instituto de astrofísica
e ciências do espaço

Institute of Astrophysics and Space Sciences

2024 Activity Report

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e ciências do espaço

Ciências ULisboa

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Unit Overview

The **Instituto de Astrofísica e Ciências do Espaço** (**IA**) is a research infrastructure with a national dimension, embodying a bold vision for the development of Astronomy, Astrophysics and Space Sciences in Portugal. It is the largest research unit of this area in the country, being responsible for the majority of the national productivity in international ISI journals in the area of Space Sciences — one of the scientific areas with the highest relative impact factor and highest average number of citations per article for Portugal. IA has a demonstrated ability to drive major astronomical projects, at all development levels: scientific and technical definition, instrument concept and design, construction and commissioning, and scientific exploitation.

The mission of IA is to foster research with the highest impact in the field of astrophysics and space sciences and to support teaching and training of young researchers and students in close collaboration with the Universities of Lisbon and Porto, and from June 2021, in Coimbra. Indeed, the expansion of IA to Coimbra has meant the creation of a new pole at the University of Coimbra, with headquarters at the Observatório Geofísico e Astronómico of the University of Coimbra (OGAUC), of the Science and Technology Faculty of the University of Coimbra (FCTUC), demonstrating the national impact of the IA. IA also aims to promote wide-ranging science communication activities that enhance public understanding of the Universe and our place in it, as well as awareness of the importance of research in this field.

Our vision is to achieve international leadership in key areas of astrophysics and space sciences, taking full advantage of and realising the potential created by the national membership of the European Space Agency (ESA), the European Southern Observatory (ESO), and the Square Kilometre Array Observatory (SKAO). This is done through state-of-the-art research, enabled by our leading participation in strategic international ground and space-based projects and missions.

After several years of pandemic, 2024 was the first year without COVID-19 restrictions and the IA team continued to engage in cutting-edge research, maintaining a leading role in international ground-and-space-based projects and missions. During the years impacted by the pandemic, IA had managed to keep the scientific output at a strong level and this meant that we were well prepared for the commencement of normal operations in 2024. The scientific output remained strong in both volume and impact, keeping IA well-placed for long-term growth. Efforts were focused on strengthening synergies across its three nodes, enhancing IA's international presence.

A key focus for the team in 2024 was the preparation of a proposal for the next funding period and the evaluation of the research centres which took place in the autumn of 2024. There was a change of coordination during this period, with the exit of Francisco Lobo as coordinator who was replaced by Jarle Brinchmann, but as a core of the IA executive board continued to the next board, the team remained cohesive throughout.

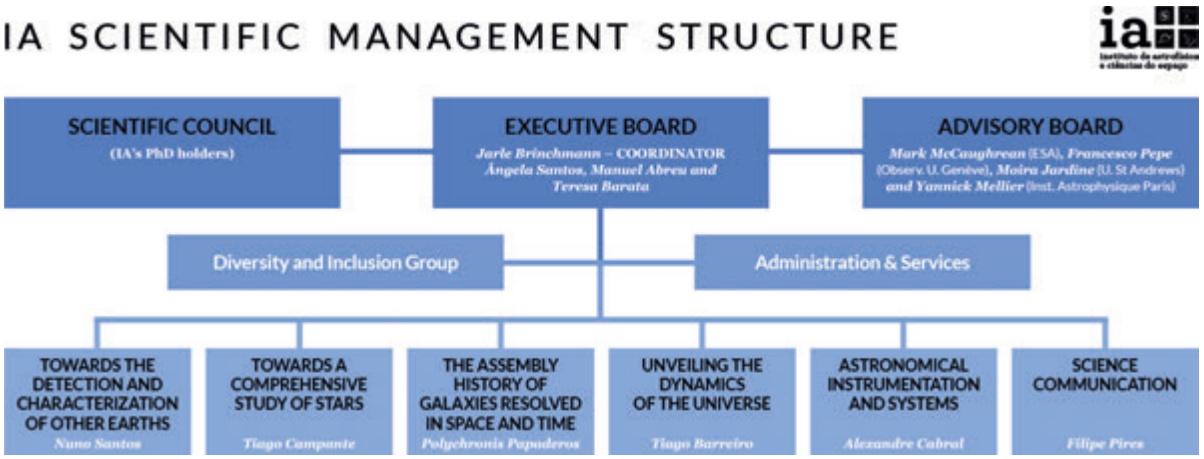
The upcoming pages offer a detailed summary of IA’s activities in 2024, highlighting IA’s involvement in ESA and ESO projects. These initiatives, initially driven by targeted scientific objectives, have fostered stronger inter-group collaboration and the creation of new synergies within IA. We would like to express our deep appreciation for the commitment of our researchers, students, and support staff, whose

