**International Astronomical Union**

Union Astronomique Internationale

POST MEETING REPORT FORM

1. **Meeting Identification Number:** Symposium XXX
2. **Meeting Title:**
3. **Coordinating Division:**
4. **Dedication of meeting (if any):**
5. **Location (city, country):**
6. **Dates of meeting:**
7. **Number of participants:**
8. **Total Amount of IAU Grant funds received (in euros):**
9. **Number of IAU Grant recipients:**
10. **List of represented countries:**
11. **Anticipated number of separate papers in the proceedings:**
12. **Report submitted by:**

1. **Date and place:**
2. **Signature of SOC Chairperson:**

**Summary of the IAU Symposium 380 Cosmic Masers: Proper Motion toward the Next-Generation Large Projects**

**Date:** 2023 March 20 - 24

**Venue:** Li-Ka Nangoku Hall, Kagoshima, Japan

**Coordinating IAU Division:** Division H “Interstellar Matter and Local Universe”

**Supporting IAU Divisions:** Division B “Facilities, Technologies and Data Science”

 Division G “Stars and Stellar Physics”

 Division J “Galaxies and Cosmology”

**Scientific Organizing Committee (Female 8/Male 7):**

Tomoya Hirota National Astronomical Observatory of Japan, Japan (co-chair)

Karl Menten Max-Planck-Institut fur Radioastronomie, Germany(co-chair)

Ylva Pihlström University of New Mexico, United States (co-chair)

Anna Bartkiewicz Nicolaus Copernicus University, Poland

Crystal Brogan National Radio Astronomy Observatory, United States

James Chibueze North-West University, South Africa

Claudia Cyganowski University of St. Andrews, United Kingdom

Guido Garay Universidad de Chile, Chile

Yoshiaki Hagiwara Toyo University, Japan

Katharina Immer Leiden University, Netherlands

Jihyun Kang Korea Astronomy and Space Science Institute, Rep. of Korea

Silvia Leurini INAF Osservatorio Astronomico di Cagliari, Italy

Mark Reid Harvard-Smithsonian Center for Astrophysics, United States

María Rioja The University of Western Australia, Australia

Bo Zhang Shanghai Astronomical Observatory, China

**Local Organizing Committee (Female 2/Male 8):**

Hiroshi Imai Kagoshima University, Japan (co-chair)

Akiharu Nakagawa Kagoshima University, Japan (co-chair)

Ross Burns National Astronomical Observatory of Japan/Riken, Japan

Toshihiro Handa Kagoshima University, Japan

Mareki Honma National Astronomical Observatory of Japan, Japan

Hiroyuki Nakanishi Kagoshima University, Japan

Aya Imakado Kagoshima University, Japan

Hiroko Shinnaga Kagoshima University, Japan

Shigehisa Takakuwa Kagoshima University, Japan

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Kei Amada Kagoshima University, Japan

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Kaito Kawakami Kagoshima University, Japan

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Yuichi Sakamoto Kagoshima University, Japan

