

MULTI-SCALE (TIME AND MASS) DYNAMICS OF SPACE OBJECTS
IAU SYMPOSIUM 364

COVER ILLUSTRATION:

Multi-scale dynamics of space objects

IAU SYMPOSIUM PROCEEDINGS SERIES

Chief Editor

JOSÉ MIGUEL RODRÍGUEZ ESPINOSA, General Secretariat

Instituto de Astrofísica de Andalucía

Glorieta de la Astronomía s/n

18008 Granada

Spain

IAU-general.secretary@iap.fr

Editor

DIANA WORRALL, Assistant General Secretary

HH Wills Physics Laboratory

University of Bristol

Tyndall Avenue

Bristol

BS8 1TL

UK

IAU-assistant.general.secretary@iap.fr

INTERNATIONAL ASTRONOMICAL UNION
UNION ASTRONOMIQUE INTERNATIONALE

International Astronomical Union



MULTI-SCALE (TIME AND MASS) DYNAMICS OF SPACE OBJECTS

PROCEEDINGS OF THE 364th SYMPOSIUM OF
THE INTERNATIONAL ASTRONOMICAL UNION
HYBRID MEETING, IASI, ROMANIA
18–22 OCTOBER, 2021

Edited by

ALESSANDRA CELLETTI (co-chair)

University of Rome Tor Vergata, Italy

CĂTĂLIN GALEȘ (co-chair)

University Al. I. Cuza Iași, Romania

CRISTIAN BEAUGÉ

Observatory of Cordoba, Argentina

and

ANNE LEMAÎTRE

University of Namur, Belgium



CAMBRIDGE
UNIVERSITY PRESS

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 2022

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 2022

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*

This journal issue has been printed on FSCTM-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 9781108490764 hardback
ISSN 1743-9213

Table of Contents

Preface	viii
Editors	x
List of Participants	xi
Dynamical constraints on the evolution of the inner asteroid belt and the sources of meteorites <i>Stanley F. Dermott, Dan Li and Apostolos A. Christou</i>	1
On Tides and Exoplanets <i>S. Ferraz-Mello</i>	20
Evolution of INPOP planetary ephemerides and Bepi-Colombo simulations <i>A. Fienga, L. Bigot, D. Mary, P. Deram, A. Di Ruscio, L. Bernus, M. Gastineau and J. Laskar</i>	31
The Lidov-Kozai resonance at different scales <i>Anne-Sophie Libert</i>	52
A numerical criterion evaluating the robustness of planetary architectures; applications to the ν Andromedæ system <i>Ugo Locatelli, Chiara Caracciolo, Marco Sansottera and Mara Volpi</i>	65
New results on orbital resonances <i>Renu Malhotra</i>	85
Latitudinal variations of charged dust in co-orbital resonance with Jupiter <i>Stefanie Reiter and Christoph Lhotka</i>	102
Chaos identification through the auto-correlation function indicator (<i>ACFI</i>) <i>Valerio Carruba, Safwan Aljbaae, Rita C. Domingos, Mariela Huaman and William Barletta</i>	108
Closed-form perturbation theory in the Sun-Jupiter restricted three body problem without relegation <i>Irene Cavallari and Christos Efthymiopoulos</i>	113
The current orbit of Atlas (SXV) <i>Demétrio Tadeu Ceccatto, Nelson Callegari Jr. and Adrián Rodríguez</i>	120
Evolution and stability of Laplace-like resonances under tidal dissipation <i>A. Celletti, E. Karampotsiou, C. Lhotka, G. Pucacco and M. Volpi</i>	128
Back-tracing space debris using proper elements <i>Alessandra Celletti, Giuseppe Pucacco and Tudor Vartolomei</i>	134
Four- and five-body periodic Caledonian orbits <i>Valerie Chopovda and Winston L. Sweatman</i>	140