efforts sustained IA through the challenges of the COVID-19 pandemic and during the preparations for the Research Unit evaluation. We also pay tribute to the resilience shown by the entire team in face of these particularly difficult circumstances.

Jarle Brinchmann, Ângela Santos, Teresa Barata, Manuel Abreu
IA Executive Board

IA Management

The Executive Board (EB) is composed of 2 members from the Porto node (Jarle Brinchmann and Ângela Santos), 1 member from the Lisbon node (Manuel Abreu) and 1 member of the Coimbra node (Teresa Barata), with Jarle Brinchmann as the coordinator of the research unit (replacing Francisco S.N. Lobo on September 15, 2024).



During 2024, the EB continued having regular weekly meetings to coordinate the scientific and management activities of the IA strategic plan. Every other week these meetings also include group leaders, including the Science Communication Group. Contacts with the management institutions were also done whenever necessary.

IA-ON 11

The IA-ON meetings continue to be a fundamental annual event enhancing scientific discussion between the whole IA team on outreach, management issues and strategic lines of the Institute. The 11th Internal workshop (IA-On 11) took place during the 24th and 25th of January, at the ***Faculty of Sciences at the University of Lisbon***.

The **IA-On 11** assembled most of the team, with an attendance of approximately 75 participants among researchers, students, and support personnel. The highlights of the year were shared and discussed with the whole team. In 2024, the focus was given to the preparations of the application for the future funding of IA and the connected evaluation of the research units by FCT.

The IA team (2024)

Towards the detection and characterization of other Earths (Planets Group)

Researchers (PhDs)

Alberto Negrão
André Miguel A. C. V. Silva * (joined 01 August)
Ângela R. G. Santos *
Clara Sousa Silva
Eduardo A. S. Cristo ((joined 01 August)
Elisa Delgado Mena * (left 31 August)
João N. T. Gomes da Silva * (left 31 December)
Koraljka Mužic *
L. Filipe Pereira *
Marta Cortesão (joined 14 June)
Nuno Peixinho *
Nuno C. Santos *
Olivier D. S. Demangeon
Pedro Machado
Pedro Figueira
Pedro B. Lacerda
Pedro T. P. Viana
Sérgio A. G. Sousa *
Susana C. C. Barros
Tiago J. L. C. E. Campante *
Vardan Zh. Adibekyan *
William Dethier (joined 09 February)

Others (PhDs students)

Afonso Morgado Mota (joined 09 September)
Alba Barka
Alexandros Antoniadis Karnavas * (finished PhD 06 June)
Ana Rita Costa Silva
André Miguel A. C. V. Silva * (finished PhD 09 June)
Bárbara M. T. B. Soares
Carmen San Nicolás Martinéz
Daniela C. Espadinha
Diogo Quirino
Eduardo A. S. Cristo (finished PhD 02 July)
Eduardo Campos Gonçalves (joined 01 September)
Francisco Brasil
Jennifer Peralta Lucero
João André B. Dias
José Rodrigues *
José Luís F. Ribeiro
Nuno M. Rosário
Pedro Branco (joined 15 October)
Rafael Rianço-Silva (joined 01 September)
Tomás de Azevedo Silva(finished PhD 04 July)
Yuri C. Damasceno (joined 15 October)