Yosuke Shibata Kagoshima University, Japan

Ka Yiu Shum Kagoshima University, Japan

Daisuke Takaishi Kagoshima University, Japan

Koki Tanaka Kagoshima University, Japan

Ryosuke Watanabe Kagoshima University, Japan

**(i) Final scientific programme**

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| Mon 20, March 2023 [IAUS Science session, day 1] |
| 08:15-08:50 | Registration |
| 　 | [Session 0] Opening: chair Hiroshi Imai |
| 08:50-09:00 | other | Announcement from LOC | Hiroshi Imai | Kagoshima University |
| 09:00-09:05 | other | Welcome greeting from Kagoshima University | Masanori Baba | Kagoshima University |
| 09:05-09:20 | other | Opening of symposium | Tomoya Hirota | National Astronomical Observatory of Japan |
| 　 | [Session 1] Theory of Masers and Maser Sources: chair Anna Bartkiewicz |
| 09:20-10:10 | Review | Polarization, variability and coherence phenomena | Martin Houde | University of Western Ontario |
| 10:10-10:35 | Invite | Recombination lines and maser effects | Zulema Abraham | Universidade de Sao Paolo |
| 10:35-11:05 | Coffee Break (and poster viewing) |
| 11:05-11:30 | Invite | Flaring Masers and Pumping | Malcolm Gray | National Astronomical Research Institute of Thailand (Public Organization) |
| 11:30-11:45 | Contributed | A comprehensive model of maser polarization | Boy Lankhaar | Chalmers University of Technology / Leiden Observatory |
| 11:45-12:00 | Contributed | Maser polarization simulation in an evolving star: effect of magnetic field on SiO maser in the circumstellar envelope | Montree Phetra | Chiang Mai University / National Astronomical Research Institute of Thailand (Public Organization) |
| 12:00-12:30 | Poster flash talks 1 (1-min flash talks up to 30 speakers) |
| 12:30-14:00 | Lunch (and poster viewing) |
| 　 | [Session 2] Black Hole Masses and the M-sigma Relation (1): chair Tomoya Hirota |
| 14:00-14:50 | Review | Supermassive blackhole mass growth in infrared-luminous gas-rich galaxy mergers and potential power of millimeter H2O megamaser observations | Masatoshi Imanishi | National Astronomical Observatory of Japan |
| 14:50-15:15 | Invite | LADUMA: The first discovery of an OH megamaser at z > 0.5 | Marcin Glowacki | Curtin University |
| 15:15-15:30 | Contributed | Could kilomasers pinpoint supermassive stars? | Katarzyna Nowak | University of Hertfordshire  |
| 15:30-15:45 | Contributed (ONLINE) | OH megamasers in extremely obscured LIRGs – probing dense and collimated outflows? | Susanne Aalto | Chalmers University of Technology |
| 15:45-16:15 | Poster session 1 |
| 16:15-16:45 | Coffee Break (and poster viewing) |
| 　 | [Session 3] Black Hole Masses and the M-sigma Relation (2): chair Tomoya Hirota |
| 16:45-17:10 | Invite | Masers in Low-Mass Galaxies | Ingyin Zaw | New York University Abu Dhabi |
| 17:10-17:25 | Contributed (ONLINE) | IC485: A candidate for a new maser disk galaxy | Elisabetta Ladu | Universita degli studi di Cagliari / INAF-Osservatorio Astronomico di Cagliari |
| 17:25-17:40 | Contributed (ONLINE) | What’s behind the corner: Maser emission in nearby and distant galaxies with the new radio facilities | Andrea Tarchi | INAF - Osservatorio Astronomico di Cagliari  |
| 17:40-18:10 | Poster flash talks 2 (1-min flash talks up to 30 speakers) |
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| Tue 21, March 2023 [IAUS Science session, day 2] |
| 　 | [Session 4] Pulsation and Outflows in Evolved Stars (1): chair Maria Rioja |
| 09:00-09:50 | Review (ONLINE) | Mass Loss in Evolved Stars | Lynn Matthews | Massachusetts Institute of Technology Haystack Observatory |
| 09:50-10:15 | Invite | Masers in evolved stars; the BAaDE survey | Lorant Sjouwerman | National Radio Astronomy Observatory |
| 10:15-10:30 | Contributed | SiO maser line ratios in the BAaDE survey | Megan Olivia Lewis | Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences  |
| 10:30-11:00 | Poster session 2 |
| 11:00-11:15 | Coffee Break (and poster viewing) |
| 11:15-11:40 | Invite | Properties of pulsating OH/IR stars revealed from astrometric VLBI observation | Akiharu Nakagawa | Kagoshima University |
| 11:40-11:55 | Contributed | Results of KVN Key Science Program for evolved stars | Youngjoo Yun | Korea Astronomy and Space Science Institute |
| 11:55-12:10 | Contributed | The Astrometric Animation of Water Masers toward the Mira Variable BX Cam | Shuangjing Xu | Korea Astronomy and Space Science Institute / Shanghai Astronomical Observatory |
| 12:10-12:25 | Contributed | Water fountain sources monitored in FLASHING | Hiroshi Imai | Kagoshima University  |
| 12:25-14:00 | Lunch (and poster viewing) |
| 　 | [Session 5] Structure of the Milky Way (1): chair Crystal Brogan |
| 14:00-14:50 | Review | Galactic Astrometry with VLBI | Kazi Rygl | INAF - Istituto di Radioastronomia |
| 14:50-15:05 | Contributed | The origin of the Perseus-arm gap revealed with VLBI astrometry | Nobuyuki Sakai | National Astronomical Research Institute of Thailand (Public Organization) |
| 15:05-15:30 | Invite (ONLINE) | Galactic Astrometry with Gaia | Carme Jordi | University of Barcelona |
| 15:30-16:00 | Coffee Break (and poster viewing) |
| 　 | [Session 6] Dynamics of Formation of Massive Stars (1): chair Crystal Brogan |
| 16:00-16:50 | Review (ONLINE) | Evolutionary Trends in Star-formation | James Urquhart | University of Kent |
| 16:50-17:05 | Contributed (ONLINE) | Snapshot of a magnetohydrodynamic disk wind traced by water maser observations | Luca Moscadelli | INAF - Osservatorio Astrofisico di Arcetri |
| 17:05-17:20 | Contributed (ONLINE) | High resolution VLBI observations of 6.7GHz periodic methanol masers | Mateusz Olech | University of Warmia and Mazury |
| 17:20-17:35 | Contributed (ONLINE) | New maser species tracing accretion flows in a high-mass young stellar object G358.93-0.03 | Andrey M. Sobolev | Ural Federal University |
| 17:35-18:00 | Invite (ONLINE) | Masers in accretion burst sources | Olga Bayandina | INAF - Osservatorio Astrofisico di Arcetri |
| 18:00-18:10 | Group photo |
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| Wed 22, March 2023 [IAUS Science session, day 3] |
| 　 | [Session 7] Structure of the Milky Way (2): chair Jihyun Kang |
| 09:00-09:25 | Invite | Galactic Maser Astrometry with VERA | Mareki Honma | National Astronomical Observatory of Japan / University of Tokyo |
| 09:25-09:40 | Contributed (ONLINE) | Mapping the “Dark Side” of the Milky Way | Mark J. Reid | Center for Astrophysics | Harvard & Smithsonian |
| 09:40-09:55 | Contributed (ONLINE) | Kinematics in the Galactic Center with SiO masers | Jennie Paine | University of Colorado Boulder  |
| 09:55-10:10 | Contributed (ONLINE) | Gaia measurements refined using radio observations from maser bearing stars | Luis Henry Quiroga-Nunez | Florida Institute of Technology  |
| 10:10-10:25 | Contributed | The structure and dynamics of the Galactic bar and the mass distribution in the central region of the Milky Way | Jayender Kumar | University of Tasmania |
| 10:25-10:55 | Coffee Break (and poster viewing) |
| 10:55-11:10 | Contributed | Trigonometric parallax, proper motion, structure, and dynamics of three southern hemisphere methanol masers | Lucas Jordan Hyland | University of Tasmania  |
| 　 | [Session 8] Dynamics of Formation of Massive Stars (2): chair Jihyun Kang |
| 11:10-11:35 | Invite | Maser Tracers of Gas Dynamics near Young Stars - New Perspectives | Alberto Sanna | INAF - Osservatorio Astronomico di Cagliari  |
| 11:35-11:50 | Contributed | Monitoring of the polarized H2O maser emission around the massive protostars W75N(B)-VLA 1 and W75N(B)-VLA 2 | Gabriele Surcis | INAF - Osservatorio Astronomico di Cagliari  |
| 11:50-12:05 | Contributed | The water and methanol masers in the face-on accretion system around the high-mass protostar G353.273+0.641 | Kazuhito Motogi | Yamaguchi University  |
| 12:05-12:20 | Contributed | Maser Activity of Large Molecules toward Sgr B2 North | Ci Xue | Massachusetts Institute of Technology  |
| 12:20-14:00 | Lunch |
| 14:00-18:45 | Excursion |
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| Thu 23, March 2023 [IAUS Science session, day 4] |
| 　 | [Session 9] Cosmic Distance Scale and the Hubble Constant: chair Mareki Honma |
| 09:00-09:50 | Review | Megamaser Cosmology | Dominic Pesce | Center for Astrophysics | Harvard & Smithsonian |
| 09:50-10:15 | Invite | The Megamaser Cosmology Project II : The Prospects for measuring a 1% H0 and distances to high-z galaxies | Cheng-Yu Kuo | National Sun Yat-Sen University /Institute of Astronomy and Astrophysics |
| 10:15-10:30 | Contributed | The megamaser disk of NGC1068 | Violette Impellizzeri | Leiden University |
| 10:30-10:45 | Contributed | Distance of the Seyfert 2 galaxy IC 2560 and the Hubble constant | Naomasa Nakai | Kwansei Gakuin University  |
| 10:45-11:00 | Contributed (ONLINE) | The Past, Present, and Groundbreaking Future of OH Megamaser Discoveries | Hayley Roberts | University of Colorado Boulder |
| 11:00-11:30 | Coffee Break (and poster viewing) |
| 11:30-11:55 | Poster session 3 |
| 　 | [Session 10] Dynamics of Formation of Massive Stars (3): chair Mareki Honma |
| 11:55-12:10 | Contributed | Detection of the longest periodic variability in 6.7 GHz methanol masers with iMet | Yoshihiro Tanabe | Ibaraki University  |
| 12:10-12:25 | Contributed | Simultaneous observations of exited OH and methanol maser - coincidence and magnetic field | Agnieszka Kobak | Nicolaus Copernicus University in Torun |
| 12:25-14:00 | Lunch (and poster viewing) |
| 　 | [Session 11] Pulsation and Outflows in Evolved Stars (2): chair James Chibueze |
| 14:00-14:25 | Contributed (ONLINE) | Mm/submm Observations of Evolved Stars | Elizabeth Humphreys | European Southern Observatory / Joint ALMA Observatory |
| 14:25-14:40 | Contributed | High resolution ALMA imaging of H2O, SiO, and SO2 masers in the complex atmosphere of the AGB star W Hya | Keiichi Ohnaka | Universidad Andres Bello |
| 14:40-14:55 | Contributed | Evolution of the outflow traced by water masers in the evolved star IRAS 18043-2116 | Lucero Uscanga | Universidad de Guanajuato |
| 14:55-15:10 | Contributed (ONLINE) | ALMA explores the inner wind of evolved O-rich stars with two widespread vibrationally excited transitions of water | Alain Baudry | University of Bordeaux, LAB  |
| 15:10-15:25 | Contributed | Nascent planetary nebulae: new identifications and extraordinary evolution | Roldan A. Cala | Instituto de Astrofisica de Andalucia |
| 15:25-15:40 | Contributed (ONLINE) | Variability of water masers in evolved stars on the timescale of decades | Jan Brand | INAF-Istituto di Radioastronomia & Italian ALMA Regional Centre |
| 15:40-15:55 | Contributed | Signposts of transitional phases on the Asymptotic Giant Branch | Sandra Etoka | JBCA - Manchester University |
| 15:55-16:25 | Coffee Break (and poster viewing) |
| 　 | [Session 12] New Projects and Future Telescopes (1): chair James Chibueze |
| 16:25-17:15 | Review | Ultra-precise astrometry: today and with the next-generation telescopes | Maria Rioja | The University of Western Australia / CSIRO Space & Astronomy / Observatorio Astronómico, IGN |
| 17:15-17:40 | Invite | Overview of the Maser Monitoring Organisation | Ross Burns | National Astronomical Observatory of Japan / Riken |
| 17:40-17:55 | Contributed | GASKAP-OH - A New Deep Survey of OH Masers in the Southern Sky | Joanne R. Dawson | Macquarie University / CSIRO Space & Astronomy |
| 17:55-18:10 | Contributed (ONLINE) | Introducing the MeerKAT Telescope: Studies of masers and their environment | Sharmila Goedhart | South African Radio Astronomy Observatory  |
| 18:10-19:00 | Transfer to venue of conference dinner |
| 19:00-21:30 | Conference dinner |
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| Fri 24, March 2023 [IAUS Science session, day 5] |
| 　 | [Session 13] New Projects and Future Telescopes (2): chair Hiroyuki Nakanishi |
| 09:00-09:25 | Invite | Southern Hemisphere Maser Astrometry | Simon Ellingsen | University of Tasmania |
| 09:25-09:50 | Invite | The 40-m Thai National Radio Telescope with its key sciences and a future South-East Asian VLBI Network | Koichiro Sugiyama | National Astronomical Research Institute of Thailand (Public Organization) |
| 09:50-10:15 | Invite | Maser science with the African VLBI Network and MeerKAT | James Chibueze | North West University / University of Nigeria |
| 10:15-10:40 | Invite | The ALMA 2030 Wideband Sensitivity Upgrade | Crystal Brogan | National Radio Astronomy Observatory |
| 10:40-11:10 | Coffee Break (and poster viewing) |
| 11:10-11:35 | Invite | SKA | Shari Breen | SKA Observatory |
| 11:35-12:00 | Invite | Maser Science with the ngVLA | Todd Hunter | National Radio Astronomy Observatory / Center for Astrophysics | Harvard & Smithsonian |
| 12:00-12:15 | Contributed | Exploring galactic and extragalactic masers with LLAMA | Tania Pereira Dominici | National Institute for Space Research |
| 12:15-12:30 | Contributed | Prospects for sub-mm maser astrometry with ngEHT | Richard Dodson | The University of Western Australia |
| 12:30-14:15 | Lunch |
| 　 | [Session 14] Closing: chair Tomoya Hirota |
| 14:15-15:00 | other | Closing remarks | Anna Bartkiewicz | Nicolaus Copernicus University in Torun |
| 15:00-15:15 | other | Announcement from SOC | Tomoya Hirota | National Astronomical Observatory of Japan |
| Announcement from LOC | Hiroshi Imai | Kagoshima University |
| 40 min talk +10 min discussion for review (total 50 min), 20 min talk +5 min discussion for invited (total 25 min), and 12 min talk +3 min discussion for contributed (total 15 min) |

