IAU Symposium
341
12-16 November 2018
Osaka, Japan

Proceedings of the International Astronomical Union

Challenges in Panchromatic Modelling with Next Generation Facilities

Edited by

Médéric Boquien
Elisabeta Lusso
Carlotta Gruppioni
Patricia Tissera

ISSN 1743-9213

International Astronomical Union

CAMBRIDGE UNIVERSITY PRESS

https://doi.org/10.1017/S1743921318008159 Published online by Cambridge University Press

CHALLENGES IN PANCHROMATIC MODELLING
WITH NEXT GENERATION FACILITIES

IAU SYMPOSIUM 341

COVER ILLUSTRATION:

The cover illustration is an art work by H. Chihara who was inspired by the autumn leaves of forest in Minoh quasi-national park near the venue, Osaka University. The image of NGC3034 (M82) taken with the Subaru Telescope operated by the National Astronomical Observatory of Japan and its SED plot provided by F. Galliano are superimposed.

https://doi.org/10.1017/S174392131900930X Published online by Cambridge University Press

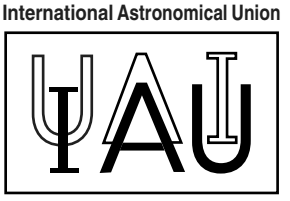
IAU SYMPOSIUM PROCEEDINGS SERIES

Chief Editor
MARIA TERESA LAGO, IAU General Secretary
Universidade do Porto
Centro de Astrofísica
Rua das Estrelas
4150-762 Porto
Portugal
mtlago@astro.up.pt

Editor
IAN ROBSON, IAU Assistant General Secretary
Royal Observatory Edinburgh
UKATC
Blackford Hill
Edinburgh EH9 3HJ
United Kingdom
ian.robson@stfc.ac.uk

INTERNATIONAL ASTRONOMICAL UNION

UNION ASTRONOMIQUE INTERNATIONALE



CHALLENGES IN PANCHROMATIC MODELLING WITH NEXT GENERATION FACILITIES

PROCEEDINGS OF THE 341st SYMPOSIUM OF THE INTERNATIONAL ASTRONOMICAL UNION HELD IN OSAKA, JAPAN 12–16 NOVEMBER, 2018

Edited by

MÉDÉRIC BOQUIEN
Universidad de Antofagasta, Chile

ELISABETA LUSSO
Durham University, United Kingdom

CARLOTTA GRUPPIONI
Astrophysics and Space Science Observatory - INAF, Italy

and

PATRICIA TISSERA
Universidad Andrés Bello, Chile

CAMBRIDGE UNIVERSITY PRESS
University Printing House, Cambridge CB2 8BS, United Kingdom
1 Liberty Plaza, Floor 20, New York, NY 10006, USA
10 Stamford Road, Oakleigh, Melbourne 3166, Australia

First published 2020

Printed in the UK by Bell & Bain, Glasgow, UK

Typeset in System LaTeX 2ε

A catalogue record for this book is available from the British Library Library of Congress Cataloguing in Publication data

This journal issue has been printed on FSC™-certified paper and cover board. FSC is an independent, non-governmental, not-for-profit organization established to promote the responsible management of the world's forests. Please see www.fsc.org for information.

ISBN 9781108471473 hardback
ISSN 1743-9213

Table of Contents

Preface xi

Editors xiii

Conference Photograph xiv

Participants xv

A historical overview of galaxy surveys 1
Sadanori Okamura

Panchromatic study of the first galaxies with large ALMA programs 12
A. Faisst, M. Béthermin, P. Capak, P. Cassata, O. Le Fèvre, D. Schaerer, J. Silverman, L. Yan and the ALPINE *team*

The average FIR SED of proto-clusters at $z = 4$ 17
Mariko Kubo, Jun Toshikawa, Nobunari Kashikawa, Hisakazu Uchiyama and Kei Ito

The spectral energy distributions of active galactic nuclei 21
M. J. I. Brown, K. J. Duncan, H. Landt, M. Kirk, C. Ricci and N. Kamraj

Panchromatic SED fitting codes and modelling techniques 26
Maarten Baes

Evolutionary Population Synthesis model with binary stars – Yunnan-II model . . . 35
F. Zhang, Z. Han and L. Li

HELP project - a dreamed-of multiwavelength dataset for SED fitting:
The influence of used models for the main physical properties of galaxies 39
Katarzyna Małek, Veronique Buat, Denis Burgarella, Yannick Roehlly, Raphael Shirley and the HELP team

Modelling the emission of passive galaxies at $z \sim 3$ 44
C. D'Eugenio, E. Daddi, R. Gobat, V. Strazzullo and S. Jin