Towards a comprehensive study of stars (Stars Group)

Researchers (PhDs)

Ângela R. G. Santos *	Maria Teresa Barata
Anna Morozova	Maria Teresa V. T. Lago (left 31 December)
Bruno Arsioli *	Mário J. P. F. G. Monteiro
Daniel F. M. Folha	Nuno C. Santos *
Elisa Delgado Mena * (left 31 August)	Pedro P. Avelino *
João J. G. Lima	Ricardo Jorge Gafeira *
João L. Yun	Rui Agostinho *
João N. T. Gomes da Silva * (left 31 December)	Sara J. Carvalho (left 31 December)
Jorge Filipe Gameiro	Sérgio A. G. Sousa *
Koraljka Mužic *	Silvia Vicente (joined 05 February)
L. Filipe Pereira *	Tiago J. L. C. E. Campante *
Margarida S. Cunha	Vardan Zh. Adibekyan *

Others (PhDs students)

Afonso M. R. Vale	Miguel T. Clara
Alexandros Antoniadis Karnavas * (finished PhD 06 June)	Nuno A. M. Moedas (finished PhD 06 November)
Ana F. S. Barros *	Paulina M. Zaworska
Andreas W. Neitzel	Rúben A. R. Costa (joined 01 September)
Carlos M. F. António (joined 01 September)	Shedrach Obumneme Chiaha (joined 17 September)
Grégoire Francisco (finished PhD 11 December)	Slava L. L. Bourgeois
Inês Rolo (joined 01 September)	Thibault Boulet

The assembly history of galaxies resolved in space and time (Galaxies Group)

Researchers (PhDs)

Abhishek Chougule (joined 01 November)
Ana S. Paulino Afonso
Bruno Arsioli *
Catarina Lobo
Cirino Pappalardo
Israel Matute
Jarle Brinchmann
Jean Michel Gomes (left 10 April)
José Afonso
Patricio Lagos
Polychronis Papaderos
Rui Agostinho *
Tom C. Scott

Others (PhDs students)

Abhishek Chougule (finished PhD 12 July)
Afonso M. A. Vale (joined 15 October)
Daniel A. D. Vaz
Davi D. Barbosa
Eleanor L. Worrell
Henrique B. Miranda
Maya Shemesh
Pedro Alexandre C. Cunha
Pedro M. Martins
Rodrigo A. Carvajal Pizarro (finished PhD 19 December)
Sandy G. Morais (finished PhD 04 June))

Unveiling the dynamics of the Universe (Cosmology Group)

Researchers (PhDs)

Andrew R. Liddle	Nelson J. Nunes
António C. da Silva	Nuno Barros e Sá
Bruno J. Barros (left 14 December)	Paulo Crawford
Carlos J. A. P. Martins	Paulo M. Sá (left 31 December)
Francisco S. N. Lobo	Paulo Maurício de Carvalho
Ismael Tereno	Pedro P. Avelino *
José Carlos Fonseca	Tiago Barreiro
José Pedro Mimoso	
Lara G. Sousa	
Marina Cortês	
Matheus R. Medeiros Silva (from 26 February to 25 October)	

Others (PhDs students)

Ana Sofia Carvalho
Catarina M. J. Marques
Clara Marie Winckler
David Grüber
David M. Oliveira
Diogo M. L. Castelão
Inês S. Albuquerque
João D. F. Dias
Luís Atayde
Miguel A. S. Pinto
Miguel J. P. C. Conceição
Ricarda Heilemann
Sergei Mukovnikov
Tiago Barreiro Gonçalves
Vitor da Fonseca

Astronomical Instrumentation and Systems (Instrumentation Group)

Researchers (PhDs)

Alexandre Cabral
André Miguel A. C. V. Silva * (joined 01 August)
Bachar Wehbe
David Castro Alves
Elena Duarte
João Coelho
João Dinis
Jorge Martins
José M. Rebordão
Manuel Abreu
Nuno Peixinho *
Pedro Moreno (joined 29 June)
Sérgio A. G. Sousa *