Satellites' orbital stability through normal forms	146
<i>Irene De Blasi, Alessandra Celletti and Christos Efthymiopoulos</i>	
Noise, friction and the radial-orbit instability in anisotropic stellar systems: stochastic N -body simulations	152
<i>Pierfrancesco Di Cintio and Lapo Casetti</i>	
A cartographic study of spin-orbit coupling in binary asteroids	158
<i>Mahdi Jafari Nadoushan</i>	
Probabilistic evolution of pairs of trans-Neptunian objects in close orbits	165
<i>Eduard Kuznetsov, Omar Al-Shiblawi and Vladislav Gusev</i>	
Multiple bifurcations around 433 Eros with Harmonic Balance Method	171
<i>Leclère Nicolas, Kerschen Gaëtan and Dell'Elce Lamberto</i>	
The effect of the passage of Gliese 710 on Oort cloud comets	178
<i>Birgit Loibnegger, Elke Pilat-Lohinger, Max Zimmermann and Sharleena Clees</i>	
Weak stability transition region near the orbit of the Moon	184
<i>Zoltán Makó and Júlia Salamon</i>	
Secular dynamics in extrasolar systems with two planets in mutually inclined orbits	191
<i>Rita Mastroianni and Christos Efthymiopoulos</i>	
Dynamics around the binary system (65803) Didymos	197
<i>R. Machado Oliveira, O. C. Winter, R. Sfair, G. Valvano, T. S. Moura and G. Borderes-Motta</i>	
Orbit propagation around small bodies using spherical harmonic coefficients obtained from polyhedron shape models	203
<i>P. Peñarroya and R. Paoli</i>	
The semi-analytical motion theory of the third order in planetary masses for the Sun – Jupiter – Saturn – Uranus – Neptune's system	211
<i>Alexander Perminov and Eduard Kuznetsov</i>	
On the scattering and dynamical evolution of Oort cloud comets caused by a stellar fly-by	214
<i>E. Pilat-Lohinger, S. Clees, M. Zimmermann and B. Loibnegger</i>	
Planetary and lunar ephemeris EPM2021 and its significance for Solar system research	220
<i>Elena Pitjeva, Dmitry Pavlov, Dan Aksim and Margarita Kan</i>	
Some of the most interesting cases of close asteroid pairs perturbed by resonance	226
<i>A. Rosaev and Eva Plavalova</i>	
Characterization of the stability for trajectories exterior to Jupiter in the restricted three-body problem via closed-form perturbation theory	232
<i>Mattia Rossi and Christos Efthymiopoulos</i>	

Astrometry and photometry of asteroids from the UkrVO database of astroplates <i>I.B. Vavilova, S.V. Shatokhina, L.K. Pakuliak, O.M. Yizhakevych, I. Eglitis, V.M. Andruk and Yu.I. Protsyuk</i>	239
Families of periodic orbits around asteroids: From shape symmetry to asymmetry <i>G. Voyatzis, D. Karydis and K. Tsiganis</i>	246
Oscillations around tidal pseudo-synchronous solutions for circumbinary planets <i>F. A. Zoppetti, H. Folonier, A. M. Leiva and C. Beaugé</i>	252
Apsidal alignment in migrating dust - Crescent features caused by eccentric planets <i>Maximilian Sommer, Petr Pokorný, Hajime Yano and Ralf Srama</i>	259
Cascade disruption in Rambo family	262
<i>Mariia Vasileva, Eduard Kuznetsov, Alexey Rosaev and Eva Plávalová</i>	
An algorithm for automatic identification of asymmetric transits in the TESS database	264
<i>M. Vasylenko, Ya. Pavlenko, D. Dobrycheva, I. Kulyk, O. Shubina and P. Korsun</i>	
Author Index	267

Preface

With the advent of powerful telescopes, instruments and computation facilities, as well as the results from space missions ventured towards the edge of the Solar system, we are witnessing a new era of extraordinary discoveries, that is pushing the frontier of science toward new horizons. Different or refined theories, methods and techniques are needed to deal with the enormous amount of highly accurate observational data on the celestial bodies. The emergence of new open problems, such as the formation, habitability and long-term evolution of planetary systems, the complex dynamical behavior of minor bodies in the Solar system, the increased traffic in Earth's orbit, the exploration and exploitation of space objects, stimulates the birth of new lines of investigation, the search for novel scientific methods and techniques, as well as the development of technologies.

The range of phenomena that manifest at all different time and length scales and the wide range of sizes of space objects, from minor bodies in the Solar system to exoplanets, from dust particles to Jupiter-size bodies, require the development of dynamics modelling and analysis tools that can handle these different scales. The understanding of the dynamics of space objects of various sizes, both natural and artificial, is a key to the advancement of various branches of science, such as celestial mechanics, astrodynamics, planetary sciences, applied mathematics and dynamical systems, with considerable benefits to society and economy.

