

IAU Symposium

318

3-7 August 2015
Honolulu, United States

Proceedings of the International Astronomical Union

Asteroids: New Observations, New Models

Edited by

Steven R. Chesley

Alessandro Morbidelli

Robert Jedicke

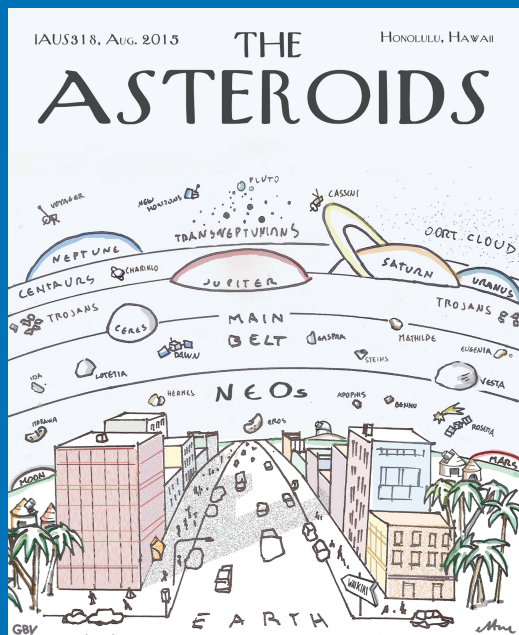
Davide Farnocchia

ISSN 1743-9213

International Astronomical Union



CAMBRIDGE
UNIVERSITY PRESS



ASTEROIDS: NEW OBSERVATIONS, NEW MODELS

IAU SYMPOSIUM 318

COVER ILLUSTRATION:

A VIEW OF THE SOLAR SYSTEM FROM HONOLULU

Composed by Ettore Perozzi and conceived by Giovanni B. Valsecchi, this illustration served as the distinctive logo for IAU Symposium 318, held in Honolulu 3-7 August, 2015. The drawing is inspired by the famous “View of the World from 9th Avenue,” illustration by Saul Steinberg that served as the cover of the March 29, 1976, edition of *The New Yorker*. As with the original, the cover illustration projects a parochial view, in this case one that emphasizes the tremendous importance of the diminutive asteroids in the realm of the solar system. As this volume amply demonstrates, the asteroids hold a wealth of information—wildly out of proportion to their tiny size—that is vital for decoding the origin of the solar system and understanding the geological and biological history of Earth. Ground-based telescopes are depicted near the horizon and several major exploratory space missions and their target bodies are highlighted, collectively emphasizing the importance of ground-based and space-based astronomical instruments to our understanding of the solar system as a whole, and the asteroids in particular.

IAU SYMPOSIUM PROCEEDINGS SERIES

Chief Editor

THIERRY MONTMERLE, IAU General Secretary
*Institut d'Astrophysique de Paris,
98bis, Bd Arago, 75014 Paris, France
montmerle@iap.fr*

Editor

PIERO BENVENUTI, IAU Assistant General Secretary
*University of Padua, Dept of Physics and Astronomy,
Vicolo dell'Osservatorio, 3, 35122 Padova, Italy
piero.benvenuti@unipd.it*

INTERNATIONAL ASTRONOMICAL UNION
UNION ASTRONOMIQUE INTERNATIONALE

International Astronomical Union



**ASTEROIDS:
NEW OBSERVATIONS,
NEW MODELS**

**PROCEEDINGS OF THE 318th SYMPOSIUM
OF THE INTERNATIONAL ASTRONOMICAL
UNION HELD IN HONOLULU, UNITED STATES
AUGUST 3–7, 2015**

Edited by

STEVEN R. CHESLEY

Jet Propulsion Laboratory, California Institute of Technology, United States

ALESSANDRO MORBIDELLI

*Département Lagrange, Université Côte d'Azur, CNRS Observatoire de la Côte
d'Azur, France*

