Back Face to Face

Europlanet Science Congress (EPSC) 2022 in Granada, Spain

A Time for Optimism
A return to the Moon heralds exciting times for the planetary community

ALSO IN THIS ISSUE
• Amanar: A Refuge in the Stars
• The Effects of Climate Change on Ground-based Facilities
• Observing the DART Impact with the Travelling Telescope
The official magazine of Europlanet, the European community for planetary sciences

Since 2005, Europlanet has provided Europe’s planetary science community with a platform to exchange ideas and personnel, share research tools, data and facilities, define key science goals for the future, and engage stakeholders, policy makers and European citizens with planetary science. The Europlanet Society promotes the advancement of European planetary science and related fields for the benefit of the community and is open to individual and organisational members.

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At the end of another year, challenging times remain. The cost of living is putting strain on many in our community, and the world is still a very unsettling place.

Nonetheless, there are some reasons for optimism. The first Artemis mission has achieved a successful orbit of the Moon and returned safely to Earth. Investment by the European Space Agency means that our community can look forward to a wealth of science from missions to explore our Solar System.

This special issue of the Europlanet Magazine showcases the science and initiatives presented at the first in-person gathering of the planetary science community in Europe since the pandemic. The Europlanet Science Congress (EPSC) 2022 in Granada brought together nearly 1200 members of our community and was an opportunity to network and re-build personal connections.

Issue 4 of the Europlanet Magazine includes reports from Africa on observations of the DART impact and building links with the Sahrawi community. We hear about the potential effects of climate change on ground-based observational facilities. We also learn more about the people that will lead Europlanet through the next steps of its evolution.

Above all, we see how individuals can make a difference. Many thanks to everyone that is helping Europlanet continue to support the planetary science community.

Anita Heward
Editor

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Recent months have provided the first opportunities since the pandemic for the planetary community to meet face-to-face, as well as continued activities online.

The Europlanet Society’s New President Elect

Congratulations to Ann Carine Vandaele, whose election as the second President of the Europlanet Society was announced at the Europlanet General Assembly in Granada on 22 September. She will take up the role in September 2023 when the term of office of the inaugural President, Nigel Mason, comes to an end.

Ann Carine is Head of Planetary Atmospheres Research Unit at the Royal Belgian Institute for Space Aeronomy. She has been active in the Europlanet Society since its foundation in 2018, serving as Vice-President on the Executive Board and the Chair of the Benelux Regional Hub. Her scientific interests include the development of remote sensing instruments and radiative transfer modelling in planetary atmospheres, and she is involved in several space missions, such as Mars and Venus Express, ExoMars Trace Gas Orbiter (TGO), Juice, Ariel and EnVision.

Her primary motivations as President will be to promote collaboration and interaction between researchers, and to support diversity, inclusion and widening participation in the planetary community. In particular, she is committed to encouraging links between education, research and industry to increase the visibility and the impact of planetary science. She believes strongly that the Europlanet Society has a valuable role to play as an active interlocutor that can represent the planetary community in engaging with decision makers, like the European Space Agency or the European Commission.

Find out more about Ann Carine in this issue’s Planetary Perspectives interview (page 24).
Geology and Planetary Mapping
Winter School 2023

The third edition of the Geology and Planetary Mapping Winter School will be held online from 30 January - 3 February 2023. The Winter School is organised by the Geological Mapping (GMAP) activity of the EU-funded Europlanet 2024 Research Infrastructure (RI) project. The 2023 edition will be largely hands-on, with a programme that includes live seminars and time for asynchronous interaction and mapping work. Registration is free and the deadline for signing up is 10 January 2023. Videos and other resources from the 2020 and 2021 Winter Schools are now available online at the Winter School website: https://www.planetarymapping.eu

Workshop on Earth Observation Techniques and Data Analysis

A workshop on ‘Applications of Earth Observation Satellite Data’ took place in Addis Ababa, Ethiopia, from 13-16 December 2022, bringing together 34 space technology specialists, scientists and students to discuss current topics in this rapidly developing field. The workshop was the second in a series organised by Europlanet 2024 that aims to support the creation of an African network in planetary science.

The course provided both theoretical knowledge and practical skills in Earth Observation techniques and their applications in Geographical Information Systems (GIS). Students learned about Earth Observation missions, with a particular emphasis on the EU’s Copernicus programme. They were trained in using remote sensing imagery from satellites to derive qualitative and quantitative information about landscapes at urban, basin and regional scales. Students also developed practical skills in processing Earth Observation data and thematic map generation. A further 65 school students took part in a hands-on lab ‘Light up the Constellation’ organised by INAF. https://eventi.unibo.it/epn24-ethiopia-workshop
At the International Conference on Research Infrastructures (ICRI) at Brno in the Czech Republic, Europlanet was invited to present case studies of the impact of its Transnational Access programme and participate in a panel discussion. ICRI is a biannual event, organised jointly by the European Commission and the host country, that brings together about 500 delegates to discuss topics concerning research infrastructures at an international level. Europlanet also co-organised a side event on sustainability of distributed research infrastructures (page 39).

Apply for time on the Europlanet Telescope Network

The Europlanet Telescope Network has a rolling call for proposals for observations. Decisions are made within two months of submission. For further information on the Europlanet Telescope Network and how to apply, see: https://bit.ly/2Br5LDt

Fulvio Franchi (Botswana International University of Science & Technology) visited Atomki in Debrecen, Hungary, on an Expert Exchange visit in May 2022.

Third Call for Transnational Access

Over 100 applications have been submitted in the third Transnational Access Call of the Europlanet 2024 RI project. Transnational Access supports travel and accommodation costs for European and international researchers to visit over 40 planetary simulation facilities, analysis laboratories and analogue field sites in Europe and around the world. The successful applications will be announced in early 2023.

Research visit to planetary field analogue sites in Greenland.

Expert Exchange Programme

Europlanet 2024 RI’s Expert Exchange Programme aims to support the planetary community to share expertise and best practice, and to prepare new facilities and services. The programme provides funding for short visits of up to one week. The next deadline for applications is 31 December for visits to take place between 1 February and 31 July 2023. Read about an Expert Exchange visit in the feature on page 34.
Almost 1200 members of the international planetary community gathered in Granada, Spain, from 18-23 September for the Europlanet Science Congress (EPSC) 2022. The meeting, which was held jointly with the European Astrobiology Network Association (EANA), was the first in-person EPSC since 2019 and was one of the largest meetings on planetary science to take place in Europe to date.

The Europlanet 2024 RI project and EANA supported 209 bursaries at a value of €118,660, covering abstract and registration fees and providing travel grants for early career participants, researchers from under-represented countries, amateur astronomers and teachers.

The programme for EPSC2022 included 733 oral presentations and 420 posters, with over 100 scientific parallel sessions, community events, early career events and interactive workshops. Innovations for 2022 included thematic debates and discussions with journal editors, as well as elements successfully trialled during the virtual meetings in 2020-2021, such as keynote lectures, morning briefings and session recordings.

Community events included Agency Night, with representatives from ESA, ASTRONET and NASA, the European Strategy Forum on Research Infrastructures (ESFRI), and presentations on the US Decadal Strategy for Planetary Science and Astrobiology 2023-2032, and a multi-agency dialogue on ‘A New Decade of Venus Exploration’.

Beyond the conference centre, planetary science infused Granada, thanks to the support of the Local Organising Committee. Restaurants around the city centre offered tapas inspired by planetary objects as part of a ‘Gastro Tour of the Solar System’. An educational outreach programme, organised in collaboration with Lecturers Without Borders, involved 18 EPSC participants visiting 12 schools and reaching around 360 students in the local community (see page 46).

Europlanet thanks all the EPSC organising committees, conveners, session chairs and Copernicus for making EPSC2022 a memorable event. See EPSC2022 in pictures feature on page 20.

http://epsc2022.eu
News from EPSC2022

EPSC2022 was a treasure-trove of science that attracted the attention of journalists around the world. A press briefing on NASA’s Double Asteroid Redirection Test (DART) spacecraft highlighted the contributions by ESA’s upcoming Hera mission, the Italian LICIACube mission and ground-based campaigns to observations of the effects of DART’s impact with the asteroid, Dimorphos (see article on page 34). The first image and spectra of Mars from the NASA/ESA/CSA James Webb Space Telescope (JWST) were also presented at the meeting (see article on page 44).

Press briefing at EPSC2022 on JWST Mars observations.

Over the course of the meeting, the EPSC2022 press office issued news releases on a wide range of planetary science topics. Here is a round-up:

Star Light Simulator Illuminates the Search for Life Around the Milky Way’s Most Common Stars

Italian researchers have demonstrated experimentally, for the first time, that microorganisms can photosynthesise using the infrared-dominated light emitted by the most common type of star in the Milky Way. The Star Light Simulator can generate light intensities and spectra at different ranges to reproduce the light for any star. At EPSC2022, Nicoletta La Rocca (University of Padua) presented an experimental set-up that simulated the effect of light emitted by the smallest type of hydrogen-burning star, known as a red M-dwarf, on an artificial planetary environment. The results suggest that these stars could support oxygen-rich worlds inhabited by complex organisms.

Earth-like Exoplanets Unlikely To Be Another ‘Pale Blue Dot’

When searching for Earth-like worlds around other stars, instead of looking for the ‘pale blue dot’ described by Carl Sagan, new research suggests that a hunt for dry, cold ‘pale yellow dots’ might have a better chance of success. The near balance of land-to-water that has helped life flourish on Earth could be highly unusual, according to a study by Tilman Spohn and Dennis Höning presented at EPSC2022. By modelling how the evolution and cycles of continents and water could shape the development of terrestrial exoplanets, the researchers demonstrated that planets have approximately an 80 percent probability of being mostly covered by land, with 20 percent likely to be mainly oceanic worlds. Barely one percent of the outcomes had an Earth-like distribution of land and water.


First 3D Renders From JunoCam Data Reveal “Frosted Cupcake” Clouds On Jupiter

An animation of the relative heights of the cloud tops of Jupiter reveals delicately textured swirls and peaks that resemble the frosting on top of a cupcake. The animation used data derived from JunoCam, a visible-light camera onboard NASA’s Juno spacecraft, which has been orbiting Jupiter since 2016. The results were presented at EPSC2022 by Gerald Eichstädt, a professional mathematician and software developer, who is part of a worldwide team of citizen scientists that work on JunoCam data in collaboration with professional astronomers and the Juno mission team.


Still from the animation of the relative heights of the cloud tops of Jupiter observed by JunoCam.
Planetary-scale ‘heat wave’ discovered in Jupiter’s atmosphere

An unexpected ‘heat wave’ of 700 degrees Celsius has been detected in Jupiter’s atmosphere. The feature was presented at EPSC2022 by James O’Donoghue (JAXA). It occurred just below the northern aurora, extending 130,000 kilometres and travelling towards the equator at a speed of thousands of kilometres per hour.