List of posters (poster flash talks)

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| Poster flash talks 1 (1-min flash talks up to 30 speakers) |
| ONLINE | The Dynamics of the Outflow Structure in W49 N | Kitiyanee Asanok | National Astronomical Research Institute of Thailand / Khon Kaen University |
| ONLINE | Interferometric Observations of the WF Candidates OH 16.3-3.0 and IRAS 19356+0754 | Priscila Chacón | Universidad de Guanajuato |
| in person | A Holistic Search for Megamaser Disks and their Role in Feeding Supermassive Black Holes | Anca Constantin | James Madison University  |
| in person | Study of Active Galactic Nuclei using water vapor masers | Deepshikha Deepshikha | Kwansei Gakuin Universiity |
| in person | Water masers associated with AGN in radio galaxies | Satoko Sawada-Satoh | Osaka Metropolitan University  |
| in person | A search for spatial and temporal variations in the proton-to-electron mass ratio from H2 spectra | Thong D. Le | Ton Duc Thang University |
| in person | Astrometric observations of water maser sources toward the Galactic Center with VLBI | Daisuke Sakai | National Astronomical Observatory of Japan |
| in person | Water Masers in the Galactic Center | Dylan Ward | New Mexico Institute of Mining and Technology  |
| in person | An ALMA View of Molecular Filaments Associated with Shock-Excited OH Masers | Hidetoshi Sano | Gifu University |
| in person | Astrometry of Water Maser sources in the Outer Galaxy with VERA | Hiroyuki Nakanishi | Kagoshima University  |
| in person | Estimating distances to AGB stars using IR data | Rajorshi Bhattacharya | University of New Mexico  |
| in person | Searching masers from the Sgr Stellar Stream | Yuanwei Wu | National Time Service Center of Chinese Academy of Sciences |
| in person | Water maser flare and potential accretion burst in NGC 2071-IR | Andrews M. K. Dzodzomenyo | North-West University |
| in person | Methanol and excited OH masers in HMYSOs observed using EVN | Anna Bartkiewicz | Nicolaus Copernicus University in Torun |
| in person | New insides of 6.7 GHz methanol maser variability in IRAS 20126+4104 | Artis Aberfelds | Ventspils University of Applied Sciences |
| in person | The first and last VLBI maps of rare 7 GHz methanol masers | Gabor Orosz | Joint Institute for VLBI ERIC |
| in person | Possibly New OH Excited Rotatonal State Masers | Ivars Smelds | Ventspils University of Applied Sciences |
| in person | Spatio-kinematics of water masers in the HMSFR NGC6334I before and during an accretion burst | Jakobus M. Vorster | University of Helsinki / North-West University  |
| in person | Jet and Outflows of a High Mass Star Forming Region: G10.34-0.14 | Jihyun Kang | Korea Astronomy and Space Science Institute  |
| in person | Multiple scales of view for outflow driven by a high-mass young stellar object, G25.82—W1 | Jungha Kim | Korea Astronomy and Space Science Institute  |
| in person | Intensity monitor of water maser emission associated with massive YSOs | Kazuyoshi Sunada | National Astronomical Observatory of Japan |
| in person | Simultaneous Single-dish Survey of Water and Methanol Masers toward High-mass YSOs in Various Evolutionary Stages | Kee-Tae Kim | Korea Astronomy and Space Science Institute  |
| in person | Yamaguchi interferometer survey of protostellar outflows embedded in 70 – μm dark infrared dark cloud | Keita Kitaguchi | Yamaguchi University |
| in person | Ultra-precise monitoring of a class I methanol maser | Maxim Voronkov | CSIRO Space & Astronomy |
| in person | Interferometric study of the class I methanol masers at 104.3 GHz | Maxim Voronkov | CSIRO Space & Astronomy |
| in person | Fast variability and circular polarization of the bursting methanol maser component in G33.641-0.228 | Kenta Fujisawa | Yamaguchi University  |
| in person | The environments of hyper-compact H II regions.I. G345.0061+01.794 B | Toktarkhan Komesh | Nazarbayev University / Al-Farabi Kazakh National University |
| Poster flash talks 2 (1-min flash talks up to 30 speakers) |
| ONLINE | Water maser emission in hard-Xray selected, highly obscured, AGN | Paola Castangia | INAF - Osservatorio Astronomico di Cagliari  |
| ONLINE | Supermassive stars as sites of H2O kilomasers | Martin G. H. Krause | University of Hertfordshire  |
| ONLINE | SMA Millimeter Continuum Imaging of 6.7 GHz CH3OH Maser Regions: Baseline epoch for future accretion outbursts | Claudia J. Cyganowski | University of St Andrews |
| ONLINE | Water masers as an early tracer of star formation | Dmitry A. Ladeyschikov | Ural Federal University  |
| ONLINE | VLA and ALMA Observations of the Extended Green Object G19.01-0.03: A partially inclined 6.7GHz Class II CH3OH maser ring and outflow-tracing NH3(3,3) and 25GHz and 278GHz Class I CH3OH masers | Gwenllian Williams | University of Leeds |
| ONLINE | Multi-scale observational study of G45.804-0.355 star forming region | Mavis Seidu | North West University |
| ONLINE | ATLASGAL: Methanol masers at 3 mm | Wenjin Yang | Max-Planck-Institut fur Radioastronomie |
| ONLINE | Water masers and host environments of FU Orionis and EX Lupi type low-mass eruptive young stellar objects | Zsofia M. Szabo | Max-Planck-Institut fur Radioastronomie / University of St Andrews / Konkoly Observatory  |
| ONLINE | A database of circumstellar OH masers update | Dieter Engels | Universitat Hamburg |
| ONLINE | A Profile-based Approach to Finding New Water Fountain Candidates using Databases of Circumstellar Maser Sources | Jun-ichi Nakashima | Sun Yat-sen University |
| in person | ALMAGAL Survey: Analysis of 59 Protostellar Clumps hosting Class II Methanol Masers | Georgina Stroud | University of Manchester |
| in person | Catching unusual phenomena with extensive maser monitoring | Michał T. Durjasz | Nicolaus Copernicus University in Torun |
| in person | A Multiwavelength study towards Galactic H II region G10.32-0.26 | Mikyoung Kim | Otsuma Women's University  |
| in person | Fine structure and refractive scattering of the H2O maser in W49N star-forming region | Nadezhda N. Shakhvorostova | P.N. Lebedev Institute of RAS  |
| in person | Torun's methanol maser monitoring program | Paweł I. Wolak | Nicolaus Copernicus University in Torun |
| in person | Water maser Zeeman splitting in the ionized jet IRAS 19035+0641 A | Tatiana M. Rodriguez | New Mexico Institute of Mining and Technology  |
| in person | High-cadence 6.7 GHz methanol maser monitoring observations by Hitachi 32-m radio telescope | Yoshinori Yonekura | Ibaraki University  |
| in person | High mass star forming region (HMSFR) G024.33: Possibly another discovery in the making | Stefanus van den Heever | South African Radio Astronomy Observatory |
| in person | Water masers -- high resolution measurements of the diverse conditions in evolved star winds | Anita M. S. Richards | JBCA, University of Manchester UK |
| in person | Investigating the inner circumstellar envelopes of oxygen-rich evolved stars with ALMA observations of high-J SiO masers | Bannawit Pimpanuwat | JBCA, University of Manchester UK |
| in person | Fully 3D modelling of masers towards AGB stars – latest development and early results | Bannawit Pimpanuwat | JBCA, University of Manchester UK |
| in person | Preliminary results on SiO v=1 J=1-0 maser emission from AGB stars | Jean-Francois Desmurs  | Observatorio Astronómico Nacional |
| in person | A sensitive search for SiO maser emission in planetary nebulae | Jose F. Gomez | Instituto de Astrofisica de Andalucia |
| in person | Discovery of SiO masers in the “Water Fountain’’ source, IRAS 16552-3050 | Kei Amada | Kagoshima University  |
| in person | HINOTORI and Maser observations | Keisuke Nakashima | Kagoshima University  |
| in person | Annual parallax measurement of extreme OH/IR candidate star OH39.7+1.5 | Ryosuke Watanabe | Kagoshima University  |
| in person | OH maser variations during the transition from AGB to postAGB evolution | Sandra Etoka | JBCA, University of Manchester UK |
| in person | VLBI studies of cosmic masers with current and future VLBI arrays | Dong-Jin Kim | Massachusetts Institute of Technology Haystack Observatory  |

Number of speakers invited talks: Female 10/Male 16

Number of speakers contributed talks: Female 15/Male 23

Number of session chairs: Female 4/Male 5

**(ii) Summary of the scientific highlights of the meeting**

 During the IAUS 380, we discussed 7 major science topics on cosmic masers.

**1) Cosmic Distance Scale and the Hubble Constant**

**2) Black Hole Masses and the M-sigma Relation**

**3) Structure of the Milky Way**

**4) Dynamics of Formation of Massive Stars**

**5) Pulsation and Outflows in Evolved Stars**

**6) Theory of Masers and Maser Sources**

**7) New Projects and Future Telescopes**

In the following, we summarize scientific highlights discussed at the IAU Symposium 380.

 Firstly, although temporal variability in an inherent property of most cosmic masers, *large scale* systematic time monitoring campaigns have only been started within the last decade. Many oral and poster presentations reported results/plans of long-term monitoring programs of maser sources using single-dish telescopes of various institutes distributed in all over the world. Interesting events found in such efforts have been followed up with interferometry. It should be emphasized that small- and medium-size projects are underway and new projects have been initiated in developing countries in the field of astronomy in Asia, Africa, and South America, as presented in the last session for the New Projects and Future Telescopes in the IAUS 380. Intensive monitoring observations have revealed maser variabilities at wide ranges of time scales from hour to decades. New episodic mass accretion events in high-mass star-forming regions have been identified through monitoring programs of methanol maser flares after the last IAUS 336 in 2017 by the "Maser Monitoring Organization (M2O)" team established during the IAUS 336. Also, long-period variable stars and high-mass young stellar objects with >1000-day periodicities are newly reported in water and methanol masers, respectively. Time-domain campaigns on the maser variability are being continued to investigate longer period sources with dedicated monitoring telescopes. Frequent monitoring and survey for short-timescale and sudden episodic events will also be conducted using future facilities. To understand the background physics of maser variability, it is proposed that frequent monitoring for multiple maser transitions/species provide crucial input for theoretical studies.