ROBERT JEDICKE

Institute for Astronomy, University of Hawaii, United States

and

DAVIDE FARNOCCHIA

Jet Propulsion Laboratory, California Institute of Technology, United States



CAMBRIDGE UNIVERSITY PRESS
University Printing House, Cambridge CB2 8BS, United Kingdom
40 West 20th Street, New York, NY 10011-4211, USA
10 Stamford Road, Oakleigh, Melbourne 3166, Australia

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First published 2016

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

Typeset in System L^AT_EX 2_ε

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

ISBN 9781107138254 hardback
ISSN 1743-9213

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Preface

Asteroids are the small, usually rocky, bodies that reside primarily in a belt between Mars and Jupiter. Although some of these objects might have formed elsewhere and evolved into the main belt, others have certainly escaped and been scattered throughout the solar system to varying degrees. They carry the signature of the processes that gave birth to the solar system in the way that they are organized, both individually and as a population. Moreover, they are the leftovers of the planetesimals from which the planets formed, and so, in a real sense, the asteroids form the fabric of our solar system. Their observed compositional, structural and dynamical properties permit testing of current theories and facilitate development of new theories regarding the evolutionary processes that brought the solar system to its present state and that continue to act to reshape our planetary neighborhood. Asteroids also inform our understanding of the evolutionary processes taking place in other solar systems at various stages of development across the Milky Way and thus have relevance to diverse cosmogonical fields from circumstellar debris disks to exoplanets.

The main asteroid belt is a lively place where the physical, rotational and orbital properties of asteroids are governed by a complicated interplay of collisions, planetary resonances, radiation forces, and the formation and fission of secondary bodies. At the same time, the main asteroid belt is a “crossroads” in the solar system, connected either genetically or dynamically to a host of other populations of small bodies. Our symposium was oriented by the following core themes and unifying connections that serve to organize both the field and the meeting itself.

Origins. The dynamical structure of the asteroid belt and the physical properties of its constituents serve as a strong constraint on models describing the formation and the evolution of the early solar system.

Collisional Evolution. The collisional evolution of the solar system continues today and is most evident in the asteroid belt that is slowly being turned back into the dust from which it came.

Orbital Evolution. The main asteroid belt is a labyrinth of dynamical resonances intersected with subtle nongravitational forces that both feed and interrupt these resonances. The orbital evolution theories are continually tested and refined as surveys fill in the asteroid catalogs to smaller sizes.

Rotational evolution. Asteroids rotate in various ways, for example with simple rotation, precession or tumbling, and their rotation evolves along different pathways due to a variety of torques. The story of asteroid rotation is complex and still unfolding.

Evolutional Coupling. The collisional, orbital and rotational evolution mentioned so far are individually complex and rich in detail, and yet they are each coupled to the others in ways that make the complete evolutionary picture for asteroids truly fascinating.

Our symposium closed with a Q&A panel session designed to bring data producers and representatives of data processing centers together with the asteroid research community to communicate capabilities and plans, and to understand future data demands. Like many scientific fields, the study of asteroids is at the intersection of computer science and astronomy. Our work is fed by an immense and growing stream of data from systematic asteroids surveys, often operated in conjunction with astrophysical surveys. Such a wealth

of data represents an exciting challenge to ensure that the data are processed, archived and distributed in a way that maximizes the scientific return.

We thank the members of the Scientific Organizing Committee for their support in organizing the Symposium and in chairing the sessions. We are particularly grateful to the many colleagues who provided timely reviews of the papers presented here, thereby ensuring a volume of high-quality, peer-reviewed papers. We are hopeful that these Proceedings from the first-ever IAU Symposium to focus exclusively on asteroids will serve as a valuable milestone in our field.

