



<b>Publication Year</b>	2017
<b>Acceptance in OA</b>	2020-09-11T08:24:52Z
<b>Title</b>	Astroinformatics
<b>Authors</b>	BRESCIA, Massimo, Djorgovski, S. G., Feigelson, Eric D., Longo, Giuseppe, CAVUOTI, STEFANO
<b>Handle</b>	<a href="http://hdl.handle.net/20.500.12386/27304">http://hdl.handle.net/20.500.12386/27304</a>
<b>Serie</b>	PROCEEDINGS OF THE INTERNATIONAL ASTRONOMICAL UNION
<b>Volume</b>	325

IAU Symposium

325

19–25 October 2016

Sorrento, Italy

Proceedings of the International Astronomical Union

# Astroinformatics

*Edited by*

Massimo Brescia

S. G. Djorgovski

Eric D. Feigelson

Giuseppe Longo

Stefano Cuvuoti

ISSN 1743-9213

International Astronomical Union



**CAMBRIDGE**  
UNIVERSITY PRESS



ASTROINFORMATICS  
IAU SYMPOSIUM 325

*In Memory of prof. Klym Ivanovyč Čurjumov,  
tragically passed away a few days before the Conference*

*COVER ILLUSTRATION:*

This is a conceptual reproduction of the Naples skyline as seen from Sorrento, location of the IAU Symposium, held in October 2016, together with some artifacts exposing the arising of the Astroinformatics science as virtual bridge between Astrophysics and ICT.

IAU SYMPOSIUM PROCEEDINGS SERIES

*Chief Editor*

PIERO BENVENUTI, IAU General Secretary

*IAU-UAI Secretariat*

*98-bis Blvd Arago*

*F-75014 Paris*

*France*

*iau-general.secretary@iap.fr*

*Editor*

MARIA TERESA LAGO, IAU Assistant General Secretary

*Universidade do Porto*

*Centro de Astrofísica*

*Rua das Estrelas*

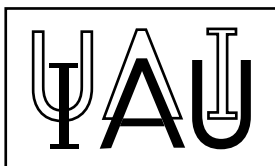
*4150-762 Porto*

*Portugal*

*mtlago@astro.up.pt*

INTERNATIONAL ASTRONOMICAL UNION  
UNION ASTRONOMIQUE INTERNATIONALE

International Astronomical Union



# ASTROINFORMATICS

PROCEEDINGS OF THE 325th SYMPOSIUM  
OF THE INTERNATIONAL ASTRONOMICAL  
UNION HELD IN SORRENTO, ITALY  
OCTOBER 19–25, 2016

Edited by

**MASSIMO BRESCIA**  
*INAF OACN, Napoli, Italy*

**S. G. DJORGOVSKI**  
*Dept. of Astronomy, Caltech, USA*

**ERIC D. FEIGELSON**  
*Dept. of Astronomy and Astrophysics, Penn State Univ., USA*

**GIUSEPPE LONGO**  
*Dept. of Physics, University Federico II, Italy*

and

**STEFANO CAVUOTI**  
*Dept. of Physics, University Federico II, Italy*



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

© International Astronomical Union 2017

This book 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 the International Astronomical Union.

First published 2017

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

Typeset in System L<sup>A</sup>T<sub>E</sub>X 2 $\epsilon$

*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<sup>TM</sup>-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](http://www.fsc.org) for information.

ISBN 9781107169951 hardback  
ISSN 1743-9213

## Table of Contents

Preface .....	xi
Address by the Local Organizing Committee .....	xii
Address by the Scientific Organizing Committee .....	xiii
The Organizing Committee.....	xiv
Conference Photograph .....	xv
Participants .....	xvi
 <b>Astroinformatics Projects</b>	
The changing landscape of astrostatistics and astroinformatics..... <i>E. D. Feigelson</i>	3
Supercomputer simulations of structure formation in the Universe..... <i>T. Ishiyama</i>	10
From Sky to Earth: Data Science Methodology Transfer .....	17
<i>A. A. Mahabal, D. Crichton, S. G. Djorgovski, E. Law &amp; J. S. Hughes</i>	
What will the future of cloud-based astronomical data processing look like?.... <i>A. W. Green, E. Mannering, L. Harischandra, M. Vuong, S. O'Toole, K. Sealey &amp; A. M. Hopkins</i>	27
Multi-wavelength studies of the statistical properties of active galaxies using Big Data.....	32
<i>A. M. Mickaelian, H. V. Abrahamyan, M. V. Gyulzadyan, G. A. Mikayelyan &amp; G. M. Paronyan</i>	
Learn from every mistake! Hierarchical information combination in astronomy.. <i>M. Süveges, S. Fotopoulou, J. Coupon, S. Paltani, L. Eyer &amp; L. Rimoldini</i>	39
Exploring the Parameter Space of Compact Binary Population Synthesis .....	46
<i>J. W. Barrett, I. Mandel, C. J. Neijssel, S. Stevenson &amp; A. Vigna-Gómez</i>	
Effects of mergers on non-parametric morphologies .....	51
<i>L. A. Bignone, P. B. Tissera, E. Sillero, S. E. Pedrosa, L. J. Pellizza &amp; D. G. Lambas</i>	
ACS/WFC Pixel History, Bringing the Pixels Back to Science .....	55
<i>D. Borncamp, N. Grogin, M. Bourque &amp; S. Ogaz</i>	
Investigation of Spatially Unresolved Magnetic Field Outside Sunspots Using Hin- ode/SOT Observations.....	59
<i>O. Botygina, M. Gordovskyy &amp; V. Lozitsky</i>	
An Effective Method for Modeling Two-dimensional Sky Background of LAMOST	63
<i>H. Haerken, F. Duan, J. Zhang &amp; P. Guo</i>	