Others (PhDs students)

André Miguel A. C. V. Silva * (finished PhD 09 June)
Cédric P. Pereira
Inês Meira Leite
Joel Filho
Nuno Miguel Gonçalves

Science Communication Group

Staff

Adriana Silva
Elsa M. P. S. Moreira
Diogo de Magalhães Sant'Ana (joined 15 October)
Filipe A. L. Pires
Francisco Miguel Gonçalves
Ilídio André P. M. Costa *
João Retrê (left 30 September)
José Manuel C. Dantas (left 31 July)
Marisa Santos (joined 15 September)
Paulo J. T. Pereira
Ricardo S. S. C. Reis
Sérgio Pereira
Tania F. S. Cunha

Researchers (PhDs)

Ilídio André P. M. Costa *
Joana Marques
Nuno Peixinho *
Raul Cerveira Lima

Others (PhDs students)

António Jorge Fonte

Interface to Science (Support to Science Activities)

Staff

Argentina Pereira
Carlos Santos (left 31 January)
Elsa Marta Silva
Joana Bateira
Sandra Homem

Researchers that work in more than one group are marked with (*).

Research Projects/Programmes

During 2024, a number of funded projects were on-going at IA, providing most of the funds available for research, including outreach activities.

Projects focused on scientific activities

The research projects that in 2024 were supported by national and European funds are:

(i) Projects funded by the European Commission (EC):

- Space Weather Awareness Training Network (SWATNet) (H2020-MSCA-ITN-955620)
  PI: Teresa Barata
  [start date: 1 March 2021 – end date: 28 Agosto 2025]

- Multifrequency and Machine Learning methods to Search for Early Super Massive Black Holes (ML-SMBH) (HORIZON-MSCA-2021-PF-01-101066981)
  PI: Bruno Arsioli
  [start date: 1 December 2022 – end date: 31 January 2025]

- Euclid Legacy Science Advanced analysis tools (ELSA) (GAP-101135203)
  PI no IA: Jarle Brinchmann
  [start date: 1 January 2024 – end date: 30 December 2026]

- FInding ExoeaRths: tackling the ChallengEs of stellar activity (FIERCE) (ERC-ADG GAP-101052347)
  PI: Nuno Santos
  [start date: 1 October 2022 – end date: 30 September 2027]

(ii) Research projects funded by Fundação para a Ciência e a Tecnologia (FCT):

- Dark matter and metals in galaxies (DarkMAGE) (PTDC/FIS-AST/4862/2020)
  PI: Jarle Brinchmann
  [start date: 1 September 2021 – end date: 31 August 2025]

- BEYond Lamba (BEYLA) (PTDC/FIS-AST/0054/2021)
  PI: Noemi Frusciante
  [start date: 1 January 2022 – end date: 31 December 2025]

- Phi in the Sky: Astrophysical probes of fundamental physics (PTDC/FIS-AST/4862/2020)
  PI: Carlos Martins
  [start date: 1 January 2023 – end date: 31 December 2025]

- Star-exoplanet compositional link: towards realistic characterization of terrestrial planets (2022.06962.PTDC)
  PI: Vardan Adibekyan
  [start date: 1 January 2023 – end date: 31 December 2024]

- Cool Stars in the near-Infrared (2022.04416.PTDC)
  PI: Elisa Delgado Mena
  [start date: 1 January 2023 – end date: 31 December 2024]

- Uncovering the nature of cosmic strings (2022.03495.PTDC)
  PI: Lara Sousa
  [start date: 1 January 2023 – end date: 30 June 2024]

- Using Ap stars as LABoratories for probing chemical transport mechanisms, with ultra-precise space- based photometry (2022.03993..PTDC)
  PI: Margarida Cunha
  [start date: 10 March 2023 – end date: 9 March 2025]