*Steve Chesley, Alessandro Morbidelli, Robert Jedicke and Davide Farnocchia
November 13, 2015*

THE SCIENTIFIC ORGANIZING COMMITTEE

M. A'Hearn (United States)	P. Michel (France)
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D. Lazzaro (Brazil)	D. Vokrouhlický (Czech Republic)
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Acknowledgements

The symposium was sponsored and supported by IAU Division F (Planetary Systems and Bioastronomy) and Commission 20 (Positions & Motions of Minor Planets, Comets & Satellites), which served as the coordinating division and commission, respectively. Additional support and sponsorship was provided by Divisions A (Fundamental Astronomy) and B (Facilities, Technologies and Data Science), and Commissions 5 (Documentation & Astronomical Data), 6 (Astronomical Telegrams), 7 (Celestial Mechanics & Dynamical Astronomy), 15 (Physical Study of Comets & Minor Planets), and the Working Group on Near-Earth Objects

CONFERENCE PHOTOGRAPH



Participants

Zouhair **Benkhaldoun**, Cadi Ayyad University, Morocco
 Lance **Benner**, Jet Propulsion Laboratory, United States
 Fabrizio **Bernardi**, SpaceDyS, Italy
 Bryce **Bolin**, Observatoire de la Côte d'Azur, France
 Alceste **Bonanos**, National Observatory of Athens, Greece
 Jiří **Borovička**, Astron. Inst. Czech Acad. Sci., Ondřejov Obs., Czech Republic
 William **Bottke**, Southwest Research Institute, United States
 Marina **Brozović**, Jet Propulsion Laboratory, United States
 Valerio **Carruba**, Unesp, Brazil
 Kenneth **Chambers**, Institute for Astronomy, United States
 Steven **Chesley**, Jet Propulsion Laboratory, United States
 Paul **Chodas**, Jet Propulsion Laboratory, United States
 Roc **Cutri**, Caltech IPAC, United States
 Marco **Delbó**, CNRS-Observatoire de la Côte d'Azur, France
 Larry **Denneau**, Institute for Astronomy - University of Hawaii, United States
 David **Dunham**, International Occultation Timing Association, United States
 Josef **Đurech**, Charles University in Prague, Czech Republic
 Siegfried **Eggl**, IMCCE Observatoire de Paris, France
 Martin **Elvis**, Harvard-Smithsonian Center for Astrophysics, United States
 Vacheslav **Emel'yanenko**, Institute of Astronomy, Russian Academy of Sciences, Russia
 Davide **Farnocchia**, Caltech JPL, United States
 Grigori **Fedorets**, University of Helsinki, Finland
 Julio **Fernández**, Departamento de Astronomía, Facultad de Ciencias, Uruguay
 Mikael **Granvik**, University of Helsinki, Finland
 Tommy **Grav**, Planetary Science Institute, United States
 Giovanni Federico **Gronchi**, Università di Pisa, Italy
 Stephen **Gwyn**, Canadian Astronomy Data Centre, Canada
 Nader **Haghighipour**, Institute for Astronomy, University of Hawaii, United States
 Paul **Hayne**, Jet Propulsion Laboratory, United States
 Mary **Hinkle**, Northern Arizona University, United States
 Masatoshi **Hirabayashi**, University of Colorado at Boulder, United States
 Henry **Hsieh**, Academia Sinica Institute of Astronomy and Astrophysics, Taiwan
 Anatoliy **Ivantsov**, Technion - Israel Institute of Technology, Israel
 Seth **Jacobson**, Universitat Bayreuth, Germany
 Robert **Jedicke**, Institute for Astronomy, University of Hawaii, United States
 Peter **Jenniskens**, SETI Institute - NASA Ames, United States