Application of Compressive Sensing to Gravitational Microlensing Experiments. <i>A. Korde-Patel, R. K. Barry &amp; T. Mohsenin</i>	67
 <b>Current and future surveys</b>	
The Euclid Data Processing Challenges . . . . . <i>P. Dubath, N. Apostolakos, A. Bonchi, A. Belikov, M. Brescia, S. Cavuoti, P. Capak, J. Coupon, C. Dabin, H. Degaudenzi, S. Desai, F. Dubath, A. Fontana, S. Fotopoulou, M. Frailis, A. Galametz, J. Hoar, M. Holliman, B. Hoyle, P. Hudelot, O. Ilbert, M. Kuemmel, M. Melchior, Y. Mellier, J. Mohr, N. Morisset, S. Paltani, R. Pello, S. Pilo, G. Polenta, M. Poncet, R. Saglia, M. Salvato, M. Sauvage, M. Schefer, S. Serrano, M. Soldati, A. Tramacere, R. Williams &amp; A. Zacchei</i>	73
The European perspective for LSST. . . . . <i>E. Gangler</i>	83
Everything we'd like to do with LSST data, but we don't know (yet) how . . . . . <i>Ž. Ivezić, A. J. Connolly &amp; M. Jurić</i>	93
Astroinformatics Challenges from Next-generation Radio Continuum Surveys . . . . . <i>R. P. Norris</i>	103
The Hubble Source Catalog . . . . . <i>S. H. Lubow</i>	114
Pan-STARRS1 as pilot-survey for panoptic time-domain science . . . . . <i>N. Hernitschek, H.-W. Rix, B. Sesar &amp; E. F. Schlafly</i>	118
AlertSim - Serbian Contribution to the LSST . . . . . <i>D. Jevremović, V. Vujčić, V. A. Srećković, J. Aleksić, S. Erkapić &amp; N. Milovanović</i>	122
 <b>Data Mining and Machine Learning</b>	
Prototype-based Models for the Supervised Learning of Classification Schemes . . . . . <i>M. Biehl, B. Hammer &amp; T. Villmann</i>	129
Classification of galaxy type from images using Microsoft R Server . . . . . <i>A. de Vries</i>	139
Hierarchical Matching and Regression with Application to Photometric Redshift Estimation. . . . . <i>F. Murtagh</i>	145
Dealing with Uncertain Multimodal Photometric Redshift Estimations . . . . . <i>K. L. Polsterer</i>	156
Cooperative photometric redshift estimation. . . . . <i>S. Cavuoti, C. Tortora, M. Brescia, G. Longo, M. Radovich, N. R. Napolitano, V. Amaro &amp; C. Vellucci</i>	166
The analysis of VERITAS muon images using convolutional neural networks . . . . . <i>Q. Feng, T. T. Y. Lin for the VERITAS Collaboration</i>	173

Identification of Interesting Objects in Large Spectral Surveys Using Highly Parallelized Machine Learning . . . . .	180
<i>P. Škoda, A. Palička, J. Koza &amp; K. Shakurova</i>	
Automatic Source Classification in Digitised First Byurakan Survey . . . . .	186
<i>M. Topinka, A. Mickaelian, R. Nesci &amp; C. Rossi</i>	
Deep learning for studies of galaxy morphology . . . . .	191
<i>D. Tuccillo, M. Huertas-Company, E. Decencière &amp; S. Velasco-Forero,</i>	
METAPHOR: Probability density estimation for machine learning based photometric redshifts. . . . .	197
<i>V. Amaro, S. Cavuoti, M. Brescia, C. Vellucci, C. Tortora &amp; G. Longo</i>	
A Comparison of Classifiers for Solar Energetic Events . . . . .	201
<i>G. Barnes, N. Schanche, K. D. Leka, A. Aggarwal &amp; K. Reeves</i>	
Morphology and Interaction of Galaxies using Deep Learning . . . . .	205
<i>F. Caro, M. Huertas-Company &amp; G. Cabrera</i>	
Uncertain Photometric Redshifts with Deep Learning Methods . . . . .	209
<i>A. D'Isanto</i>	
Determining the parameters of high amplification microlensing events by means of statistical machine learning techniques. . . . .	213
<i>E. Fedorova</i>	
Galaxy Classifications with Deep Learning . . . . .	217
<i>V. Lukic &amp; M. Brüggen</i>	
An Automated Galaxy Spectra Recognition Method Basing on Spectral Lines Information . . . . .	221
<i>J. Zhang, X. Chen, Y. Wu &amp; X. Li</i>	
ELM-KNN for photometric redshift estimation of quasars. . . . .	225
<i>Y. Zhang, Y. Tu, Y. Zhao &amp; H. Tian</i>	
<b>Time Domain &amp; Cosmology</b>	
Detection of quasars in the time domain . . . . .	231
<i>M. J. Graham, S. G. Djorgovski, D. J. Stern, A. Drake &amp; A. Mahabal</i>	
Transient events in LSST survey data . . . . .	242
<i>J. Aleksić, V. Vujčić &amp; D. Jevremović</i>	
Exploring the spectroscopic diversity of type Ia supernovae with Deep Learning and Unsupervised Clustering. . . . .	247
<i>E. E. O. Ishida, M. Sasdelli, R. Vilalta, M. Agüena, V. C. Busti,</i>	
<i>H. Camacho, A. M. M. Trindade, F. Gieseke, R. S. de Souza, Y. T. Fantaye &amp; P. A. Mazzali</i>	
Challenges in Timeseries Analysis from Microlensing . . . . .	253
<i>R. A. Street</i>	
An autoregressive model for irregular time series of variable stars . . . . .	259
<i>S. Eyheramendy, F. Elorrieta &amp; W. Palma</i>	

