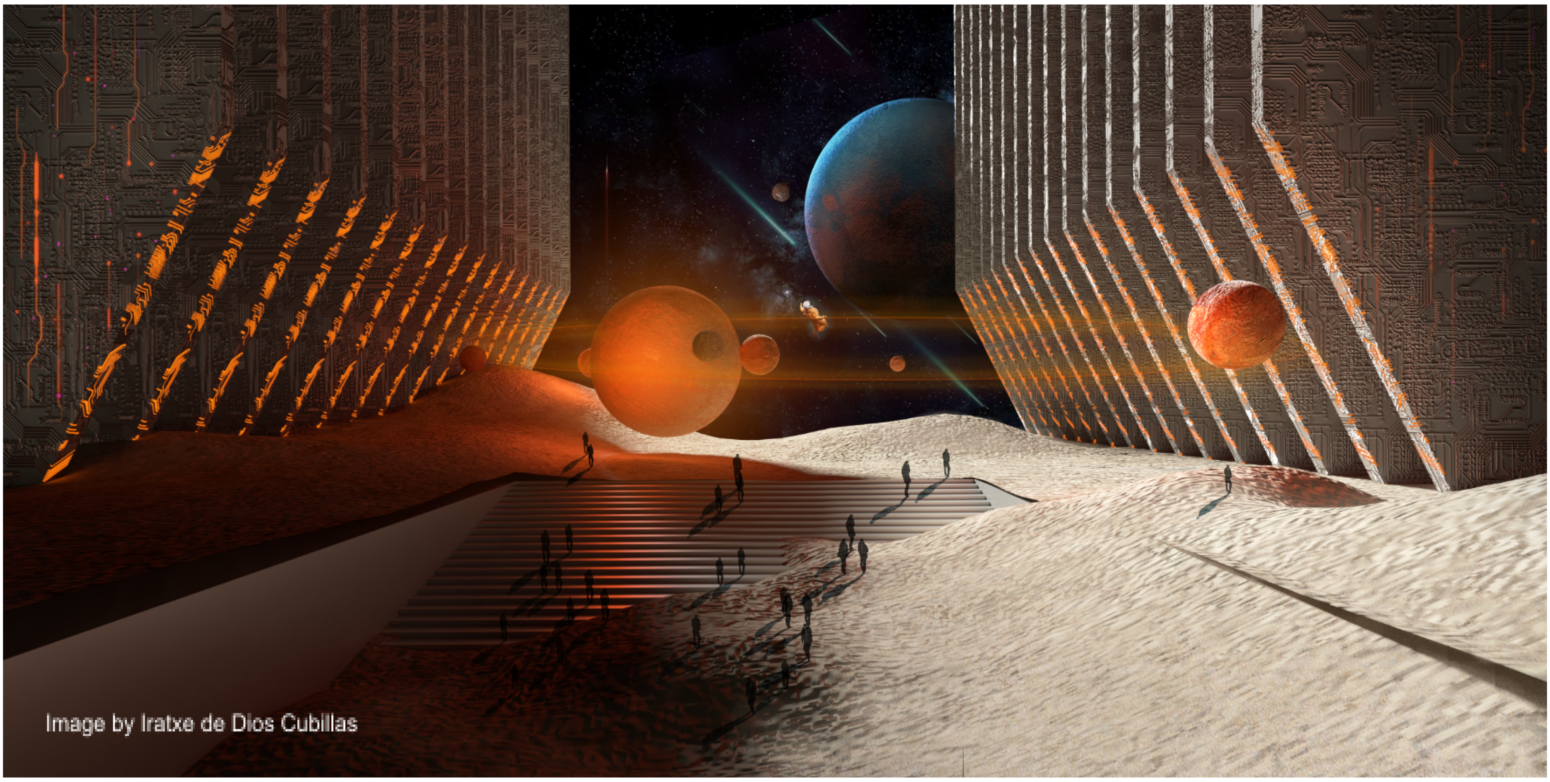


Keep you uP^{h}Dated days
CAB-INTA
14th-15th December 2023

Contents

Welcome

Welcome to the **Keep You uPhDated Days CAB-INTA 2023**, our second edition of the in-house conference designed exclusively for predoctoral students conducting groundbreaking research at the Centro de Astrobiología (CAB) and the Instituto Nacional de Técnica Aeroespacial (INTA). Building upon the success of the first edition, which saw the participation of 38 students delivering oral and poster presentations, this year promises to be equally enlightening and enriching. With over 30 talks and a diverse array of posters, our program spans the domains of Astrophysics and Astrochemistry, Planetology and Habitability, Molecular Evolution and Life Sciences, as well as Instrumentation and Space Missions. Responding to your valuable feedback from the 2022 edition, we have crafted a schedule that includes technical discussions and non-technical activities, ensuring a dynamic and well-rounded experience for all attendees.

As in the previous edition, we embrace a commitment to prioritizing mental health throughout the demanding journey of pursuing a PhD or any other predoctoral training. In this line, we will have the opportunity to participate in a mental health seminar imparted by Sara Arias and Raquel Alcalde, psychologists and founders of the company **Base Psicología**. This seminar aims to destigmatize mental health discussions, providing accessible resources for coping mechanisms and professional support.

We are also excited to announce an invited speaker, Juan Fernández Macarrón, who will talk about communication skills for scientists. Juan is a science communicator and founder of the company **CosmoAventura.** As early career researchers, we recognize the important role effective communication plays in sharing our work successfully. Through this seminar, we will learn strategies for expressing scientific concepts with clarity and tailored for diverse audiences.

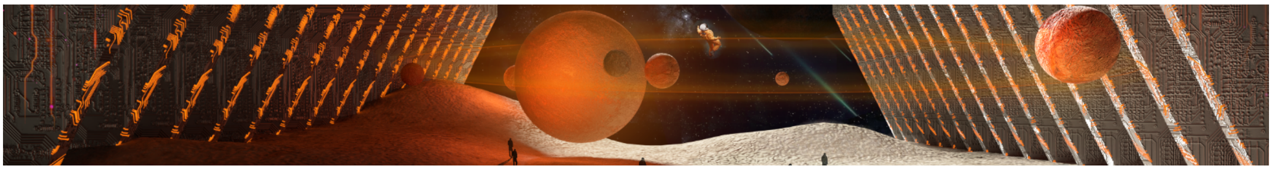
Finally, don't miss our interesting roundtable discussion about the multitude of career avenues available after a PhD. On this occasion, we have invited three speakers with different professional profiles and expertise who will share their insights and experiences pursuing both academic and non-academic trajectories post-PhD. They are Samuel Moncayo, founder of **Antares Instrumentacion**, Miguel Ángel Lominchar, technician at the Molecular Evolution lab at CAB, and María Lamprecht, science communicator and founder of **lampscience.com.**

We would like to thank all presenters and attendees for their engagement and invaluable contributions to the success of the conference.

We look forward to enjoying the conference with you.