These topics motivated the organization of the **IAU Symposium 364, Multi-scale (time and mass) dynamics of space objects**, held online from Iasi (Romania) during the period October 18–22, 2021. Although the pandemic situation did not allow to gather together in Iasi, the Symposium represented a unique opportunity to share ideas and projects. This book is a collection of contributions given by distinguished scientists at **the IAU Symposium 364**. The methods in dynamics modeling of space objects have already reached a state of maturity, and their implementation provided a large number of results of particular importance both in theory and in applications. The contributions in this volume deal with a variety of important topics covering the recent advances in the multi-scale dynamics of natural and artificial space objects from various perspectives, among which:

- a) dynamics modelling of space objects at different time and length scales (multi-scale): dust particles, asteroids and comets, planets and exoplanets, satellites and space debris;
- b) theories and tools to analyze the long-term evolution of space objects: perturbation methods, numerical, semi-analytical and analytical techniques, computer-algebraic techniques, planetary ephemerides, special manipulators and computational environments, dynamical systems methods;
- c) multi-scale stability analysis of celestial bodies: resonances, mechanisms of onset of chaos, chaos indicators, equilibrium points, invariant manifolds, local and global analysis;

The Symposium was attended by an overall number of 199 participants from different institutions all over the world. The Symposium was made possible thanks to the support of the International Astronomical Union, with the endorsement of Division A Fundamental Astronomy, A4-Inter-Division A-F Commission Celestial Mechanics and Dynamical Astronomy. The Symposium was organized thanks to the collaboration of the University of Rome Tor Vergata (Italy), the University Alexandru Ioan Cuza of Iași (Romania) and the Romanian National Committee for Astronomy.

We take the opportunity to thank all members of the Scientific Organizing Committee (SOC) of the Symposium and all members of the Local Organizing Committee. We acknowledge the Department of Mathematics of the University of Al. I. Cuza, Iasi, Romania, for hosting the Symposium and, in particular, we warmly thank the dean of the Faculty, Prof. Răzvan Lițcanu, and the vice-dean, Prof. Marius Apetrii.

Alessandra Celletti and Cătălin Gales (co-chairs)
Cristian Beaugé and Anne Lemaitre (co-editors)

Editors

Alessandra Celletti (co-chair)
University of Rome Tor Vergata, Italy

Cătălin Galeş (co-chair)
University Al. I. Cuza Iaşi, Romania

Cristian Beaugé
Observatory of Cordoba, Argentina

Anne Lemaître
University of Namur, Belgium

Scientific Organising Committee

Alessandra Celletti	University of Rome Tor Vergata, Italy (co-chair)
Cătălin Galeş	University Al. I. Cuza Iaşi, Romania (co-chair)
Cristian Beaugé	Observatory of Cordoba, Argentina
Mirel Bîrlan	Astronomical Inst. Romanian Academy, Romania
Alexandre Correia	University of Coimbra, Portugal
Christos Efthymiopoulos	Academy of Athens, Greece
Giovanni F. Gronchi	University of Pisa, Italy
Douglas P. Hamilton	University of Maryland, USA
Daniel Hestroffer	IMCCE, Observatory of Paris, PSL Research University, France
Eiichiro Kokubo	National Astronomical Observatory of Japan, Japan
Anne Lemaître	University of Namur, Belgium
Daniel J. Scheeres	University of Colorado, USA
Bonnie Steves	Glasgow Caledonian University, UK
Winston Sweatman	Massey University, New Zealand
Massimiliano Vasile	University of Strathclyde, UK
Marie Yseboodt	Royal Observatory of Belgium, Belgium

Local Organising Committee

Cătălin Galeş	University Al. I. Cuza Iaşi, Romania (co-chair)
Răzvan Liţcanu	University Al. I. Cuza Iaşi, Romania (co-chair)
Marius Apetrii	University Al. I. Cuza Iaşi, Romania
Andreea Arusoaie	University Al. I. Cuza Iaşi, Romania
Simona Barna	University Al. I. Cuza Iaşi, Romania
Ionel-Dumitrel Ghiba	University Al. I. Cuza Iaşi, Romania
Gabriela Ana Nadabaică	University Al. I. Cuza Iaşi, Romania
Dan Alin Nedelcu	Astronomical Inst. Romanian Academy, Romania
Roberto Paoli	University Al. I. Cuza Iaşi, Romania
Vlad Turcu	Romanian Academy - Astronomical Observatory of Cluj, Astronomical Institute, Romania
Tudor Vartolomei	University of Rome Tor Vergata, Italy