Just like Earth, Jupiter experiences auroral light-shows around its poles as an effect of the solar wind. However, while Earth’s auroras are transient and only occur when solar activity is intense, auroras at Jupiter are permanent and have a variable intensity. These powerful auroras can heat the region around the poles, and winds can redistribute the heat globally around Jupiter. The heat wave was most likely triggered by a pulse of enhanced solar wind plasma impacting Jupiter’s magnetic field, which boosted auroral heating and forced hot gases to expand and spill out towards the equator.


EXPLORE Data Challenge 2022 Winners

The 2022 EXPLORE Lunar Data Challenges, launched at EPSC2022, invited lunar enthusiasts of all ages to identify hazards on the Moon’s surface and plot a safe journey for a rover across the lunar surface. The winners are: Isabella Claire Adriani, Lewis Lovell and Freya Thoresen (Machine Learning Challenge) and Shantibala Singha, Serge Paupy and students from Lycée Français International Molière, Karol Sawick, Stavros Sklavenitis and Julia Krzyzaniak (Public Challenge).

https://exploredatachallenges.space
Four-legged Jumping Robots LEAP to Explore the Moon

Patrick Bambach (Max Planck Institute for Solar System Research) showed how a four-legged robot, trained through artificial intelligence, has learned the same lesson as the Apollo astronauts – that jumping can be the best way to move around on the surface of the Moon.

LEAP (Legged Exploration of the Aristarchus Plateau) is a mission concept by a consortium from ETH Zurich, the Max Planck Institute for Solar System Research, OHB, the University of Münster, and the Open University, which aims to explore some of the most challenging lunar terrains. The LEAP team is working towards the robot being integrated on ESA’s Argonaut European Large Logistic Lander, which is scheduled to land on the Moon multiple times from the late 2020s to the early 2030s.


ExoClock Counts Down Ariel Exoplanet Targets

Details of the orbits of 450 exoplanets, all potential observation targets for ESA’s Ariel space mission, were presented at EPSC2022 by the ExoClock project team. A paper summarising the results, co-authored by 217 researchers, amateur astronomers, university students and high school pupils, has been submitted for publication in the Astrophysical Journal Supplement Series.

Ariel will study a population of more than 1000 exoplanets to characterise their atmospheres. Participants in the ExoClock project submit measurements known as ‘light curves’, which show the drop in intensity as an exoplanet ‘transits’ or passes in front of its host star and blocks some of the light. When Ariel launches in 2029, it will need to have precise knowledge of the expected transit time of each exoplanet that it observes, in order to maximise the mission’s efficiency and impact. The ExoClock results demonstrate that observations by amateur astronomers using their own telescopes can contribute to real science and have a high impact for a mission.

https://arxiv.org/abs/2209.09673
**First Probable Impact Crater Discovered in Spain**

A probable impact crater has been discovered in the province of Almeria in southern Spain. While around 200 impact structures have been identified around the world, this is the first time that signs of a crater have been found on the Iberian Peninsula. The study, presented at EPSC2022 by Juan Antonio Sánchez Garrido (University of Almeria), is the result of 15 years of research by an international team of scientists from the University of Almeria, the Astrobiology Center of Madrid, the University of Lund and the University of Copenhagen. The impact event, which probably occurred around 8 million years ago, formed a crater about 4 kilometres in diameter, and is surrounded by a larger structure about 20 kilometres across where the impact caused the sedimentary strata to collapse.


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**Big planets get a head start in pancake-thin nurseries**

Super-thin planet nurseries have a boosted chance of forming big planets, according to a study presented by Marion Villenave (NASA-JPL) at EPSC2022. High resolution images of a remarkably thin disc of dust and gas around a young star showed that its structure accelerated the process of grains clumping together to form planets. Further studies of thin discs might help provide more insights into the dominant mechanisms for how wide-orbit planets form, a field of research where there are still many open questions.

Virtual Hiking Map for Jezero Crater, the Mars 2020 Perseverance Rover Landing Site

Prospective Mars explorers can now take a hike around the landing site of NASA’s Mars 2020 Perseverance rover with an interactive map. The map, presented at EPSC2022 by Sebastian Walter (Freie Universität Berlin), can be accessed through a normal web browser and is loaded with orbital imagery and terrain data, as well as synthetic and real 3D panoramic views of Jezero crater and its surrounding area.

https://maps.planet.fu-berlin.de/jezero

Farinella Prize 2022

Julie Castillo-Rogez, a planetary scientist working at NASA’s Jet Propulsion Laboratory (JPL) in California (USA), and Martin Jutzi, a physicist working at the Physics Institute of the University of Bern (Switzerland), have been awarded jointly the 2022 Paolo Farinella Prize for their outstanding contributions to the field of ‘Asteroids: Physics, Dynamics, Modelling and Observations’.

Dr Castillo-Rogez has made significant contributions to the understanding of the physical and chemical evolutions of small and mid-sized Solar System bodies. Her work was critical to the success of the Dawn mission at the dwarf planet Ceres.

Dr Jutzi has played an important role in the study of collisional processes involving bodies ranging from asteroid-sized to planetary scale. In particular, he developed a state-of-the-art Smoothed Particle Hydrodynamic (SPH) code especially suited to studying how collisions occur among small bodies.

The annual prize was established in 2010 to honour the memory of the Italian scientist Paolo Farinella (1953-2000). The winners received their awards during EPSC and gave 20-minute prize lectures.

The 2022 Europlanet Prize for Public Engagement has been awarded to Kosmas Gazeas and the team behind the ‘Planets In Your Hand’ tactile exhibition.

‘Planets In Your Hand’ is an interactive set of models of planetary surfaces. Constructed in portable square frames, the exhibition gives a multisensory impression of the wide variety of surface characteristics and environmental properties of the planets in our Solar System.

Although suitable for people of all ages, the models have been specifically designed for visually impaired audiences. Since 2017, ‘Planets in Your Hand’ has travelled to schools, universities and private institutes and organisations, reaching thousands of visitors to date.

The award was presented during EPSC2022 in Granada (on behalf of the team) to Dimitrios Athanasopoulos, who gave a 20-minute prize lecture. The team has also received a cash award of €1500. https://bit.ly/EuroplanetPrize2022
The Europlanet Early Career (EPEC) network organised a ‘bouquet’ of activities for early careers at EPSC2022, including contests, short courses and social events.

Science Flash 2022

Science Flash was back as an in-person event at EPSC2022. Early career researchers were challenged to give a three-minute presentation featuring three non-text images plus any supporting material to quickly introduce a scientific topic in a creative and engaging way. First prize and a free registration for an upcoming EPSC went to Alessandro Pisello, with Johannes Brötzner as runner up and Noah Molinski in third place receiving Science Flash mugs.

#PlanetaryScience4All
EPEC-EPSC Video Contest 2022

Cai Stoddard-Jones, a first year PhD student at Cardiff University, has won the 2022 edition of the #PlanetaryScience4All EPEC-EPSC Video Contest, which challenges early career researchers to showcase their work in a four-minute film. Cai’s winning film presents Comet 29P and the Comet Chasers project. The unusual activity of Comet 29P is still poorly understood despite being the most observed comet to date. The Comet Chasers project in Wales supports school children to learn about cometary science and take their own images of comets for use by researchers.


Outstanding Poster Competition at EPSC2022

The Outstanding Poster Competition at EPSC2022 attracted 64 entries, and 44 conference participants took time out of their schedules to act as the contest judges. Six winners were selected, who each received a certificate and the option of a free registration for either the DPS-EPSC Joint Meeting 2023 in San Antonio, USA, or EPSC2024 in Helsinki, Finland. The winners are Amy Dugdale (Impact generated modification of the mineralogy at Oxia Planum), Lucy Wright (Stratospheric HCN and Evolution of a Mixing Barrier in Titan’s Equatorial Region from Low-Resolution Cassini/CIRS Spectra), Nikolaj Dahmen (A Deep Catalogue of Marsquakes), Amy Tuson (A Search for Long-Period Transiting Exoplanets with TESS and CHEOPS), Ana de Dios Cubillas (Abiotic clathrite synthesis from CO2-clathrate under ocean world conditions) and Cem Berk Senel (Hypervelocity impact simulations of DART on asteroid Dimorphos: Impact-generated porosity and gravity anomalies).

Save the date

ERIM 2023

The first Europlanet Research Infrastructure Meeting (ERIM) will take place from 19-23 June 2023 in hybrid format at the Hotel Sorea, Bratislava, Slovakia, and online.

ERIM 2023 will bring together a range of planetary science and Europlanet community workshops, including interactive sessions on geological mapping, planetary space weather, the VESPA planetary virtual observatory, the Europlanet Telescope Network, industry engagement, and innovations in outreach tools. The Europlanet Early Career (EPEC) Annual Week will be co-hosted with ERIM 2023, along with Europlanet Society meetings of the Regional Hubs and the Europlanet General Assembly.


The Hotel Sorea Regia in Bratislava will be the venue for ERIM 2023.

Career (EPEC) Annual Week will be co-hosted with ERIM 2023, along with Europlanet Society meetings of the Regional Hubs and the Europlanet General Assembly.


 Northern Europe Hub

Harri Haukka.

Incoming Chair of Northern Europe Regional Hub

Harri Haukka is Development Manager in the Space Research and Observation Technologies Unit at the Finnish Meteorological Institute (FMI). He has worked on space projects and missions as a systems engineer and project manager, including the development of humidity and pressure instruments for NASA’s Curiosity and Perseverance missions and ESA’s ExoMars Rosalind Franklin rover.

He has been involved in networking activities of Europlanet research infrastructure programmes since 2015, served in various roles on the EPSC Committee, including Co-Chair, and has acted as Industry and Policy Officer for the Northern Europe Regional Hub since 2019.

He now follows Jon Merrison as Hub Chair.


Save the date

DPS-EPSC Joint Meeting 2023

The Europlanet Science Congress (EPSC) 2023 will take place as a joint meeting with the American Astronomical Society’s Division of Planetary Sciences (DPS) at the San Antonio Marriott Rivercenter, San Antonio, Texas, USA, from 1-6 October 2023.

EPSC-DPS Joint Meeting 2025 and EPSC2026

The call for the venues for EPSC-DPS Joint Meeting 2025 and EPSC2026 will open in January 2023. Submissions from prospective Local Organising Committees in Europe are welcomed. Priority will be given to locations that have not hosted EPSC before, especially in central, east and south-east Europe. Find out more.