Evolution histories of massive galaxies at $z \sim 2$ over the past 3 Gyr 50
T. Morishita, L. E. Abramson, T. Treu, G. B. Brammer, T. Jones, P. Kelly, M. Stiavelli, M. Trenti, B. Vulcani and X. Wang

Spatially resolved stellar mass buildup and quenching in massive disk galaxies
over the last 10 Gyr revealed with spatially resolved SED fitting 55
Abdurro'uf and Masayuki Akiyama

Exploring the star formation histories of galaxies in different environments
from MaNGA spectra 60
Maria Argudo-Fernández, Médéric Boquien, Shiyin Shen, Fangting Yuan, Jun Yin, Ruixiang Chang and Lei Hao

https://doi.org/10.1017/S174392131900930X Published online by Cambridge University Press

High-resolution radiation transfer modelling of barred galaxies 65
A. Nersesian, S. Verstocken, S. Viaene and M. Baes

Which attenuation curves for star-forming galaxies? 70
Véronique Buat, David Corre, Médéric Boquien and Katarzyna Małek

Dust attenuation on and off the galaxy Main Sequence at $z \geqslant 1$ 74
Annagrazia Puglisi

Spatially resolved dust-to-gas mass ratios in nearby galaxies 78
Basilio Solís-Castillo and Marcus Albrecht

A MUSE inquiry into the physical processes taking place within the Abell 2667 Brightest Cluster Galaxy 83
E. Iani, G. Rodighiero, J. Fritz, G. Cresci, C. Mancini, P. Tozzi, L. Rodríguez-Muñoz, P. Rosati, G. B. Caminha, S. Berta, P. Cassata, A. Concas, A. Enia, D. Fadda, A. Franceschini, A. Liu, A. Mercurio, L. Morselli, P. G. Pérez-González, P. Popesso, G. Sabatini and A. Zanella

Pushing the technical frontier: From overwhelmingly large data sets to machine learning 88
Viviana Acquaviva

Modeling with the crowd: Optimizing the human-machine partnership with Zooniverse 99
Hugh Dickinson, Lucy Fortson, Claudia Scarlata, Melanie Beck and Mike Walmsley

Deep learning for galaxy mergers in the galaxy main sequence 104
William J. Pearson, Lingyu Wang, James Trayford, Carlo E. Petrillo and Floris F. S. van der Tak

Automatic classification of sources in large astronomical catalogs 109
Agnieszka Pollo, Aleksandra Solarz, Małgorzata Siudek, Katarzyna Małek, Maciej Bilicki, Tomasz Krakowski, Tsutomu Takeuchi and the VIPERS team

Predicting the global far-infrared emission of galaxies 114
Wouter Dobbels and Maarten Baes

`Mentari`: A pipeline to model the galaxy SED using semi analytic models 119
Dian Triani, Darren Croton and Manodeep Sinha

Variations of the stellar Initial Mass Function in semi-analytic models: Implications for the mass assembly of galaxies in the GAEA model 124
Fabio Fontanot

Modeling the panchromatic emission of galaxies with `CIGALE` 129
M. Boquien, D. Burgarella, Y. Roehlly, V. Buat, L. Ciesla, D. Corre, A. K. Inoue and H. Salas

Going beyond galaxy ages with dense basis star formation history reconstruction 134
Kartheik G. Iyer and Eric Gawiser

https://doi.org/10.1017/S174392131900930X Published online by Cambridge University Press

A hierarchical bayesian dust SED model and its application to the nearby universe 138
Frédéric Galliano

Bayesian discrimination of the panchromatic spectral energy distribution modelings of galaxies 143
Yunkun Han, Zhanwen Han and Lulu Fan

Stellar population synthesis of galaxies with chemical evolution model 147
Shiyin Shen and Jun Yin

A new galaxy Spectral Energy Distribution model with the evolution of dust consistent with chemical evolution 152
Kazuki Y. Nishida, Tsutomu T. Takeuchi, Takuma Nagata, Ryosuke S. Asano and Akio K. Inoue

The Spitzer Extragalactic Representative Volume Survey - measuring photometric redshifts for ∼4 million galaxies - challenges and ways forward 157
Janine Pforr

Probing the building blocks of galaxies: Sub-galactic scaling relations between X-ray luminosity, SFR and stellar mass 162
K. Kouroumpatzakis, A. Zezas, P. H. Sell, P. Bonfini, M. L. N. Ashby and S. P. Willner

Tips learned from panchromatic modeling of AGNs 167
Y. Sophia Dai (戴昱)

X-ray - Infrared relation of AGNs and search for highly obscured accretion in the *AKARI* NEP Field 172
Takamitsu Miyaji and AKARI *NEP Survey Team*