On the relationship between long-period comets and large trans-Neptunian planetary bodies . . . . .	263
<i>R. Guliyev &amp; A. Guliyev</i>	
Optical light curves of FUor and FUor-like objects . . . . .	266
<i>E. Semkov, S. Peneva &amp; S. Ibryamov</i>	
The search of radio transients in the RATAN-600 radio telescope surveys . . . . .	270
<i>O. P. Zhelenkova &amp; E. K. Majorova</i>	
Starspot migration in close binaries: A fast parameters evaluation from large sky surveys. . . . .	274
<i>B. Debski &amp; S. Zola</i>	

## Data Visualization

Deep data: discovery and visualization Application to hyperspectral ALMA imagery. . . . .	281
<i>E. Merényi, J. Taylor &amp; A. Isella</i>	
Integrated data access, visualization and analysis for Galactic Plane surveys: the VIALACTEA case . . . . .	291
<i>S. Molinari, R. Butora, S. Cavuoti, M. Molinaro, G. Riccio, E. Sciacca, F. Vitello, U. Becciani, M. Brescia, A. Costa &amp; R. Smareglia</i>	
Interactive (statistical) visualisation and exploration of a billion objects with vaex	299
<i>M. A. Breddels</i>	
3-D interactive visualisation tools for HI spectral line imaging . . . . .	305
<i>J. M. van der Hulst, D. Punzo &amp; J. B. T. M. Roerdink</i>	
Collaborative visual analytics of radio surveys in the Big Data era . . . . .	311
<i>D. Vohl, C. J. Fluke, A. H. Hassan, D. G. Barnes &amp; V. A. Kilborn</i>	
Data mining and visualization from planetary missions: the VESPA-Europlanet2020 activity . . . . .	316
<i>A. Longobardo, M. T. Capria, A. Zinzi, S. Ivanovski, M. Giardino, G. Di Persio, S. Fonte, E. Palomba, L. A. Antonelli, S. Fonte, P. Giommi &amp; the Europlanet VESPA 2020 Team</i>	
A team spectral inspection platform based on ASERA . . . . .	320
<i>H. Yuan, Y. Zhang, Y. Wu, Y. Lei, Y. Dong, Z. Bai, G. Li, H. Zhang &amp; Y. Zhao</i>	

## Astroinformatics Tools

C <sup>3</sup> : A Command-line Catalogue Cross-matching tool for modern astrophysical survey data . . . . .	327
<i>G. Riccio, M. Brescia, S. Cavuoti, A. Mercurio, A. M. Di Giorgio &amp; S. Molinari</i>	