We are looking for volunteers to take on other roles in the Regional Hubs and Committees. Find out more:
Wiki-Edit-a-Thon

The third EPSC Planetary Science Wiki-Edit-a-Thon kicked off with a training session ahead of the Icebreaker event on Sunday 18 September and continued throughout the week of EPSC2022 in a dedicated booth in the exhibition hall. The Keynote Diversity Lecture, ‘Let’s talk about women astronomers and ‘Wikipedia’, was delivered by Mentxu Ramilo Araujo, a member of Wikimujeres and Wikimedia España, and highlighted some inspiring efforts to create a diverse and egalitarian Wikipedia in which women are not part of a minority. New results from the Wiki-Edit-a-Thon include over 70 biographies translated by WikiEmakumeak into Basque. Other participants contributed four new translations into Italian, two into German and six new articles in Azerbaijani.


The Moons Symphony

The Moons Symphony is an orchestral and choral work inspired by moons in our Solar System that has been created by the award-winning Australian composer, Amanda Lee Falkenberg. Earlier this year, the world premiere of The Moons Symphony was recorded by the London Symphony Orchestra, conducted by Marin Alsop, with the London Voices Choir conducted by Ben Parry. The recording has now been released by Signum Classics, featuring the seven-movement work, as well as ‘Clair de Lune’ by Claude Debussy, performed by Amanda on piano, and her poem, ‘Reflections on Symphonic Space Flight’, read by the NASA astronaut, Nicole Stott.

Attendees of the EPSC-DPS Joint Meeting 2019 in Geneva may remember that Amanda previewed some of the movements during the conference and spoke about her research and incorporation of planetary concepts into the musical structure.

https://www.moons-symphony.com/

Central Europe

Conference on Variable Star Research

The 54th Variable Star Research Meeting took place on 25-27 November 2022 in hybrid format online and hosted by the Planetarium Ostrava in the Czech Republic. The meeting, which was organised by the Variable Stars and Exoplanet Section of the Czech Astronomical Society (VSES CAS), attracted 85 participants and included presentations on DART and exoplanet missions. High school and university students were also invited to present their work. Recordings of the talks have been uploaded to the YouTube channel of VSES CAS, with presentation files accessible on the meeting website. Papers from the meeting will be published in Open European Journal on Variable Stars.


EANA Election

The European Astrobiology Network Association (EANA) has elected its new Executive Board. The incoming President is Jean-Pierre de Vera, with Rosa De La Torre Noetzel and Lena Noack as Vice Presidents, Ruth-Sophie Taubner and Séverine Robert as Secretaries, Frédéric Foucher as Treasurer, and Silvana Pinna as the early career AbGradE representative.

http://www.eana-net.eu
"Journey to the Planets", the winning proposal of this year’s Europlanet Funding Scheme for Public Engagement, aims to inspire children’s curiosity about space and planetary sciences through play and puppet theatre.

Conceived and developed by a team led by Katia Pinheiro, the project is producing a series of short planetary-themed movies. The stories are told by puppets in ‘Bimbim’s team’, a group of animals led by Bimbim the dog. The scientific content of the videos will be supplemented with illustrations and animations about planets in the Solar System, with a particular focus on Earth and Mars.

‘Journey to the Planets’ brings researchers from Germany, Macedonia, India, Argentina and the UK together with a producer and theatre companies from Brazil. The videos will be translated into several languages (initially Portuguese, English and French) to reach out to audiences around the world.


The Bimbim’s Gang puppets.

Visuals from the story "Journey to the centre of the Earth".

Katia and the real Bimbim.
Back Face to Face

For the first time in three years, the planetary science community had the opportunity to meet face-to-face at the Europlanet Science Congress (EPSC) 2022 in Granada, Spain. Thibaut Roger (Europlanet/Universität Bern/NCCR PlanetS) and Vix Southgate (Europlanet/Vixen Design) present a selection of EPSC2022 images.
Main picture: Exhibition hall of EPSC2022. Left: Entrance to the Palacio de Congresos de Granada. Right: For the first time, EPSC was held jointly with the European Astrobiology Network Association (EANA).
Niamh Shaw hosts the first morning briefing with Luisa Lara (Local Organising Committee Chair), Lena Noack (EPSC Chair), Stavro Ivanovski (Scientific Organising Committee Co-Chair) and Akos Kereszturi (Scientific Organising Committee Co-Chair).

Above: Over 1100 presentations were given as posters (left) or in parallel scientific sessions (right).

Far left: Solmaz Adeli gives the keynote lecture for the Terrestrial Planets programme group.

Left: Mayor of Granada, Francisco Cuenca Rodríguez, visits the EPSC2022 exhibition.

Above: Ines Belgacem (EPEC Co-Chair) gives an overview of short courses and activities organised for early careers during EPSC2022.

Above: Over 1100 presentations were given as posters (left) or in parallel scientific sessions (right).
Above: Agency Night was an opportunity for EPSC participants to interact with representatives of strategic organisations, Colin Vincent (ASTRONET), Nigel Mason (Europlanet), Kristiaan Temst (ESFR), Robin Canup (Co-Chair, Decadal Strategy for Planetary Science and Astrobiology) and Nicole Buckley (ESA).

Above right: The Copernicus team and conference assistants ensured EPSC2022 ran smoothly throughout the week.

Right: The conference dinner was held in the palace of Carmen de los Mártires.

Above: Members of the Europlanet Society gathered for the General Assembly.

Above: All the 50+ institutions participating in the Europlanet 2024 Research Infrastructure (RI) project were represented in the Council meeting at EPSC2022.
Ann Carine Vandaele is Head of the Planetary Atmospheres Group at the Royal Belgian Institute for Space Aeronomy (IASB-BIRA). She was announced as the President-Elect of the Europlanet Society during EPSC2022 in Granada and will take over as the second President of the Europlanet Society in September 2023.
You started as an Earth atmosphere and climate scientist. How did you get into planetary science?

I studied engineering, taking a physics option. I wanted my Master’s thesis to be related to Earth’s atmosphere, so I developed an instrument to detect pollution-related trace gases in cities. I continued to work on the instrument during my PhD thesis, soon realising that if you want an instrument to perform well, you also need accurate laboratory reference data. So, I spent the next 10 years in the lab characterising atmospheric species by measuring spectral line parameters and cross-sections (the ability of molecules to absorb photons). In parallel, I was involved in the analysis of data obtained from Earth observation satellites and ground-based stations. I work at the Royal Belgian Institute for Space Aeronomy (IASB-BIRA), which was involved in the Mars Express and Venus Express missions by the European Space Agency (ESA). IASB-BIRA designed and built the SOIR infrared spectrometer which was one of the channels of the SPICAV instrument onboard Venus Express. SOIR was a brand-new design never used in space before. Because it had to be developed very rapidly, it could not be tested before launch. When the spacecraft arrived at Venus in 2006, our engineers were therefore quite surprised when it woke up and proved to be working perfectly!

Up to that point, no scientists had been involved in the development of SOIR, as it was merely a technology concept demonstration. One of our department heads started looking for scientists who would be interested in the instrument and Venus exploration and, apparently, I was the first to respond! I had all the tools and knowledge I’d learned from the lab and my involvement in Earth observation instruments, so the transition to Venus was easy.

Venus is a captivating planet with a complex atmosphere that challenges me both as an engineer and a scientist. Our instrument proved to be quite exceptional and we proposed an improved version – NOMAD – for the ESA ExoMars Trace Gas Orbiter (TGO) mission. This is still orbiting the Red Planet and gathering incredible information on its atmosphere and surface. We are now designing a new high-resolution infrared spectrometer, VenSpec-H, for the ESA mission EnVision, which will go back to Venus.

What would you most like to achieve as President of the Europlanet Society?

The coming years will be challenging for the Society and we need to ensure its sustainability. We must convince our members of the usefulness of being part of a Society that can represent them and lobby for their interests. We need to increase the number of members and open up the Society to corporate or institutional memberships. Alongside this, we need to ensure we are building a diverse Society, which represents the whole planetary community in its multitude of nations and their cultural difference of languages, of origins, etc, and an inclusive society that is open to everyone interested in planetary science. It is essential for the Society to be supportive of all under-represented communities,
including those excluded because of their socio-economic situation.

A sustainable Society is also a Society that can count on its members and their determination to work for their community. This can be done at a local level by supporting the Regional Hubs, by proposing activities that address the Society’s objectives and promote planetary sciences, and by engaging with the public or with policymakers. The range of possibilities is tremendous, but without members willing to engage, the Society will not be able to achieve great things.

Can you tell us a little about the new Europlanet Association that will be hosted by your institute?

If the Europlanet Society wants to be a game-changer, it needs to be visible to policymakers and people making decisions. It, therefore, needs to be involved in projects – in particular in projects funded through the European Commission. This is only possible if the Society becomes a legal entity that can participate in projects as a named partner. One of the ways to get there is for the Society to become an AISBL (Association Internationale Sans But Lucratif), which is an international non-profit association. It will be associated under Belgian law and will be hosted at IASB-BIRA, which is giving its full support to the Europlanet Society: we are one of the few institutional members and we already host several key members of the Benelux Regional Hub, as well as the current Treasurer and Vice-President/President-Elect of the Society. The structure of the AISBL follows exactly that of the Europlanet Society: the Executive Board members, including the President, Vice-Presidents, Secretary, and Treasurer are the same. Their mandates are of four years and members will change following the results of the election carried out within the Europlanet Society.

What steps could the planetary community take to support diversity and widen participation from under-represented groups?

I have already expressed my wish for the Europlanet Society to be as diverse as possible and open to all under-represented groups. How to do this is not straightforward or easy. First of all, we should all work on our own preconceptions and unconscious biases. We need to make sure that nobody gets excluded or marginalised because of their origin, belief or gender, make sure that all groups get represented in conferences, as conveners, session chairs, or invited speakers, and make sure that during open discussions, we give the floor to all. We should organise meetings so that everyone, including scientists with disabilities, can access all the content and all the physical spaces. The Europlanet Society’s Diversity Committee proposes activities to promote equality and integrity, checking the way Europlanet activities are organised to ensure diversity. This is very important for me.

It is also crucial to engage with students and early careers, sharing experiences and ways forward. Europlanet has already implemented a mentoring program, which is a great initiative to foster discussions between early career and established scientists. Europlanet is also supporting students in planetary science, through bursaries to attend conferences, and scientists from under-represented European countries, through reduced memberships. These are only some examples of what Europlanet is doing, and these kinds of activities should be encouraged further.

EPSC2022 was the first Europlanet in-person meeting since the pandemic, what was your favourite moment?

It was definitely the first few hours during which I met colleagues I had not seen for years and found out what had happened since the last time we met. I enjoyed discussions over a drink and some tapas, meeting students in person for the first time, and talking about collaborations, new ideas, or future projects during the coffee breaks.

If you could talk to a younger self at the beginning of your studies or career, what would you say to yourself?

