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STATISTICAL CHALLENGES IN 21ST CENTURY COSMOLOGY

IAU SYMPOSIUM No. 306

COVER ILLUSTRATION:

Mean of the posterior pdf of filaments in the matter density field, given the observed SDSS galaxy positions. For further details on this Bayesian method, see the article by Leclercq and Wandelt in this volume.

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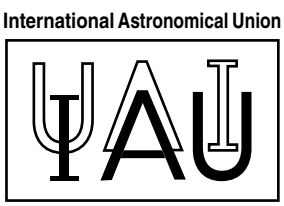

STATISTICAL CHALLENGES IN 21ST CENTURY COSMOLOGY

PROCEEDINGS OF THE 306th SYMPOSIUM OF THE INTERNATIONAL ASTRONOMICAL UNION HELD IN LISBON, PORTUGAL MAY 25–29, 2014

Edited by

ALAN HEAVENS
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University Printing House, Cambridge CB2 8BS, United Kingdom

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

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

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

79 Anson Road, #06-04/06, Singapore 079906

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Information on this title: www.cambridge.org/9781107078567

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First published 2015

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

ISBN 978-1-107-07856-7 Hardback

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Preface

On behalf of the International Astronomical Union, I am very happy to welcome the speakers, participants and readers of the IAU Symposium 306, 'Statistical Challenges in 21st Century Cosmology' conference in Lisbon Portugal. In the 19th century, when confronting observational data with predictions of Newtonian celestial mechanics, mathematicians like Legendre, Laplace and Gauss laid the foundations for modern statistics with least squares theory. During the 20th century, the astronomical and statistical communities drifted apart, one towards other branches of astrophysics and the other towards terrestrial affairs.

But, with the advent of advanced instruments and huge surveys, the 21st century is witnessing a resurgence of astrostatistical science. Interpretation of the cosmic microwave background, weak and strong gravitational lensing, galaxy clustering and other signatures of the early Universe all require advanced statistical techniques. This was the motivation for the IAU's Working Group in Astrostatistics and Astroinformatics (recently formed in 2012) to encourage first-class leaders – Alan Heavens, Jean-Luc Starck, Alberto Krone-Martins and their colleagues – to organize this conference. Unlike most cosmology research conferences, the emphasis here is not on the latest survey findings or their astrophysical implications, but rather on the intricate mathematical methods needed for the extraction of scientific insights from the large and complicated datasets.

The conference auditorium was full and the invited presentations were excellent. Together with poster papers, informal discussions and social events, the entire experience was very exciting. The IAU Working Group could not be more pleased with this inaugural astrostatistical Symposium, and we hope that it stimulates the larger community of astronomers and statisticians to further development of methodology for cosmology.

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Acknowledgements

The symposium is sponsored and supported by IAU Division B (with its Commission 5 and Working Group in Astrostatistics and Astroinformatics) and Division J, Commissariat à l'Energie Atomique, Service d'Astrophysique, France, European Research Council (ERC), International Astrostatistics Association, Academia das Ciências de Lisboa and Systems, Instrumentation and Modeling Laboratory (SIM), Universidade de Lisboa, Portugal, and the Imperial Centre for Inference and Cosmology (ICIC), Imperial College, London.

The Local Organizing Committee operated under the auspices of the Portuguese Astronomical Society.

Funding by the
International Astronomical Union,
European Research Council,
Imperial Centre for Inference and Cosmology (ICIC),
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CAMBRIDGE

Cambridge University Press
978-1-107-07856-7 — Statistical Challenges in 21st Century Cosmology (IAU S306)
Edited by Alan Heavens , Jean-Luc Starck , Alberto Krone-Martins
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Address by the Scientific and Local Organizing Committees

Dear Colleagues,

In the era of large astronomical surveys that are grappling with unsolved methodological and data challenges, transforming Data into Science is a huge, and exciting, problem.

With surveys and instruments such as Planck, Pan-STARRS1, DES, VST KiDS, LSST, Gaia, Euclid, JPAS, SKA, wide-field spectroscopic surveys and the large and interconnected databases of archival material coming online, a special scientific focus on cosmological inference is of great interest. Without this focus there is no guarantee that the best possible science will be the outcome of this flood of data. However, transforming data of the size and complexity of current and future surveys into knowledge presents considerable challenges, and is a problem that can benefit from cross-disciplinary efforts.

During recent years there has been a resumption of the dialogue between astronomers and statisticians, led by the Penn State conferences organized by Professors Jogesh Babu and Eric Feigelson. This dialogue has been fruitful and has been at the origin of a new Astrostatistics discipline. Since 2009 this discipline has a committee in the International Statistical Institute, (roughly) the counterpart of the IAU, and later, in 2012 an IAU Working Group in Astrostatistics and Astroinformatics was created.

It was thus timely to hold the first IAU Symposium devoted to Astrostatistics, which was also the first IAU Symposium in Portugal. This was a symposium with a cross-disciplinary nature, reflected in the inclusion of themes and speakers from the Astronomy and from the Statistics community, and covering topics from data processing to model selection. The aim of the meeting was to explore methods at a more technical level than would be normal at a typical cosmology conference, providing exposure to new ideas and techniques, to establish fruitful collaborations and to provide a natural discussion forum for both communities. We were delighted at the standard and technical level of the presentations and posters, and hope that these proceedings act as a useful starting point for researchers in search of the latest thinking in this exciting area of research.

Alan Heavens and Jean-Luc Starck (co-chairs SOC), Alberto Krone-Martins (chair LOC)
London, Paris and Lisbon, 27 August 2014

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