MONDAY 3

8h00–9h20 Registration

9h20–9h40 Welcome & Opening remarks Anne-Sophie Libert (chair of the SOC)

9h40–10h20 A. Morbidelli, Interdisciplinarity: an effective approach to comprehending the formation of planetary systems

10h20–11h00 Coffee break

11h00–11h40 D. Scheeres, Binary Asteroids: A Pathway to Understanding the Morphological Evolution of Rubble Pile Asteroids

11h40–12h20 D. Fabrycky, Resonant Chain Dynamics: Interpretation of Observations

12h20–12h25 A. Füzfa, The UNamur observatory

12h25–14h00 Lunch

14h00–15h40 Parallel session - S01

- D. Vavilov, Partial Banana Mapping: search for close encounters and impact probability
- L. Benet, Transversal Yarkovsky acceleration for Apophis exploiting automatic differentiation tools
- Ch. Lhotka, On the Celestial Dynamics of Charged Dust in the Solar System
- D. Ragozzine, Non-Keplerian Motion of Trans-Neptunian Binaries: Shapes, Spins, and Formation
- E. Pilat-Lohinger, Inward and outward scattering of Oort cloud comets due to Gliese 710

14h00–15h40 Parallel session - PA02

- B. Kumar, Europa-Induced Overlapping of Secondary Resonances in the 4:3 Jupiter-Ganymede Unstable Resonant Orbit Family
- A. Rodriguez, Mapping the structure of the planetary 2:1 mean motion resonance: the TOI-216, K2-24, and HD27894 systems
- G. Pucacco, Normal forms for Laplace-like resonances
- S. Gomes, The passage through the 5:3 resonance between Ariel and Umbriel with inclination
- Z. Knežević, Secular resonance maps

15h40–16h20 Coffee Break

16h20–17h00 Parallel session - S01

- S. Dermott, Asteroid family membership in the inner belt
• B. Sicardy, *Resonances around small bodies of the solar system: where should be the rings?*

16h20–17h00 **Parallel session - PA02**

• E. Kokubo, *Orbital Architecture of Planetary Systems Formed by Gravitational Scattering and Collisions*
• J. Mah, *Forming Super-Mercuries: Role of stellar abundances*

18h00–20h00 **Welcome Reception - Boat tour**

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**TUESDAY 4**

9h00–9h40 M. Granvik, *Destruction mechanisms for near-Earth objects*

9h40–10h20 A. J. Rosengren, *On the Multiscale Astrodynamics of Cislunar xGEO Space*

10h20–11h00 **Coffee break**

11h00–12h20 **Parallel session - S01**

• S. Di Ruzza, *Analysis of co-orbital motion of real asteroid in a medium-term timescale*
• E. Legnaro, *MEO Secular Resonances: Phase Space, Eccentricity Growth and Diffusion of Navigation Satellites*
• G. Lari, *Orbital evolution of the Galilean moons driven by a fast orbital expansion of Callisto*
• C. Grassi, *Revisiting the computation of the critical points of the squared distance between two ellipses with a common focus*

11h00–12h20 **Parallel session - PA02**

• S. Crespi, *Terrestrial Planet formation Simulations: Homogeneous Comparison between Methods*
• Ph. Griveaud, *Migration of giant planets in low viscosity discs and consequences on the Nice model*
• N. Haghighipour, *Secular Resonances and Terrestrial Planet Formation in Planetary Systems with Multiple Stars: Theory and Application*
• G. Pichierri, *Forming the Trappist-1 system in two steps during the recession of the disc inner edge*

12h20–14h00 **Lunch**

14h00–14h40 A. Johansen *Forming planetary systems via pebble accretion*

14h40–15h40 **Round table “Space awareness”**

A. Rosengren, *Space debris dynamics*
J.-M. Van Nypseheer, *An initiative in space debris removal*
D. Hestroffer, *Hazardous asteroids and the Hera mission*
C. Linard, Mapping population from space
Y. Nazé, Food for thought

15h40–16h20 Coffee Break

16h20–17h00 Parallel session - S01
- M. Rossi, Dynamical asymmetries for L4/L5 captures
- G. Tommei, On the predictability horizon in Impact Monitoring of NEOs
- N. Torii, Gap Structure Created by Satellite Embedded in Saturn’s Ring
- J. Li, An overview of the high-inclination resonant population in the Kuiper belt