 Jianghui **Ji**, Purple Mountain Observatory, CAS, China
 Yun **Jiang**, Purple Mountain Observatory, CAS, China
 Lynne **Jones**, University of Washington, United States
 Mario **Jurić**, University of Washington, United States
 Martin **Jutzi**, University of Bern, Switzerland
 Myung-Jin **Kim**, Korea Astronomy and Space Science Institute, South Korea
 Hubert **Klahr**, Max-Planck-Institute for Astronomy, Germany
 Zoran **Knežević**, Astronomical Observatory, Serbia
 Svitlana **Kolomiyets**, Kharkov National University of Radio electronics, Ukraine
 Irina **Kovalenko**, Paris Observatory, IMCCE-LESIA; CNRS, France
 Leonid **Ksanfomality**, Space Research Institute Moscow, Russia
 Daniela **Lazzaro**, Observatorio Nacional, Brazil
 Anne **Lemaitre**, University of Namur - Center naXys, Belgium
 Tim **Lister**, Las Cumbres Observatory (LCOGT), United States
 Philip **Lubin**, University of California at Santa Barbara, United States
 Mordecai-Mark **Mac Low**, American Museum of Natural History, United States
 Amy **Mainzer**, Jet Propulsion Laboratory, United States
 Simone **Marchi**, Southwest Research Institute, United States
 Jean-Luc **Margot**, University of California at Los Angeles, United States
 Joseph **Masiero**, NASA Jet Propulsion Laboratory, United States
 Kazuma **Matsue**, Kobe University, Japan
 Robert **McMillan**, University of Arizona, United States
 Patrick **Michel**, Observatoire de la Côte d'Azur, France
 Marco **Micheli**, Space Dynamics Services srl, Italy
 Andrea **Milani**, University of Pisa, Italy
 Michael **Mommert**, Northern Arizona University, United States
 Hong-Kyu **Moon**, Korea Astronomy and Space Science Institute, South Korea
 Alessandro **Morbidelli**, CNRS - Observatoire de la Côte d'Azur, France
 Nicholas **Moskowitz**, Lowell Observatory, United States
 Karri **Muinenen**, University of Helsinki, Finland
 Hiroko **Nagahara**, The Univ. Tokyo, Japan
 Wladimir **Neumann**, German Aerospace Center (DLR), Germany
 Bojan **Novaković**, University of Belgrade, Serbia
 Elizabeth **Palmer**, Western Michigan University, United States
 Elena **Pitjeva**, IAA RAS, Russia
 David **Polishook**, Weizmann Institute of Science, Israel
 Petr **Pravec**, Astron. Inst. Czech Acad. Sci., Ondřejov Obs., Czech Republic
 William **Reach**, USRA, United States
 Michael **Rudenko**, Minor Planet Center, United States
 Paul **Sánchez**, University of Colorado Boulder, United States
 Gal **Sarid**, Florida Space Institute, University of Central Florida, United States
 Isao **Sato**, Nihon University, Japan
 Daniel **Scheeres**, University of Colorado, United States
 Peter **Scheirich**, Astron. Inst. Czech Acad. Sci., Ondřejov Obs., Czech Republic
 George **Sonneborn**, NASAs Goddard Space Flight Center, United States
 Federica **Spoto**, Space Dynamics Services srl, Italy
 Pavel **Spurný**, Astron. Inst. Czech Acad. Sci., Ondřejov Obs., Czech Republic
 Gonzalo **Tancredi**, Depto. Astronomía, Fac. Ciencias, Uruguay
 Patrick **Taylor**, Arecibo Observatory, United States
 Audrey **Thirouin**, Lowell Observatory, United States
 Cristina **Thomas**, NASA GSFC + PSI, United States
 Miloš **Tichý**, Kleť Observatory, Czech Republic
 Georgios **Tsirvoulis**, Astronomical Observatory, Serbia

