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# Astroinformatics

*Edited by*

Massimo Brescia
S. G. Djorgovski
Eric D. Feigelson
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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.

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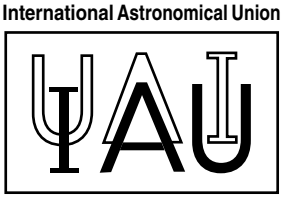
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# ASTROINFORMATICS

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

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## 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

### Astroinformatics Projects

The changing landscape of astrostatistics and astroinformatics . . . . . 3
*E. D. Feigelson*

Supercomputer simulations of structure formation in the Universe . . . . . 10
*T. Ishiyama*

From Sky to Earth: Data Science Methodology Transfer . . . . . 17
*A. A. Mahabal, D. Crichton, S. G. Djorgovski, E. Law & J. S. Hughes*

What will the future of cloud-based astronomical data processing look like? . . . . 27
*A. W. Green, E. Mannering, L. Harischandra, M. Vuong, S. O'Toole, K. Sealey & A. M. Hopkins*

Multi-wavelength studies of the statistical properties of active galaxies using Big Data. . . . . 32
*A. M. Mickaelian, H. V. Abrahamyan, M. V. Gyulzadyan, G. A. Mikayelyan & G. M. Paronyan*

Learn from every mistake! Hierarchical information combination in astronomy . . 39
*M. Süveges, S. Fotopoulou, J. Coupon, S. Paltani, L. Eyer & L. Rimoldini*

Exploring the Parameter Space of Compact Binary Population Synthesis . . . . . 46
*J. W. Barrett, I. Mandel, C. J. Neijssel, S. Stevenson & A. Vigna-Gómez*

Effects of mergers on non-parametric morphologies . . . . . 51
*L. A. Bignone, P. B. Tissera, E. Sillero, S. E. Pedrosa, L. J. Pellizza & D. G. Lambas*

ACS/WFC Pixel History, Bringing the Pixels Back to Science . . . . . 55
*D. Borncamp, N. Grogin, M. Bourque & S. Ogaz*

Investigation of Spatially Unresolved Magnetic Field Outside Sunspots Using Hinode/SOT Observations. . . . . 59
*O. Botygina, M. Gordovskyy & V. Lozitsky*

An Effective Method for Modeling Two-dimensional Sky Background of LAMOST 63
*H. Haerken, F. Duan, J. Zhang & P. Guo*

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Application of Compressive Sensing to Gravitational Microlensing Experiments . 67
*A. Korde-Patel, R. K. Barry & T. Mohsenin*

## Current and future surveys

The Euclid Data Processing Challenges . . . . . 73
*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 & A. Zacchei*

The European perspective for LSST. . . . . 83
*E. Gangler*

Everything we'd like to do with LSST data, but we don't know (yet) how . . . . . 93
*Ž. Ivezić, A. J. Connolly & M. Jurić*

Astroinformatics Challenges from Next-generation Radio Continuum Surveys . . 103
*R. P. Norris*

The Hubble Source Catalog . . . . . 114
*S. H. Lubow*

Pan-STARRS1 as pilot-survey for panoptic time-domain science . . . . . 118
*N. Hernitschek, H.-W. Rix, B. Sesar & E. F. Schlafly*

AlertSim - Serbian Contribution to the LSST. . . . . 122
*D. Jevremović, V. Vujčić, V. A. Srećković, J. Aleksić, S. Erkapić & N. Milovanović*

## Data Mining and Machine Learning

Prototype-based Models for the Supervised Learning of Classification Schemes . 129
*M. Biehl, B. Hammer & T. Villmann*

Classification of galaxy type from images using Microsoft R Server . . . . . 139
*A. de Vries*

Hierarchical Matching and Regression with Application to Photometric Redshift Estimation. . . . . 145
*F. Murtagh*

Dealing with Uncertain Multimodal Photometric Redshift Estimations . . . . . 156
*K. L. Polsterer*

Cooperative photometric redshift estimation. . . . . 166
*S. Cavuoti, C. Tortora, M. Brescia, G. Longo, M. Radovich, N. R. Napolitano, V. Amaro & C. Vellucci*

The analysis of VERITAS muon images using convolutional neural networks . . . 173
*Q. Feng, T. T. Y. Lin for the VERITAS Collaboration*

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Identification of Interesting Objects in Large Spectral Surveys Using Highly Parallelized Machine Learning . . . . . 180
*P. Škoda, A. Palička, J. Koza & K. Shakurova*

Automatic Source Classification in Digitised First Byurakan Survey . . . . . 186
*M. Topinka, A. Mickaelian, R. Nesci & C. Rossi*

Deep learning for studies of galaxy morphology . . . . . 191
*D. Tuccillo, M. Huertas-Company, E. Decencière & S. Velasco-Forero,*

METAPHOR: Probability density estimation for machine learning based photometric redshifts . . . . . 197
*V. Amaro, S. Cavuoti, M. Brescia, C. Vellucci, C. Tortora & G. Longo*

A Comparison of Classifiers for Solar Energetic Events . . . . . 201
*G. Barnes, N. Schanche, K. D. Leka, A. Aggarwal & K. Reeves*

Morphology and Interaction of Galaxies using Deep Learning . . . . . 205
*F. Caro, M. Huertas-Company & G. Cabrera*

Uncertain Photometric Redshifts with Deep Learning Methods . . . . . 209
*A. D'Isanto*

Determining the parameters of high amplification microlensing events by means of statistical machine learning techniques . . . . . 213
*E. Fedorova*

Galaxy Classifications with Deep Learning . . . . . 217
*V. Lukic & M. Brüggen*

An Automated Galaxy Spectra Recognition Method Basing on Spectral Lines Information . . . . . 221
*J. Zhang, X. Chen, Y. Wu & X. Li*