16h20–17h00 Parallel session - PA02
- A. Courtot, Chaos in meteor showers: the example of Draconids, Leonids and Taurids
- Al. Petit, Challenges of the catalogue building and maintenance based on optical survey of the LEO region
- M. Romano, Network perspective to study the state of Earth’s orbital traffic
- M. Farhat, The Impact of Laplace Surface Dynamics on Debris Disc Architecture
- A. Dgokas, Secular evolution of debris in highly eccentric and inclined orbits
- A. Celletti, SIMPRO: a simulator of breakup events and propagation of orbits of space debris

WEDNESDAY 5

9h00–9h40 C. Gales, Dynamics modelling and stability analysis of satellites orbiting oblate bodies

9h40–10h00 Poster flash talks 1-20

10h00–11h00 Poster session & coffee break

11h00–11h40 K. Batygin, Towards a Uniﬁed Model of Planet Formation

11h40–12h20 D. Lay, Hot Jupiters and Super-Earths: Spin-Orbit Puzzles in Exoplanetary Systems

12h25–14h00 Lunch

14h00–14h40 E. Bolmont, A journey from planets to stars: improving tidal models in orbital evolution codes

14h40–14h50 A few words by Anne

14h50–15h50 Parallel session - S01
- C. Charalambous, Tidal effects in resonant chains of close-in planets
- A. Revol, Dynamical evolution and heat dissipation in the Trappist-1 system
• T. Ghosh, *Dynamical Instabilities and the Orbits of Kepler’s Multis*

**14h50–15h50 Parallel session - PA02**

• M. Yseboodt, *Mars rotational elements and their quadratic behavior*
• M. Saillenfest, *Oblique rings as a natural end state of migrating exomoons*
• X. J. Xi, *Analytical representation for the numerical ephemeris of Titan within short time spans*

**15h50–16h30 Coffee Break**

**16h30–17h30 Parallel session - S01**

• A. Leleu, *Recovery and characterisation of resonant terrestrial planets hidden in transit surveys*
• J. Korth, *Hot Jupiters and their nearby surroundings*
• Th. Baycroft, *The BEBOP search for circumbinary planets in radial velocity*

**20h00–22h00 Vera Rubin show - Le Delta**

**THURSDAY 6**

**9h00–9h40** G. Ba`u, *Alternative state representations for orbit prediction*

**9h40–10h00 Poster flash talks 21-36**

**10h00–11h00 Poster session & coffee break**

**11h00–12h20 Parallel session - S01**

• M. Efroimsky, *Pathways of Survival of Exomoons and Inner Exoplanets*
• N. Georgakarakos, *Dynamical habitable zones for circumbinary planets.*
• V. Christiaens, *A new directly imaged giant planet*
• Y. Suto, *Dynamics of a triple system comprising an inner binary black hole in a mutually inclined orbit.*

**11h00–12h20 Parallel session - PA02**

• S. Hadden, *Celestial Mechanics with the celmec code*
• J. Daquin, *Quantifying chaos with geometrical indicators*
• F. Gronchi, *Initial orbit determination from one position vector and a very short arc of optical observations*
• D. Hernandez, *Switching integrators reversibly in the astrophysical N-body problem*
12h20–14h00 Lunch

14h00–14h40 C. Dorn Planet cores store majority of planetary water budgets

14h40–15h40 Round table “Habitability”

  E. Bolmont, Habitable worlds and climate
  M. Gillon, Future detections of habitable worlds
  E. Javaux, From early Life to Habitability
  V. Debaille, Life and meteorites
  B. Hespeels, Rotifers in space

15h40–16h20 Coffee Break

16h20–17h00 A. Correia, New methods to study the tidal evolution of planetary systems

17h00–17h40 R.-M. Baland, The obliquity of Mercury: Models and interpretation

19h00–22h00 Gala dinner - Brasserie François

FRIDAY 7

9h00–9h40 J.-B. Delisle, Planetary systems in resonant chains

9h40–10h20 C. Petrovich, Long-term evolution of exoplanet systems

10h20–11h00 Coffee break

11h00–12h20 Parallel session - S01

  • F. Mogavero, Timescales of chaos in the inner Solar System: Lyapunov spectrum and quasi-integrals of motion
  • R. Mastroianni, The phase-space architecture in the secular 3D planetary three-body problem
  • N. Todorović, Encounter manifolds in the Solar System. Preliminary results
  • T. Hayashi, Lagrange stability of triple systems: disruption timescale distribution and its dependence on the orbital parameters