Target and (Astro-)WISE technologies Data federations and its applications . . .	333
<i>E. A. Valentijn, K. Begeman, A. Belikov, D. R. Boxhoorn, J. Brinchmann, J. McFarland, H. Holties, K. H. Kuijken, G. V. Kleijn, W.-J. Vriend, O. R. Williams, J. B. T. M. Roerdink, L. R. B. Schomaker, M. A. Swertz, A. Tsyganov &amp; G. J. W. van Dijk</i>	
What can the programming language Rust do for astrophysics? . . . . .	341
<i>S. Blanco-Cuaresma &amp; E. Bolmont</i>	
Astrophysics and Big Data: Challenges, Methods, and Tools. . . . .	345
<i>M. Garofalo, A. Botta &amp; G. Ventre</i>	
CoLiTec software - detection of the near-zero apparent motion. . . . .	349
<i>S. V. Khlamov, V. E. Savanevych, O. B. Briukhovetskyi &amp; A. V. Pohorelov</i>	
Design and Implement of Astronomical Cloud Computing Environment In China-VO . . . . .	353
<i>C. Li, C. Cui, Linying Mi, B. He, D. Fan, S. Li, S. Yang, Y. Xu, J. Han, J. Chen, H. Zhang, C. Yu, J. Xiao, C. Wang, Z. Cao, Y. Fan, L. Liu, X. Chen, W. Song &amp; K. Du</i>	
PERICLES: a knowledge management programme applied to solar data from International Space Station-Columbus. . . . .	357
<i>C. Muller and the PERICLES consortium</i>	
UkrVO Astroinformatics Software and Web-services . . . . .	361
<i>I. B. Vavilova, Ya. S. Yatskiv, L. K. Pakuliak, I. L. Andronov, V. M. Andruk, Yu. I. Protsyuk, V. E. Savanevych, D. O. Savchenko &amp; V. S. Savchenko</i>	
<b>Archives in Astronomy</b>	
The Hubble Catalog of Variables . . . . .	369
<i>P. Gavras, A. Z. Bonanos, I. Bellas-Velidis, V. Charmandaris, I. Georgantopoulos, D. Hatzidimitriou, G. Kakalettris, A. Karamelas, N. Laskaris, D. J. Lennon, M. I. Moretti, E. Pouliaisis, K. Sokolovsky, Z. T. Spetsieri, K. Tsinganos, B. C. Whitmore &amp; M. Yang</i>	
The WFIRST Science Archive and Analysis Center . . . . .	373
<i>S. R. Heap, A. S. Szalay and the WFIRST Science Archive Team</i>	
Evolution of the NASA/IPAC Extragalactic Database (NED) into a Data Mining Discovery Engine . . . . .	379
<i>J. M. Mazzarella and the NED Team</i>	
Data Management in the Euclid Science Archive System. . . . .	385
<i>P. de Teodoro, S. Nieto &amp; B. Altieri</i>	
Meteor Databases in Astronomy. . . . .	389
<i>S. V. Kolomiyets</i>	
Mol-D a Database and a Web Service within the Serbian Virtual Observatory and the Virtual Atomic and Molecular Data Centre . . . . .	393
<i>V. A. Srećković, D. Jevremović, V. Vujčić, L. M. Ignjatović, N. Milovanović, S. Erkačić &amp; M. S. Dimitrijević</i>	

The HST/WFC3 Quicklook Project: A User Interface to Hubble Space Telescope  
Wide Field Camera 3 Data ..... 397  
*M. Bourque, V. Bajaj, A. Bowers, M. Dulude, M. Durbin, C. Gosmeyer, H.  
Gunning, 366 H. Khandrika, C. Martlin, B. Sunnquist & A. Viana*

Author index ..... 401

## Preface

As President of Commission on Astroinformatics and Astrostatistics of the International Astronomical Union, I welcome you to the first IAU Symposium on astroinformatics. This is not the first meeting in the field: the 26th meeting on ADASS (Astronomical Data Analysis Software and Systems) was held last week in Trieste (and members of that group are here today), and this symposium has a strong heritage in workshops held in recent years at Caltech, Seattle, and Sydney. But this is the first time that the broader community of astronomers, through the IAU in collaboration of the giant IEEE organization has recognized this new field of study devoted to the challenges of Big Data and advanced methodology in astronomical research. This is the first time experts from around the world have gathered to share experiences and plan for the future. I have a comment to make. The typical IAU Symposium treats some well-established field of stars or galaxies or cosmology where the leading groups know each other well. But astroinformatics is such a young field, that we do not know each other and we do not know what ideas will emerge from this meeting. So I encourage each of us to have a creative approach to this meeting, work hard to talk to strangers, and help generate a community of scholars who can lead this field into the future.

*Eric D. Feigelson*

*Pennsylvania State University*

*IAU Commission B3 Astroinformatics and Astrostatistics*

*December 18, 2016*

## Address by the Local Organizing Committee

Dear colleagues,

On behalf of the Local Organizing Committee, it was a real pleasure to host all of you to the Symposium on Astroinformatics of the International Astronomical Union. We hope that, in this new occasion, we did not disappoint you and that the symposium fulfilled your expectations. All our efforts were in this direction. We have counted with very efficient people in the LOC, especially Arianna, who was the true pillar of the organization. Also, we have been very fortunate of having the unconditional help and support of students Civita, Giuseppe, Michele, young collaborators Alfonso, Giuseppe, Stefano and the staff and personnel of the Grand Hotel Vesuvio.

We are deeply grateful to several institutions and corporations for their financial and organizing support: the International Astronomical Union, the Microsoft Corporation, the IEEE Computational Intelligence Society and Astrominer Task Force, the Department of Physics Ettore Pancini of the University Federico II, the Capodimonte Astronomical Observatory of the Italian National Institute of Astrophysics, the Italian Society of Relativity and Gravitational Physics, the Italian National Institute of Nuclear Physics, the Astroinformatics and Astrostatistics Portal.

Thank you very much, and hope to see you again somewhere.

*Massimo Brescia, chair LOC  
Sorrento, October 24, 2016*

## Address by the Scientific Organizing Committee

Dear colleagues,

The SOC welcomes you at this IAU Symposium No. 325. We are delighted to see you all here, in Sorrento. This is also the sixth international workshop in the series Astrominformatics which started in 2011 in Pasadena. We gathered here because during the last decade our discipline has experienced a true paradigmatic shift moving from small data sets to the big data regime. Dedicated survey telescopes, both ground based and space borne, are routinely producing on a daily base many tens of terabytes of data of unprecedented quality and complexity. In the near future, new instruments such as LSST and SKA will increase this data stream by several orders of magnitude. Such volumes of data cannot be dealt with traditional tools and each step of the data acquisition chain, from acquisition to processing and interpretation, needs to be tackled with a different mind frame, delegating most of the work to automatic tools exploiting all advances in high performance computing, machine learning and visualization. Astronomy is not the only science which is undergoing such transformation: biosciences, geophysics, remote sensing, environmental sciences, are confronting similar problems and while the underlying methodologies are the same, each field is proposing its own solutions to specific problems and rising new issues which can be profitably used by the other fields. This is why this meeting is attended not only by astronomers.