Fuen, Víctor, Antonio, Marina, Eduardo and Pablo (the organizing committee)

Programme



Thursday 14th December

8:30 – 9:00 **Registration**

9:00 – 9:15 **Welcome**

9:15 – 10:30 **Session Lavoisier & Pierrette Paulze**

9:15 – 9:30 **David San Andrés:** The H_2CN/H_2NC abundance ratio: a new potential temperature tracer for the interstellar medium

9:30 – 9:45 **Antonio López-García**: HCN chemistry in aqueous systems

9:45 – 10:00 **Gonzalo José Carracedo Carballal**: This is the (Bayesian) way: informed correction of field distortions in HARMONI

10:00 – 10:15 **Miguel Arribas Tiemblo**: Preservation of organics in martian regolith analogues under a simulated Mars surface environment

10:15 – 10:30 **Andrés Megías:** A machine learning model to predict the composition and temperature of infrared ice spectra

10:30 – 11:30 **Mental health seminar:** "Primeros pasos para cuidar la salud mental"

- **Dra. Sara Arias De Benito (base psicologia.es)**
- **Dra. Raquel Alcalde Herrera (basepsicologia.es)**

11:30 – 12:00 Coffee Break – Posters

12:00 – 13:00 **Session Marie Curie**

12:00 – 12:15 **Mara Laguna Castro:** Virus evolution at low host density depending on the environmental temperature

12:15 – 12:30 **Olga Balsalobre Ruza:** First tentative observational evidence of exotrojan formation: PDS 70 L5b

12:30 – 12:45 **Álvaro López-Gallifa:** Chemical composition of G31.41 and its comparison with different phases of the star formation

12:45 – 13:00 **Víctor I. Muñoz Hisado**: Técnicas -ómicas y su relevancia en la comprensión de ecosistemas desconocidos de interés astrobiológico

13:00 – 14:00 Lunch

14:00 – 15:00 Science communication seminar. **Dr. Juan Fernández Macarrón:** "Comunicación y divulgación efectivas: pautas para acercarse al público general y científico". CosmoAventura (www.cosmoaventura.com)

15:00 – 16:15 **Session Leonardo Da Vinci**

15:00 – 15:15 **Eduardo Alonso Pintado:** Follow the polymers: Could they be present elsewhere? Would their detection mean life? How can we detect them?

15:15 – 15:30 **Pablo L. Finkel**: Lipid biomarker preservation in a high altitude Andean lake

15:30 – 15:45 **Diego Martín Carrero:** Search for photometric variability and determination of physical parameters in very low-mass stars and brown dwarfs

15:45 – 16:00 **David Tovar Rodriguez:** Gorgona Island as a potential terrestrial analog of Syrtis Major – Mars

16:00 – 16:15 **Beatriz Gallego Fernández:** Molecular and cell responses of the cyanobacterium Chroococcidiopsis sp. 029 to Mars-relevant perchlorate salts

Friday 15th December

09:00 – 10:30 **Session Lynn Margulis**

9:00 – 9:15 **Federico Mansilla Núñez:** Trazando la habitabilidad de Marte

9:15 – 9:30 **David Rodríguez:** Development of superconducting circuits for space and quantum applications

9:30 – 9:45 **Eva Herrero Cisneros:** Atmósferas de exoplanetas con espectroscopía de transmisión

9:45 – 10:00 **Alicia Rodríguez Moreno**: Supervivencia y evolución de virus en ambientes de interés astrobiológico simulados en el laboratorio

10:00 – 10:15 **Raquel Murillo Ojeda:** An introduction to white dwarfs with substellar companions

10:15 – 10:30 **María Ángeles López Cayuela:** The dance of suspended dust in the Martian atmosphere

10:30 – 11:30 **Round Table - Careers post PhD:**

- **Dr. Samuel Moncayo: (**www.antaresinstrumentacion.com)
- **Dr. Miguel Ángel Lominchar: (CAB profile** link)
- **Dra. María Lamprecht: (**www.lampscience.com)

11:30 – 12:00 Coffee Break – Posters

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	12:30 – 12:45	**Carlos Del Burgo Olivares:** Simulación Experimental de Procesos Físico-Químicos en Análogos de Hielo Interestelar
	12:45 – 13:00	**Marina Fernández Ruz:** La autocatálisis como mecanismo fundamental en el origen de la vida
	13:00 – 13:15	**Lorenzo Ulivi:** Exploring the Nuclear Region of Arp220 with NIRSpec@JWST
	13:15 – 13:30	**María Angélica Leal Leal:** The potential of Deception-Antarctica island as a Martian analog os astrobiological interest
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13:45 – 14:45		**Session Jocelyn Bell**
	13:45 – 14:00	**Amadeo Castro-González:** A planet covered in steam? Exploring TOI-244 b and the growing population of low-density super-Earths
	14:00 – 14:15	**Marcos Martínez Jiménez:** Study of a model for the origin of molecular complexity through explainable machine learning and statistical models
	14:15 – 14:30	**Michelangelo Pantaleoni González**: A 3D Map of the Milky Way Galaxy
14:30 – 14:45		**Closing Remarks**

Abstracts

Thursday 9:15-10:30 Session Lavoisier & Pierrette Paulze

9:15-9:30	**The H2CN/H2NC abundance ratio: a new potential temperature tracer for the interstellar medium**
	David San Andrés
	CAB
	The H2NC radical is the high-energy metastable isomer of H2CN radical, which has been recently detected for the first time in the interstellar medium towards a handful of cold galactic sources, besides a warm galaxy in front of the PKS 1830−211 quasar. These detections have shown that the H2CN/H2NC isomeric ratio, likewise the HCN/HNC ratio, might increase with the kinetic temperature of the gas (Tkin), but the shortage of them in warm sources still prevents us from confirming this hypothesis and shedding light on their chemistry. In will present the first detection of H2CN and H2NC towards a warm galactic source, the G+0.693−0.027 molecular cloud (with Tkin > 70 K), using IRAM 30-m telescope observations. We have detected multiple hyperfine components of the 1_01–0_00 and 2_02–1_01 rotational transitions, deriving an H2CN/H2NC abundance ratio of 2.2 ± 0.5. These detections confirm that the H2CN/H2NC ratio is ≳2 for sources with Tkin > 70 K, larger than the ∼1 ratios previously found in colder cores (Tkin ∼ 10 K). This isomeric ratio dependence on temperature cannot be fully explained with the currently proposed gas-phase formation and destruction pathways. Grain surface reactions, including the H2NC → H2CN isomerization, deserve consideration to explain the higher isomeric ratios and H2CN abundances observed in warm sources, where the molecules can be desorbed into the gas phase through thermal and/or shock-induced mechanisms.
9:30-9:45	**HCN chemistry in aqueous systems**
	Antonio López-García
	CAB
	According to the hypothesis of Oparin and Haldane (First the metabolism), on the primitive Earth there were certain temperature conditions, as well as radiation from the Sun, which affected the substances that existed at that time in the primitive seas. These substances combined in such a way to give rise to living beings [1,2]. The experiment demonstrated that under the abiotic conditions envisaged by Oparin-Haldane it was possible to synthesize the constituent units of proteins and, at the same time, establish the methodology for other researchers, varying the conditions, to obtain other types of biomolecules essential for the organization of living forms [3]. To test this hypothesis, the Miller-Urey experiment was conducted to be recognized as a major breakthrough in the study of the origin of life. It was received as confirmation that several of the key molecules of life could have been synthesized on the early Earth under the conditions envisioned by Oparin and Haldane. As a conclusion, it is confirmed that, from abiotic conditions, organic molecules were formed, and then pre-cellular systems that gave rise to the first cells [4]. To demonstrate this theory, Miller proposed an experiment in which the water was heated to evaporate and, in another vessel, electrodes emitted electrical discharges that passed through the water vapor and gases in the evaporation flask, simulating the atmosphere of the early Earth [4]. Stanley Miller gave experimental support to Oparin's idea that the conditions and simple inorganic molecules of the planet's primitive atmosphere had the ability to combine to form organic molecules from living beings. So, with all this previous information, we move to Joan Oró and the experiments he carried out. It is important to remark the synthesis processes he performed to determine the structure of adenine, simulating these prebiotic conditions and starting from HCN as a precursor [5]. Oró was one of the promoters of the theory of panspermia to explain the origin of life on our planet. The theory of panspermia holds that the organic matter that gave rise to life could have arrived on our planet in the comets and asteroids that impacted the primitive Earth. HCN was indeed present in these meteorites. In our lab we recreate these aforementioned experiments by varying the experimental and synthesis conditions in order to determine the plausible molecules that could have originated life on Earth as we know it, in particular in the presence of aqueous aerosols.