This is not really original, but I would say: ‘Believe in yourself, make your own choices and decisions. Always respect your own personality, you have the right to be different.’ When I was about to graduate, I met a person who told me exactly that. I was attending a careers fair, trying to find a job in industry, as I was an engineer and that’s what was expected of me! This person helped me understand that it was not what I really wanted to do. What I truly wanted was to be in a lab, making experiments and devising theories to better understand the world in which I lived. I knew this, but sometimes you need someone to spell it out for you.

Ann Carine with the NOMAD instrument on the ExoMars TGO spacecraft (at the top left) in the Thales clean room.
The Sahrawi population has lived in refugee camps located in the driest part of the Sahara desert since 1975. There, they have limited access to basic resources and experience urgent humanitarian needs. Growing up in this environment, young people face a life with no future prospects, with a high rate of absenteeism in classrooms and rising unemployment.

GalileoMobile is a volunteer astronomy outreach initiative that originated during the UN International Year of Astronomy 2009. Since its foundation, GalileoMobile has organised actions in 15 countries, sharing astronomy with more than 20,000 people. The scope of the programme has included activities with under-represented groups, such as indigenous people in Brazil and communities in territories in conflict, like the separated Greek and Turkish Cypriot populations in Cyprus. GalileoMobile established the Amanar project to inspire young Sahrawis through astronomy, as well as increase their interest in science. The project seeks to facilitate the development of scientific skills, such as critical thinking, through practical activities and sky observations. In

Amanar: A Refuge in the Stars

Felipe Carrelli, Jorge Rivero González, Andrea Rodríguez Antón, Nayra Rodríguez Eugenio and Diego Torres Machado on behalf of GalileoMobile and the Amanar Task Force explain how the ‘Amanar: Under the Same Sky’ project is using astronomy to support Sahrawi refugee communities through skills development and self-empowerment activities.
addition, the programme promotes workshops for teachers to encourage them to use astronomy as a tool for teaching and learning, and contributes to improving the quality of education.

The Foundations of Amanar

The Amanar project was established in 2019 with activities both in the Canary Islands (Spain) and in refugee camps near Tindouf (Algeria). The project started as a collaboration between GalileoMobile, the Instituto de Astrofísica de Canarias (IAC), the Asociación Canaria de Amistad con el Pueblo Saharaui (ACAPS), and the International Astronomical Union (IAU), through its Office for Astronomy for Development (OAD) and its centenary celebrations.

For the past 30 years, the ‘Holidays in Peace’ programme has made it possible for thousands of Sahrawi children from the Tindouf camps to be temporarily hosted by Spanish families during the hardest months of the summer. During the summer of 2019, we organised hands-on astronomy activities and visits to professional observatories in the Canary Islands for the Sahrawi children and hosts participating in the programme. In October 2019, Amanar organised educational activities and teacher-training at the Sahrawi refugee camps and donated kits of educational material. An ethnographic study on the Sahrawi traditional knowledge of the sky was also conducted. In total, 635 children, 66 teachers, and 150 people from the general public participated in the project activities.
Follow-up Activities in Pandemic Times

Thanks to grants from the IAU OAD and the Europlanet Public Engagement Funding Scheme, we were able to ensure the sustainability of activities to support the Sahrawi communities beyond 2019. However, the Covid-19 pandemic forced us to modify our plans, as we were prevented from organising the summer programme in 2020 and 2021. The return of activities in the camps was also postponed due to travel restrictions.

Nonetheless, the project was able to continue support to the Sahrawi community in alternative ways. For instance, we initiated a training programme with the Sahrawi teachers we worked with in 2019. The programme was developed through WhatsApp, which works efficiently, even with a poor internet connection, and teachers can easily use it through their mobile phones.

Other important actions included supporting a Sahrawi research group, with whom we started a study on ethnoastronomy and the development of ‘transmedia narratives’.

Ethnoastronomy

One essential goal of GalileoMobile is to learn about the context and culture we are working with. Together with educational activities, Amanar is involved in ethnoastronomical research for the preservation of the Sahrawi astronomical knowledge. During the visit to the refugee camps in 2019, we interviewed various people who lived in the desert before the Moroccan occupation in the 1970s, as well as their relatives. In particular, we were able to meet the descendants of a cultural icon for the Sahrawis, Chej Mohammed el Mami, who established the foundations of Western Saharan society in the nineteenth century. These conversations were an initiation to a long-standing tradition of careful observation of the sky for various purposes. The semi-nomadic Sahrawis needed to have a firm grasp on the position of particular celestial bodies to orientate both in the territory and time, but the cosmos was also a place inhabited.
by mythological figures and was the stage for different stories.

In 2021, in the framework of Amanar follow-up activities, we awarded five grants to Sahrawi researchers in the camps. Over the course of the next year they made a tremendous effort to carry out interviews with various elders who lived in the desert before their forced exile, and transcribed all the information collected. The physical and technical conditions were precarious because, even though we could finance the acquisition of some basic audiovisual and computer equipment, the electrical and internet connectivity was unstable and sometimes non-existent. However, we adapted to the conditions. At least every month, we met with the researchers via WhatsApp video calls to discuss the evolution of the research, their needs and also to provide training in computer and astronomical skills.

Since the Sahrawis consider astronomy a key element of their cultural identity, we believe it is very important to try to continue collaborations and preserve this ancestral knowledge, which we have already incorporated into the Amanar outreach activities.

Exploring Transmedia Narratives

An important outcome of the Amanar Project is the development of the Desert Stars Transmedia Narrative. During the interviews with the Sahrawi star experts, we recorded conversations through film, audio, photographs and 360-degree immersive videos. Our objective was to create a record of the oral memory of the Saharawi people and also to disseminate their astronomical knowledge. In reaching diverse audiences, regardless of their level of access to technology, we aimed to approach scientific knowledge from a decolonial perspective.

We adopted a co-creation process in order to listen to what the interviewees had to say about our goal. From these interactions, other demands and themes emerged. This, in turn, led us to adopt a ‘transmedia’ strategy, a concept based on the creation and dissemination of different - albeit related - content on different platforms that is built around the relationship and engagement with the public.

Our Transmedia Narrative was composed of six different products: Desert Stars VR (a virtual reality documentary), Desert Stars 360º (a 360º documentary), Searching for Stars (an interactive docugame), A Refuge in the Stars (a feature-length film), GalileoCast (a podcast series) and Irifi (an art gallery installation). Each piece explores a complementary approach and user experience, based on the specific media and platform.

So far, there have been very positive responses from the public regarding the products. Irifi was part of the ‘Ocupação Refúgio’ show in Sesc Quitandinha, Petropolis, Brazil, between 8 October 2021 and 30
January 2022, and the installation was visited by 137,670 people. Desert Stars 360º was exhibited at the ‘ArtSpaceShip’ on the Ukrainian platform V-Art and at the ‘Crystals of Time - CoMciência Exhibition’, organised by the Museum of Mines and Metal in Belo Horizonte, Brazil. Desert Stars 360º was also selected by The Science Film Festival 2021 and exhibited at the Bibliotheca Alexandrina Planetarium Science Center, in Alexandria, Egypt.

2022 Summer Activities
In summer 2022, as the pandemic restrictions were lifted, the ‘Holidays in Peace’ programme resumed, along with Amanar’s summer programme. This year, we expanded our activities to Tenerife, Madrid, Granada, Valencia and A Coruña. This was possible thanks to collaborations with the Instituto de Astrofísica de Canarias (IAC) in Tenerife, the European Space Agency’s CESAR education facility in Madrid, the Instituto de Astrofísica de Andalucía in Granada, the Observatorio de Valencia and the Agrupación Astronomía Coruñesa Io in A Coruña, as well as Sahrawi organisations, which organised the local activities.

A total of 100 Sahrawi children and around 50 members of the host families participated in visits to science centres and observatories. The children experienced the excitement of the Universe through hands-on activities about the Solar System, stars and exoplanets, as well as telescope observations.

Future Actions
The Amanar project is committed to continuing its support of Sahrawi refugee communities. The summer programme has been reinforced by establishing collaborations with the participating astronomical institutions. In 2023 we expect to add new cities in Spain and also begin summer activities in Italy. At the moment, the project is starting discussions for a new visit to the refugee camps near Tindouf. This will help to cement the relationship we have established, with the Sahrawi communities in the camps as well as during our follow-up remote activities in the past years, and finally reaffirm our support to the Sahrawi cause.

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While climate change is nowadays an accepted reality, its impact on astronomical observations has been poorly studied due to a lack of suitable tools. Large ground-based observatories are high-cost projects so observing time lost due to unfavourable weather or climate conditions needs to be minimised, while the high quality of the acquired data must also be guaranteed. This means sites should be selected to have low cloud coverage, low humidity, low precipitable water vapour and good astronomical ‘seeing’ for observations in the visible and infrared.

Unfortunately, the local site conditions are not the only elements to be considered when selecting the site of new telescopes. Indeed, historical and political factors, such as pre-existing infrastructure or cultural environments, play an important role too. Moreover, the timescale for site selection is usually too short to account for long-term changes in observing conditions, such as those arising from anthropogenic climate change, and the process is costly and thus limited in number and time.

As an example, the Thirty Meter Telescope (TMT) site selection started with a large set of candidates, out of which five were pre-selected to get a full climate study for up to five years. This is only a fraction of the lifespan of an observatory, and not enough to identify long-term trends due to climate change at a site. The timescale between the start of the selection process for the TMT and its estimated first-light spans three decades, to which its subsequent years in operation must be added, and famous observatories, such as La Silla in Chile or Teide in Tenerife, have been running for over fifty years and keep receiving new instruments and telescopes.

Together with Prof Brice-Olivier Demory and an interdisciplinary team of astronomers and climate scientists, we initiated a project to study how various atmospheric conditions are expected to evolve due to climate change for eight major astronomical observing sites: Mauna Kea, Cerro Paranal, La Silla, Cerro Tololo, La Palma, Sutherland, Siding Spring and San Pedro Mártir. The code used to perform the study has been published as open-source in order to allow future studies of additional observing sites. Such an extensive and detailed study on multiple observing sites has only been possible due to the advent of climate models that are able to simulate atmospheric conditions with a high degree of accuracy.

Above: The Very Large Telescope (VLT) at Cerro Paranal in the Atacama Desert of Chile.

Right: Map showing the observing sites included in the study.

Understanding the Past to Forecast the Future

Caroline Haslebacher (University of Bern/NCCR PlanetS) and her team look into how climate change will affect ground-based observations.
been made possible by the advent of climate models with a high-enough resolution to investigate specific sites. The starting point for our team was to acquire as much in-situ weather data as possible for each observatory. The next step was to assess how well the climate models represent the current site conditions, as depicted by the in-situ data. First, we used a service called ERA5 from the European Centre for Medium-Range Weather Forecasts,¹ which exploits physical models to reanalyse archived observational data and produce a homogeneous dataset. Second, we used global climate models (GCM) provided by PRIMAVERA,² a project funded by the European Union (EU) Horizon 2020 programme, which simulate climate evolution from 1950 to 2050.³ PRIMAVERA provides six different GCMs, at the highest horizontal resolution (18-50 kilometres) available to date, which we averaged to produce one output. By comparing the PRIMAVERA results for the ‘historic’ period from 1950-2014 with the ERA5 reanalysis, our team could assess how well the PRIMAVERA, ERA5 and in-situ data agreed with each other. Once this was evaluated, we were able to project climate evolution for each observatory, assuming the worst-case scenario regarding greenhouse gas emissions.