Over the last decade, astrominformatics has in fact established itself as a new, vibrant field of research placed at the intersection of many different disciplines -mathematics, statistics, computer science. These efforts have led, among the other things, to the establishment of new professional associations such as the International Astrostatistics Association or the Astrominer Task Force under the auspices of the Data Mining Technical Committee of the IEEE Computational Intelligence Society.

This symposium would have not been possible without the contributions of many institutes and bodies. We wish to thank for their sponsorship the Department of Physics Ettore Pancini of the University Federico II in Napoli, the Capodimonte Observatory of the Italian National Institute for Astrophysics (INAF), the Napoli Unit of the Italian National Institute for Nuclear Physics (INFN), the Astrominer Task Force of the IEEE, the Municipality of Sorrento, the Microsoft Research and, last but not least, the International Astronomical Union who has provided numerous grants to allow the participation of many colleagues from other countries. The SOC also wishes to thank the members of the LOC and his chair person Massimo Brescia for having organized such a great meeting.

We wish you all a very constructive and pleasant five working days here.

*Giuseppe Longo, Stanislav G. Djorgovski and Eduardo Vera, Co-chairs SOC  
Sorrento, October 20, 2016*

## THE ORGANIZING COMMITTEE

### Scientific

S. G. Djorgovski (USA), Co-Chair	G. Longo (Italy), Co-Chair
E. Vera (Chile), Co-Chair	
M. Brescia (Italy)	
P. Estevez (Chile)	E. Feigelson (USA)
A. Goodman (USA)	
G. Lake (Switzerland)	E. Merenyi (USA)
F. Murtagh (UK)	V. Pankratius (USA)
S. Staggs (USA)	A. Szalay (USA)
R. Vilalta (USA)	D. Vinkovic (Croatia)

### Local

M. Brescia (chair)	G. Angora
A. Cavallo	S. Cavuoti
M. Delli Veneri	Nocella
C. Vellucci	

### Acknowledgements

The symposium is sponsored and supported by the IAU Division B Facilities, Technologies and Data Science; and by the IAU Commission B3 Astroinformatics and Astrostatistics.

The Local Organizing Committee operated under the auspices of the  
Istituto Nazionale di Astrofisica - Osservatorio Astronomico di Capodimonte,  
University of Naples Federico II.

Funding by the  
IAU - International Astronomical Union,  
IEEE CIS - IEEE Computational Intelligence Society,  
MICROSOFT - Microsoft Corporation,  
UNINA - Universita' degli Studi Federico II, Napoli,  
INFN - Istituto Nazionale di Fisica Nucleare,  
DSF - Dipartimento di Fisica Ettore Pancini, UNINA,  
OACN - Osservatorio Astronomico di Capodimonte - INAF,  
SIGRAV - Societa' Italiana di Relativita' e Fisica della Gravitazione,  
and  
IEEE - Astrominer Task Force,  
ASAIP - Astrostatistics and AstroInformatics Portal,  
IMS - Institute for Mathematical Statistics,  
are gratefully acknowledged.

