi-u.ac.jp
Gabriele Surcis, JIVE, Dwingeloo, Netherlands	gabsurcis2@yahoo.it
Andrea Tarchi, INAF-Osservatorio Astronomico di Cagliari, Italy	atarchi@oa-cagliari.inaf.it
Clemens Thum, IRAM, Granada, Spain	thum@iram.fr
Anita Titmarsh, UTas/CASS, Tasmania, Australia	anitatt@postoffice.utas.edu.au
Jose-Maria Torrelles, ICE(CSIC)-UB/IEEC, Barcelona, Spain	torrelles@ieec.cat
Karl Johan Erik Torstensson, JIVE/Leiden Observatory, Netherlands	kalle@strw.leidenuniv.nl
Miguel Angel Trinidad, Guanajuato University, Guanajuato, Mexico	trinidad@astro.ugto.mx
Irina Val'tts, Astro Space Center of the Lebedev Physical Institute, Russia	ivaltts@asc.rssi.ru
Stefanus Petrus van den Heever, North West University, South Africa	13077724@nwu.ac.za
Johan van der Walt, North-West University, South Africa	johan.vanderwalt@nwu.ac.za
Huib van Langevelde, JIVE/Leiden, Dwingeloo, Netherlands	langevelde@jive.nl
Wouter Vlemmings, Chalmers University, Sweden	wouter.vlemmings@chalmers.se
Maxim Voronkov, CSIRO Astronomy & Space Science, Australia	Maxim.Voronkov@csiro.au
Andrew Walsh, James Cook University, Australia	andrew.walsh@jcu.edu.au
Junzhi Wang, Department of Astronomy, Nanjing University, China	junzhiwang@nju.edu.cn
Mark Wardle, Macquarie University, Australia	mark.wardle@mq.edu.au
Patricia Whitelock, SAAO/UCT, South Africa	paw@sao.ac.za
Kyle Willett, University of Minnesota, MN, USA	willett@physics.umn.edu
Markus Wittkowski, ESO, Garching, Germany	mwittkow@eso.org
Pawel Wolak, Nicolaus Copernicus University, Poland	wolak@astro.uni.torun.pl
Alwyn Wootten, NRAO, Charlottesville, VA, USA	awootten@nrao.edu
Yuanwei Wu, MPIfR, Bonn, Germany	ywei@mpifr-bonn.mpg.de
Ye Xu, Purple Mountain Observatory, Nanjing, China	xuye@pmo.ac.cn
Ingyin Zaw, New York University Abu Dhabi, New York, USA	iz6@nyu.edu
Jiangshui Zhang, Center for Astrophysics, Guangzhou University, China	jszhang@gzhu.edu.cn
Bo Zhang, MPIfR, Bonn, Germany	bzhang@mpifr.de
Jianjun Zhou, Xinjiang Astronomical Observatory, Xinjiang, China	zhoujj@xao.ac.cn

Tribute to Yolanda Gómez Castellano

The proceedings of IAU Symposium 287 are dedicated to the memory of Yolanda Gómez Castellano. Yolanda died on 16 February 2012, shortly after the symposium, at the age of forty-nine. She had struggled with cancer for a number of years, and her illness took a sudden, and unexpected, turn for the worse just weeks before the meeting. She was a member of the Scientific Organizing Committee of the symposium, and had planned to attend the meeting, canceling her travel plans only days before her scheduled departure for South Africa. Despite the state of her health, Yolanda still had sufficient energy to fulfill her wish to participate in the conference by sending her contribution as a poster (*Imaging the water masers toward the H_2 O-PN IRAS 18061-2505*) through Mexican colleagues.

Yolanda's professional career was based at the National Autonomous University of Mexico (UNAM). Her professional degrees (in physics) were all obtained from the UNAM, although her doctoral research (*A study in Radio Frequencies of Young Planetary Nebulae and OH/IR Stars*) was carried out at the Harvard-Smithsonian Center for Astrophysics. Upon her return to Mexico from Boston, she worked side-by-side with her husband, Luis Felipe Rodríguez, to establish a Mexican presence in the international radio astronomy community.

Yolanda worked for more than twenty years at the UNAM; she began her research career at the Institute for Astronomy at the Mexico City campus. Later, she was a founding member of the Center for Radio Astronomy and Astrophysics (CRyA) at the Morelia Campus of the UNAM, where she was a full professor.

Yolanda's primary research area was the study of gaseous nebulae, both young planetary nebulae associated with evolved stars and compact HII regions associated with young massive stars. She also did significant work on protoplanetary disks and jets associated with young stellar objects. Her research resulted in more than 65 published papers with numerous important contributions. Among her most notable discoveries was the first detection of water vapor around a planetary nebula. This was unexpected because the radiation field around these stars should destroy any nearby molecules. She was actively pursuing this fascinating line of research at the time of her death and in fact this was the topic of her contribution at the Symposium. In addition, Yolanda was a generous and cheerful teacher, always willing to help and guide her students. Her enthusiasm led many of her students to become astronomers: without exception her former masters and doctoral students have joined the research community, and are now independent researchers.

She was a firm believer that science is for everyone — not just for specialists but also for the general public. Consequently, Yolanda not only assumed an active role in the postgraduate astronomy program of the UNAM but she also taught undergraduate physics at the state university of Michoacán, in addition to giving courses in astronomy in several Latin American countries. Particularly notable was Yolanda's extensive involvement in public outreach. She gave innumerable talks, workshops, radio and television interviews and published more than 40 popular science articles. She had a key role in the International Year of Astronomy as celebrated in Mexico, organizing all of the events of the CRyA and serving as president of the state organizing committee. The 350 public outreach events that took place that year attracted more than 100,000 participants. The highlight was the *Noche de las Estrellas* at the prehispanic ruins in Tzintzuntzan, Michoacán, which an estimated 10,000 people attended. In addition, Yolanda contributed to the development of teaching materials for popularizing astronomy and the design of

xviii

astronomical displays and activities for science museums. Thanks to the warmth, enthusiasm and dedication with which Yolanda took astronomy to the public, the state government of Michoacán awarded her the 2008 State Prize for Public Outreach of Science and Technology.

Although perhaps little recognized by her professional colleagues, Yolanda was a avid lover of the arts. Not only did she come from a very musically-talented family, but she was also a devoted follower of the visual arts, decorating her home with outstanding works by national and regional Mexican artists. Moreover, she herself had a creative, artistic side: the logo of the CRyA — a radio telescope depicted in the style of Oriental calligraphy — was of her own design.

Those of us who knew Yolanda personally will miss her ready smile and the cheerfulness that accompanied her wherever she went. She will be greatly missed, by her former students, by her colleagues and friends in Morelia, in Mexico, and around the world, and most of all by her family, in particular by her children, Vicente and Cecilia, and her husband Luis Felipe, to whom we extend the warmest embrace.

Rest in Peace, Yolanda.

S. Kurtz & J.M. Torrelles