List of Participants

1. AGGARWAL Rajiv
Deshbandhu College, University of Delhi, India
2. ALESSI Elisa Maria
Consiglio Nazionale delle Ricerche, Italy
3. ALVES Raphael
University of Sao Paulo, Brazil
4. ANGHEL Simon
Astronomical Institute of the Romanian
Academy / Faculty of Physics, University of
Bucharest / IMCCE, Observatoire de Paris,
Romania
5. APETRII Marius
UAIC, Romania
6. ARUSOAIIE Andreea
Faculty of Computer Science, Alexandru Ioan
Cuza University of Iasi, Romania
7. AZANFIREI Gabriela- Ana
Faculty of Mathematics, Al. I. Cuza University
of Iasi, Romania
8. BALYAEV Ivan
Saint Petersburg State University, Russia
9. BARBOSA Gerson
UNESP, Brazil
10. BAU' Giulio
University of Pisa, Italy
11. BEAUGÉ Cristian
Instituto de Astronomía Teórica y Experimental
SpaceDyS, Italy
12. BERNARDI Fabrizio
SpaceDyS, Italy
13. BERTOLUCCI Alessia
SpaceDyS, Italy
14. BIRLAN Mirel
Astronomical Institute of the Romanian
Academy & IMCCE, Paris Observatory, Romania
15. BOACA Ioana-lucia
Astronomical Institute of the Romanian
Academy, Romania
16. BOLDEA Afrodita Liliana
National Institut for Physics and Nuclear
Engineering, Bucharest, University of Craiova,
Romania
17. BORDERES MOTTA Gabriel
Universidad Carlos III de Madrid, Spain
18. BOUÉ Gwenaél
IMCCE, France
19. BRAGA CAMARGO Barbara Celi
UNESP, Brazil
20. CĂLIMAN Alexandru
Alexandru Ioan Cuza University of Iasi, Romania
21. CALLEGARI JR. Nelson
São Paulo State University (Unesp), Institute of
Geosciences and Exact Sciences (IGCE), Brazil
22. CARDOSO DOS SANTOS Josué
ITA - Aeronautics Institute of Technology (Brazil)
and Technion - Israel Institute of Technology
(Israel), Brazil
23. CARLOS EDUARDO Eligio
Department of Physics, UNESP Rio Claro., Brazil
24. CARRUBA Valerio
UNESP, Brazil
25. CASTRO GUIMARÃES Millena
UNESP, Brazil
26. CAVALLARI Irene
Universita' di Pisa, Italy
27. CECCATTO Demétrio Tadeu
Universidade Estadual Paulista, Brazil
28. CELLETTI Alessandra
University of Rome Tor Vergata, Italy
29. CHARALAMBOUS Carolina
UNamur, Belgium
30. CHAUDHARY Harindri
Deshbandhu College, University of Delhi, India
31. CHAUHAN Shipra
Department of Mathematics, University of Delhi,
India
32. CHUVASHOV Ivan
Institute of Astronomy, Russian Academy of
Sciences, The Russian Federation
33. CINELLI Marco
Tor Vergata - University of Rome, Italy
34. CORREIA Alexandre
University of Coimbra, Portugal
35. COUTURIER Jérémy
IMCCE, Observatoire de Paris, France
36. COYETTE Alexis
University of Namur, Belgium
37. DA SILVA SOARES Paulo Victor
Ana Maria da Silva, Brazil