 Secondly, we are really seeing the massive impact of high resolution and sensitivity radio observations with ALMA and the JVLA in all fields of maser science from Galactic star-forming regions and evolved stars to starburst galaxies and active galactic nuclei, as we expected in the original proposal to the IAU Symposium. Detailed views on high-mass young stellar objects, evolved stars, and the central molecular zones of galaxies, including that of the Milky Way galaxy can be traced by *thermal* molecular and dust emission with ALMA and free-free and synchrotron emission with the JVLA at comparable resolutions with VLBI imaging of masers. New submillimeter maser images from ALMA are also presented which are opening a new window to investigate higher temperature/density regions. It should be noted that some new/unexpected centimeter maser lines are also reported, and hence, future follow-up observations with ALMA and/or the JVLA at high resolution will constrain their pumping mechanisms combined with theoretical modelling.

 Thirdly, some parallaxes from Gaia DR2, especially for Mira variables, had shown very large discrepancies when compared to VLBI parallaxes. However, updated results from Gaia DR3 now are in much better agreement with the VLBI measurements. While Gaia will produce extremely large numbers of parallaxes, being an optical system it cannot freely probe the Milky Way, owing to strong dust extinction in the plane. In the meeting we heard updates on two large VLBI parallax surveys: the Bar and Spiral Structure Legacy (BeSSeL) Survey and the VLBI Exploration of Radio Astrometry (VERA) project. These target massive young stars with maser emission, which are excellent tracers of spiral structure.  Results from these projects presented at the meeting showed there are now over VLBI 250 parallaxes, some with accuracies of +/-6 micro-arcseconds, which have revealed many interesting features of our Galaxy's structure.  For example, the "expanding 3-kpc arm" now looks to be composed of orbits around the Galactic long bar; thus it is neither expanding, at 3-kpc, or a spiral arm.  Planned VLBI observations should provide a complete picture of the spiral structure of the Milky Way in the future using new facilities such as South-East Asian VLBI, African VLBI, SKA, and ngVLA.

 Finally, as summarized above, the panchromatic information that is currently available is enabling a much deeper view of the physical conditions and overall environments in which masers exist. Now the maser images taken with the highest resolution VLBI observations at milli-arcsecond resolutions are directly compared with multi-wavelength datasets in most of the presentations for individual studies in the IAUS 380. Such multi-wavelength observations are under development within next-generation projects that are directly and indirectly related to maser observations, as introduced in the last session of the IAUS 380.