9:45-10:00	**This is the (Bayesian) way: informed correction of field distortions in HARMONI**
	Gonzalo José Carracedo Carballal
	CAB
	HARMONI is the first light visible and near-IR integral field spectrograph for the Extremely Large Telescope (ELT). To achieve its optimal image quality, an accurate measurement of the telescope's pointing error is necessary. These measurements are affected both by systematic and random error contributions. In order to remove the systematic contribution, a corrective model is necessary. In this talk, we start by outlining the current formulation of the corrective model and how it is expected to be calibrated. We continue by introducing the Bayesian formulation of the calibration process and the extra benefits derived from the knowledge of the measurement process. Next, we share the results of our simulated calibrations, classical and Bayesian, along with the number of calibrations required to achieve the desired acuracy. We finish with a summary of the performance of the calibration process, and future improvements of the corrective model.
10:00-10:15	**Preservation of organics in martian regolith analogues under a simulated Mars surface environment**
	Miguel Arribas Tiemblo
	CAB
	The preservation of organic biosignatures in the Martian surface is likely to be impaired by several factors, the most prevalent of them being the lack of both a thick atmosphere and a magnetosphere, and the oxidative pressure exerted by the regolith itself. The absence of a thick atmosphere in Mars means that the practical totality of the UV spectrum reaches the surface. The energetic regions of this spectrum (UVB and UVC) are highly associated with the oxidative stress that promotes organic matter degradation, and are particularly damaging to aromatic residues. This stress makes aromatic-containing organic matter, like proteins and DNA, particularly susceptible to photolytic or chemical degradation. Proteins are extremely heterogeneous and their varied amino acidic composition makes them good targets of preservation studies. To assess to which degree are proteins protected from UV irradiation when adsorbed to the martian regolith, we spiked bovine serum albumin (BSA), a commonly used model protein, into two commercially available martian regolith simulants (MMS-2 and MGS-1) and subjected them to UVB irradiation under several atmospheric and humidity conditions. Samples were then hydrolized through MSA acid hydrolysis, and the resulting amino acidic patterns were analysed and quantified through HPLC-FLD and OPA derivatizations, which allowed for the quantification of 16 different amino acid. We determined that 1 mm thick regolith layers could prevent most UV-induced damage when compared to directly irradiated films. Irradiation of wet substrates, however, led to increased amino acid degradation in all conditions, although the presence of regolith still offered significant protection. There were also differences between regoliths, as MMS-2 was significantly more oxidative and could lead to UV-independent chemical alterations. It was also determined that Trp, Met, His and Tyr were the more unstable amino acids under UV irradiation.
10:15-10:30	**A machine learning model to predict the composition and temperature of infrared ice spectra**
	Andrés Megías
	CAB
	Interstellar dust is composed of micrometric particles of silicates and carbon, usually covered by an ice layer of varying composition. The main species of this ice layer is water, followed by carbon monoxide, carbon monoxide, methanol, methane and ammonia, but it may contain more complex organic compounds. Surface chemistry in interstellar dust plays a key role in the chemistry on the interstellar medium, and it is believed to be important for the formation of complex organic molecules that lead to the formation of prebiotic molecules in solar-type systems. However, measuring the composition of dust ices requires very sensitive astronomical observations, which is difficult with ground based telescopes. Fortunately, current and future observations carried out by James Webb Space Telescope (JWST) allow to observe absorption features of ices with high sensitivity and spectral

	resolution. But, despite the good quality of the data, identifying the spectral features of the different molecules present in the ice is not trivial but a time-demanding task that is usually done manually. In this talk I will present a machine-learning algorithm based on artificial neural networks that allows to predict the fractional composition and temperature of a given absorption ice spectrum on the infrared range from 2.5 to 20 microns. In order to train the model, we have used hundreds of laboratory experiments of ice mixtures available from a public database. Once trained, the algorithm is very fast and our results show a good performance, with errors of 5-10 %. This would allow us to make fast and automatized predictions on the major ice components of astronomical observations.

Thursday 12:00 – 13:00 Session Marie Curie

12:00-12:15	**Virus evolution at low host density depending on the environmental temperature**
	Mara Laguna Castro
	CAB
	Microbes, as well as their viruses, can be found in most environments on our planet, including some presenting very harsh conditions for life. In the same way as the formers are able to get adapted to adverse conditions, viruses have developed mechanisms to optimize the infection of their hosts. However, the molecular basis of the adaptive strategies can be difficult to identify. Experimental evolutionary studies carried out under controlled conditions in the lab can be of great help in these cases, allowing to identify the relationships between environment, phenotype and genotype (1). We have used bacteriophage Qβ, an RNA phage that replicates optimally at 37 °C, to carry out evolution experiments at suboptimal host density, both at optimal temperature (37 ºC) and at suboptimal ones (30 ºC and 43 ºC). Qβ adaptation to low host density at 30 ºC and 37 ºC took place through a mutation in the minor capsid protein, whose location and function are not well defined. In contrast, Qβ adaptation to low host density at 43 ºC took place through a different mutation, located in the protein described as the receptor binding protein, which also acts as a promoter of bacterial lysis. Surprisingly, both mutations have the same effect; they enhance virus capacity to entry into the cell, revealing a common strategy for adaptation to low host density. However, mutation selected at 43 °C has a strong fitness cost at 30 ºC and 37 °C, manifested in a great increase on the length of the latent period. Our results show how the interaction between adaptive advantages and potential fitness costs define viral evolutionary pathways depending on the physicochemical traits of the environment (2, 3).
12:15-12:30	**First tentative observational evidence of exotrojan formation: PDS 70 L5b**
	Olga Balsalobre Ruza
	CAB
	The young PDS 70 system is currently our best planetary formation laboratory. Hosting the only two non-controversial planets in the process of formation, this target allows numerous studies not yet accessible to any other system. This is the case for Trojan formation, bodies that share their orbital path around the star as thousands of asteroids do with Jupiter. Gas and dust from the birth disk are expected to get trapped in the Lagrangian regions of protoplanets, and eventually, can form massive bodies up to planetary sizes. Over the last two decades, exotrojans were predicted by theory and simulations, but there were no observational hints of either their existence or their formation to date. In this talk, I will present our recent results searching for Trojan formation evidence in the PDS 70 system using archival ALMA data. We have found tentative sub-millimeter emission in the L5 region of the inner planet. It corresponds with 0.7 masses of the Moon of ~ 1mm-sized dust particles that may share the orbit with a protoplanet. If confirmed, this would be the first direct evidence of exotrojan formation, supporting their formation theories and opening the window to their detection in mature systems.
12:30-12:45	**Chemical composition of G31.41 and its comparison with different phases of the star formation**
	Álvaro López-Gallifa
	CAB