ELM-KNN for photometric redshift estimation of quasars . . . . . 225
*Y. Zhang, Y. Tu, Y. Zhao & H. Tian*

## Time Domain & Cosmology

Detection of quasars in the time domain . . . . . 231
*M. J. Graham, S. G. Djorgovski, D. J. Stern, A. Drake & A. Mahabal*

Transient events in LSST survey data . . . . . 242
*J. Aleksić, V. Vujčić & D. Jevremović*

Exploring the spectroscopic diversity of type Ia supernovae with Deep Learning and Unsupervised Clustering . . . . . 247
*E. E. O. Ishida, M. Sasdelli, R. Vilalta, M. Aguena, V. C. Busti, H. Camacho, A. M. M. Trindade, F. Gieseke, R. S. de Souza, Y. T. Fantaye & P. A. Mazzali*

Challenges in Timeseries Analysis from Microlensing . . . . . 253
*R. A. Street*

An autoregressive model for irregular time series of variable stars . . . . . 259
*S. Eyheramendy, F. Elorrieta & W. Palma*

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On the relationship between long-period comets and large trans-Neptunian planetary bodies . . . . . 263
*R. Guliyev & A. Guliyev*

Optical light curves of FUor and FUor-like objects . . . . . 266
*E. Semkov, S. Peneva & S. Ibryamov*

The search of radio transients in the RATAN-600 radio telescope surveys . . . . . 270
*O. P. Zhelenkova & E. K. Majorova*

Starspot migration in close binaries: A fast parameters evaluation from large sky surveys. . . . . 274
*B. Debski & S. Zola*

## Data Visualization

Deep data: discovery and visualization Application to hyperspectral ALMA imagery. . . . . 281
*E. Merényi, J. Taylor & A. Isella*

Integrated data access, visualization and analysis for Galactic Plane surveys: the VIALACTEA case . . . . . 291
*S. Molinari, R. Butora, S. Cavuoti, M. Molinaro, G. Riccio, E. Sciacca, F. Vitello, U. Becciani, M. Brescia, A. Costa & R. Smareglia*

Interactive (statistical) visualisation and exploration of a billion objects with vaex 299
*M. A. Breddels*

3-D interactive visualisation tools for H I spectral line imaging . . . . . 305
*J. M. van der Hulst, D. Punzo & J. B. T. M. Roerdink*

Collaborative visual analytics of radio surveys in the Big Data era . . . . . 311
*D. Vohl, C. J. Fluke, A. H. Hassan, D. G. Barnes & V. A. Kilborn*

Data mining and visualization from planetary missions: the VESPA-Europlanet2020 activity . . . . . 316
*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 & the Europlanet VESPA 2020 Team*

A team spectral inspection platform based on ASERA . . . . . 320
*H. Yuan, Y. Zhang, Y. Wu, Y. Lei, Y. Dong, Z. Bai, G. Li, H. Zhang & Y. Zhao*

## Astroinformatics Tools

$C^3$: A Command-line Catalogue Cross-matching tool for modern astrophysical survey data . . . . . 327
*G. Riccio, M. Brescia, S. Cavuoti, A. Mercurio, A. M. Di Giorgio & S. Molinari*

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Target and (Astro-)WISE technologies Data federations and its applications . . . 333
*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 & G. J. W. van Dijk*

What can the programming language Rust do for astrophysics? . . . . . 341
*S. Blanco-Cuaresma & E. Bolmont*

Astrophysics and Big Data: Challenges, Methods, and Tools. . . . . 345
*M. Garofalo, A. Botta & G. Ventre*

CoLiTec software - detection of the near-zero apparent motion. . . . . 349
*S. V. Khlamov, V. E. Savanevych, O. B. Briukhovetskyi & A. V. Pohorelov*

Design and Implement of Astronomical Cloud Computing Environment In China-VO . . . . . 353
*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 & K. Du*

PERICLES: a knowledge management programme applied to solar data from International Space Station-Columbus. . . . . 357
*C. Muller and the PERICLES consortium*

UkrVO Astroinformatics Software and Web-services . . . . . 361
*I. B. Vavilova, Ya. S. Yatskiv, L. K. Pakuliak, I. L. Andronov, V. M. Andruk, Yu. I. Protsyuk, V. E. Savanevych, D. O. Savchenko & V. S. Savchenko*

## Archives in Astronomy

The Hubble Catalog of Variables . . . . . 369
*P. Gavras, A. Z. Bonanos, I. Bellas-Velidis, V. Charmandaris, I. Georgantopoulos, D. Hatzidimitriou, G. Kakaletris, A. Karampelas, N. Laskaris, D. J. Lennon, M. I. Moretti, E. Pouliasis, K. Sokolovsky, Z. T. Spetsieri, K. Tsinganos, B. C. Whitmore & M. Yang*

The WFIRST Science Archive and Analysis Center . . . . . 373
*S. R. Heap, A. S. Szalay and the WFIRST Science Archive Team*

Evolution of the NASA/IPAC Extragalactic Database (NED) into a Data Mining Discovery Engine . . . . . 379
*J. M. Mazzarella and the NED Team*

Data Management in the Euclid Science Archive System. . . . . 385
*P. de Teodoro, S. Nieto & B. Altieri*

Meteor Databases in Astronomy. . . . . 389
*S. V. Kolomiyets*

Mol-D a Database and a Web Service within the Serbian Virtual Observatory and the Virtual Atomic and Molecular Data Centre . . . . . 393
*V. A. Srećković, D. Jevremović, V. Vujčić, L. M. Ignjatović, N. Milovanović, S. Erkapić & M. S. Dimitrijević*

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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

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# 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 weak 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*

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## 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*

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## 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 Astroinformatics 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, astroinformatics 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*

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