**(iii) List of participants**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Given name | Middle name | Family name | Country | Affiliation Name | 　 |
| Susanne | 　 | Aalto | Sweden | Chalmers University of Technology | online |
| Artis | 　 | Aberfelds | Latvia | Ventspils University of Applied Sciences | in person |
| Zulema | 　 | Abraham | Brazil | University of Sao Paulo | in person |
| Takuya | 　 | Akahori | Japan | National Astronomical Observatory of Japan | online |
| Kei | 　 | Amada | Japan | Kagoshima University | in person |
| Kitiyanee | 　 | Asanok | Thai | National Astronomical Research Institute of Thailand (Public Organization) | online |
| Anna | 　 | Bartkiewicz | Poland | Torun Institute of Astronomy | in person |
| Alain | 　 | Baudry | France | University Bordeaux, L.A.B. | online |
| Olga | 　 | Bayandina | Italy | INAF - Osservatorio Astrofisico di Arcetri | online |
| Rajorshi | 　 | Bhattacharya | USA | University of New Mexico | in person |
| Shuaibo | 　 | Bian | China | Purple Mountain Observatory | online |
| James | 　 | Braatz | USA | National Radio Astronomy Observatory | online |
| Jan | 　 | Brand | Italy | INAF - Istituto di Radioastronomia | online |
| Shari | L  | Breen | UK | SKA Observatory | in person |
| Crystal | L | Brogan | USA | National Radio Astronomy Observatory | in person |
| Andreas | 　 | Brunthaler | Germany | Max-Planck-Institut fur Radioastronomie | online |
| Ross | Alexander | Burns | Japan | National Astronomical Observatory of Japan | in person |
| Roldan | A. | Cala | Spain | Instituto de Astrofisica de Andalucia (IAA-CSIC) | in person |
| Paola | 　 | Castangia | Italy | INAF - Osservatorio Astronomico di Cagliari | online |
| Priscila | 　 | Chacón | Mexico | Universidad de Guanajuato | online |
| James | Okwe | Chibueze | South Africa | North-West University | in person |
| Se-Hyung | 　 | Cho | Korea | Seoul National University | online |
| Mark | J | Claussen | USA | National Radio Astronomy Observatory | in person |
| Anca | 　 | Constantin | USA | James Madison University | in person |
| Claudia | J | Cyganowski | UK | University of St Andrews | online |
| Joanne | R | Dawson | Australia | Macquarie University / CSIRO Space & Astronomy | in person |
| Deepshikha | 　 | Deepshikha | Japan | Deepshikha | in person |
| Jean-Francois | 　 | DESMURS | Spain | Observatorio Astronomico Nacional | in person |
| Philip | 　 | Diamond | UK | SKA Observatory | online |
| Richard | 　 | Dodson | Australia | ICRAR/UWA | in person |
| Tania | Pereira | Dominici | Brazil | National Institute for Space Research (INPE/MCTI) | in person |
| Le | Thong | Duc | Vietnam | Institute for Computational Science | in person |
| Michal | Tomasz | Durjasz | Poland | Nicolaus Copernicus University | in person |
| Andrews | Mawuli, Kodzo | Dzodzomenyo | South Africa | North-West University | in person |
| Simon | 　 | Ellingsen | Australia | University of Tasmania | in person |
| Dieter | 　 | Engels | Germany | Hamburger Sternwarte, Universitat Hamburg | online |
| Sandra | 　 | Etoka | UK | Jodrell Bank Centre for Astrophysics, University of Manchester | in person |
| Kenta | 　 | Fujisawa | Japan | Yamaguchi Univeristy | in person |
| Marcin | 　 | Glowacki | Australia | CIRA (Curtin Institute of Radio Astronomy) | in person |
| Sharmila | 　 | Goedhart | South Africa | South African Radio Astronomy Observatory | online |
| Jose-Francisco | 　 | Gomez | Spain | Instituto de Astrofisica de Andalucia (IAA-CSIC) | in person |
| Mark | Daniel | Gorski | Sweden | Chalmers University of Technology | online |
| Malcolm | David | Gray | Thai | National Astronomical Research Institute of Thailand (Public Organization) | in person |
| Jimi | A | Green | UK | SKA Observatory | online |
| Yoshiaki | 　 | Hagiwara | Japan | Toyo University | online |
| Chaojie | 　 | Hao | China | Purple Mountain Observatory | online |
| Tomoya | 　 | Hirota | Japan | National Astronomical Observatory of Japan | in person |
| Peter | 　 | Hofner | USA | New Mexico Tech & NRAO | in person |
| Mareki | 　 | Honma | Japan | National Astronomical Observatory of Japan | in person |
| Martin | 　 | Houde | Canada | University of Western Ontario | in person |
| Elizabeth | 　 | Humphreys | Chile | ESO / ALMA | in person |
| Todd | 　 | Hunter | USA | National Radio Astronomy Observatory | in person |
| Lucas | Jordan | Hyland | Australia | University of Tasmania | in person |
| Nao | 　 | Ikeda | Japan | Kagoshima University | in person |
| Hiroshi | 　 | Imai | Japan | Kagoshima University | in person |
| Masatoshi | 　 | Imanishi | Japan | National Astronomical Observatory of Japan | in person |
| Katharina | 　 | Immer | Netherlands | Leiden University / ESO | online |
| Violette | 　 | Impellizzeri | Netherlands | Leiden Observatory | in person |
| Carme | 　 | Jordi | Spain | University of Barcelona (ICCUB-IEEC) | online |
| Jihyun | 　 | Kang | Korea | Korea Astronomy and Space Science Institute | in person |
| Rina | 　 | Kasai | Japan | Kagoshima University | in person |
| Kaito | 　 | Kawakami | Japan | Kagoshima University | in person |
| Dongjin | 　 | Kim | USA | MIT Haystack Observatory | in person |
| Jungha | 　 | Kim | Korea | Korea Astronomy and Space Science Institute | in person |
| Kee-Tae | 　 | Kim | Korea | Korea Astronomy and Space Science Institute | in person |
| Mikyoung | 　 | Kim | Japan | Otsuma Women's University | in person |
| Soon-Wook | 　 | Kim | Korea | Korea Astronomy and Space Science Institute | online |
| Keita | 　 | Kitaguchi | Japan | Yamaguchi University | online |
| Agnieszka | 　 | Kobak | Poland | Nicolaus Copernicus University in Torun | in person |
| Hideyuki  | 　 | Kobayashi | Japan | National Astronomical Observatory of Japan | online |
| Toktarkhan | 　 | Komesh | Kazakhstan | Nazarbayev University | in person |
| Busaba | 　 | Kramer | Germany | Max Planck Institute for Radio Astronomy | online |
| Martin | Gustav Heinrich | Krause | UK | University of Hertfordshire | online |
| Jayender | 　 | Kumar | Australia | University of Tasmania | in person |
| Cheng-Yu | 　 | Kuo | Taiwan | National Sun Yat-Sen University | in person |
| Tomoharu | 　 | Kurayama | Japan | Teikyo University of Science | in person |
| Dmitry | A. | Ladeyschikov | Russia | Ural Federal University  | online |
| Elisabetta | 　 | Ladu | Italy | Universita degli studi di Cagliari - Osservatorio Astronomico di Cagliari - INAF | online |
| Boy | 　 | Lankhaar | Sweden | Chalmers University of Technology | in person |
| Katharina | Olivia | Lewis | Poland | Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences | in person |
| Jingjing | 　 | Li | China | Purple Mountain Observatory | online |
| Yingjie | 　 | Li | China | Purple Mountain Observatory | online |
| Zehao | 　 | Lin | China | Purple Mountain Observatory | online |
| Dejian | 　 | Liu | China | Purple Mountain Observatory | online |