	Stars and planets are born within dense regions of molecular clouds, which are composed of interstellar dust and a rich chemical reservoir of molecules. Some of these molecules have a high prebiotic interest, and they could have been delivered to the Earth through meteorites and comets that were formed in the parental molecular cloud of our Solar System. Therefore, it is important to study a high-mass star forming region to know the available molecules when our Solar System was formed. We choose G31.41 because is a chemically rich stellar cluster. We analyzed 34 molecules for the first time and we use them adding other 24 species analyzed in previous GUAPOS works, to compare this source with a low-mass star-forming region (IRAS 16293–2422B) and two comets (67P/Churyumov-Gerasimenko and 46P/Wirtanen). Thus, we are comparing the molecular reservoir of 4 sources which represents different stages of a planetary system formation. We want to find correlations between the molecules by making a comparative study, retrieving if there is chemical heritage between these sources. We obtained that the abundances of oxygen- and nitrogen-bearing molecules have a good correlation for all sources suggesting a chemical heritage of these species during the process of star-formation, and thus an early phase formation of the molecules. However, sulfur- and phosphorus-bearing species present a worse correlation and are more abundant in comets. This suggests that while S-bearing species could be trapped on the surface of icy grains in star-forming regions, they could be released freely into gas phase in comets, allowing their cosmic abundances to be recovered.
12:45-13:00	**Técnicas -ómicas y su relevancia en la comprensión de ecosistemas desconocidos de interés astrobiológico.**
	Víctor Ignacio Muñoz Hisado
	CAB
	Uno de las lineas de investigación centrales en Astrobiología es el estudio de los denominados microorganismos extremófilos. Hasta hace relativamente poco tiempo, las técnicas de análisis (genómica, proteómica etc.) no permitían una gran resolución a la hora de conocer la composición y el comportamiento de las comunidades microbianas que podemos encontrar en una muestra ambiental. Desde hace unos años, la expansión de las técnicas ómicas nos permite conocer con mucho más detalle qué microorganismos habitan una muestr ambiental, en qué se diferencian de otros microorganismos muy similares, cómo responden a cambios ambientales y qué rol desempeñan en la dinámica de ese ecosistema. Estas limitaciones anteriormente mencionadas, junto con lo inexplorado de algunos ambientes de interés astrobiológico como las cuevas heladas, los glaciares, o los desiertos helados constituyen un nicho de investigación con mucho potencial desde el punto de vista del análisis de la adaptación de los microorganismos a condiciones extremas. Los ambientes helados atraen gran atención en el campo de la astrobiología por diversos motivos, entre los que destacan su capacidad de preservar biomarcadores, su estabilidad ambiental de cara a la reconstrucción de paleoambientes y su analogía respecto a cuerpos estelares como las lunas heladas Europa, Encélado o Titán considerados lugares compatibles con la vida en nuestro sistema solar. En mi tesis doctoral, uno de los principales objetivos es describir las poblaciones microbianas, sus mecanismos de adaptación a condiciones extremas de baja temperatura y las dinámicas ecosistémicas de varias cuevas heladas localizadas en los pirineos, haciendo uso de técnicas ómicas como la metagenómica y la metaproteómica.

Thursday 15:00 – 16:15 Session Leonardo Da Vinci

15:00-15:15	**Follow the polymers: Could they be present elsewhere? Would their detection mean life? How can we detect them?**
	Eduardo Alonso Pintado
	CAB
	For life to exist, the storage of information in the genetic material as well as its expression through translation is compulsory. Without polymers, these processes would not be possible. Based on the strategy of searching for polymers as the first step to finding life beyond Earth, we describe the simplest polymers that must have emerged abiotically based on organic monomers found in space, mainly amino acids. It's difficult to distinguish

	whether they are biological or not when it comes to peptides (small amino acid polymers) that can also be generated abiotically. The tripeptide DGD, for example, is composed of amino acids abundant in meteoritic material and forms a catalytic site overrepresented in proteins (biological catalytic amino acid polymers) of all three domains of life. To test our hypotheses, a series of polymerization experiments are being carried out under abiotic conditions. To find these amino acid polymers in planetary exploration, a series of antibodies have been developed that recognize the different motifs whose abiotic polymerization we are trying to carry out. This falls within SOLID's strategy in the search for biological peptides in planetary exploration.
15:15-15:30	**Lipid biomarker preservation in a high altitude Andean lake**
	Pablo L. Finkel
	CAB
	Lipids are apolar (1) organic compounds that form an integral part of biological cell membranes. As such, lipids are ubiquitous in life on Earth, which is why they are considered effective biomarkers in terrestrial extreme environments with analogy to Mars (2). A notable strength of lipidic compounds over other biomolecules is their greater geostability, meaning that they are more thermally and diagenetically stable, and thus, more prone to conserve their molecular integrity over time. Under ideal conditions involving a preservation-favoring environment along with mild diagenesis, lipids have the capacity to retain diagnostic information about their biological source and synthetic metabolism for billions of years (3), which is an indispensable condition in astrobiology given the timespan that the geological ages of planetary bodies encompass. Our work has been focused on the lipid biomarker analysis of fresh and lithified bacterial communities from a high altitude Andean lake in Argentina, where we expect to assess a spectrum of stages of degradation from the fresher samples, where lipid biomarkers are abundant, to the more lithified samples, where only the most geostable lipids remain. By discussing this perspective, we hope to provide an overview of the potential of lipids in astrobiology, which will be accompanied by ideas on how to seize their potential as biomarker targets for future space missions.
15:30-15:45	**Search for photometric variability and determination of physical parameters in very low-mass stars and brown dwarfs**
	Diego Martín Carrero
	CAB
	Spectrophotometric variability in stars and brown dwarfs is mostly caused by large-scale atmospheric structures that rotate in and out of view. Their monitoring allows us to measure the rotation period of the dwarf. According to the most recent census for very low-mass stars and brown dwarfs, only 130 of them have a measurement of their rotation period. This compilation reveals that none of these objects has a rotation period shorter than 1 hr, which contrast with theoretical predictions. In this project we are searching for photometric variability that can be linked to rotation in very low-mass stars and brown dwarfs of different masses and effective temperatures to increase the significance of the 1-hr empirical limit. In particular, our team has compiled more than 200 h of photometric time series of some of the coldest brown dwarfs and planetary mass objects by using >8-m class telescopes. The most promising objects identified in the study will be further characterized by tools developed as part of the Virtual Observatory. As a result, we will have a WD catalogue that will detail the best fit model, if they have an infrared flux excess and the reasons. These results will be confirmed with observational data obtained from telescopes such as the VLT and GTC.
15:15-16:00	**Gorgona Island as a potential terrestrial analog of Syrtis Major - Mars**
	David Tovar Rodriguez
	CAB
	Gorgona Island (Colombia), located in the Pacific, emerges as a promising terrestrial analog for the Syrtis Major region on Mars. This study highlights the distinctive geochemical composition of its ultramafic lava flows (komatiites), providing a unique platform for research in planetary geology and astrobiology. Geochemical similarities, instrument calibration, and possible astrobiological implications are presented, highlighting

	the relevance of Gorgona in classifying terrestrial analogs. The island is positioned as a potential analog, focusing on petrological processes, astrobiology, and engineering applications. This study compiles the available information on Gorgona Island. It allows us to hypothesize that it could be considered a crucial geochemical analog for future research in planetary geology and astrobiology, as well as possible research prospects to characterize it as an analog of Mars.
16:00-16:15	**Molecular and cell responses of the cyanobacterium Chroococcidiopsis sp. 029 to Mars-relevant perchlorate salts**
	Beatriz Gallego Fernández
	CAB