A Mixed Picture
The projected impact of climate change on astronomical observations is not black and white. Results of the simulations suggest worsening observing conditions, although some aspects could potentially improve.

Out of several atmospheric parameters tracked and studied by the team, three display clear trends in their projected evolution. First, the total amount of water vapour in the air column above the observatory is likely to increase, resulting in a higher atmospheric absorption of light and a lower observation quality. Second, the temperatures are also likely to increase, which could impact the seeing, both in the atmosphere, due to higher temperature gradients, and within the dome. Third, although less certain, is a trend towards a slight decrease in relative humidity (the saturation of air with water vapour) at ground level. This may potentially reduce the number of dome closure events, which occur when there is a risk of water condensation forming on critical telescope parts.

Of the eight facilities tested in the simulations, it seems that Mauna Kea in Hawaii will be the least impacted by climate change. However, it is also the site with the worst agreement with model data.

Of all the variables, cloud coverage and seeing evolution are currently poorly represented by the climate models, since the cloud processes are difficult to simulate and the vertical resolution in model outputs is insufficient to calculate the seeing. Nonetheless, improvements will soon be possible with NextGEMS, the next generation of GCMs, for which a 1-kilometre horizontal resolution is currently being calculated by supercomputers.

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Observing DART with the Travelling Telescope

Colin Clarke of Armagh Observatory and Planetarium in Northern Ireland visited the Travelling Telescope Team in Kenya through the Europlanet Expert Exchange Programme.

Time lapse of the DART impact over about 90 minutes, capturing a huge magnitude increase, as well as ejecta launched from the system following the impact.
The Travelling Telescope is a Kenyan enterprise dedicated to sharing the wonder of the cosmos with people from all walks of life. Established in 2014 by Susan Murabana and Daniel Chu Owen, the project has enabled hundreds of thousands of children to engage with planetary science and astronomy by bringing a portable 12-inch telescope, an inflatable planetarium and outreach resources to remote and under-served regions of Kenya.

In January 2020, the team completed the construction of the Nairobi Planetarium, the first digital planetarium in East Africa, using bamboo harvested at the site to create a low-cost and environmentally sustainable structure. Susan and Chu were awarded the Europlanet Prize for Public Engagement in 2020 for their outstanding work to inspire young people from diverse communities through astronomy and planetary science.

In August 2022, I was invited by the Travelling Telescope team to visit them in Kenya with the aim of supporting the company to grow and reach even more children and adults. We applied successfully to the Europlanet Expert Exchange programme for funds to support my travel and subsistence costs.

I arrived in Kenya on 11 September, and got to work right away. Over the next 39 days, I assisted in every aspect of the Travelling Telescope enterprise, contributing experience in science communication, data science and event organisation gained at the Armagh Observatory and Planetarium, as well as my technical background in astrophotography and stargazing using powerful telescopes.

I assisted with programmes delivered by the Travelling Telescope to its many partner schools inside and outside Nairobi, including night-time stargazing activities and day-time sessions with the inflatable planetarium. In addition, I observed the general set up and then gradually began presenting shows myself in the Nairobi Planetarium. These included live presentations of objects in the night sky and navigation using the stars, as well as narrated shows on topics such as the high energy universe, black holes, and life as an astronaut in the ISS. At the end of these shows, I answered questions from children and adults in the audience.

Working with the team, we were able to increase the length of the shows for the visitors, and halve the workload for the planetarium operator.

My visit took place during the lead-up, observation and the aftermath of NASA’s Double Asteroid Redirection Test (DART) mission. The DART spacecraft was intentionally crashed into Dimorphos, the moon of the asteroid Didymos (with which it forms a binary system) in order to observe the resulting change in its trajectory. The mission was designed as the first test of ‘planetary defence’, the preparation for humankind to avoid a catastrophic collision between Earth and asteroids.

Due to the position of Dimorphos in the night sky, south and east Africa had the best view of the moment of impact. The Travelling Telescope team were invited to join the official DART science team meetings to share our observation plans and how
we would be communicating our work and the science of the mission with the public.

I was tasked with evaluating whether the two sensitive CCD cameras would give us the capability to observe Dimorphos before and, especially, after the impact. I also helped the team to ensure that the telescopes had smooth and reliable tracking, giving us a better chance at a successful observation.

Following a few moderately-successful nights of testing the telescopes and new cameras, we travelled to Laikipia, a remote location about a 4-hour drive outside Nairobi. We set up the equipment and, while we prepared to attempt to observe the impact, the team was interviewed by the BBC on what we were doing and why we’d chosen the location. We also visited a nearby girls boarding school called Daraja to run an observing session of the beautiful African night sky and talk to the students about the significance of the DART mission.

A further team supported by Europlanet, DART-OPTIK, which included a collaboration of researchers from the University of Edinburgh, Science and Technology Facilities Council (STFC), Technical University of Kenya and the Turkana Basin Institute (TBI) also travelled to Kenya to participate in the DART ground-based observation campaign. They set up a portable telescope at the TBI base in Ileret, in the north of Kenya, to observe Dimorphos over a few weeks either side of the impact to gain accurate information on any changes to the orbit.

In the early hours of 27 September (local time) we successfully observed the DART impact. We saw a dramatic brightening and a large cloud of ejecta spread through the Didymos system.

Over the following days, I used the Astropy Python package to convert the data we collected into a form that we could use to create time-lapses and enhance the quality in post-processing.

Towards the end of my stay in Nairobi, I took part in the monthly Star Safari experience, an all-inclusive camping and stargazing experience on the outskirts of Nairobi. We were able to observe the Moon, Saturn, Jupiter (which was in opposition) and the spiral arm of the Milky Way, as well as some deep sky objects such as the Orion and the Eagle nebulae. It was also an opportunity to talk to visitors about the DART mission and my research on measuring the distances to galaxies.

In summary, the Expert Exchange visit was an amazing experience. The Travelling Telescope team and I learned a lot from each other. The organisation is expanding its outreach programme to share the wonders of our universe with people of all ages. We also firmly believe that the enterprise is now on a path to grow into a valuable scientific observational team.
VESPA Comes of Age

Stéphane Erard (Observatoire de Paris) explores the evolution of Europlanet’s virtual access service.

Like many other fields of research, planetary science has experienced a huge increase in data over recent years. The exponential growth of the volumes of data and their increasing complexity calls for new and more efficient ways to handle them. Not only is this needed to ensure optimal exploitation, but also to facilitate the comparison between independent but related data records, for instance imaging and spectroscopic observations of a small region on Mars.

Practical issues include how to identify observations overlapping in space and time, or specific illumination configurations in datasets from space experiments. Finding planetary data of interest in telescope archives, locating relevant reference data for laboratory or field measurements, or accessing simulations of actual observations for any given field, such as planetary atmospheres, can be challenging.

The key to solving these problems is to have a metadata system that describes the data in an informative and uniform way. Although this has long been recognised, several such systems currently co-exist in planetary science. Thus, in practice, the issues remain: archives are not always consistent between successive space missions; descriptions in telescope archives are more adapted to astronomical data than moving objects; experimental measurements use a variety of proprietary formats; and various fields of Solar System studies make use of entirely different systems (for example, the standards used for plasma data and planetary surfaces data have little in common). Beyond the metadata descriptions, there are further inconsistencies in accessing the data themselves e.g.

VESPA enables visualisation of data from multiple sources through services like Aladin, e.g. HRSC and OMEGA session footprints shown over a MOLA map of Mars (top) and superimposed olivine map (top right).

Vesta spectra compared to basaltic meteorites measured in the laboratory (middle), shown in CASSIS.

Amateur astronomers can contribute observations, like these of Jupiter (bottom), to the PVOL database.
although NASA’s Planetary Data System (PDS) and telescope archives provide some similar services to users,¹ the access and query methods can be entirely different, and each community uses specific data formats.

During the first Europlanet Research Infrastructure (RI) programme (2009–2012), the Integrated and Distributed Information Service (IDIS) activity conducted a study of existing and desirable data handling systems that could be used to develop interoperability in this field and facilitate access to Solar System data in general.²

The outcome of this study was to identify the Virtual Observatory (VO) as the most mature and promising infrastructure to handle planetary science data in general, and the most flexible provider of interfaces for thematic use. The VO has been under development since the early 2000s to address similar issues in astronomy.³ However, astronomy provides a less challenging context: all objects are located in the same co-ordinated frame, most data relate to measurements of light (rather than physical interactions), and time variations are simpler (e.g. there are no seasons or daily cycles).

During the Europlanet 2020 and 2024 RI programmes (2015–present), VESPA has focused on expanding the VO to accommodate planetary science data and take advantage of developments elsewhere in the VO.⁴ The first step has been to define a uniform description of data that could encompass all fields of Solar System research, at least at the top level, so that users could search for data of interest for their research. This metadata system, called EPNCore, is associated with a common mechanism to send queries online (Table Access Protocol), to form the EPN-TAP protocol accessing Solar System data. Both EPNCore and EPN-TAP are now a standard of the International Virtual Observatory Alliance (IVOA), the consortium which supervises VO developments. As a VO standard, the EPN-TAP data search and access protocol is compliant with the Open Science policy, and in particular with Findable, Accessible, Interoperable, Reusable (FAIR) principles, which were pioneered through the development of the VO.⁵ EPN-TAP not only opens the use of powerful VO tools to visualise and analyse the data, but can also be interfaced with other environments used in planetary science for specific applications, e.g. Geographic Information Systems (GIS) for planetary surfaces or the Space Physics Archive Search and Extract (SPASE) standards for plasma data.

VESPA also uses the publication system of the VO to make the data accessible. A simple and easy procedure has been identified so that any institute can publish their data online with minimum effort and make their data services visible in the VO. The VO uses a distributed infrastructure, with no single data centre. Each institute hosts their own data services and simply declares them in a common registry, so that even small teams have the same visibility as large space agency databases.

There are currently 63 EPN-TAP data services published from more than 20 institutes. The VESPA portal (https://vespa.obspm.fr) is a specific user interface that queries all planetary science services together and locates not only datasets of interest, but also detailed configurations inside many datasets, based on space/time/spectral/illumination coverages, and provenance of the data. Space borne data are already discoverable this way (e.g. ESA’s Planetary Science Archive provides an EPN-TAP interface), and further interfaces with archives from space agencies are being developed with a common dictionary for PDS4, a project of the International Planetary Data Alliance, of which VESPA is a member along with the space agencies.