The Diagnostic power of radio spectra from star-forming galaxies 177
Eric J. Murphy

Challenges in modelling the rest-frame ultraviolet/optical spectra of galaxies at the high-redshift frontier 187
Erik Zackrisson and Anton Vikaeus

Systematic errors in dust mass fits: The role of dust opacity 196
Lapo Fanciullo, Francisca Kemper, Sundar Srinivasan, Peter Scicluna and James M. Simpson

Properties of LBGs with [OIII] detection at z > 3: The importance of including nebular emission data in SED fitting 201
Fang-Ting Yuan, Denis Burgarella, David Corre, Veronique Buat, Médéric Boquien and Shiyin Shen

Census of Lyα, [OIII]5007, Hα, and [CIII]158μm line emission with ∼1000 galaxies at $z = 4.9 - 7.0$ revealed with Subaru/HSC, Spitzer, and ALMA 206
Yuichi Harikane

https://doi.org/10.1017/S174392131900930X Published online by Cambridge University Press

Detections of far-infrared [OIII] and dust emission in a galaxy at $z = 8.312$: Early metal enrichment in the heart of the reionization era 211
Y. Tamura, K. Mawatari, T. Hashimoto, A. K. Inoue, E. Zackrissonm, L. Christensen, C. Binggeli, Y. Matsuda, H. Matsuo, T. T. Takeuchi, R. S. Asano, K. Sunaga, I. Shimizu, T. Okamoto, N. Yoshida, M. Lee, T. Shibuya, Y. Taniguchi, H. Umehata, B. Hatsukade, K. Kohno and K. Ota

Dust mass and dust production efficiencies on the redshift frontier 216
Hiroyuki Hirashita, Denis Burgarella and Rychard J. Bouwens

The onset of star formation 250 million years after the Big Bang 221
Takuya Hashimoto

Extreme variations in star formation activity in the first galaxies 226
Christian Binggeli, Erik Zackrisson, Xiangcheng Ma, Akio K. Inoue, Anton Vikaeus, Takuya Hashimoto, Ken Mawatari, Ikkoh Shimizu and Philip F. Hopkins

Subaru/HSC identifications of protocluster candidates at $z \sim 6 - 7$: Implications for cosmic reionization 231
Ryo Higuchi, Masami Ouchi, Yoshiaki Ono, Takatoshi Shibuya, Jun Toshikawa, Yuichi Harikane, Takashi Kojima, Yi-Kuan Chiang, Eiichi Egami, Nobunari Kashikawa, Roderik Overzier, Akira Konno, Akio K. Inoue, Kenji Hasegawa, Seiji Fujimoto, Tomotsugu Goto, Shogo Ishikawa, Kei Ito, Yutaka Komiyama and Masayuki Tanaka

Probing the ISM of HeIIλ1640 emitters at $z = 2 - 4$ via MUSE 235
Themiya Nanayakkara, Jarle Brinchmann and The MUSE Collaboration

Panchromatic study of the first galaxies in cosmological simulations 240
Hidenobu Yajima, Shohei Arata, Makito Abe and Kentaro Nagamine

FIRSTLIGHT: Cosmological simulations of first galaxies at cosmic dawn 245
Daniel Ceverino

The distribution and physical properties of high-redshift [OIII] emitters in a cosmological hydrodynamics simulation 249
Kana Moriwaki

Pop III supernova feedback on the formation of the first galaxies 253
Li-Hsin Chen and Ke-Jung Chen

Chemical enrichment of Pop III supernovae in the first galaxies 257
Ke-Jung Chen

Radiative properties of the first galaxies: Rapid transition from blue to red 261
Shohei Arata, Hidenobu Yajima, Kentaro Nagamine, Yuexing Li and Sadegh Khochfar

Helium rich stars produce the UV upturn 264
R. De Propris, S. Ali, M. N. Bremer and S. Phillipps

Stellar and gas mass distributions for understanding the nature of spiral arms 266
Fumi Egusa, Erin Mentuch Cooper, Jin Koda and Junichi Baba

Panchromatic modeling of the extremely luminous dust-obscured quasars at the cosmic noon 268
Lulu Fan, Yunkun Han and Kirsten K. Knudsen

The new fundamental plane dictating galaxy cluster evolution 271
Yutaka Fujita, Keiichi Umetsu, Elena Rasia, Massimo Meneghetti, Megan Donahue, Elinor Medezinski, Nobuhiro Okabe, Marc Postman and Stefano Ettori

Radial resolved galaxy disks models based on semi-analytic models of galaxy formation 273
Jian Fu

A comparison of star formation history between NGC 300 and M33 275
Xiaoyu Kang, Fenghui Zhang and Ruixiang Chang

The environment of large equivalent width Lyα emitters at $z \sim 3$ 277
Arisa Kida, Satoshi Kikuta, Yuichi Matsuda, et al.