Friday 9:00 – 10:30 Session Lynn Margulis

9:00-9:15	**Trazando la habitabilidad de Marte**
	Federico Mansilla Nuñez
	CAB
	Los signos de un pasado hídrico en Marte nos ayudan a encontrar los lugares donde es mas posible que haya existido un ambiente habitable. Para este fin el análisis geomorfológico desempeña un papel fundamental, que, mediante el uso de distintos métodos de teledetección, nos permite identificar elementos del paisaje indicativos del flujo tanto de agua líquida como helada sobre la superficie de Marte. Para ello hacemos uso de una amplia zona del espectro electromagnético que abarca desde las ondas de radio utilizadas por los instrumentos de radar como SHARAD (MRO) o MARSIS (Mars Express), hasta la radiación gamma detectada por los espectrómetros como GRS (Mars Oddisey) o FREND (TGO – Exo Mars) , haciendo especial hincapié en los sensores dentro de los rangos visible e infrarrojo. Con todas estas fuentes de información integradas en un conjunto de capas dentro de un sistema de información geográfica (QGIS), podemos realizar análisis multiparamétricos de una zona concreta caracterizándola tanto mineralógica, morfológica como estructuralmente, para, con posterioridad y mediante técnicas como la datación por conteo de cráteres acabar asignando edades a esas unidades que conforman la compleja geología marciana, con el fin de desentrañar cuando pudieron ser habitables las zonas de estudio y poder realizar un mapa de la habitabilidad de Marte tanto pasada como actual. El fin último de estos trabajos es conferir a la comunidad de una serie de herramientas para la toma de decisiones en el ámbito de la protección planetaria para evitar tanto la colonización accidental de Marte con organismos terrestres como una posible interacción no deseada con biomas marcianos.
9:15-9:30	**Development of superconducting circuits for space and quantum applications**
	David Rodriguez
	CAB
	Superconducting resonators promise to be crucial elements in upcoming scientific breakthroughs as enabling technologies for many applications as astronomical detectors or in quantum computing [1]. These resonators are used in a wide range of applications that include space instrumentation, quantum computing, quantum sensing and dark matter detection [2]. The main advantages of using this type of resonators are their the extremely low noise and that they are frequency multiplexable, which allows to simultaneously measure hundreds of them using with a single wire, simplifying the experimental setup and giving room to scalability for different applications. In particular, my thesis focuses on the optimization of this superconducting resonators for three main applications: i) state-of-the-art photon detectors for astrophysical instrumentation and dark matter sensing [3], as they provide outstanding sensitivity as compared with semiconducting detectors; ii) as essential building blocks for the development of a quantum processor based on molecular qubits [4]; and iii) as extremely sensitive biological sensors. In this talk, I will present my work for the development of this microwave superconducting technologies, covering the design, nanofabrication, low temperature (mK) electrical characterization and I will give a brief introduction for the different applications mentioned

	before.
9:30-9:45	**Atmósferas de exoplanetas con espectroscopía de transmisión**
	Eva Herrero Cisneros
	CAB
	La técnica de espectroscopía de transmisión es una herramienta fundamental para estudiar atmósferas de exoplanetas. Esta metodología, consistente en la observación espectroscópica de exoplanetas durante el tránsito sobre su estrella, nos permite identificar diversas especies atómicas y moleculares, ofreciendo detalles sobre la composición atmosférica, así como información sobre perfiles de temperatura y la dinámica de vientos atmosféricos. En esta presentación abordaremos los procesos clave y las herramientas empleadas en la caracterización de atmósferas de exoplanetas, mostrando ejemplos de observaciones obtenidas con el espectrógrafo ESPRESSO del Very Large Telescope (VLT).
9:45-10:00	**Supervivencia y evolución de virus en ambientes de interés astrobiológico simulados en el laboratorio**
	Alicia Rodríguez Moreno
	CAB
	Antes de que surgiera la vida celular, en nuestro planeta tuvieron que existir moléculas capaces de almacenar información genética y transmitirla mediante su replicación. Los inevitables errores asociados al proceso de copia de las moléculas informativas favorecerían la generación de poblaciones heterogéneas, sobre las que actuaría la selección natural, permitiendo así la optimización evolutiva. En el mundo actual, las entidades más similares a esos primitivos replicadores son los virus. Estos tienen una fase extracelular, en la cual se comportan como partículas inertes expuestas a las condiciones del medio externo, y una fase intracelular, durante la cual se replican en el interior de su hospedador. La radiación ultravioleta procedente del Sol, las temperaturas elevadas y la desecación son tres de los principales factores que limitan la estabilidad de los virus en ambientes terrestres, condicionando su viabilidad posterior. En ambientes extraterrestres, puede haber otros muchos más factores y con valores más extremos. Los valores de las variables físico-químicas fuera del óptimo no solo influyen en la viabilidad viral, sino que también pueden tener un efecto en su evolución, debido a su doble actuación como presiones selectivas y, en algunos casos, también como agentes mutagénicos. Como consecuencia, un posible resultado a largo plazo de la exposición de una población viral a una condición ambiental concreta (o una mezcla de ellas) sería el incremento de su resistencia a esa misma condición. Las condiciones ambientales, cuyo impacto sobre el virus que utilizamos como modelo experimental (el bacteriófago Qβ) estamos analizando en nuestro grupo, son la luz ultravioleta de diferente longitud de onda, la desecación producida por diferentes métodos, la microgravedad (usando un clinostato 3D), la interacción con un sustrato que simula el regolito marciano y la repetición de ciclos de congelación y descongelación. En la exposición mostraré los primeros resultados obtenidos.
10:00-10:15	**An introduction to white dwarfs with substellar companions**
	Raquel Murillo Ojeda
	CAB
	White dwarfs are stellar remnants of low and intermediate mass stars, such as the Sun. They are compact objects, with typical masses around half a solar mass and planetary sizes. They are one of the most common objects in the universe. In this talk I will explain how a star becomes a white dwarf, what are their most important characteristics and why it is important to study them. I will focus on white dwarfs with substellar companions, how we search for these binary systems with Virtual Observatory tools and what objects they may be accompanied by.
10:15-10:30	**The dance of suspended dust in the Martian atmosphere**
	María Ángeles López Cayuela
	INTA
	The Martian atmospheric dust cycle is pivotal in the planet's radiative balance. Despite

	years of extensive modelling and measurement efforts, several key parameters remain insufficiently understood like the total mass of dust in circulation, dust lifting and settling rates, and its primary sources and sinks. Our study presents a data reduction methodology based on global and seasonal orbital measurements of atmospheric dust opacity. The method can accurately describe the annual dust redistribution cycle on a planetary scale with a remarkable 95% accuracy. The approach was applied to 9.3 μm infrared data from the Thermal Emission Spectrometer aboard the Mars Global Surveyor. By comparing these observations with Earth's data, we propose a mass-to-extinction conversion factor of 1.9 ± 0.3 g m-2, assuming a dust density of 2.6 g cm-3. The analysis estimates that approximately 4 10^17 kg of dust is transported globally in the Martian atmosphere during a typical Martian year, a quantity similar to the minimum annual dust transport on Earth. Notably, this methodology relies on remote sensing and cannot fully separate local surface dust dynamics from dust advection, but it provides upper bounds for comparison with in-situ observations. The examination of the dust sedimentation cycle suggests the potential formation of a dust layer measuring about 50-100 μm on the surface in specific regions, consistent with in-situ rover observations on Mars. The primary dust sources are mainly located within latitudes ranging from 20°S to 60°S, with substantial agreement with sources identified by existing planetary circulation models. This large-scale analysis serves as a foundation for refining calculations and studying the annual and geographical variability of dust-mass transport on Mars using remote sensing data.