- | | | |
|-----|-------------------------------|--|
| 38. | DANESI Veronica | University of Rome Tor Vergata, Italy |
| 39. | DAQUIN Jerome | University of Namur, Belgium |
| 40. | DE BLASI Irene | University of Turin, Italy |
| 41. | DELL'ELCE Lamberto | Inria, France |
| 42. | DERMOTT Stanley | University of Florida, USA |
| 43. | DI CINTIO Pierfrancesco | Enrico Fermi Research Centre (CREF) and INFN, Italy |
| 44. | DI RUZZA Sara | Università di Padova, Italy |
| 45. | DOLGAKOV Ivan | Institute of Applied Astronomy of the Russian Academy of Sciences, Russia |
| 46. | DUBEIBE Fredy | Universidad de los Llanos, Colombia |
| 47. | EFIMOV Sergey | Moscow Institute of Physics and Technology, Russia |
| 48. | EFTHYMIOPOULOS Christos | Dipartimento di Matematica, Università degli Studi di Padova, Italy |
| 49. | EMEL'YANENKO Vacheslav | Institute of Astronomy, Moscow, Russia |
| 50. | ESMER Ekrem Murat | Ankara University, Turkey |
| 51. | FENUCCI Marco | University of Belgrade, Serbia |
| 52. | FERNINI Ilias | Sharjah Academy for Astronomy, Space Sciences, and Technology, UAE |
| 53. | FERRAZ-MELLO Sylvio | Universidade de São Paulo, Brazil |
| 54. | FERREIRA Lucas S. | Grupo de Dinâmica Orbital & Planetologia - São Paulo State University - UNESP - Brazil, Brazil, Brazil |
| 55. | FIENGA Agnes | Observatoire de la Côte d'Azur, France |
| 56. | FOLTRAN Bruno | UNESP, Brazil |
| 57. | FUNATO Yoko | University of Tokyo, Graduate Division of International and Interdisciplinary Studies, Japan |
| 58. | GALES Catalin | Al. I. Cuza University of Iasi, Romania |
| 59. | GALLARDO Tabare | Facultad de Ciencias, Udelar, Uruguay |
| 60. | GASLAC GALLARDO Daniel Martin | Sao Paulo State University UNESP, Brazil |
| 61. | GEVORGYAN Yeva | University of São Paulo, Brazil |
| 62. | GIMENO Joan | University of Rome Tor Vergata, Italy |
| 63. | GIULIATTI WINTER Silvia | UNESP, Brazil |
| 64. | GIUPPONE Cristian | Iate - Conicet, Argentina |
| 65. | GKOLIAS Ioannis | Aristotle University of Thessaloniki, Greece |
| 66. | GOMES Luiz | UNESP, Brazil |
| 67. | GOMES Sérgio | University of Coimbra, Portugal |
| 68. | GRASSI Clara | University of Pisa, Italy |
| 69. | GRONCHI Giovanni Federico | University of Pisa, Italy |
| 70. | GUERRA Francesca | SpaceDyS, Italy |
| 71. | GULIYEV Rustam | Shamakhy Astrophysical Observatory, Azerbaijan |
| 72. | GUZZO Massimiliano | University of Padova, Italy |
| 73. | HAGHIGHIPOUR Nader | Institute for Astronomy, University of Hawaii, USA |
| 74. | HAMILTON Douglas | University of Maryland, USA |
| 75. | HERASIMENKA Alesia | Université Côte d'Azur, CNRS, Inria, LJAD, France |
| 76. | HESTROFFER Daniel | Paris observatory, France |
| 77. | HILTON James | U.S. Naval Observatory, USA |
| 78. | HOANG Hoai Nam | IMCCE, observatory of Paris, France |
| 79. | HOWELL Kathleen | Purdue University, USA |
| 80. | IBRAIMOVA Aigerim | Fesenkov Astrophysical Institute, Kazakhstan |