zouhair@uca.ma
 lance.benner@jpl.nasa.gov
 bernardi@spacedys.com
 pie314271@gmail.com
 bonanos@noa.gr
 jiri.borovicka@asu.cas.cz
 bottke@boulder.swri.edu
 marina.brozovic@jpl.nasa.gov
 vcarruba@feg.unesp.br
 chambers@ifa.hawaii.edu
 steve.chesley@jpl.nasa.gov
 paul.chodas@jpl.nasa.gov
 roc@ipac.caltech.edu
 marcodelbo@gmail.com
 denneau@hawaii.edu
 dunham@starpower.net
 durech@sirrah.troja.mff.cuni.cz
 siegfried.eggl@obspm.fr
 melvis@cfa.harvard.edu
 vvemel@inasan.ru
 Davide.Farnocchia@jpl.nasa.gov
 grigori.fedorets@helsinki.fi
 julio@fisica.edu.uy
 mgranvik@iki.fi
 tgrav@psi.edu
 gronchi@dm.unipi.it
 stephen.gwyn@nrc.ca
 nader@ifa.hawaii.edu
 Paul.O.Hayne@jpl.nasa.gov
 hinklem@gmail.com
 hirabayashi.masatoshi@gmail.com
 hhsieh@post.harvard.edu
 ivantsov@tx.technion.ac.il
 seth.jacobson@gmail.com
 jedicke@hawaii.edu
 Petrus.M.Jenniskens@nasa.gov
 jijh@pmo.ac.cn
 yjiang@pmo.ac.cn
 ljones@astro.washington.edu
 mjuric@astro.washington.edu
 martin.jutzi@space.unibe.ch
 skarma@kasi.re.kr
 klahr@mpia.de
 zoran@aob.rs
 s.kolomiyets@gmail.com
 i.d.kovalenko@gmail.com
 leksanf@gmail.com
 lazzaro@on.br
 anne.lemaitre@unamur.be
 tlister@lcogt.net
 lubin@deepspace.ucsb.edu
 mordecai@amnh.org
 Amy.Mainzer@jpl.nasa.gov
 marchi@boulder.swri.edu
 jlm@astro.ucla.edu
 Joseph.Masiero@jpl.nasa.gov
 141s419s@stu.kobe-u.ac.jp
 bob@lpl.arizona.edu
 michelp@oca.eu
 marco.micheli@esa.int
 milani@dm.unipi.it
 michael.mommert@nanu.edu
 fullmoon@kasi.re.kr
 morby@oca.eu
 nmosko@lowell.edu
 karri.muinenen@helsinki.fi
 hiroko@eps.s.u-tokyo.ac.jp
 wladimir.neumann@dlr.de
 bojan@math.rs
 elizabeth.m.palmer@wmich.edu
 evpitjeva@gmail.com
 david.polishook@weizmann.ac.il
 petr.pravec@asu.cas.cz
 wreach@sofia.usra.edu
 mrudenko@cfa.harvard.edu
 diego.sanchez-lana@colorado.edu
 galahead@gmail.com
 satoisao@nifty.com
 scheeres@colorado.edu
 petr.scheirich@gmail.com
 george.sonneborn@nasa.gov
 spoto@spacedys.com
 pavel.spurny@asu.cas.cz
 gonzalo@fisica.edu.uy
 ptaylor@naic.edu
 thirouin@lowell.edu
 cathomas09@gmail.com
 mtichy@klet.cz
 gtsirvoulis@aob.rs

Erika **Verebelyi**, Konkoly Observatory, Hungary
Matti **Viikinkoski**, Tampere University of Technology, Finland
Faith **Vilas**, Planetary Science Institute, United States
Richard **Wainscoat**, Institute for Astronomy, University of Hawaii, United States
Xiaobin **Wang**, Yunnan Observatories, CAS, China
Diane **Wooden**, NASA Ames Research Center, United States
Xiaosheng **Xin**, Nanjing University, China
Minami **Yasui**, Kobe University, Japan
Hong-Suh **Yim**, Korea Astronomy and Space Science Institute, Republic of Korea
Zhao **Yuhui**, Purple Mountain Obs., Chinese Academy of Sciences, China

verebelyi.erika@csfk.mta.hu
matti.viikinkoski@tut.fi
fvilas@psi.edu
rjw@ifa.hawaii.edu
wangxb@ynao.ac.cn
dwooden@mac.com
xiaoshengxin@outlook.com
minami.yasui@pearl.kobe-u.ac.jp
yimhs0@naver.com
zhaoyuhui@pmo.ac.cn