## CONFERENCE PHOTOGRAPH



## Participants

- Walter **Alef**, Max Planck Inst. for Radio Astronomy, Germany  
 Jovan **Aleksić**, Astronomical Obs. of Belgrade, Serbia  
 Rupert **Allison**, Princeton Univ., USA  
 Valeria **Amaro**, Dept. of Physics - Univ. Federico II, Napoli, Italy  
 Ji-Hye **Baek**, Korea Astronomy and Space Science Inst., Korea  
 Aneta **Baloyan**, Byurakan Astrophysical Obs., Armenia  
 Graham **Barnes**, NorthWest Research Associates, USA  
 Jim **Barrett**, Univ. of Birmingham, UK  
 Sudhanshu **Barway**, South African Astronomical Obs. (SAAO), South Africa  
 Michael **Biehl**, J. Bernoulli Inst., Univ. of Groningen, Netherlands  
 Lucas Axel **Bignone**, IAFE (UBA/CONICET), Argentina  
 Sergi **Blanco-Cuaresma**, Obs. of Geneva, Switzerland  
 David **Borncamp**, Space Telescope Science Inst., Baltimore, Maryland, USA  
 Olga **Botygina**, Astronomical Obs. of the T. Shevchenko National Univ. of Kyiv, Ukraine  
 Matthew **Bourque**, Space Telescope Science Inst., Baltimore, Maryland, USA  
 Carlos Henrique **Brandt**, La Sapienza Univ. of Rome, Italy  
 Maarten **Breddels**, Univ. of Groningen, The Netherlands  
 Massimo **Brescia**, INAF - Capodimonte Astronomical Obs., Italy  
 Fernando **Caro**, Observatoire de Paris - Lerma, France  
 Stefano **Cavuoti**, Dept. of Physics - Univ. Federico II, Napoli, Italy  
 Kenneth **Chambers**, Inst. for Astronomy Univ. of Hawaii, USA  
 Seonghwan **Choi**, Korea Astronomy and Space Science Inst., Korea  
 Dan **Crichton**, NASA Jet Propulsion Laboratory, USA  
 Cristina **Dalle Ore**, USRA - Lunar and Planetary Inst., USA  
 Pilar **de Teodoro**, European Space Agency, Spain  
 Andrie **De Vries**, Microsoft Corporation, USA  
 Antonio **D'Isanto**, Heidelberg Inst. for Theoretical Studies - HITS, Germany  
 George **Djorgovski**, California Inst. of Technology, Pasadena CA, USA  
 Shep **Doelman**, MIT Haystack Obs., USA  
 Fuqing **Duan**, Beijing Normal Univ., China  
 Pierre **Dubath**, Univ. of Geneva, Switzerland  
 Felipe **Elorrieta**, Pontificia Universidad Católica de Chile, Chile  
 Pablo **Estevez**, Univ. of Chile & Millennium Inst. of Astrophysics, Chile  
 Susana **Eyheramendy**, Pontificia Universidad Católica de Chile, Chile  
 Elena **Fedorova**, National Taras Shevchenko Univ. of Kiev, Astronomical Obs., Ukraine  
 Eric **Feigelson**, Pennsylvania State Univ., USA  
 Qi **Feng**, McGill Univ., Canada  
 Francisco **Forster Burón**, Univ. of Chile, Chile  
 Emmanuel **Gangler**, LPC - Université Blaise Pascal, France  
 Mauro **Garofalo**, DIETI, Univ. Federico II, Napoli, Italy  
 Jorge Enrique **García Farieta**, Universidad Nacional de Colombia, Colombia  
 Fabio **Gastaldello**, INAF IASF Milan, Italy  
 Panagiotis **Gavras**, IAASARS, National Obs. of Athens, Greece  
 Nikos **Gianniotis**, Heidelberg Inst. for Theoretical Studies, Germany  
 Carlos Alberto **Gomez Gonzalez**, Univ. of Liege, Belgium  
 Alyssa **Goodman**, Harvard-Smithsonian CFA, USA  
 Matthew **Graham**, California Inst. of Technology, Pasadena CA, USA  
 Andrew **Green**, Australian Astronomical Obs., Australia  
 Steve **Groom**, IPAC, California Inst. of Technology, Pasadena CA, USA  
 Rustam **Guliyev**, Shamakhy Astrophysical Obs., Azerbaijan  
 Ping **Guo**, Beijing Normal Univ., China  
 Hasitceer **Haerken**, Beijing Normal Univ., China  
 Yuan **Hailong**, National Astron. Obs., Chinese Acad. of Sciences, China  
 Jeremy **Hare**, The George Washington Univ., USA  
 Sara **Heap**, NASA/Goddard (Emeritus Scientist), USA  
 Nina **Hernitschek**, California Inst. of Technology, Pasadena CA, USA  
 Alisher S. **Hojaev**, Ulugh Beg Astronomical Inst. of Uzbek, Uzbekistan  
 Maohai **Huang**, National Astron. Obs., Chinese Acad. of Sciences, China  
 Pablo **Huijse**, Univ. of Chile, Chile  
 Emille **Ishida**, Laboratoire de physique de Clermont  