| Michael | 　 | Logue | UK | University of St Andrews | online |
| Xiaofeng | 　 | Mai | China | Shanghai Astronomical Observatory | online |
| Lynn | D. | Matthews | USA | MIT Haystack Observatory | online |
| Karl | M | Menten | Germany | Max Planck Institute for Radio Astronomy | online |
| Ryo | 　 | Miyamoto | Japan | Gifu Univerisity | online |
| Hafieduddin | 　 | Mohammad | Indonesia | ITB | online |
| James | Michael | Moran | USA | Center for Astrophysics | Harvard & Smithsonian | online |
| Ren | 　 | Moriizumi | Japan | Ibaraki University | in person |
| Luca | 　 | Moscadelli | Italy | INAF - Osservatorio Astrofisico di Arcetri | online |
| Kazuhito | 　 | Motogi | Japan | Yamaguchi University | in person |
| Akiharu | 　 | Nakagawa | Japan | Kagoshima University | in person |
| Naomasa | 　 | Nakai | Japan | Kwansei Gakuin University | in person |
| Hiroyuki | 　 | Nakanishi | Japan | Kagoshima University | in person |
| Jun-ichi | 　 | Nakashima | China | Sun Yat-sen University | online |
| Keisuke | 　 | Nakashima | Japan | Kagoshima University | in person |
| Katarzyna | 　 | Nowak | UK | University of Hertfordshire | in person |
| Keiichi | 　 | Ohnaka | Chile | Universidad Andres Bello | in person |
| Mateusz | 　 | Olech | Poland | University of Warmia and Mazury | online |
| Gabor | 　 | Orosz | Netherlands | JIVE | in person |
| Gisela | 　 | Ortiz-Leon | Mexico | Universidad Nacional Autonoma de Mexico | online |
| Tomoaki | 　 | Oyama | Japan | National Astronomical Observatory of Japan | online |
| Jennie | E. | Paine | USA | University of Colorado Boulder | online |
| Dominic | 　 | Pesce | USA | Center for Astrophysics | Harvard & Smithsonian | in person |
| Anita | 　 | Petzler | Australia | CSIRO | online |
| Montree | 　 | Phetra | Thai | Chiang Mai University | in person |
| Ylva | 　 | Pihlstrom | USA | University of New Mexico | online |
| Bannawit | 　 | Pimpanuwat | UK | Jodrell Bank Centre for Astrophysics, University of Manchester | in person |
| Luis | Henry | Quiroga Nunez | USA | Florida Institute of Technology | online |
| Mark | J. | Reid | USA | Center for Astrophysics | Harvard & Smithsonian | online |
| Anita | M. S. | Richards | UK | Jodrell Bank Centre for Astrophysics, University of Manchester | in person |
| Maria | J. | Rioja | Australia | ICRAR/UWA,CSIRO,OAN | in person |
| Hayley | 　 | Roberts | USA | University of Colorado Boulder | online |
| Tatiana | Magali | Rodriguez | USA | New Mexico Institute of Mining and Technology | in person |
| Zulfazli  | 　 | Rosli | Malaysia | International University of Malaya Wales | online |
| Kazi | L. J. | Rygl | Italy | INAF - Istituto di Radioastronomia | in person |
| Raghvendra | 　 | Sahai | USA | Jet Propulson Laboratory | online |
| Daisuke | 　 | Sakai | Japan | National Astronomical Observatory of Japan | in person |
| Nobuyuki | 　 | Sakai | Thai | National Astronomical Research Institute of Thailand (Public Organization) | in person |
| Yuichi | 　 | Sakamoto | Japan | Kagoshima university | in person |
| Alberto | 　 | Sanna | Italy | INAF - Osservatorio Astronomico di Cagliari | in person |
| Hidetoshi | 　 | Sano | Japan | Gifu University | in person |
| Satoko | 　 | Sawada-Satoh | Japan | Osaka Metropolitan University | in person |
| Mavis | 　 | Seidu | South Africa | North West University | online |
| Nadezhda | N. | Shakhvorostova | Russia | Astro Space Center of the P.N. Lebedev Physical Institute of RAS | in person |
| Yosuke | 　 | Shibata | Japan | Kagoshima University | in person |
| Hiroko | 　 | Shinnaga | Japan | Kagoshima University | in person |
| Ka Yiu | 　 | Shum | Japan | Kagoshima University | in person |
| Lorant | 　 | Sjouwerman | USA | National Radio Astronomy Observatory | in person |
| Ivars | 　 | Smelds | Latvia | Ventspils University of Applied Sciences  | in person |
| Andrey | M. | Sobolev | Russia | Ural Federal University | online |
| Bringfried | Gerhard Werner | Stecklum | Germany | Thueringer Landessternwarte | online |
| Georgina | 　 | Stroud | UK | University of Manchester | in person |
| Hiroshi | 　 | Sudou | Japan | Gifu Univerisity | in person |
| Koichiro | 　 | Sugiyama | Thai | National Astronomical Research Institute of Thailand (Public Organization) | in person |
| Kazuyoshi | 　 | Sunada | Japan | National Astronomical Observatory of Japan | in person |
| Gabriele | 　 | Surcis | Italy | INAF - Osservatorio Astrofisico di Arcetri | in person |
| Zsofia | Marianna | Szabo | Germany | Max Planck Institute for Radio Astronomy | online |
| Hiroshi | 　 | Takaba | Japan | Gifu University | in person |
| Daisuke | 　 | Takaishi | Japan | Kagoshima University | in person |
| Shigehisa | 　 | Takakuwa | Japan | Kagoshima University | in person |
| Yoshihiro | 　 | Tanabe | Japan | Ibaraki University | in person |
| Koki | 　 | Tanaka | Japan | Kagoshima university | in person |
| Andrea | 　 | Tarchi | Italy | INAF - Osservatorio Astronomico di Cagliari | online |
| Jose Maria | 　 | Torrelles | Spain | Institut de Ciencies de l'Espai (CSIC/IEEC) | online |
| Sascha | 　 | Trippe | Korea | Seoul National University | online |
| James  | Stuart | Urquhart | UK | University of Kent | online |
| Lucero | 　 | Uscanga | Mexico | University of Guanajuato | in person |
| Stefanus | Petrus | van den Heever | South Africa | South African Radio Astronomy Observatory | in person |
| Huib | 　 | van Langevelde | Netherlands | JIVE | online |
| Sophie | Maria | Venselaar | Netherlands | Leiden Observatory | online |
| Maxim | 　 | Voronkov | Australia | CSIRO Space & Astronomy | in person |
| Jakobus | Marthinus | Vorster | Finland | University of Helsinki | in person |
| Dylan | 　 | Ward | USA | New Mexico Institute of Mining and Technology | in person |
| Ryosuke | 　 | Watanabe | Japan | Kagoshima University | in person |
| Gwenllian | 　 | Williams | UK | University of Leeds | online |
| Pawel | Izydor | Wolak | Poland | Nicolaus Copernicus University in Torun | in person |
| Ka Tat | 　 | Wong | Sweden | Uppsala University | online |
| Gang | 　 | Wu | Germany | Max Planck Institute for Radio Astronomy | online |
| Yuanwei | 　 | Wu | China | National Time Service Center of Chinese Academy of Sciences | in person |
| Shuangjing | 　 | Xu | Korea | Korea Astronomy and Space Science Institute | in person |
| Ye | 　 | Xu | China | Purple Mountain Observatory | online |
| Ci | 　 | Xue | USA | Massachusetts Institute of Technology  | in person |
| Wenjin | 　 | Yang | Germany | Max Planck Institute for Radio Astronomy | online |
| Yoshinori | 　 | Yonekura | Japan | Ibaraki University | in person |
| Youngjoo | 　 | Yun | Korea | Korea Astronomy and Space Science Institute | in person |
| Ingyin | 　 | Zaw | UAE | New York University Abu Dhabi | in person |
| Bo | 　 | Zhang | China | Shanghai Astronomical Observatory | online |
| Jianjun | 　 | Zhou | China | Xinjiang Astronomical Observatory | online |