Friday 12:00 – 13:30 Session James Hutton

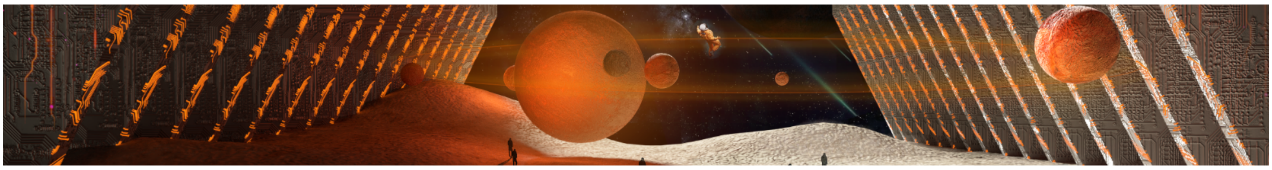
12:00-12:15	**Exploring Our Cosmic Roots: Understanding the Epoch of Reionization with JWST and ALMA**
	Carmen Blanco
	CAB
12:15-12:30	**An Exocomet Sandbox**
	Jose Luis Gragera Más
	CAB
	Beta Pictoris is a 20 Ma old stellar system, situated 63,4 ly from our planet. It hosts two planets but it is better known for having a debris disk and multiple exocomets belonging to two distinct exocomet populations. Although the disk was first imaged four decades ago, subsequent observations have revealed a very complex structure. The primary focus of my PhD research is the application of N-body simulations to investigate the infall of minor bodies into the system's inner planets. This process holds significant interest as it mimics the assumption that comets might have been responsible of the delivery of the majority of Earth's water. By studying this process in other stellar systems, such as Beta Pictoris, we can gain invaluable insights into the history of terrestrial life and the potential for extraterrestrial life in the cosmos.
12:30-12:45	**Simulación Experimental de Procesos Físico-Químicos en Análogos de Hielo Interestelar**
	Carlos del Burgo Olivares
	CAB
	En las regiones más frías de las nubes moleculares se forman mantos de hielo sobre los granos de polvo. Estos mantos de hielo están compuestos principalmente de moléculas simples volátiles. El procesamiento ultravioleta sufrido por estos hielos produce reacciones fotoquímicas que dan lugar a la formación de moléculas cada vez más complejas. El aumento de la temperatura del hielo (por ejemplo, en núcleos calientes) provoca la desorción de estas moléculas, pudiendo ser detectadas por observaciones astronómicas. Por lo tanto, la comprensión de la fotoquímica y la desorción que tiene lugar en los hielos es fundamental para interpretar las abundancias obtenidas en las

	observaciones astronómicas. En nuestros experimentos hemos estudiado el comportamiento de hielos de moléculas orgánicas complejas sometidos a radiación UV y procesamiento térmico. La exposición de estas especies (ácido acético CH3COOH, metanol CH3OH y metilamina CH3NH2) a radiación UV provoca la formación de fotoproductos. En nuestros experimentos se han obtenido moléculas como CO, CO2, CH4, H2CO, HCONH2, CH3CH2NH2, y el N-heterociclo hexametilentetramina ((CH2)6)N4), denominado HMT, considerado un precursor de aminoácidos.
12:45-13:00	**La autocatálisis como mecanismo fundamental en el origen de la vida**
	Marina Fernández Ruz
	CAB
13:00-13:15	**Exploring the Nuclear Region of Arp220 with NIRSpec@JWST**
	Lorenzo Ulivi
	CAB / INAF
13:15-13:30	**The potential of Deception-Antarctica island as a martian analog of astrobiological interest**
	María Angélica Leal Leal
	CAB
	The establishment of the possible existence of life on Mars is based on the study of planetary analogs, which allows in situ analysis of the environments in which living organisms adapt to often extreme conditions. Although Mars has been a candidate for hosting life, based on observations made decades ago, it is thanks to the characteristics identified in environments, mainly volcanic, that it has been possible to calibrate instruments and detail the features of the red planet. In this paper, we present a review of the characteristics of the different planetary analogs, the classified analogs, particularly deepening in Antarctica, to expose later the factors studied in Deception Island that have contributed to considering it as an analog of Mars from different perspectives. Finally, although geological and geomorphological studies on the analogies of the island already exist, detailed analyses that present the approach of astrobiological analogs are required, thus allowing research.

Friday 13:45 – 14:45 Session Jocelyn Bell

13:45-14:00	**A planet covered in steam? Exploring TOI-244 b and the growing population of low-density super-Earths**
	Amadeo Castro-González
	CAB
	Small planets located at the lower mode of the bimodal radius distribution are generally assumed to be composed of iron and silicates in a proportion similar to that of the Earth. However, recent discoveries are revealing a new group of low-density planets that are inconsistent with that description. Their low densities could be explained by a scarcity of iron within their cores, by the presence of a significant amount of volatile elements, or by both effects. Recently, Adibekyan et al. found that stars with higher Mg/Fe and Si/Fe ratios host lighter super-Earths, which indicates a compositional star-planet connection. However, the lowest dense super-Earths cannot be explained by having an iron-poor core, and instead require a significant amount of volatile elements in their compositions. The reason why those planets have such large amounts of volatiles is still unknown. In this talk, I will present our recent characterization of the unusually low-density super-Earth TOI-244 b based on ESPRESSO and TESS data and discuss its possible composition. Besides, I will present two tentative trends in the density-metallicity and density-insolation parameter space that might hint at the formation and composition of the lowest-density super-Earths.
14:00-14:15	**Study of a model for the origin of molecular complexity through explainable machine learning and statistical models**
	Marcos Martínez Jiménez