81. IPATOV Sergei Vernadsky Institute of Geochemistry and Analytical Chemistry of Russian Academy of Sciences, Moscow, Russia
82. JAFARI NADOUSHAN Mahdi K N Toosi University of Technology, Iran
83. JHA Devanshu MVJCE, India
84. JUNQUEIRA Camila UNESP, Brazil
85. KARAMPOTSIU Efsevia University of Rome Tor Vergata, Aristotle University of Thessaloniki, Greece
86. KARTHICK Chrisphin Indian Institute of Astrophysics (Iia), India
87. KARYDIS Dionysios Aristotle University of Thessaloniki, Greece
88. KAUR Dr Bhavneet University of Delhi, India
89. KNEŽEVIĆ Zoran Serbian Academy of Sciences and Arts, Serbia
90. KOKUBO Eiichiro National Astronomical Observatory of Japan, Japan
91. KOTOULAS Thomas Department of Physics, A.U.Th., Greece
92. KUMAR Bhanu Georgia Institute of Technology, USA
93. KUMAR Dinesh Department of Mathematics, University of Delhi, India
94. KUMAR Sumit University of Delhi, New Delhi-110007, India
95. KUZNETSOV Eduard Ural Federal University, Russian Federation
96. LARI Giacomo University of Pisa
97. LASKAR Jacques Paris Observatory, France
98. LATTARI Victor São Paulo State University - UNESP, Brazil
99. LECLERE Nicolas University of Liege, Belgium
100. LEGNARO Edoardo Academy of Athens, Italy
101. LEMAITRE Anne University of Namur, Belgium
102. LEVKINA Polina The Institute of Astronomy of the Russian Academy of Sciences, Russian Federation
103. LHOTKA Christoph Department of Astrophysics, University of Vienna, Austria
104. LIBERT Anne-sophie naXys, University of Namur, Belgium
105. LIN Houyuan Purple Mountain Observatory, China
106. LITCANU Razvan University Al. I. Cuza of Iasi, Romania
107. LOCATELLI Ugo Dipartimento di Matematica, Università degli Studi di Roma "Tor Vergata", Italy
108. LOIBNEGGER Birgit University of Vienna, Department of Astrophysics, Türkenschanzstraße 17, 1180 Vienna, Austria
109. MACHADO Raí São Paulo State University, Brazil
110. MADEIRA Gustavo São Paulo State University, Brazil
111. MAKÓ Zoltan Sapientia Hungarian University of Transylvania, Romania
112. MALHOTRA Renu The University of Arizona, USA
113. MANCHENKO Liliia V.N. Karazin Kharkiv National University, Department of Theoretical Physics named by academician I. M. Lifshits, Ukraine
114. MARO' Stefano University of Pisa, Italy
115. MARTIN Andreza São Paulo State University, Brazil
116. MASTROIANNI Rita University of Padova, department of Mathematics, Italy
117. MEENA Om Prakash University of Delhi, India
118. MILIĆ ŽITNIK Ivana Astronomical Observatory Belgrade, Assistant Research Professor, Serbia
119. MINGLIBAYEV Mukhtar Fesenkov Astrophysical Institute, Almaty
120. MISQUERO Mauricio University of Rome Tor Vergata, Italy

121. MITTAL Amit University of Delhi, India
 122. MOGAVERO Federico Institut de mécanique céleste et calcul des éphémérides, France
 123. MORAIS Helena UNESP (São Paulo State University), Brazil
 124. MORBIDELLI Alessandro CNRS/OCA, France
 125. MORINJ Bruno Unesp/undergraduate, Brazil
 126. MOURA Tamires UNESP, Brazil
 127. MOURÃO Daniela UNESP - São Paulo State University, Brazil
 128. MOURSI Ahmed National Research Institute of Astronomy and Geophysics, Egypt
 129. NDUNGE Mbonteh Roland Cameroon Astronomy and Space Research Organization, Cameroon
 130. NICOLÁS Begoña University of Barcelona, Spain
 131. NUNES Daniel Grupo de Dinâmica Orbital & Planetologia - São Paulo State University - UNESP - Brazil, Brazil
 132. OLIVEIRA Patrick National Observatory, Brazil
 133. PAGANELLI Flora NRAO, USA
 134. PAOLI Roberto UAIC, Romania
 135. PAVLOV Dmitry St. Petersburg Electrotechnical University (LETI), Russian Federation
 136. PEÑARROYA Pelayo Deimos Space S.L.U., Spain
 137. PERMINOV Alexander Ural Federal University, Russia
 138. PETIT Antoine Lund University, Sweden
 139. PICHIERRI Gabriele MPIA, Germany
 140. PILAT-LOHINGER Elke Department of Astrophysics, University of Vienna, Austria
 141. PINHEIRO Tiago São Paulo State University, UNESP, Brazil
 142. PIRES Priscilla Rio de Janeiro State University, Brazil
 143. PLÁVALOVÁ Eva Mathematical Institute Slovak Academy of Sciences, Slovakia
 144. POMET Jean-baptiste INRIA Sophia Antipolis, France
 145. PONS Juan UdelaR, Uruguay
 146. POPESCU Marcel Astronomical Institute of the Romanian Academy, Romania
 147. POUSSE Alexandre IMATI-CNR, Italy
 148. RIOFRIO Louise International Lunar Observatory, USA
 149. ROBUTEL Philippe IMCCE/Observatoire de Paris/PSL, France
 150. RODRÍGUEZ DEL RÍO Óscar Universitat Politècnica de Catalunya & Università di Pisa, Italy
 151. RODRIGUEZ Adrian Universidade Federal do Rio de Janeiro, Brazil
 152. ROIG Fernando Observatorio Nacional, Brazil
 153. ROISIN Arnaud University of Namur, naXys, Belgium
 154. ROSAEV Alexey Research and Educational Center “Nonlinear Dynamics”, Yaroslavl State University, Russia
 155. ROSENGREN Aaron Jay University of California San Diego, USA
 156. ROSSI Alessandro IFAC-CNR, Italy
 157. ROSSI Mattia Department of Mathematics - Università degli Studi di Padova, Italy
 158. RUIZ DOS SANTOS Lucas UNIFEI - Brazil, Brazil
 159. SACHAN Prachi Department of Mathematics, University of Delhi, India
 160. SAILLENFEST Melaine IMCCE, Paris Observatory, France
 161. SCHEERES Daniel University of Colorado Boulder, USA