 Tomoaki **Ishiyama**, Inst. of Management and Information Technologies, Chiba Univ., Japan  
 Zeljko **Ivezic**, Univ. of Washington, USA  
 Colin **Jacobs**, Swinburne Univ. of Technology, Australia  
 Darko **Jevremovic**, Astronomical Obs. Belgrade, Serbia  
 Alin **Kalam**, Vienna Univ., Austria  
 Jeffrey **Kern**, National Radio Astronomy Obs., USA  
 Sergii **Khlamov**, Kharkiv National Univ. of Radioelectronics, Ukraine  
 Johan **Knapen**, Instituto de Astrofísica de Canarias, Spain  
 Svitlana **Kolomyiets**, Kharkiv National Univ. of Radio Electronics, Ukraine  
 Asmita **Korde-Patel**, NASA/Goddard Space Flight Center, USA  
 Irina **Kovalenko**, IMCCE/LESIA Paris Obs., France  
 Michael **Kurtz**, CFA Harvard, USA  
 Changhua **Li**, National Astron. Obs., Chinese Acad. of Sciences, China  
 Zhou **Lixiao**, National Astron. Obs., Chinese Acad. of Sciences, China  
 Giuseppe **Longo**, Dept. of Physics - Univ. Federico II, Napoli, Italy  
 Andrea **Longobardo**, INAF, IAPS, Italy  
 Colin **Lonsdale**, MIT Haystack Obs., USA  
 Stephen **Lubow**, Space Telescope Science Inst., USA  
 Vesna **Lukic**, Hamburger Sternwarte, Germany  
 Ashish **Mahabal**, California Inst. of Technology, Pasadena CA, USA  
 Abhishek **Malali**, Harvard Univ., USA  
 Joseph M. **Mazzarella**, California Inst. of Technology, Pasadena CA, USA  
 Erzsébet **Merényi**, Rice Univ., Houston, TX, USA  
 Areg M. **Mickaelian**, Byurakan Astrophysical Obs., Armenia  
 Sergio **Molinari**, INAF, IAPS, Rome, Italy  
 Christian **Muller**, Belgian Users Support and Operation Centre, Belgium  
 Fionn **Murtagh**, Univ. of Derby, and Goldsmiths Univ. of London, UK  
 Sara **Nieto Rodriguez**, European Space Agency, Spain  
 walef@mpifr-bonn.mpg.de  
 jaleksic@aob.rs  
 rallison@ast.cam.ac.uk  
 amaro@na.infn.it  
 jhbaek@kasi.re.kr  
 aregmick@yahoo.com  
 graham@nwra.com  
 jbarrett@star.sr.bham.ac.uk  
 barway@sao.ac.za  
 m.biehl@rug.nl  
 lbignone@gmail.com  
 Sergi.Blanco@unige.ch  
 dborncamp@stsci.edu  
 botygina86@gmail.com  
 bourque@stsci.edu  
 carlos.brandt@icranet.org  
 breddels@astro.rug.nl  
 brescia@na.astro.it  
 fernando.caro@obspm.fr  
 stefano.cavuoti@gmail.com  
 chambers@ifa.hawaii.edu  
 shchoi@kasi.re.kr  
 daniel.j.crichton@jpl.nasa.gov  
 cristina.m.dalleore@nasa.gov  
 pilar.teodoro@esa.int  
 adevries@microsoft.com  
 antonio.disanto@h-its.org  
 george@astro.caltech.edu  
 sdoelman@haystack.mit.edu  
 fqduan@bnu.edu.cn  
 pierre.dubath@unige.ch  
 felorrieta@mat.puc.cl  
 pestevez@cec.uchile.cl  
 susana@mat.puc.cl  
 efedorova@ukr.net  
 edf@astro.psu.edu  
 qi.feng2@mail.mcgill.ca  
 francisco.forster@gmail.com  
 gangler@clermont.in2p3.fr  
 mauro.garofalo@gmail.com  
 joegarciafa@unal.edu.co  
 gasta@iasf-milano.inaf.it  
 pgavras@noa.gr  
 nikos.gianniotis@h-its.org  
 cgomez@ulg.ac.be  
 agoodman@cfa.harvard.edu  
 mjg@caltech.edu  
 andrew.green@aao.gov.au  
 sgroom@ipac.caltech.edu  
 rustamdb@gmail.com  
 pguo@bnu.edu.cn  
 hastear@163.com  
 yuanhl@bao.ac.cn  
 jeh86@gwu.edu  
 sara.heap@gmail.com  
 hernitschek@mpia.de  
 ash@astrin.uz  
 mhuang@nao.cas.cn  
 pablo.huijse@gmail.com  
 emille.ishida@clermont.in2p3.fr  
 ishiyama@chiba-u.jp  
 ivezic@astro.washington.edu  
 colinjacobs@swin.edu.au  
 darko@aob.rs  
 info@alinkalam.eu  
 jkern@nrao.edu  
 sergii.khlamov@gmail.com  
 jhk@iac.es  
 s.kolomyiets@gmail.com  
 asmita.a.korde@nasa.gov  
 ikovalenko@imcce.fr  
 kurtz@cfa.harvard.edu  
 lich@nao.cas.cn  
 lxzhou@nao.cas.cn  
 longo@na.infn.it  
 andrea.longobardo@iaps.inaf.it  
 cj@haystack.mit.edu  
 lubow@stsci.edu  
 vesna.lukic@hs.uni-hamburg.de  
 aam@astro.caltech.edu  
 abhishekmalali@g.harvard.edu  
 mazz@ipac.caltech.edu  
 erzsebet@rice.edu  
 aregmick@yahoo.com  
 molinari@iaps.inaf.it  
 christian.muller@busoc.be  
 fmurtagh@acm.org  
 sara.nieto@esa.int