	CAB
	Despite the recent detection of an increasing number of complex organic molecules in outer space, the limits of the natural molecular complexity it can harbor are still unknown. Astrochemical models based on complex systems, like the recently proposed NetWorld computational framework (1), have shown promising results in the study of the emergence of chemical complexity and how the most basic bricks of life on Earth could be created in the interstellar medium. NetWorld simulates the evolution of abstract network structures that can join or be divided in different environments, producing an artificial chemistry that despite its lack of direct connection with real chemistry is able to reproduce important properties related with the origin of complex molecules with potential astrobiological interest. In this work we analyze the NetWorld framework in more detail and improve its efficiency by using machine learning and statistical techniques to predict network abundance from different network measures, discovering new relationships that can be used to determine the abundance of a network. We identified several measures based on the topology of networks and on the ways they can be formed that support abundance prediction. Furthermore, multivariate models including several measures simultaneously allowed us to improve our results, achieving considerable predictive power. Our work may be extended to real astrochemical environments, where it could be used to obtain a baseline for the abundance of different molecules, helping to determine the types of molecules that can potentially arise abiotically in the interstellar medium.
	A 3D Map of the Milky Way Galaxy
14:15-14:30	Michelangelo Pantaleoni González
	CAB
	Since Galileo's realisation that the Milky Way is in fact a vast field of "innumerable" stars, astronomers have been working hard to map our own Galaxy. Thanks to the outstanding capabilities of ESA's Gaia mission, we are now able to do this in 6 dimensions (3D positional and kinematic) for more than a billion stars across the sky. We have approached Galactic cartography from the point of view of massive blue stars (Maíz Apellániz et al. 2017), tracing the spiral arm structure and the main star forming regions of the Solar Neighbourhood (Maíz Apellániz et al. 2022), while uncovering evidence of a spatial vertical oscillation in the disc (Pantaleoni et al. 2021) that might contain relevant information about previous galactic mergers. I will also show maps of the Galaxy using the most accurate dust mapping available (Edenhofer et al. 2023) and compare the different tracers. Tracing the spiral arms and their motion has interesting consequences for arguments related to the Rare Earth hypothesis, and thus presents an important discussion for astrobiology.



Posters

P1 **Testing Silicon Photomultipliers (SiPMs) characteristics with temperature for the development of a Mars atmospheric LiDAR**
Alberto Moya
INTA

P2 **Hunting substellar companions in ultra-cool objects in young kinematics groups.**
Abel Cuchi Olcina
INTA

P3 **Learning compact reduced-order models for chaotic fluid flows using beta variational autoencoders and transformers.**
Alberto Solera Rico
INTA

Reduced-order models (ROMs) play a crucial role in advancing science and engineering by providing computationally efficient yet accurate approximations of complex or high-dimensional systems. Their importance lies in enabling rapid simulations, real-time decision making and cost-effective analysis in fields as diverse as fluid dynamics, weather forecasting, structural dynamics and biomedical engineering. Variational autoencoder (VAE) architectures have the potential to develop ROMs for chaotic fluid flows. We propose a method for learning compact and near-orthogonal ROMs using a combination of a beta-VAE and a transformer, tested on numerical data from a two-dimensional viscous flow in both periodic and chaotic regimes. The beta-VAE is trained to learn a compact latent representation of the flow velocity, and the transformer is trained to predict the temporal dynamics in latent-space. By using the beta-VAE to learn disentangled representations in latent-space, we obtain a more interpretable flow model with features similar to those observed with proper orthogonal decomposition, a classical linear method, but with a more efficient representation. Using Poincaré maps, the results show that our prediction method can capture the underlying dynamics of the flow and outperform other prediction models.

P4 **The origin of SiO emission in high-mass stars.**
Rong Liu
CAB

The production of Silicon monoxide (SiO) can be considered a fingerprint of shock interaction. Broad SiO emission is commonly attributed to molecular outflow activity, while the detection of narrow SiO emission toward a few massive star-forming regions is postulated to be due to gas compressed by large-scale shocks driven by cloud-cloud collisions. In this work, we use high-sensitivity SiO (2-1) and H13CO+ (1-0) emission to investigate broad and narrow SiO emission toward 146 massive star-forming regions in the ATOMS survey. We detected SiO emission in 136 regions and distinguished broad and narrow components across 118 sources that include 58 UCHII regions. The calculation of SiO luminosity (L_SiO) in broad and narrow components shows that the majority of L_SiO (above 87%) is attributed to the broad components, indicating their association with strong outflows. A comparison of filamentary skeletons and IR emissions (3.6, 4.5, and 8 um) with the SiO images reveals that most SiO emissions originate from the outflows. Based on the morphology of the broad and narrow components, we classify these sources into two categories. (A) The broad SiO is distributed more extensively than the narrow SiO; (B) The narrow SiO is distributed more extensively than the broad SiO. There is a moderate positive correlation between L_bol and L_SiO within these groups in broad components, while the correlation between these parameters is weak in narrow components. These results imply higher luminosity sources showing more intense outflow activities and also confirm that the broad SiO is attributed to outflows. Based on the spatial distribution analysis of SiO and 3mm continuum emissions in 58 UCHII sources, we observed that sources with coinciding SiO and 3mm continuum emissions exhibited more intense shock activities in both broad and narrow components. These findings suggest that HII regions might negatively influence the shock activities for sources where the SiO and 3mm continuum emission appear spatially separated.

P5 A Theoretical Approach to the Complex Chemical Evolution of Phosphorus in the Interstellar Medium

Marina Fernández-Ruz
CAB

The study of phosphorus chemistry in the interstellar medium has become a topic of growing interest in astrobiology because it is plausible that a wide range of P-bearing molecules were introduced in the early Earth by the impact of asteroids and comets on its surface, enriching prebiotic chemistry. Thanks to extensive searches in recent years, it has become clear that P mainly appears in the form of PO and PN in molecular clouds and star-forming regions. Interestingly, PO is systematically more abundant than PN by factors typically of ~1.4–3, independently of the physical properties of the observed source. In order to unveil the formation routes of PO and PN, in this work we introduce a mathematical model for the time evolution of the chemistry of P in an interstellar molecular cloud and analyze its associated chemical network as a complex dynamical system. By making reasonable assumptions, we reduce the network to obtain explicit mathematical expressions that describe the abundance evolution of P-bearing species and study the dependences of the abundance of PO and PN on the system's kinetic parameters with much faster computation times than available numerical methods. As a result, our model reveals that the formation of PO and PN is governed by just a few critical reactions, and fully explains the relationship between PO and PN abundances throughout the evolution of molecular clouds. Finally, the application of Bayesian methods constrains the real values of the most influential reaction rate coefficients making use of available observational data.

P6 Virus resistance to freezing-thawing cycles

Mara Laguna & Alicia Rodríguez
CAB

Life on Earth can withstand very harsh conditions. Extreme temperatures, low water availability, acidic pH, or high radiation levels are only some examples. Hypothetical life outside Earth could develop itself in even more extreme environments, which makes the study of terrestrial extremophile microorganisms to be of a great interest in the field of astrobiology. One of the most extreme circumstances that exist in our planet are relevant differences between night and day temperatures in some places such as deserts, where cyclical episodes of freezing and thawing are common. Since planets with a light atmosphere, with little capacity to generate a greenhouse effect, are places where life would have to endure conditions similar to those described, the study of the possible adaptations is quite relevant.

Viruses are biological entities that are similar in many aspects to the so-called primitive replicators that probably populated early Earth before the emergence of cellular life [1]. They consist of a genome that contains the genetic information necessary to generate a progeny using the resources of the cells they infect. They are covered by a protein capsid that provides protection against external environmental agents and contains the molecules that facilitate their entry into the cell. Viruses, in the virion form, are similar to inert matter and can withstand more extreme conditions than most cellular life. A general property of viruses is their high error rate, which in RNA viruses reaches values in the order of 10^{-6} to 10^{-4} errors per nucleotide copied [2]. This fact, together with the usually large sizes of their populations, leads to the generation of highly diverse populations that have a high potential for adaptation. For all these reasons, they are a good model to unveil the molecular mechanisms that allow adaptation and evolution of life.