11h00–12h20 Parallel session - PA02

  • J. Rekier, Resonantly amplified tidal dissipation in the fluid layers of planets and moons
  • F. Zoppetti, Tidal orbital evolution of circumbinary planets
  • E. Valente, Excitation of the obliquity of Earth-like planets via tidal forcing
  • A. Coyette, Cassini States of Ganymede and Callisto

12h20–14h00 Lunch

14h00–14h40 A. Petit, Long-term stability of compact planetary systems
14h40–15h20 N. Rambaux, *Lunar reference system from science to MoonLight and LunaNet*

15h20–16h00 **Coffee Break**

16h00–16h40 M. H. Lee, *Dynamics of Circumstellar Planets in Binary Star Systems*

16h40–17h20 J. Laskar, *The AstroGeo project*

17h20–17h30 **Closing Remarks**
Invited talks

Baland  Rose-Marie  The obliquity of Mercury: Models and interpretation
Batygin  Konstantin  Towards a Unified Model of Planet Formation
Bau  Giulio  Alternative state representations for orbit prediction
Bolmont  Emeline  A journey from planets to stars: improving tidal models in orbital evolution codes
Correia  Alexandre  New methods to study the tidal evolution of planetary systems
Delisle  Jean-Baptiste  Planetary systems in resonant chains
Dorn  Caroline  Planet cores store majority of planetary water budgets
Fabrycky  Daniel  Resonant Chain Dynamics: Interpretation of Observations
Gales  Catalin  Dynamics modelling and stability analysis of satellites orbiting oblate bodies
Granvik  Mikael  Destruction mechanisms for near-Earth objects
Johansen  Anders  Forming planetary systems via pebble accretion
Lai  Dong  Hot Jupiters and Super-Earths: Spin-Orbit Puzzles in Exoplanetary Systems
Lee  Man Hoi  Dynamics of Circumstellar Planets in Binary Star Systems
Morbidelli  Alessandro  Interdisciplinarity: an effective approach to comprehending the formation of planetary systems
Petit  Antoine  Long-term stability of compact planetary systems
Petrovich  Cristobal  Long-term evolution of exoplanet systems
Rambaux  Nicolas  Lunar reference system from science to MoonLight and LunaNet
Rosengren  Aaron Jay  On the Multiscale Astrodynamics of Cislunar xGEO Space
Scheeres  Daniel  Binary Asteroids: A Pathway to Understanding the Morphological Evolution of Rubble Pile Asteroids

Sessions:

SMALL BODIES DYNAMICS
SPACE DEBRIS
ROTATION
FORMATION
RESONANCES
EXOPLANETS
LONG-TERM EVOLUTION & STABILITY
NUMERICAL METHODS
Scientific highlights of the meeting

The IAU Symposium IAUS-382 was entitled *Complex Planetary Systems II*, or shortly CPSII. It was the second edition, the first one being organized in Namur in July 2014 (IAUS-310). The subtitle chosen for this second edition was *Latest methods for an interdisciplinary approach*. The Kavli label was attributed to the symposium and contributed to reinforce and develop the (already present) interdisciplinarity of the topic.

By definition, complex systems are systems composed of interacting parts/agents whose local behavior, resulting from the interactions between them, cannot provide a complete understanding of the global behavior, i.e. when the system is considered as a whole, on a macroscopic scale. Several levels of description/modeling of the system should be considered at the same time. This forces complex systems to be studied by transdisciplinary teams, able to understand the whole construction and critically analyze the connections among the description levels. This vision is really efficient and challenging for space and astronomy sciences.