Alfonso **Nocella**, INAF - Capodimonte Astronomical Obs., Italy  
 Ray **Norris**, Australia Telescope National Facility, Australia  
 Michael **Olberg**, Onsala Space Obs. Chalmers Univ. of Technology, Sweden  
 Wilfredo **Palma**, Pontificia Universidad Católica de Chile, Chile  
 Victor **Pankratius**, MIT Haystack, USA  
 Maurizio **Paolillo**, Dept. of Physics - Univ. Federico II, Napoli, Italy  
 Jongyeob **Park**, Korea Astronomy and Space Science Inst., Korea  
 Reynier **Peletier**, Univ. of Groningen, Netherlands  
 Maura **Pilia**, INAF - OA Cagliari, Italy  
 Kai **Polsterer**, Heidelberg Inst. for Theoretical Studies, Germany  
 Troy **Porter**, Hansen Experimental Physics Lab., Stanford Univ., USA  
 Pavlos **Protopapas**, Harvard Univ., USA  
 Nicholas James **Rattenbury**, Univ. of Auckland, New Zealand  
 Giuseppe **Riccio**, INAF - Capodimonte Astronomical Obs., Italy  
 Luca **Rizzi**, Keck Obs., USA  
 Thomas **Robitaille**, Freelance  
 Helge **Rottmann**, Max-Planck-Institut für Radioastronomie, Germany  
 Anna **Scaife**, Univ. of Manchester, UK  
 Nicole **Schanche**, Univ. of St Andrews, UK  
 Bernard **Schutz**, Cardiff Univ., UK  
 Francesca **Scipioni**, USRA - Lunar and Planetary Inst., USA  
 Kazuhiro **Sekiguchi**, National Astron. Obs. of Japan, Japan  
 Evgeni **Semkov**, Inst. of Astronomy, Sofia, Bulgaria  
 Brigitta **Sipocz**, Univ. of Hertfordshire, UK  
 Petr **Skoda**, Astron. Inst. of the Czech Acad. of Sciences, Czech Republic  
 Yihan **Song**, National Astron. Obs., Chinese Acad. of Sciences, China  
 Peter **Sorensen**, NOT - Nordic Optical Telescope, La Palma, Spain  
 Vladimir **Sreckovic**, Inst. of Physics, Belgrade  
 Rachel **Street**, LCOGT, UK  
 Anton **Strigachev**, Inst. of Astronomy, Sofia, Bulgaria  
 Maria **Süveges**, Max-Planck-Inst. für Astronomie, Heidelberg, Germany  
 Brian **Thorsbro**, Lund Univ., Sweden  
 Martin **Topinka**, Inst. for Advanced Studies, Dublin, Ireland  
 Alessio **Trois**, INAF - OA Cagliari, Italy  
 Diego **Tuccillo**, GEPI - Observatoire de Paris; MINES Paris Tech, France  
 Mattia **Vaccari**, Univ. of Western Cape, South Africa  
 Edwin A. **Valentijn**, Kapteyn Inst., Univ. of Groningen, Netherlands  
 Thijs J.M. **van der Hulst**, Kapteyn Astron. Inst. Univ. of Groningen, Netherlands  
 Iryna **Vavilova**, Main Astron. Obs. of the National Acad. of Sciences, Ukraine  
 Civita **Vellucci**, DIETI, Univ. Federico II, Napoli, Italy  
 Dany **Vohl**, Swinburne Univ. of Tech., Australia  
 Veljko **Vujcic**, Astronomical Obs. Belgrade, Serbia  
 Bingyi **Wang**, Beijing Normal Univ., China  
 Mengxin **Wang**, National Astron. Obs., Chinese Acad. of Sciences, China  
 Yue **Wu**, National Astron. Obs. of Chinese Acad. of Sciences, China  
 Zhang **Yanxia**, National Astron. Obs., Chinese Acad. of Sciences, China  
 Yaroslav **Yatskiv**, Main Astronomical Obs. of NASU, Ukraine  
 Jiannan **Zhang**, National Astron. Obs., Chinese Acad. of Sciences, China  
 Mo **Zhang**, National Astron. Obs., Chinese Acad. of Sciences, China  
 Olga **Zhelenkova**, SAO RAS, Russia  
 Stanislaw **Zola**, Astronomical Obs., Jagiellonian Univ., Poland  
 nocella@na.astro.it  
 raypnorris@gmail.com  
 michael.olberg@chalmers.se  
 wilfredo.palma@gmail.com  
 pankrat@mit.edu  
 paolillo@na.infn.it  
 parkjy@kasi.re.kr  
 peletier@astro.rug.nl  
 maura.pilia@gmail.com  
 kai.polsterer@h-its.org  
 tporter@stanford.edu  
 pavlos@seas.harvard.edu  
 n.rattenbury@auckland.ac.nz  
 riccio@na.astro.it  
 lrizzi@keck.hawaii.edu  
 thomas.robitaille@gmail.com  
 rottmann@mpifr-bonn.mpg.de  
 anna.scaife@manchester.ac.uk  
 nicole.thom@gmail.com  
 bernard.schutz@aei.mpg.de  
 scipioni@lpi.usra.edu  
 kaz.sekiguchi@nao.ac.jp  
 esemkov@astro.bas.bg  
 bsipocz@gmail.com  
 skoda@sunstel.asu.cas.cz  
 yhsong@bao.ac.cn  
 pms@not.iac.es  
 vlada@ipb.ac.rs  
 rstreet@lcogt.net  
 anton@astro.bas.bg  
 maria.suveges@unige.ch  
 brian@thorsbro.dk  
 martin.topinka@gmail.com  
 atrois@oa-cagliari.inaf.it  
 diego.tuccillo@obspm.fr  
 mattia.vaccari@gmail.com  
 valentyn@astro.rug.nl  
 vdulst@astro.rug.nl  
 irivav@mao.kiev.ua  
 civita.vellucci@gmail.com  
 dvohl@swin.edu.au  
 veljko@aob.rs  
 1019525779@qq.com  
 beawmx@163.com  
 wuyue@bao.ac.cn  
 zyx@bao.ac.cn  
 yatskiv@mao.kiev.ua  
 jnzhang@bao.ac.cn  
 mzhang@nao.cas.cn  
 zhe@sao.ru  
 zola@oa.uj.edu.pl