In our lab, we perform experimental evolution studies using as experimental model the bacteriophage Qβ, an RNA virus that infects *Escherichia coli*. In the work presented here, we have studied the adaptation of Qβ under periodic exposure to freezing-thawing cycles, a selective pressure that strongly reduces its infectivity. Our results show that after thirty of such cycles - allowing replication of survivor viruses after thawing -, it is possible to obtain populations that better cope with this condition. The genetic characterization of the adapted populations, has allowed us to identify some specific mutations that make them better adapted. These mutations, mostly found by modifying the protein capsid of the virus, make populations more resistant to freezing-thawing cycles. In this paper we show the characterization of these new mutations and how they change the behaviour of evolved populations.

[1] I. de la Higuera and E. Lázaro, *Frontiers in Microbiology*, **13,** (2022)
[2] S. Gago, S. F. Elena, R. Flores and R. Sanjuán, *Science*, **323** (5919), 1308, (2009)

P7 Mineral interaction with cyanide-aqueous interfaces based on prebiotic chemistry conditions

Antonio López García
CAB

HCN is a ubiquitous molecule in the Universe and it can be synthesized relatively easily in the laboratory in the presence of a reducing atmosphere (with chemical simulation experiments and with high yields) [1]. HCN polymerization takes place spontaneously under an extensive scope of experimental terms. Within the field, it has been proposed that HCN polymers could be present in meteorites, asteroids and moons of the Solar System. Therefore, it is important to note the key role played by these compounds in the processes of chemical evolution and in the increasing molecular complexity of systems [2]. Polymerization/oligomerization processes of cyanide in the presence of alkaline aqueous aerosols will lead to the formation of a huge and complex organic matrix, where a large number of interactions trigger the formation of polar organic compounds such as amino acids, N-heterocycles and carboxylic acids, among others. Many of these are key compounds in the field of prebiotic chemistry and in the research of chemical evolution in these environments [3].

The effect of mineral surfaces in terms of increased molecular complexity has been considered important in origin of life studies. Not only for the information that provides, but also for the search and investigation of these newly formed structures as well as the chemistry involved in such processes [4]. Thus, a natural interaction between water systems and minerals is expected [5]. That is why we are currently exploring the effects of some minerals in the cyanide polymerization processes in the presence of aqueous aerosols in order to simulate plausible prebiotic environments. We have executed several cyanide syntheses (with varying reaction times) in the presence of mineral species based on its relativity abundance on the Martian surface and on the prebiotic Earth. We used them as potential analogues due to the relevant interactions between the mineral surfaces and the organic complex. The compounds obtained were elucidated (FT-IR, thermal analysis…) and showed remarkable changes in structure (dependent on the substrate used and the reaction conditions).

P8 Characterization and paleoreconstruction of a polar lacustrine environment using lipid biomarkers

Pablo L. Finkel
CAB

Lakes serve as valuable records of past environmental fluctuations, as they store information about their local ecosystem and surrounding basin within their sediments. As such, the study of sedimentary organic matter in lakes from polar latitudes not only allows for an ample characterization of the autochthonous and allochthonous biota, but also for a precise examination of the impact of particular geochemical changes in a climatically susceptible region of Earth (1). Our research is centered on a lake called Store Saltsø (Salt Lake in English) in the Kangerlussuaq territory of western Greenland. Salt Lake is a ~1 km long, ~0.5 km wide closed basin that receives its hydrological budget solely from meteoric inputs. The lake is emplaced at an altitude of 200 metres above sea level, and what distinguishes it from other freshwater bodies in the area is its high pH of 8.9 (1,880 mg/L of dissolved calcium carbonate) and its elevated electrical conductivity (3110 µS/cm), where sodium (343 mg/L), chloride (372 mg/L) and bromide ions (667 mg/L) are the most concentrated species contributing to salinity (2).

With the use of molecular and compound-specific isotopic analysis of lipid biomarkers, we aimed to investigate the biogeochemistry of this ecologically interesting lake. As structural components of all cell membranes, lipids combine ubiquity and geostability, meaning that they are able to be effectively preserved in the geological record for up to billions of years (3), which are invaluable qualities for reconstructing past life, with relevance toward understanding early life and toward the search for life beyond Earth. In this study, we first characterized the lipid molecular profile of lacustrine and shore sediments to identify the most likely biological sources. This, in combination with the carbon isotopic analysis of the identified lipid biomarkers, allowed us to better narrow down the prevailing biosources and associated carbon metabolisms.

Furthermore, the use of a series of lipid proxies diagnostic of sources and environmental conditions provided additional information about the paleoenvironment of Salt Lake to reconstruct its formation and evolution. Different molecular ratios were calculated in samples from a sediment core and from a vertical terrace transect by the lake shore to identify changes over time in the relative contribution of terrigenous versus aqueous material, or prokaryotic versus eukaryotic sources, which were contextualized by radiocarbon dating. The level of unsaturation of long chain alkenones – lipid biomarkers of certain class of algae (Prymnesiophyceae) – was studied through the terrace and sediment profiles to reconstruct the lake paleotemperatures. Altogether, the distribution of lipid biomarkers, compound-specific isotopic signatures, molecular ratios and environmental proxies contributed to hypothesize when the lake was formed.

1. *D. Carrizo, L. Sánchez-García, R.J. Menes et al. Science of the Total Environment* ***672****, 657-668 (2019).*
2. *E. Henkemans, S.K. Frape, T. Ruskeeniemi et al. Arctic, Antarctic and Alpine Research* ***50*** *(1), e1420863 (2018).*
3. *G. Vinnichenko, A.J.M. Jarrett, J.M. Hope et al. Geobiology* ***18*** *(5), 544-559 (2020).*
4. *W.J. D'Andrea & Y. Huang. Organic Geochemistry* ***36****, 1234-1241 (2005).*

P9 Abiotic synthesis and bioaffinity detection of a key peptide in the manipulation of phosphate groups

Eduardo Alonso
CAB

One of the essential traits of all living beings is the ability to catalyse chemical reactions through molecules called proteins. They use an alphabet of 20 amino acids to synthesize them, some of which are produced abiotically and have also been detected in meteorites. These could have been incorporated directly into any abiogenesis process, especially if their polymerization resulted in a peptide (short protein) catalyst. In this sense, the peptide DGDGD becomes relevant because is composed only of two amino acids (glycine and aspartic acid) that are easy to produce abiotically.
This and related peptides are conserved at the catalytic core of several essential proteins, suggesting their appearance early in life history. DGDGD peptides "manipulate" phosphate groups associated with sugars on proteins with RNA polymerase, phosphoglucomutase, phosphomanomutase, or dihydroxyacetone kinase activity.
The objectives of this work are: 1) to investigate whether it is possible to polymerize DGDGD peptide

under abiotic conditions and; 2) to develop an immunological assay for its detection and its implementation into the LDChip (Life Detector Chip), an antibody microarray immunosensor which can detect hundreds of organic molecules, polymers and prokaryotic strains in environmental monitoring and planetary exploration. The abiotic polymerization of the DGDGD peptide would point to the universality of peptide catalysts and would give special relevance to their search in planetary exploration.

To date, we have carried out a series of polymerization experiments with the most abundant amino acids identified in meteorites. The products of the chemical reactions are subsequently analysed to identify any polymerized product. In addition, we have developed polyclonal antibodies specific to the DGDGD peptide and immunoassays have been carried out to characterize and optimize them, and it has been found that they can detect the DGDGD peptide up to concentrations of the order of ng/mL.