 Distribution by country Distribution by gender

 

**(iv) List of recipients of IAU grants, stating the amount received, country and gender**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Affiliation | Country | Gender | Amount (EURO) |
| Rajorshi BHATTACHARYA | University of New Mexico  | USA | M | 250 |
| Tania Pereira DOMINICI | National Institute for Space Research | Brazil | F | 2,000 |
| Andrews Mawuli Kodzo Dzodzomenyo | North-West University | South Africa | M | 1,600 |
| Sandra ETOKA | JBCA - Manchester University | UK | F | 1,500 |
| Dongjin KIM | MIT Haystack Observatory  | USA | M | 1,500 |
| Agnieszka KOBAK | Nicolaus Copernicus University  | Poland | F | 250 |
| Jayender KUMAR | University of Tasmania | Australia | M | 1,400 |
| Thong Duc LE | Ton Duc Thang University | Vietnam | M | 1,200 |
| Megan Olivia LEWIS | Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences  | Poland | F | 1,500 |
| Katarzyna NOWAK | University of Hertfordshire  | UK | F | 1,500 |
| Nobuyuki SAKAI | National Astronomical Research Institute of Thailand  | Thai | M | 1,200 |
| Lucero USCANGA | University of Guanajuato  | Mexico | F | 1,600 |
| Jakobus Marthinus VORSTER | University of Helsinki / North-West University  | Findand / South Africa | M | 1,500 |
| Dylan WARD | New Mexico Institute of Mining and Technology  | USA | M | 1,500 |

Number of recipients: Female 6/Male 8 Total 18,500 EURO

**(v) An Executive Summary of the Meeting**

 We have organized the IAUS 380 on cosmic masers to take place from March 20 (Mon) 2023 to March 24 (Fri) 2023 at Kagoshima, Japan. All sessions were held in Li-Ka Nangoku hall, which was just opened in 2021and is located in front of the Kagoshima Central train station. Given the unexpected situation due to the COVID-19 pandemic at the time of registration in late 2022, we also accepted the online participants via the Zoom virtual meeting software. Thus, the meeting was held in the hybrid mode.

 Cosmic masers have been employed as unique probes of various astronomical objects such as young stellar objects, evolved stars, the interstellar medium, the structure of the Milky Way galaxy, and active galactic nuclei. Thanks to their high brightness and narrow spectral features, maser observations using large radio interferometers and, in particular, Very Long Baseline Interferometry (VLBI) have provided high spatial and spectral resolution images, three dimensional velocity fields including proper motions, and annual parallaxes, and hence have constrained basic physical properties of their host regions. In terms of research topics, the maser scientific community is diverse and multidisciplinary but has long been tied together through the common background physics and observational techniques. An important method for the community to connect and build new international collaborations is through regular meetings. Over the past decades, there have been international meetings on cosmic masers spaced by 5-9 years; 1992 in the USA, 2001 in Brazil (IAUS 206), 2007 in Australia (IAUS 242), 2012 in South Africa (IAUS 287), and 2017 in Italy (IAUS 336). Since the last IAUS 336 on cosmic masers in 2017, the Atacama Large Millimeter/submillimeter Array (ALMA) has achieved comparable resolution to those of previous longer wavelength interferometers. Gaia DR3 also has provided a huge Galactic astrometric database at comparable accuracy with the currently available VLBI maser astrometry. Future large projects such as the Square Kilometre Array (SKA) and the next generation Very Large Array (ngVLA) feature key science projects targeting masers. Pilot surveys are in progress with the SKA precursors such as MeerKAT and ASKAP in South Africa and Australia, respectively. Future collaboration in the global VLBI have been already initiated including projects covering the southern hemisphere. Considering this recent progress in maser research, we decided to organize the IAUS 380 on masers in 2023 in Asia, following the past large conferences on maser, finally fill in the gap in global coverage,