DEIMOS and MOSFIRE spectroscopy of star-forming galaxies in the AKARI NEP-Deep field 279
Helen K. Kim, Matt Malkan, Nagisa Oi, Toshinobu Takagi, Denis Burgarella, Véronique Buat, Samir Salim, Chris Pearson and Hideo Matsuhara

Mid-infrared PAH emission from star-forming galaxies selected at 250 μm 281
Seong Jin Kim and AKARI NEP Collaboration

First [N II] 122 μm line detection in a starburst pair at $z = 4.7$ 283
Minju M. Lee, Tohru Nagao, Carlos De Breuck, et al.

Panchromatic Analysis for Nature of HIgh-z galaxies Tool (PANHIT) 285
Ken Mawatari, Akio K. Inoue, Satoshi Yamanaka, Takuya Hashimoto and Yoichi Tamura

First galaxy SED: Contribution from pre-main-sequence stars 287
Hiroto Mitani, Naoki Yoshida, Kazuyuki Omukai and Takashi Hosokawa

Direct collapse to SMBH seeds in cosmological halos with radiation transfer 289
Kentaro Nagamine, Isaac Shlosman and Yang Luo

Optical properties of infrared-bright dust-obscured galaxies viewed with Subaru Hyper Suprime-Cam 292
A. Noboriguchi, T. Nagao, Y. Toba, M. Niida, M. Kajisawa, M. Onoue, Y. Matsuoka, T. Yamashita, Y. Chang, T. Kawaguchi, Y. Komiyama, K. Nobuhara, Y. Terashima and Y. Ueda

Investigating the early phase of the galaxy evolution through high-z damped Lyα absorption systems 294
Kazuyuki Ogura, Tohru Nagao, Masatoshi Imanishi, Nobunari Kashikawa, Yoshiaki Taniguchi, Masaru Kajisawa, Masakazu A. R. Kobayashi and Yoshiki Toba

Strong FeII emission in NLS1s: An unsolved mystery 297
Swayamtrupta Panda, Katarzyna Małek, Marzena Śniegowska and Bożena Czerny

https://doi.org/10.1017/S174392131900930X Published online by Cambridge University Press

Modeling galaxy evolution at high-redshift in highly overdense and normal regions 299
Raphael Sadoun, Emilio Romano-Díaz, Isaac Shlosman and Zheng Zheng

Spectral study of scattered light by interstellar dust grains 302
Kei Sano

Caught in the web: A tale of filament galaxies 304
Ankit Singh, Smriti Mahajan and Devika Shobhana

Galactic outflows in star-forming galaxies at $z \sim 6$ studied with deep UV spectra and ALMA emission line 307
Yuma Sugahara, Masami Ouchi, Yuichi Harikane, Nicolas Bouché, Peter D. Mitchell and Jérémy Blaizot

ALMA detection of the [OIII] 88 μm line in a highly-magnified Lyman break galaxy at z = 6.1 309
Kaho Sunaga, Yoichi Tamura, Minju Lee, Ken Mawatari, Akio K. Inoue, Takuya Hashimoto, Hiroshi Matsuo and Akio Taniguchi

Dust evolution in galaxies at $z > 7$ 312
Tsutomu T. Takeuchi, Ryosuke S. Asano, Sayaka Nagasaki, Takaya Nozawa, Yoichi Tamura, Ken Mawatari and Akio K. Inoue

X-Ray spectral model from clumpy torus and its application to circinus galaxy 314
Atsushi Tanimoto

Propeties of H alpha emitters at $z \sim 2.3$: Derivation of H alpha luminosity from multi-band photometry 316
Yasunori Terao, Lee Spitler and Kentaro Motohara

Probing the luminous and dark matter profiles in the inner regions of a group-scale lens at z = 0.6 318
Mônica Tergolina, Cristina Furlanetto and Marina Trevisan

Magneto-Hydrodynamic simulations on galaxy modeling 320
Wei-Chen Wang and Ke-Jung Chen

Active and dust obscured star-forming galaxies at $z \sim 4$ probed with UV spectral slope beta 323
Satoshi Yamanaka and Toru Yamada

https://doi.org/10.1017/S174392131900930X Published online by Cambridge University Press