Beyond the publication of data related to a research paper, there are many applications for such a system. Space experiments can use EPN-TAP as an off-the-shelf data-management system that allows restricted access (an important facility used by the VESPA team itself). Small nanosat projects can use it as a data handling, archiving and distribution system. EPN-TAP can help experimental projects to promote their data in a simple way by favouring cross-searches with observational data (e.g. through the PVOL service).⁶ Ground-based observational networks and pro-amateur projects can use it to share their data (e.g. as demonstrated by PVOL and other observational networks within the Europlanet project).⁷ EPN-TAP also provides a simple and cost-effective solution for making data open access, and is thus supporting Open Science policy, as required by funders (e.g. in Horizon Europe).

EPNCore can help to handle composite datasets during a research project and provides an easy interface with tools such as TOPCAT, Aladin or CASSIS to manipulate tables, images, cubes, or spectra.⁸ Installation on the European Open Science Cloud (EOSC) is also being assessed by VESPA.

In summary, VESPA has developed an infrastructure to handle and publish large datasets in many areas of Solar System and exoplanet studies. Through deep roots in the VO, and recognition as a community standard, VESPA has secured a sustainable long-term future.⁹

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Long-term Sustainability of Small and Mid-scale Distributed RI Projects

Liliana Avila Ospina and Patrick England (MOSBRI), Ana Helman (ESF), and Anita Heward and Nigel Mason (Europlanet) report on a side event session at the International Conference of Research Infrastructures (ICRI) 2022.

An important evolution over recent decades in the landscape of European research has been the increasing number of institutions, facilities and laboratories organising their operations and services through a Research Infrastructure (RI).

The European Commission (EC) has provided significant investment in RIs through its Research and Innovation Programme. A key driver in this is the...
Distributed Research Infrastructures (RIs) cover a wide range of fields, from the sciences and social science, to the arts.

RIs presented during the ICRI 2022 Side Session included:

- **ARICE** - Arctic research icebreaker consortium. [https://arice-h2020.eu](https://arice-h2020.eu)
- **ENRIITC** - European network of research infrastructures and industry for collaboration. [https://enriitc.eu](https://enriitc.eu)
- **ESTEEM3** - Enabling science and technology through European electron microscopy. [https://www.esteeem3.eu](https://www.esteeem3.eu)
- **EUFAR** - The European facility for airborne research. [https://www.eufar.net](https://www.eufar.net)
- **EUROFLEETS+** - An alliance of European marine research infrastructure. [https://www.eurofleets.eu](https://www.eurofleets.eu)
- **iNEXT-Discovery** - Structural biology for translational research & discovery. [https://inext-discovery.eu](https://inext-discovery.eu)
- **MOSBRI** - The Molecular-scale biophysics research infrastructure. [https://www.mosbri.eu](https://www.mosbri.eu)
- **PRISMAP** - Building a European network for medical radionuclides. [https://www.prismap.eu](https://www.prismap.eu)
- **TRANSVAC** - European infrastructure for the development of human and veterinary vaccines. [https://www.transvac.org](https://www.transvac.org)
- **VetBioNet** - Veterinary biocontained facility network for excellence in animal infectious disease research and experimentation. [https://www.vetbionet.eu](https://www.vetbionet.eu)
- **VITALISE** - Virtual health and wellbeing living lab infrastructure. [https://vitalise-project.eu](https://vitalise-project.eu)

provision of ‘transnational access’ whereby researchers are funded to use facilities in a different country from where they are based, thus promoting international scientific mobility. By pooling resources and data to provide easy access to state-of-the-art infrastructure, the EC aims to support the best science, connect national scientific communities and avoid duplication of effort.¹

In wider society, the term ‘research infrastructure’ may bring to mind a single, big facility, such as CERN, or a network of large-scale infrastructure, such as the Square Kilometre Array (SKA), funded at a governmental level. However, many RIs are composed of multiple small or mid-scale facilities, owned by individual institutions, that are networked to provide coordinated access to users. More than 100 of these ‘distributed’ RI projects in all fields of science have been, or are currently being, funded by the EC, either as ‘starting’ or ‘advanced’ communities. Europlanet is a good example of this model of distributed RI and, since 2009, it has grown into an advanced community to support planetary science and includes over 40 laboratories and field sites around the world.

**Building a Community**

Distributed RIs, despite their proliferation, have to date been rather under-represented in strategic planning activities, such as in the European Strategy Forum...
on Research Infrastructures (ESFRI) Roadmaps. To address this, a consortium of distributed RIs and the European Science Foundation (ESF) initiated a programme in 2021 to try to bring together similar projects and provide them with a forum to raise their profile, identify common challenges and share best practice.

As a first step, a two-day virtual meeting was organised in April 2021. This proved very successful, attracting 130 participants. The outcomes included a recommendation to organise annual meetings to allow the distributed RI community to continue to interact.

As a follow-up, we organised a side-event at the International Conference on Research Infrastructures (ICRI) in Brno, Czech Republic. The event was organised by the ESF, Europlanet, and the EC-funded MOSBRI and VITALISE projects and attracted 50 in-person participants, with over 70 registering to take part online.

The goal of the workshop was to reflect on current challenges experienced by small and mid-scale distributed RIs and to explore options for developing and sustaining their operations. The workshop covered a wide range of fields of research supported by small- and mid-scale distributed RIs, with a focus on transnational access and the impact of RIs in Europe and around the world.

The workshop had an interactive format and was organised in three sessions. In the first part, representatives of 10 RI projects presented their plans for sustainability. This was followed by a presentation by Anne Charlotte Joubert, Coordinator of the ENRIICT project, who shared best practice for developing relationships between RIs and industry. In the second session, the on-site participants were split into three thematic groups and a further co-creation group was organised for online attendees. Group 1 discussed sustainability of distributed RIs, including funding models and operational solutions. Taking points included research and innovation, harmonisation of standards, Open Science, education and networking activities. Group 2 focused on sustainability of services, including transnational access and models for physical, remote, and virtual access. Group 3 discussed visibility and impact of RI activities, including catalogues of services and outreach activities to all types of users and the public. The online group discussed a range of aspects relating to sustainability, including some of the challenges for RIs in choosing and setting up a legal entity. In the final session, rapporteurs presented the conclusions of the thematic discussion groups, and the issues raised were analysed and commented on by panellists.

The main conclusions of the workshop were:

- RIs play a critical role in developing leading international research.
- There are significant benefits in enabling distributed RIs to work together in the development of different sustainability models.
- Transnational access is a unique programme that provides Europe with important scientific advantages. However, EC support remains critical as funding through national sources is difficult, and in some cases not permitted by national laws.
- Creating a legal entity can pose major administrative challenges to researchers, especially in small RI communities.
- Engaging in projects with the private sector is not easy. Often, there is no investment when short-term revenue is not guaranteed.
- There is a risk that the ‘top-down’ trend in current Horizon Europe calls towards funding large-scale initiatives and thematic clusters of RIs may mean that valuable smaller communities are lost.
- The provision of remote access by RIs may be useful for ‘automatised’ services but is less applicable for tailored, more complex, experimental set-ups.
- Demonstrating user support is vital for long-term sustainability vis-à-vis funders.
- Effective outreach activities need to be targeted at specific stakeholder groups, but this requires dedicated resources and staff time. Nonetheless, these activities can help RIs find funders other than the EC, e.g. national funding agencies, regional innovation clusters, etc.

Future meetings of distributed RIs are planned, with the next taking place at the Europlanet Research Infrastructure Meeting (ERIM) from 19–23 June 2023 in Bratislava.

For more information about the event and follow-up activities, contact Liliana Avila-Ospina (liliana.avila-ospina@pasteur.fr) and Anita Heward (aheward@europlanet-society.org).

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Béla Sulik explains how the Institute for Nuclear Research (Atomki), Hungary’s national centre of accelerator-based nuclear and atomic physics, became involved with and has benefitted from collaboration with Europlanet.

The involvement of Atomki with Europlanet starts with a personal story.

I met Nigel Mason, the Coordinator of Europlanet, some 20 years ago through the Low-Energy Ion-Beam Facility (LEIF) network, which was a research infrastructure for small accelerators funded by the European Union from 2000-2004. Later, Nigel coordinated the RADAM COST Action, which was a project to study radiation on living systems. This brought together people in the health business – medical doctors, chemists and physicists – and was a very important opportunity for me, and many others, to learn more about research than our own narrow fields. I was working on gas-phase molecular collisions, and I organised a meeting at the end of this COST Action in 2008 in Debrecen. From that time, Nigel and I kept up regular discussions on collision physics and many other things.

In 2018, we installed a new Tandetron accelerator at Atomki in Debrecen, and started to construct the beam lines. I invited Nigel, who was working at the Open University (OU) at the time, to visit our Atomic and Molecular Collision Group. Half of the beam line was still free and, after visiting the laboratory, a plan started to take shape to build an astrophysics/astrochemistry line at our accelerator. We visited the OU’s facilities and drew up a contract between our two organisations.

In the summer of 2019, the first chamber was delivered in a big parcel. By the autumn of 2019, it was installed and we were able to take our first spectra. We now had two accelerators that could produce ions of different species and energies to mimic the effects of cosmic rays and the solar wind on icy materials. Nigel and Sergio Ippolo from Queen Mary University of London provided expertise to help us set up the facility, and an active group was quickly formed here. At this point, we also joined the new Europlanet 2024 Research Infrastructure (RI) consortium, which kicked-off at a meeting in Windsor in February 2020.

Then the pandemic hit but, despite it, everything happened very fast.

Duncan Mifsud, of the University of Kent, visiting the Atomki facility in November 2020.
Over the summer of 2020, we checked all the parts of the system to make sure everything was working.

We were very lucky, here in Debrecen, because although there were very strict rules due to Covid-19, the accelerator was allowed to keep running. This was a huge advantage as, over the autumn and through the following year, we performed a long set of different Transnational Access projects. Only two of them were non-remote, but they were very successful. We have now completed the seventh visit – in fact we are even over-subscribed.

In parallel, Nigel organised a Joint Research Activity to install another chamber from Queen’s University of Belfast, which was set up on the beam line of our Electron Cyclotron Resonance (ECR) source. An excellent PhD student, Duncan Mifsud, came out to work with us at the beginning of the test measurement period. As a person onsite with expertise in chemistry, he accelerated our training in the necessary techniques, with support from Sergio and Nigel in remote mode. Commissioning was completed in September 2022 and we are now taking measurements and have opened the facility for applications in the most recent Europlanet Transnational Access Call.