 At the meeting place, Kagoshima City located in the south-western region of Japan, an active and large astronomy community exists at Kagoshima University, which is involved in many aspects of maser research. In particular, Kagoshima Prefecture hosts one of the 20-m radio telescopes of VLBI Exploration of Radio Astrometry (VERA) operated by Kagoshima University with advanced support by the Mizusawa VLBI Observatory of National Astronomical Observatory of Japan (NAOJ). This provides great opportunities for collaborative research on maser sources and technical training for the telescope operation led by a young generation of scientists. The IAUS 380 on masers highly motivated those researchers in Japan. In fact, a total of 11 young researchers and graduate students at Kagoshima University and 3 students from foreign institutes supported the IAUS 380 as volunteer staff with vibrant energy.

 The total number of registered participants of IAUS 380 was 172, of which 102 participated in-person and 70 online, working in 28 countries (counted by the first affiliation of institutes/university for each participant). As for the regions, 41 participants were from Japan (35 in-person and 6 online), 30 from Asia except Japan (14 in-person and 16 online), 9 from Oceania (8 in-person and 1 online), 58 from Europe (24 in-person and 34 online), 5 from Africa (3 in-person and 2 online), 25 from North America (14 in-person and 11 online), and 4 from South America (4 in-person). Except for Japan, about half of the participants were online. The numbers of female and male participants were 52 and 119, respectively (1 has no information). Judging from the titles of participants, senior (Dr. and Prof.) and junior (Mr. and Ms.) were split by 129 and 43, respectively. A high percentage of the participants were possibly young graduate students.

 The science sessions were opened on March 20 (Mon) 2023 by the Welcome Greeting from Masanori Baba, the vice president of Kagoshima University. In the science sessions, we discussed 7 major topics on maser sciences in 13 sessions as summarized in the "Summary of the scientific highlights of the meeting" section in this report. In order to allow online speakers to join the meeting during their convenient time zones, we divided each science topic into 2 or more sessions at different time ranges (i.e. mainly morning for North/South America and afternoon for Europe and Africa). All sessions were recorded via Zoom and shared with the registered participants.

 As clearly expressed in the sub-title of this IAUS 380, "Proper Motion toward the Next-Generation Large Projects", we had intensive discussion sessions for currently on-going and future projects related to most of the topics. While the main focus of this IAUS 380 was on cosmic masers, we intended to invite speakers from outside of the maser communities to broaden the impact of this symposium, thus emphasizing synergies with other research fields. For each of the 7 topics, we invited 1 reviewer to give an overview of the current status and future prospects for the research field, and 1-4 invited speakers to cover representative work in each field. In the session for future projects, we invited 7 speakers to discuss the impact of a given project on maser research. Considering the number of submitted abstracts and the oversubscription rate, we decided to include as many contributed talks as possible to give opportunities to young researchers, rather than having long general discussion sessions. For poster presentations, we organized two poster flash talk sessions, in which each poster was introduced in one minute. Although the poster flash sessions were challenging, these helped the participants to review all the presentations at once in shortly before poster viewing.

 In summary, we had 7 review talks (5 in-person and 2 online), 18 invited talks (16 in-person and 2 online), 38 contributed talks (24 in-person and 14 online), and 55 poster presentations (43 in-person and 12 online).

 As expected, IAUS 380 provided valuable opportunities to start discussion on future collaboration as in the previous IAUS 336 in Italy, where the new international collaboration network "Maser Monitoring Organization (M2O)" was established. For this purpose, we helped arranging satellite meetings during every lunch periods, such as the East Asian VLBI Science Working Groups (astrometry and star-formation), GASKAP-OH team, and the Spectral line EHT collaboration.

 The conference hall was fully equipped with modern audio-visual facilities and Wi-Fi to enable the hybrid Zoom option. The LOC and volunteer staff also prepared Slack to allow discussions and communication between online and in-person participants. Slack was also used to share the Zoom recording files. There was no serious problem in this hybrid mode during the meeting and the sessions were smoothly organized thanks to the support staff in the Li-Ka Nangoku hall and the student volunteers. A large foyer in front of the hall was used for coffee/tea breaks and the poster exhibition. We secured ample time for coffee/tea breaks in every morning and afternoon to stimulate off-line discussion, which is one of the biggest advantages of in-person meetings. During these breaks, the local staff served coffee, Japanese green tea, and different kind of local cakes and cookies every time with the local pottery dishes.

 The LOC and volunteer staff well organized associated social events for participants and their accompanying persons. Prior to the science session, a welcome reception was held in the evening of March 19 (Sun) 2023 in the foyer of the Li-Ka Nangoku hall. Welcome drinks and snacks were offered during the registration. In the afternoon on March 22 (Wed) 2023, an excursion was held to visit a local vinegar factory and the active volcano Sakura-jima to encounter local culture and to promote friendship with each other. On March 23 (Thu) 2023, a conference banquet was held in The Peak Premium Terrace close to the central downtown area in which the participants enjoyed local foods and alcohol as well as traditional music and dancing.

 After all main science sessions were closed, we organized outreach and educational programs to enhance the legacy of the IAUS 380 in Kagoshima. The public outreach talk event was held on March 25 (Sat) 2023 in Kimi & Kesa Memorial Hall of Inamori Auditorium in Kagoshima University. The Opening Greetings of this event was given by Keiichi Wada, the director of the Amanogawa Galaxy Astronomy Research Center (AGARC), followed by three talks on maser results for 35 minutes each in the Japanese language by Tomoya Hirota (NAOJ), Mikyoung Kim (Otsuma Women's University), and Ross A. Burns (Riken/NAOJ). After these talks, panel discussion and Q&A sessions were organized by Hiroshi Imai (Kagoshima University). The total number of participants was about 20.

 In the week following IAUS 380, another educational program was held. First, a guide tour to the VERA Iriki station took place on March 29 (Wed) 2023. About 25 participants (elementary school students or older) visited the 20-m VLBI radio telescope of VERA located at Iriki-cho in Satsuma-Sendai-shi by 1-hour chartered bus trip from either Kagoshima Central train station or Sendai train station. The staff members and students from NAOJ and Kagoshima University introduced the 20-m antenna and instruments of the VLBI station, and also took the participants to the upper cabin of the 20-m antenna. Following the tour, a hands-on tutorial of radio astronomy observations was offered at Kagoshima University on March 30 (Thu) and 31 (Fri) 2023. In the hands-on tutorial, a 50-cm size horn antenna was made by the participants under the instruction of local staff and students at Kagoshima University, and radio emission from the Galactic plane was observed using a spectrum analyzer. The participants experienced the real radio astronomical observations, successfully detecting the signal from the 21-cm atomic hydrogen line emitted from the Galactic plane.

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