Preface

How galaxies form and evolve across cosmic times is one of the fundamental questions in modern astronomy. Over the past decade, modeling the panchromatic emission of galaxies has become one of the key tools in measuring their properties. As new and next-generation facilities progressively open a new era in astronomy, we face new and specific challenges in this endeavor: LSST and Euclid will provide us with an avalanche of data; the advent of e-ROSITA and the preparation for Athena make it ever more pressing to include X-ray emission into the standard UV-to-IR panchromatic models while EVLA and LOFAR expand our view of galaxies far into the radio domain; JWST will observe the first galaxies with extreme stellar populations and in the meantime ALMA is already starting to provide us with remarkable dust and metal observations at high redshift. As we are pivoting into this new era, IAU symposium 341 took place at Ōsaka University Hall from November 12 to November 16, only the third IAU symposium being held in Japan over the past 21 years after the general assembly in Kyoto in 1997. Besides the support from IAU, it also benefited of the sponsorship of the *Science Council of Japan*, *Ōsaka Sangyo University*, the *Department of Earth and Space Science of Ōsaka University*, the *National Astronomical Observatory of Japan*, and the *Society for Promotion of Space Science*. The meeting was attended by 127 people (90 men and 37 women), 36 of whom were supported by travel grants obtained with the support of IAU and NAOJ.

The programme consisted of 8 invited talks, 65 regular talks and 44 posters divided over four themes.

1. "State-of-the-art panchromatic surveys and studies". Three major reviews were given. Sadanori Okamura (University of Tokyo, Japan) gave a historical overview of galaxy surveys. Stéphane Charlot (Institut d'Astrophysique de Paris, France) presented the physical ingredients for panchromatic modeling, with a particular emphasis on stellar populations. Finally Maarten Baes gave a presentation on panchromatic codes and modeling techniques.
2. "Pushing the technical frontier: from overwhelmingly large datasets to machine learning". An introductory review on the new technique of machine learning was given by Viviana Acquaviva (New York City College of Technology, USA)
3. "Pushing the wavelength frontier: extending models towards X-rays and radio". Two reviews focused on each end of the electromagnetic spectrum. First, Andrea Merloni (Max-Planck-Institut für Extraterrestrische Physik, Germany) extensively presented the different sources of X-ray emission in galaxies before presenting in detail the eROSITA plans to map the universe in the X-rays. Eric Murphy (National Radio Astronomy Observatory, USA) then focused his review on the modeling of the energetic processes powering radio continuum emission from galaxies.
4. "Pushing the redshift frontier: modeling the first galaxies". Two reviews were given. Erik Zackrisson (Uppsala University, Sweden) presented the modeling challenges in the rest-frame UV/optical at the high-redshift frontier, focusing in particular on population III stars. Toru Yamada (JAXA/ISAS, Japan) presented future missions that will be critical to shape the field of panchromatic modeling in the next decades.

In order to avoid possible unconscious biases based on career stage, gender, country of origin, affiliation, etc., abstracts were anonymised and graded independently by 15 of the 16 SOC members. Talk allocations were granted purely based on the final ranking

https://doi.org/10.1017/S174392131900930X Published online by Cambridge University Press

until the scheduled was filled. This resulted in a selection rate of abstracts submitted by women almost identical to the proportion of women among applicants (29%) and while giving the opportunity to numerous more junior members of the community to present their investigations.

To encourage the interaction between attendants and poster presenters, posters were installed in the room reserved for refreshments during breaks. Poster presenters gave flash presentations during three poster sessions over the first two days of the meeting. In parallel, a small jury made of a few SOC/LOC members and invited speakers evaluated posters. This led to an award to 8 poster presenters (3 women and 5 men), with the top-ranked person, Dr. Minju Lee (Nagoya University/National Astronomical Observatory of Japan), being offered the opportunity to give a talk.

Denis Burgarella (Laboratory of Astrophysics of Marseille, France) and Michael Brown (Monash University, Australia) also presented the activities of IAU commission J1 to the attendants in an effort to raise awareness of the existence and gather what the community expects from this commission.

Editors

Médéric Boquien
Universidad de Antofagasta, Chile

Elisabeta Lusso
Durham University, United Kingdom

Carlotta Gruppioni
Astrophysics and Space Science Observatory - INAF, Italy

Patricia Tissera
Universidad Andrés Bello, Chile

Organising Committee

Scientific Organising Committee

SOC Chairs

Médéric Boquien	Universidad de Antofagasta, Chile

SOC Members

Véronique Buat	Aix-Marseille University, France
Laure Ciesla	Laboratory of Astrophysics of Marseille, France
Andrew Connolly	University of Washington USA
Daniel Dale	University of Wyoming, USA
Ilse De Looze	University College London, UK
Maud Galametz	CEA Saclay, France
Carlotta Gruppioni	Astrophysics and Space Science Observatory - INAF, Italy
Hiroyuki Hirashita	ASIAA, Taiwan
Akio Inoue	Osaka Sangyo University, Japan
Elisabeta Lusso	Durham University, UK
Kentaro Nagamine	Osaka University, Japan
Giulia Rodighiero	University of Padova, Italy
Daniel Schaerer	University of Geneva, Switzerland
Renske Smit	University of Cambridge, UK
Patricia Tissera	Universidad Andrés Bello, Chile