Now we are at the end of 2022 and we have very promising new students from the university working with us, and it’s a very active group. We have seven Hungarians, including me, and we collaborate with Duncan, who is doing his PhD at the University of Kent, as well as an excellent postdoc from India and, of course, Nigel. It’s a real opportunity for the young people to not only participate in something that is interesting and enjoyable, but also to work efficiently and produce important results.

This makes me very happy because, when I retire and leave the field, I will feel that in Atomki we have built something on a European scale that is becoming an important hub in this field of astrophysics and astrochemistry.

https://europlanet.atomki.hu

Above: A meeting of the group at Atomki.
Below left: The Atomki-Queen’s University Ice Laboratory for Astrochemistry (AQUILA).
Sanje Fenkart, a science communicator and freelance journalist, is the new editorial assistant for the CERN Courier. She took part in the media internship programme at the Europlanet Science Congress (EPSC) from 18-23 September 2022 funded by the Europlanet 2024 Research Infrastructure (RI) project. Here she reports on results presented at the meeting.

Since the start of its scientific mission in June, the James Webb Space Telescope (JWST) has impressed the astronomical world by taking images of the far-away Universe with unprecedented resolution and detail. Recently the telescope – a joint project by NASA, the European Space Agency (ESA), and the Canadian Space Agency (CSA) – has shifted its focus to our next-door neighbour, Mars. Earth’s ‘little sibling’ is a rather photogenic fellow, observed by amateurs, public observatories, professional ground-based and space telescopes. Since 1964, there has been a constant trickle of probes, satellites, landers and rovers, which explore the Red Planet.

![Spectrum of Mars' atmosphere and its components, respectively taken by NIRSpec. It features a high abundance of carbon dioxide, some water, and carbon monoxide. Future observations will look for methane, which can be a powerful tracer for living organisms.](image-url)
While these robots send us close-ups from a familiar yet strange world, it’s worthwhile taking a look at Mars with a telescope – even one in your backyard.

JWST is designed to look primarily at faint objects such as exoplanets as well as the first (and oldest) stars and galaxies in space. In order for them to be captured, JWST is equipped with very sensitive instruments, which allow it to collect as much light as possible.

Mars, however, is close by and very bright – nearly too bright for JWST. Fortunately, a team of international scientists, led by researchers from NASA’s Goddard Space Flight Center, has been able to collect and edit spectroscopic data into valuable pictures (right). The Near-Infrared Camera (NIRCam) managed to take snapshots of Mars’s surface at two different wavelengths using two of the instrument’s 29 filters. A zoomed-in picture shows different features on the surface like craters, volcanic rocks and properties of the coating of dust.

A second image shows a heat map that marks brighter and darker regions, depending how much heat is given off. As expected, the polar regions are cold, as is the shadowed right-side, which is delineated with a distinct ‘terminator’ (the border between day and night). Towards the equator, where the Sun is shining almost full-on (at 2pm Martian time), the heating results in an overly bright spot. Curiously, the hottest part exhibits a darker patch; this coincides with an impact structure called “Hellas Basin”, which has a depth of over 7,000 metres (≈23,000 feet). Within the basin, the pressure changes considerably from top to bottom and consequently affects the atmosphere, leading to the dark feature spotted by JWST.

Switching instruments, the Near-Infrared Spectrograph (NIRSpec) has documented Mars’s atmospheric composition (left). These first results were obtained during Guaranteed Time Observations (GTO) and they look promising. NIRSpec found an abundance of carbon dioxide (CO₂), alongside water (H₂O) and carbon monoxide (CO).

However, what scientists are really looking for is methane (CH₄). On Earth, methane is one of the most prominent tracers for living organisms, a so-called ‘biomarker’. Organisms like us, microbes and plants all produce methane. The planet itself can outgas methane if it has geological activity. So far, methane has been found only in the slightest traces on Mars, with its origin – and even existence – still under discussion.

In these first JWST spectra, there were no new results on the methane abundance. However, JWST will look at Mars many times in the future - whenever an observation window opens - and the spectrograph’s capabilities should be able to find even the slightest whiff of it.

From Online to Granada: Bringing Scientific Conferences to Schools

Ulysse Pedreira-Segade, Education Officer for Europlanet 2024 RI and Scientific Coordinator for Lecturers Without Borders, describes how activities to bring planetary sciences to the classroom has transitioned from online to in-person.

It is late September 2022 in Granada, Spain. The long-awaited, in-person Europlanet Science Congress (EPSC) week is going well: professional researchers are communicating results in planetary science during numerous parallel sessions, press conferences are opening up these results to the media, and fascinating keynote lectures enable the community to reflect upon past achievements and new goals. It is also a week of experiments in outreach and education for Europlanet and its partner, Lecturers Without Borders (LeWiBo), who are bringing the third edition of EPSC Goes Live for Schools to classrooms in Andalucía.

EPSC was originally supposed to be held in Granada in September 2020. However, the pandemic changed the rules of meetings – like so many other things – and the congress was held online.

LeWiBo had a similar struggle: designed to organise visits to schools by travelling scientists, even local outreach activities became impossible during the height of the pandemic. As EPSC was moved online, a collaboration was born: LeWiBo crafted a programme of online outreach talks so that, if scientists could not go to schools, then maybe schools could join the virtual conference.

**A Window into Science**

The first EPSC Goes Live for Schools, also supported by Scientix and Frontiers in Science along with the Europlanet Diversity Committee and EPEC early career network, was a great success. Key ingredients included a demand for online educational content, the public’s passion for planetary science, the motivation of teachers to try new things, and the enthusiasm of scientists to participate in educational activities in a time of mistrust for science.

A large range of experiences were offered to the students who joined the event with their teachers. The complete programme comprised six live-streamed and recorded lectures (via Zoom and YouTube), 13 on-demand scientific talks with plain-language summaries, a Q&A with teachers, an art contest, and a dedicated Slack channel for questions and conversation. For 16 days, the event brought together more than 20 scientists and 114 schools from 28 different countries. EPSC Goes Live for Schools adopted a new approach to showcase how science is made: students and teachers could watch recordings of real scientific talks and were able to use educational resources to discuss the structure, purpose, and content of professional scientific communications. The live
webinars and the Slack channel offered an opportunity to engage directly with researchers. Participating scientists also found that revealing the reality of life in research to the views, knowledge and interests of the public could be challenging and enriching.

At the time, I was a researcher in astrobiology and living in New York State, which was hit very hard by Covid-19. My lab was closed from March to September 2020. As I slowly went back to my experiments, volunteering some time to help with campus-wide PCR testing at my institute, I was invited to share the floor with another scientist at the first edition of EPSC Goes Live for Schools and talk about astrobiology. A few months later, I decided to leave academia as a researcher and focus on a career in outreach and education. I wanted to help build a better society through education, action, trust, inclusiveness and cultural exchanges. I stayed in touch with LeWiBo, which in August 2021 offered me a position to coordinate the next EPSC Goes Live for Schools. As EPSC was again virtual, the second edition of the outreach satellite event was again planned online.

Building on the past format of the event and considering feedback from teachers, students and scientists, we focused on inclusivity and interactivity by adding new sessions of simple Q&A discussions in several languages. Although science is shared in English by the professional research community around the world, education and outreach activities need to encompass the diversity of cultures and languages to promote dialogue between scientists and the audience. The programme innovated from the first iteration to include three live-streamed and recorded lectures, one Q&A session for teachers, 13 Q&A sessions for students (held in five different languages), and on-demand resources.

Overall, 51 schools from 15 countries joined the month-long event. We also invited scientists from the Europlanet community to contribute to Europlanet’s wider education and outreach programme by helping translate our Mars astrobiology resources (available now in French, Portuguese, Spanish, Italian and Greek).²

Finally, this year, the third EPSC Goes Live for Schools took place in Granada. As everyone was itching to get back to in-person meetings, we hoped to take advantage of
that enthusiasm and organise local school visits. The Local Organising Committee (LOC) was extremely helpful in connecting us with schools and teachers to try to understand the needs, timeline, and interests of the targeted audience. In total, 20 scientists participating in EPSC visited six schools in and around Granada.

Lessons Learned
I would like to share a few highlights and lessons learned with you. Although you might not coordinate an outreach event anytime soon, I hope these thoughts might help you appreciate such events more and maybe encourage you to participate in one (if you have not already).

- As a coordinator for outreach events, start early: your audience and invited participants have their own timelines and schedules (e.g. the summer is a difficult time to contact teachers and scientists), so engaging them as early as possible is key to success.

- Free activities based on voluntary participation of scientists does not mean lowering the bar on quality and inclusivity. Craft an adaptable outreach programme that can be included within constraints (time, location, schedule of a conference etc) and with minimal effort. Scientists and schools are genuinely interested in participating in such events and will find the time to take part even if their schedules are tough to work around.

- Offer freedom to participants, but make sure to include clear guidelines and a “standard” activity. Although some scientists and teachers might have a pretty good idea of the kind of activity they would like to give/host, most would prefer to trust the coordinator to craft a well-thought-out programme.

- Language is a barrier: we could only work with schools with a bilingual programme or scientists speaking Spanish. This greatly limited the number of visits we could coordinate.

- As a scientist, if you do speak several languages, make sure to use them in your outreach practices to reach a more diverse audience.

- There are many ways to help lower barriers for non-native English speakers: speaking slowly, adding more text to presentations, having the English teacher present, and including captions can greatly enhance the experience for the audience and the speaker. If sharing pre-talk material, offer to help translate it with the teacher.

- Make the most of the visit! Teachers: if possible, organise tours of the school and schedule the visit so that as many students as possible can join, voluntarily if possible. If you would like the scientists to spend more time at your school, ask them! Scientists: the visit is an exchange, not a unidirectional lesson you are giving. Take some time to reflect on your practices, your own work and your connections with your audience and society. Make
sure to leave ample time for questions. If you want to spend longer at the school, ask if it would be possible.

A key finding: visiting a school can be an amazing experience, both for the scientist and the classroom. There is power and motivation in such exchanges that can have a lasting impact on both sides.

The third edition of EPSC Goes Live for Schools also included an online component from mid-October to mid-November. This time, we focused on a simple programme of live-streams and recorded lectures for 40 schools. Everything was available free for later viewing on LeWiBo’s YouTube channel.3

Looking Ahead
The educational landscape has changed since 2020 and the use of online content is shifting. Although live content is still of interest to many, it seems that requirements tend more towards teaching/training resources that can be viewed on-demand. This needs to be considered in the future as, traditionally, the world of education has focused on in-person activities and direct exchanges.

We look forward to organising a similar event during the Europlanet Research Infrastructure Meeting (ERIM) and EPEC Annual Week from 19-23 June 2023 in Bratislava. We hope to see you there!