Indeed, the huge number of available observations (from ground and space) and their accurate precision, as well as the computational power and speed of our present-day computers have spectacularly changed the nature of the dynamical models, especially for planetary evolution studies. Planetology, celestial mechanics, cosmology, space geodesy have considerably evolved in that direction during the last decade, and have reinforced the need for crossing experiences and methods. Let us mention several examples: the concept of habitability of an extrasolar planet, the dynamical history of the Solar System and other planetary systems, the rotation of planets and satellites linked to their internal structure, the motion of natural satellites needing astrometry, tides and dissipations, the thermal effects on the evolution of the rotating small asteroids, the long term evolution of space debris and satellites, including drags, shadowing effects, collisional chain reactions. All these problems as well as many others were tackled at CPSII, showing how the formal historical border between analytical and numerical approaches has now disappeared.

The symposium was a real opportunity to show the power of interdisciplinary collaboration and was a unique occasion to gather astronomers of many disciplines together. While the global thematic remained the planetary systems as in the first edition, CPSII highlighted that first, the tools and the methods have considerably evolved, and second, the interdisciplinarity has touched more communities. Also the organization of the meeting was innovative, with a priority to young promising speakers, on interdisciplinary topics, two round tables on space awareness and habitability, poster flash talks with different prizes awarded to the best poster presentations. CPSII opened new doors and created collaborations, exchanges of ideas, combinations of techniques, sometimes unexpected, to solve complex planetary systems.

The symposium brought together 132 scientists, from 30 different countries, and proposed a challenging program, with 19 invited speakers, 57 talks and 33 posters. The scientific communities on the Solar system and the exoplanets, were particularly happy to meet again after the pandemic. It was a great success in terms of contacts, discussions and new projects.
The meeting was a success, with 140 (finally 132 present) participants, coming from 30 different countries. Several sponsors contributed to the success of the event: IAU and Kavli supports, FNRS and UNITER, UNamur, Fonds Jacques Cox pour les Générations Futures.

The programme included the following 8 sessions, namely
- Small bodies dynamics,
- Dynamics of space debris,
- Rotation of planets and satellites,
- Formation of planetary systems,
- Dynamics of resonances and observations,
- Exoplanets, climate and interiors,
- Long-term evolution and stability of planetary systems,
- Numerical methods.

One, two or three key speakers were invited for each session. The 19 key speakers were selected among the promising scientists of the different fields, with a special attention to recent and innovative research, as well as geographical and gender balance. They were all invited to give a talk of 30 minutes (followed by 10 minutes of questions) and to emphasize the interdisciplinary aspects of their results.

The KAVLI label was the opportunity to enlarge the scope of the symposium, with additional contributions of scientists from close fields, as geologists, biologists, geographers, applied mathematicians, observers, and engineers.

After a welcome message from the authorities of UNamur and the naXys Research institute (organizers), the opening session consisted in the conference of A. Morbidelli (Observatoire de la Côte d'Azur) entitled Interdisciplinarity: an effective approach to comprehending the formation of planetary systems. The topic was very representative of the spirit of the symposium: it is impossible to solve a real astronomical problem without considering its full complexity and interdisciplinary.

The SOC selected 57 talks with a duration of 15 minutes; the questions were numerous and very interesting, giving suggestions for future works or comparisons. The majority of the presentations consisted of very recent research works (published in the year or only submitted). The two long coffee breaks a day were the occasion for open discussions, comments, and questions, and this opportunity was greatly appreciated by the participants.

In the spirit of KAVLI, two round tables were proposed, one on Space awareness and the other one on Habitability, with contributors from UNamur scientists, Belgian university colleagues and astronomers, and representatives of the sponsors, all with totally different backgrounds. This innovative way of discussing a topic through different disciplines, was a nice opportunity to cross the boundaries, compare the points of view, and connect researchers with different expertise.
33 posters (proposed by 31 scientists) were exhibited the whole week; the researchers summarized their results during two flash talk sessions (one slide, one minute). Prizes for the best posters were awarded to four participants, two in the category *Space Awareness* and two in *Complex Planetary Systems*.

Several social events were proposed, well appreciated by the participants: the welcome reception on a boat tour (3/7), the Vera Rubin dance and theater show about the life of the astrophysicist Vera Rubin (5/7), the guided underground tour of the citadel of Namur, the visit of the UNamur observatory, and the gala dinner (6/7) during which the poster prizes were announced. An invitation to the welcome session and the two round tables was also sent to all the university members, while a Space quizz outreach activity was organized (in French) for the citizens of Namur (8/7).