162. SFAIR Rafael UNESP, Brazil
163. SHOAI B Muhammad Smart and Scientific Solutions, Pakistan
164. SIDORENKO Vladislav Keldysh Institute of Applied Mathematics, Moscow, Russia, Russian Federation
165. SINGH Rishabh Narayana Etechno School, India
166. SLYUSAREV Ivan V.N. Karazin Kharkiv National University, Ukraine
167. SOMMER Maximilian Institute of Space Systems, University of Stuttgart, Germany
168. STEVES Bonnie Glasgow Caledonian University, Scotland, UK
169. SURAJ Md. Sanam University of Delhi, India
170. SWEATMAN Winston Massey University, New Zealand
171. SZÜCS-CSILLIK Iharika-magdolna Romanian Academy. Astronomical Institute of Cluj-Napoca., Romania
172. TAN Pan School of Astronomy and Space Science, Nanjing University, China
173. TARNOPOLSKI Mariusz Jagiellonian University, Poland
174. TCHAPTCHET TCHAPTCHET William Christian Astronomy Club of Cameroon / University of Dschang, Cameroon
175. TEIXEIRA GUIMARÃES Gabriel IAG-USP, Brazil
176. TODOROVIĆ Nataša Astronomical Observatory in Belgrade, Serbia
177. TRUONG LE Gia Bao International University - Vietnam National University, Vietnam
178. TSIGANIS Kleomenis Aristotle University of Thessaloniki, Greece
179. VAILLANT Timothée CFisUC, Universidade de Coimbra, Portugal
180. VALENTE Ema University of Coimbra, Portugal
181. VALSECCHI Giovanni IAPS-INAF, Italy
182. VALVANO Giulia Student from UNESP, Brazil
183. VARTOLOMEI Tudor University of Rome Tor Vergata, Italy
184. VASILE Massimiliano University of Strathclyde, UK
185. VASILEVA Mariia UrFU, Russia
186. VASYLENKO Maksym Main Astronomical Observatory of NAS of Ukraine, Ukraine
187. VAVILOVA Iryna Main Astronomical Observatory of the NAS of Ukraine, Ukraine
188. VOLPI Mara University of Rome Tor Vergata, Italy
189. VOYATZIS George Aristotle University of Thessaloniki, Greece
190. WILLIET NYUYWIYNI Dinka Astronomy club of Cameroon (program Officer), Cameroon
191. WINTER Othon São Paulo State University - UNESP, Brazil
192. XI Xiaojin National Time Service Center, Chinese Academy of Sciences, China
193. YESILIRMAK Burcak Akdeniz University - Space Science and Technologies Department, Turkey
194. YOSHIDA Haruo National Astronomical Observatory of Japan, Japan
195. YOUSUF Saleem Central University of Rajasthan, India
196. YSEBOODT Marie Royal Observatory of Belgium, Belgium
197. ZHUMABEK Torebek Al-Farabi Kazakh National University, Faculty of Mechanics and Mathematics, Kazakhstan
198. ZIMMERMANN Max University of Vienna, Departement of Astrophysics, Austria
199. ZOPPETTI Federico Observatorio Astronómico de Córdoba, Argentina