Local Organising Committee

LOC Chair

Akio Inoue	Osaka Sangyo University, Japan

LOC Members

Denis Burgarella	Laboratory of Astrophysics of Marseille, France
Takuya Hashimoto	Osaka Sangyo University, Japan
Ken Mawatari	Osaka Sangyo University, Japan
Tohru Nagao	Ehime University, Japan
Hiroshi Shibai	Osaka University, Japan

https://doi.org/10.1017/S174392131900930X Published online by Cambridge University Press

CONFERENCE PHOTOGRAPH

https://doi.org/10.1017/S174392131900930X Published online by Cambridge University Press

Participants

Name & Institution	Email
Abdurrouf Abdurrouf, Academia Sinica Institute of Astronomy and Astrophysics	abdurrouf@astr.tohoku.ac.jp
Viviana Acquaviva, Physics Department, CUNY NYC College of Technology	VAcquaviva@citytech.cuny.edu
Shohei Aoyama, Academia Sinica (IAA)	saoyama@asiaa.sinica.edu.tw
Shohei Arata, Osaka University	arata@astro-osaka.jp
Maria Argudo Fernández, Universidad de Antofagasta	maria.argudo@uantof.cl
Maarten Baes, Universiteit Gent	maarten.baes@ugent.be
Laia Barrufet, ESA	lbarrufet@sciops.esa.int
Andrew John Battisti, Australian National University	andrew.battisti@anu.edu.au
Christian Binggeli, Uppsala University	christian.binggeli@physics.uu.se
Mederic Boquien, Universidad de Antofagasta	mederic.boquien@uantof.cl
Fabio Bresolin, Institute for Astronomy, University of Hawaii	bresolin@ifa.hawaii.edu
Michael Brown, Monash University	Michael.Brown@monash.edu
Véronique Buat, Laboratoire d'Astrophysique de Marseille	veronique.buat@lam.fr
Denis Burgarella, Laboratoire d'Astrophysique de Marseille, Aix-Marseille Univ.	denis.burgarella@lam.fr
Gabriela Calistro-Rivera, Leiden Observatory	gcalistrorivera@gmail.com
Adam Christopher Carnall, Observatory Edinburgh	adamc@roe.ac.uk Royal
Daniel Ceverino, Heidelberg University	ceverino@uni-heidelberg.de
Stephane Charlot, CNRS / Institut d'Astrophysique de Paris	charlot@iap.fr
Li-Hsin Chen, National Taiwan University/Institut of Astronomy and Astrophysics, Academia Sinica	r06244001@ntu.edu.tw
Ke-Jung Chen, ASIAA	chenken1229@gmail.com
Benjamin A. Cook, Harvard-Smithsonian Center for Astrophysics	bacook17@gmail.com
Asantha Cooray, UC Irvine	acooray@uci.edu
Chiara D'Eugenio, CEA/Irfu, AIM Service d'Astrophysique, Université Paris 7	chiara.deugenio@cea.fr
Yu Sophia Dai, NAOC	daysophia@gmail.com
Roberto De Propris, FINCA, University of Turku	rodepr@utu.fi
Hugh John Dickinson, University of Minnesota	hdickins@umn.edu
Wouter Dobbels, Ghent University	wouter.dobbels@ugent.be
Fumi Egusa, Institute of Astronomy, University of Tokyo	fegusa@ioa.s.u-tokyo.ac.jp
Andreas Lukas, Caltech/IPAC	Faisst afaisst@ipac.caltech.edu
Lulu Fan, Shandong University, Weihai	llfan@sdu.edu.cn
Lapo Fanciullo, ASIAA	lfanciullo@asiaa.sinica.edu.tw
Fabio Fontanot, INAF - Trieste Observatory	fabio.fontanot@inaf.it
Jian Fu, Shanghai Astronomical Observatory	fujian@shao.ac.cn
Yutaka Fujita, Osaka University	fujita@astro-osaka.jp
Maud Galametz, CEA Astrophysics Department	maud.galametz@cea.fr
Frédéric Galliano, AIM	frederic.galliano@cea.fr
Xiaobo Gong, Yunnan Observatories, Chinese Academy of Sciences	gxbo@ynao.ac.cn
Tomotsugu Goto, National Tsing Hua University	tomo@gapp.nthu.edu.tw
Yanxin Guo, National Astronomical Observatories, Chinese Academy of Sciences	yxguo@bao.ac.cn
Yunkun Han, Yunnan Observatories, Chinese Academy of Sciences	hanyk@ynao.ac.cn
Yuichi Harikane, The University of Tokyo	hari@icrr.u-tokyo.ac.jp
Takuya Hashimoto, Osaka Sangyo University, NAOJ	thashimoto@est.osaka-sandai.ac.jp
Ryo Higuchi, ICRR (Institute for Cosmic Ray Research), the University of Tokyo	rhiguchi@icrr.u-tokyo.ac.jp
Hiroyuki Hirashita, Academia Sinica Institute of Astronomy and Astrophysics	hirashita@asiaa.sinica.edu.tw
Edoardo Iani, Università degli Studi di Padova	edoardo.iani@phd.unipd.it
Akio Inoue, Osaka Sangyo University,	akinoue@est.osaka-sandai.ac.jp
Kartheik G Iyer, Rutgers, the State University of New Jersey	kgi1@physics.rutgers.edu
Yipeng Jing, Shanghai Jiao Tong University, Department of Astronomy	ypjing@sjtu.edu.cn
Xiaoyu Kang, Yunnan Observatories, Chinese Academy of Sciences	kxyysl@ynao.ac.cn
Arisa Kida, Kwansei Gakuin University	arisa.kd@gmail.com
Seong-Jin Kim, National Tsing Hua University	seongini@gmail.com
Helen Kyung Kim, University of California, Los Angeles	hkim@astro.ucla.edu
Eunbin Kim, Astronomy & Space Science Institute	ebkim@kasi.re.kr Korea