For more details, contact: education@europlanet-society.org

Feedback from EXPLORE Data Challenge Workshop during EPSC Goes Live for Schools.
Status of Women in Astronomy: Still a Long Way to Go

Mamta Pommier (LUMP/CNRS, Université de Montpellier, France) and Arianna Piccialli (Royal Belgium Institute of Space Aeronomy, Belgium), on behalf of the IAU Women in Astronomy Working Group, take a first look at factors suppressing the careers of women astronomers around the world.

For decades, women have been under-represented in the fields of astronomy and STEM (science, technology, engineering and mathematics) due to a variety of factors suppressing their careers. While there have been global efforts in the past to address these issues, they have only been marginally successful and recent global surveys do not show promising trends.

The IAU strategic plan from 2020-2030 aims to address the challenges faced by women in working in astronomy, foster inclusiveness, and facilitate the advancement of the next generation of astronomers. By developing effective policies and action plans, the strategy aims to improve gender-balance and equal opportunity in the workplace.

The IAU membership data for the last 25 years suggests that the percentage of women among the total members has risen from 11.2% in 1997 to 20.7% in 2021. However, digging into the statistics further presents a more complex picture. There was a slow increase of 1.7% from 1997 to 2006, a surge of up to 6.1% in 2015 due to an increase in registrations by younger members globally, followed by another period of slow growth (1.7%) from 2015 to 2021.

In 2022, only 21.2% of all IAU members are female, and just 1.6% of members from any gender participate in the Women in Astronomy Working Group (Figures 1 and 2). This astonishingly low figure reflects a poor engagement of members in activities.
to promote equity, diversity and inclusion.

A survey conducted by the IAU Working Group from 2019-2021 on working conditions of women in astronomy received responses from 750 members around the world, mainly from EU countries (Figure 3).

The results of this survey suggest that the most prominent factors reported as affecting the career of women astronomers are: maternity breaks, child and family caring responsibilities, stereotypes, non-permanent or low paid positions, suppression of work and expertise, lack of acknowledgment, the ‘leaky pipeline’ and ‘glass ceiling’ effects, unethical and biased work evaluation, unfair hiring practices, humiliation and bullying by younger and older colleagues due to working conditions, discrimination due to origin, and sexual/mental harassment issues by both male and female colleagues (Figure 4).

While gender-balance policies have existed in workplaces for decades, they have proved to be ineffective, due to a lack of funds to support women in astronomy at every career stage. Most of the work related to gender-balance is being carried out on a volunteer (unpaid) basis, since (largely) no funds are provided to address these issues by funding agencies and institutions. However, with the impacts affecting half of the working population in this field of expertise, this is an area of serious concern for all astronomy.

In December 2021, the IAU Women in Astronomy Working Group launched Ensemble, a magazine to offer a voice to women in astronomy to share ideas, experiences, skills, define key efforts for the future, and engage policy makers and worldwide citizens. You can find a full report on the survey and much more in the first issue: [https://bit.ly/EnsembleIAU](https://bit.ly/EnsembleIAU). For any queries—contact Mamta Pommier (Chair, IAU Women in Astronomy, email: mamtapan@gmail.com).

References
Hidden in the Noise

Yoshifumi Futaana (Swedish Institute of Space Physics) shows how asking unusual questions can lead to ground-breaking science.

My scientific philosophy is that I try to answer the questions that people have never even thought about.

Noise in data is usually considered as junk or garbage. People don’t take it seriously. In line with my philosophy, we decided to try and look at noise data from instruments that we built at the Swedish Institute of Space Physics for the Mars Express and Venus Express missions. We developed an algorithm to extract information on cosmic rays in noise data from the ASPERA plasma sensors. We were successful and managed to extract valuable scientific information that we have now published in a paper in the Astrophysical Journal.

Galactic cosmic rays are particles, travelling at almost the speed of light, that originate outside our Solar System. They are important because they can cause instrument errors in space systems, as well as destroying DNA in humans. So, galactic cosmic rays are a threat for future exploration in space and for all human activities in space.

The European Space Agency’s Mars Express mission was launched in 2003 and remains in service around the Red Planet. Its sister mission, Venus Express, operated from 2006 until 2014. We took the 17-year dataset from Mars and 8-year dataset from Venus, together with Earth-based cosmic ray measurements from the Thule neutron monitor in Greenland, and compared them with the number of sunspots visible on the surface of the Sun. We used the median value of cosmic ray counts over 3-month periods to minimise the influence of sporadic solar activity, such as flares or coronal mass ejections. We were able to show how cosmic ray counts are suppressed during peaks of activity in the 11-year solar cycle.

All the datasets showed a decrease in the number of cosmic ray detections as the peak in activity for Solar Cycle 24 was reached. In particular, the Mars Express data and the observations from Earth showed very similar features. However, there was an apparent lag of around nine months between the maximum number of sunspots and the minimum in cosmic ray detections at Mars.

Previous studies have suggested that there is a delay of several months between solar activity and the behaviour of cosmic rays at the Earth and at Mars. Our results appear to confirm this and also provide further evidence that Solar Cycle 24 was a bit unusual, perhaps due to the long solar minimum between Cycle 23 and 24, or the relatively low activity during Cycle 24.

As well as the decadal-long relationship with the solar cycle, we looked at how cosmic ray detections varied over the short timescales of an orbit. To our surprise, we found that the area protected from cosmic rays behind Mars is more than 100 kilometres wider than the planet’s actual radius. To understand why this blocked area should be so large will need further study.

The databases of background radiation counts extracted for the study have been published and can be accessed through the Europlanet SPIDER planetary space weather service.

References
If you need something to make you smile and banish the ‘January Blues’, try the Massive Exoplanet Meme Exhibition (MEME) on 27 January 2023. From an impromptu event organised in Leiden, with colleagues queueing to see printouts taped to an office wall, MEME has grown into an annual online gathering that harnesses the creativity and humour of memes to communicate the day-to-day lives and research interests of astrophysicists around the world.

The organisers have now set up a second online venue specifically for high schools, where scientists provide guided tours to explain to students the science or work-related aspects behind the memes.

Using Internet culture is an unconventional way to teach astrophysics, but it can be effective. A Google/Ipsos survey found that 80% of teens reported using YouTube to become more knowledgeable about a subject. While traditional outreach (observing nights, museum exhibits, open days etc) by the planetary community is useful and necessary, it tends to reach a public who is already ‘converted’ to science. So how can we engage, grow and retain new audiences and communities that have previously had no interest or experience of astronomy and planetary sciences?

Science communication can learn from marketing techniques, which aim to trigger an emotional response, such as surprise. Unconventional outreach activities are often, by their nature, unexpected and can result in a positive experience for the public, especially if tailored for different audiences. Following co-creation practices of involving the target community during design phases can help make such activities more effective.

Non-science festivals, from music (e.g. Bluedot) to science-fiction (e.g. Fantasy Basel) offer another unconventional outreach opportunity. In Switzerland, we have been attending the latter type since 2016, starting with a 10 m² stand and now managing a ‘space village’ of over 500 m² in a partnership with space-related institutes, museums, associations and student projects. Although each event requires some financial investment, plus over 50 volunteers to cover the weekend, it enables us to reach over 60,000 visitors with exhibits, science demonstrations and stage talks. Initially, the public were surprised to find actual science alongside the science-fiction. Now, regular attendees are excited to meet us again and recommend us to their friends. Each time, we also see an increase in the number of students coming to us for advice on studies and careers.

Unconventional or not, these personal interactions are important.

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Fifty years after the last humans set foot on the lunar surface, NASA's Orion capsule has successfully orbited the Moon and returned to Earth. Artemis I has prepared the way for a series of missions that will take a new generation of astronauts back to the Moon and on to Mars.

Inset: An overview of the European Space Agency (ESA) vision for exploration of near-Earth orbit, the Moon and Mars was presented by Nicole Buckley of the Directorate of Human Spaceflight and Robotic Exploration during EPSC2022.
The Last Word

A Time for Optimism

Nigel Mason (University of Kent/Atomki) reflects on positive news for the planetary science community.

At the European Space Agency (ESA) Ministerial Council, held in Paris on 22-23 November 2022, government ministers representing ESA’s Member States, Associate States and Cooperating States agreed to a budget of €16.9 billion for the period of 2023-27. This is a record 17% increase on the budget agreed at the last ESA Ministerial Council in 2019. Coupled with increases in national spending being announced by many of the Member States, this sets us on track for something of a golden age of planetary science conducted by European scientists and engineers.

The decision to maintain ESA’s exploration of Mars by pursuing the ExoMars mission and participating in the Mars Sample Return campaign is welcomed by our community. There are exciting opportunities to plan for exploration of the outer planets, which will help fully reveal the nature of our own Solar System, in addition to the fleet of ongoing and upcoming ESA missions like BepiColombo (to Mercury), Juice (to Jupiter and its icy moons), EnVision (to Venus) and Comet Interceptor (to a pristine comet). The CHEOPS, PLATO and Ariel missions build upon the rich heritage and infrastructure built up in Europe for the study of exoplanets and will enable us to begin the search for biomarkers and life beyond our Solar System.

Europe has made a funding commitment to the International Space Station (ISS) until 2030, allowing time to prepare properly for the post-ISS phase. ESA is also playing a part in lunar exploration missions that will establish a permanent presence for humanity beyond the confines of Earth. It will provide vital modules (Argonaut, formerly called the European Large Logistics Lander) to transport cargo, infrastructure and science equipment to the lunar surface. ESA is also developing the International Habitation (I-HAB) and European System Providing Refuelling, Infrastructure and Telecommunications (ESPRIT) modules, key elements of the first lunar space station, Gateway, which will permanently orbit the Moon.

Such a commitment, even at a time of conflict on our continent, recognises that space will play a major role in all our futures, with commercial uses of space increasingly transforming our world. Thus, it is vital to build a strong workforce in the space sector, so we have a responsibility to enthuse school-age students and encourage them to consider a career within our community (see page 46).

In creating a legal entity (AISBL) for the Europlanet Society, we aim to secure a sustainable, inclusive infrastructure to support the pan-European planetary science community. Through the activities of the Europlanet Early Careers (EPEC) network, we aim to support early career researchers in recognition that they are the mission leaders and workforce of the future. Through the industry working group, we seek to foster those academic-industry collaborations that are pivotal to future space missions and the Space 4.0 concept of joint public-private partnerships. Through EPSC and other meetings, in collaboration with other European astronomy and space networks, we provide a showcase for planetary science through which we can highlight to policy makers and citizens that Europe is leading the way in research and technology.

However, we can only achieve these goals if the community supports us by joining the Society. The next 12 months will be a key time for growth. The new President Elect of the Europlanet Society, Ann Carine Vandaele, has an exciting vision for leading us through the critical years ahead (see page 24). Every member can aid us by both recruiting in their institution and volunteering to serve in the Regional Hubs and other Society Committees. With the new ESA, NASA and national space strategies being announced and enacted, as we look ahead to 2023, there has never been a more exciting time to participate in European planetary science!