https://doi.org/10.1017/S174392131900930X Published online by Cambridge University Press

Name & Institution	Email
Kotaro Kohno, The University of Tokyo	kkohno@ioa.s.u-tokyo.ac.jp
Konstantinos Kouroumpatzakis, FORTH	kkouroub@physics.uoc.gr
Mariko Kubo, NAOJ	mariko.kubo@nao.ac.jp
Minju Lee, Nagoya University / NAOJ	minju.lee@nao.ac.jp
Kai-yang Lin, Institute of Astronomy and Astrophysics, Academia Sinica (ASIAA)	kylin@asiaa.sinica.edu.tw
Lihwai Lin, ASIAA	lihwailin@asiaa.sinica.edu.tw
Elisabeta Lusso, Durham University, Physics Department	elisabeta.lusso@durham.ac.uk
Katarzyna Ewa Malek, National Centre for Nuclear Research	katarzyna.malek@ncbj.gov.pl
Yuichi Matsuda, NAOJ	yuichi.matsuda@nao.ac.jp
Ken Mawatari, University of Tokyo	mawatari@icrr.u-tokyo.ac.jp
Andrea Merloni, Max-Planck Institute fuer Extraterrestrische Physik (MPE)	am@mpe.mpg.de
Hiroto Mitani, Graduate School of Science, The University of Tokyo	mitani@utap.phys.s.u-tokyo.ac.jp
Takamitsu Miyaji, Unversidad Nacional Autónoma de México, Instituto de Astronomía sede Ensenada	miyaji@astro.unam.mx
Amanda Moffett, Vanderbilt University	amanda.moffett@vanderbilt.edu
Takahiro Morishita Space Telescope Science Institute	tmorishita@stsci.edu
Kana Moriwaki, The University of Tokyo	kana.moriwaki@utap.phys.s.u-tokyo.ac.jp
Kentaro Motohara, University of Tokyo	kmotohara@ioa.s.u-tokyo.ac.jp
Eric Murphy, National Radio Astronomy Observatory	emurphy@nrao.edu
Kentaro Nagamine, Osaka University	kn@astro-osaka.jp
Tohru Nagao, Ehime University	tohru@cosmos.ehime-u.ac.jp
Themiya Nanayakkara, Leiden Observatory	themiyananayakkara@gmail.com
Kazuki Y Nishida, Division of Particle and Astrophysical Science, Nagoya University	nishida.kazuki@nagoya-u.jp
Akatoki Noboriguchi, Ehime University	noboriguchi@cosmos.phys.sci.ehime-u.ac.jp
Shoji Ogawa, Kyoto University	ogawa@kusastro.kyoto-u.ac.jp
Kazuyuki Ogura, Bunkyo University	kazu8astro@gmail.com
Sadanori Okamura, University of Tokyo	sadanori.okamura@emp.u-tokyo.ac.jp
Swayamtrupta Panda, Center for Theoretical Physics - Polish Academy of Sciences	panda@cft.edu.pl
William James Pearson, SRON Netherlands Institute for Space Research	w.j.pearson@sron.nl
Janine Pforr, ESA/ESTEC	janine.pforr@esa.int
Agnieszka Pollo, Jagiellonian University and National Center for Nuclear Research	agnieszka.pollo@gmail.com
Gergö Popping, MPIA	popping@mpia.de
Annagrazia Puglisi, IRFU CEA-Saclay (France)	annagrazia.puglisi@cea.fr
Joel R, Harvard University	joel.leja@cfa.harvard.edu
Sadoun Raphael, Department of Earth & Space Science, Graduate School of Science, Osaka University	sadoun@astro-osaka.jp
Chang Hee Ree, Korea Astronomy and Space Science Institute	chr@kasi.re.kr
David Rosario, Centre for Extragalactic Astronomy, Durham University	david.rosario@durham.ac.uk
Brett Salmon, Telescope Science Institute	bsalmon@stsci.edu Space
Kei Sano, Kwansei Gakuin University	sano0410@kwansei.ac.jp
Daniel Schaerer, Geneva Observatory, University of Geneva	daniel.schaerer@unige.ch
Shiyin Shen, Astronomical Observatory, Chinese Academy of Sciences	ssy@shao.ac.cn Shanghai
Hiroshi Shibai, Osaka University	shibai@ess.sci.osaka-u.ac.jp
Ankit Singh, Indian Institute of Science Education and Research	ansingh16@gmail.com
Marzena Sniegowska, Center for Theoretical Physics PAS	marzena.sniegowska@gmail.com
Basilio Solis, Argelander Institute for Astronomy, University of Bonn	bsolis1984@gmail.com
Mimi Song, NASA Goddard Space Flight Center	mmsong.rustedfaith@gmail.com
Yihan Song, National Astronomical Observatories, Chinese Academy of Sciences	yhsong@bao.ac.cn
Yuma Sugahara, The University of Tokyo	sugayu@icrr.u-tokyo.ac.jp

https://doi.org/10.1017/S174392131900930X Published online by Cambridge University Press

Name & Institution	Email
Kaho Sunaga, Nagoya University	sunaga@a.phys.nagoya-u.ac.jp
Koyo Suzuki, Nagoya University	koyo@a.phys.nagoya-u.ac.jp
Nao Suzuki, Kavli IPMU, Univ of Tokyo	nao.suzuki@kavli-ipmu.jp
Tsutomu T. Takeuchi, Division of Particle and Astrophysical Science, Nagoya University	takeuchi.tsutomu@g.mbox.nagoya-u.ac.jp
Yoichi Tamura, Nagoya University	ytamura@nagoya-u.jp
Yoshiaki Taniguchi, Open University of Japan	tani@cosmos.phys.sci.ehime-u.ac.jp
Atsushi Tanimoto, Kyoto University	tanimoto@kusastro.kyoto-u.ac.jp
Dan Taranu, Princeton University	dtaranu@astro.princeton.edu
Yasunori Terao, Institute of Astronomy, The University of Tokyo	y_terao@ioa.s.u-tokyo.ac.jp
MÔnica Tergolina, Federal University of Rio Grande do Sul	monica.tergolina@ufrgs.br
Akihiko Tomita, Wakayama University	atomita@center.wakayama-u.ac.jp
Dian Triani, Swinburne University	dtriani@swin.edu.au
Yoshihiro Ueda, Kyoto University	ueda@kusastro.kyoto-u.ac.jp
Etsuko UJIKE, The Open University of Japan	e.ujike@ouj.ac.jp
Alexa Villaume, University of California Santa Cruz	avillaum@ucsc.edu
Wei-Chen Wang, Academia Sinica Institute of Astronomy and Astrophysics	weichenwang.network@gmail.com
Mengxin Wang, NAOC	beawmx@163.com
Tao Wang, University of Tokyo	taowang@ioa.s.u-tokyo.ac.jp
Hidenobu Yajima, University of Tsukuba	yajima@ccs.tsukuba.ac.jp
Toru Yamada, ISAS, JAXA	yamada@ir.isas.jaxa.jp
Satoshi Yamada, Kyoto University (Department of Astronomy)	styamada@kusastro.kyoto-u.ac.jp
Satoshi Yamanaka, Osaka Sangyo University	s.yamanaka@est.osaka-sandai.ac.jp
Takuji Yamashita, Center for Space and Cosmic Evolution, Ehime University	takuji@cosmos.phys.sci.ehime-u.ac.jp
Tova Yoast-Hull, Canadian Institute for Theoretical Astrophysics	yoasthull@cita.utoronto.ca
Fangting Yuan, Shanghai Astronomical Observatory	yuanft@shao.ac.cn
Erik Zackrisson, Uppsala University	erik.zackrisson@physics.uu.se
Fenghui Zhang, Yunnan Observatories, Chinese Academy of Sciences	zhangfh@ynao.ac.cn

https://doi.org/10.1017/S174392131900930X Published online by Cambridge University Press