(iii) Infrastructure funded projects (FCT):

- R&D Unit Financing: Instituto de Astrofísica e Ciências do Espaço (UIDB/04434/2020 & UIDP/04434/2020)
  PI: Francisco Lobo / Jarle Brinchmann
  [start date: 1 January 2020 – end date: 31 December 2024]

(vi) Other projects

- ARIEL OGSE and Baffle Development (PRODEX - ESA Contract Nº 4000138111)
  PI: Manuel Abreu
  [start date: 1 June 2020 – end date: 31 December 2025]

- PLATO OGSE and PDC Phase B (ESA Contract No. 4000133026)
  PI: Nuno Santos
  [start date: 1 January 2018 – end date: 31 December 2025]

- e-CHEOPS: Extending the CHEOPS mission (ESA Contract No. 4000142255)
  PI: Sérgio Sousa
  [start date: 1 October 2023 – end date: 31 December 2025]

- ANDES@ELT: ANDES, the high-resolution optical-infrared spectrograph for the ELT (ESA Contract No. 4000143136)
  PI: Nuno Santos
  [start date: 1 January 2023 – end date: 31 December 2025]

- MWWM: Mars Wind Wave Mapping (ESA RFP/3-17570/22/ES/CM)
  PI: Pedro Machado
  [start date: 6 June 2022 – end date: 14 May 2025]

- Moons AIT: Partnership for the MOONS Consortium for the Construction of a Multi-Object Optical and Near-infrared Spectrometer for the VLT (ESO-VLT-MOU-MON-14620-0001)
  PI: Alexandre Cabral
  [start date: 27 November 2020 – end date: 31 December 2026]

- ESOST-PT-1: Euclid Survey Operations Support Team: phase 1 (PRODEX - ESOST-PT-1- PEA 4000141663)
  PI: Ismael Tereno
  [start date: 1 May 2023 – end date: 31 August 2024]

- Athena OBM: Onboard metrology for Athena mission: ESA contract: 40001311014/20/NL/HB/gg
  PI: Manuel Abreu
  [Start date June 2020- end date: December 2024

- Space Weather (SWE) Products for Southern Europe - Phase 1 (PROSE) (ESA)
  PI: Anna Morozova
  [start date: 23 June 2022 – end date: 30 June 2024]

- Space Weather Modeling: A Coupled Ionosphere-Thermosphere Physics-Based Approach – MIT Portugal Partnership 2030 (MPP2030)
  PI: Anna Morozova / Teresa Barata
  [start date: June 2023 end date: August 2024]

- Space Debris Laboratory of the University of Coimbra (SpaDeLab) - SeedProjects@UC
  PI: Ricardo Gafeira / Nuno Peixinho
  [start date: September 2024]

Projects focused on communication and outreach

During 2024 there were several funded projects in IA:

- AstroCamp 2024
  PI: Carlos Martins
  [start date: 1 january 2024 – end date: 1 December 2024]

- Ocupação Científica dos Jovens nas Férias 2024
  PI: Carlos Martins
  [start date: 1 January 2024 – end date: 31 December 2024]

- Formação ESERO 2024
  PI: Filipe Pires / Ilídio Costa
  [start date: 1 January 2024 – end date: 31 December 2024]

- Rede de Escolas Ciência Viva (RE-C06-i04.02 – Impulso Jovem Steam)
  PI: Filipe Pires
  [start date: 1 March 2023 – end date: 30 June 2025]

- Rede de Clubes Ciência Viva na Escola (RE-C06-i04.02 – Impulso Jovem Steam)
  PI: Filipe Pires
  [start date: 1 September 2023 – end date: 30 September 2025]

Scientific Output and Activities

The overall output of IA in **2024** was (see appendix **Scientific Output** for details)

237
Papers in refereed journals

27
Papers in books and proceedings

169
Communications in international meetings

36
Communications in national meetings

43
Seminars in other institutions

24
Seminars organized at IA

143
Public outreach talks

22
MSc thesis completed

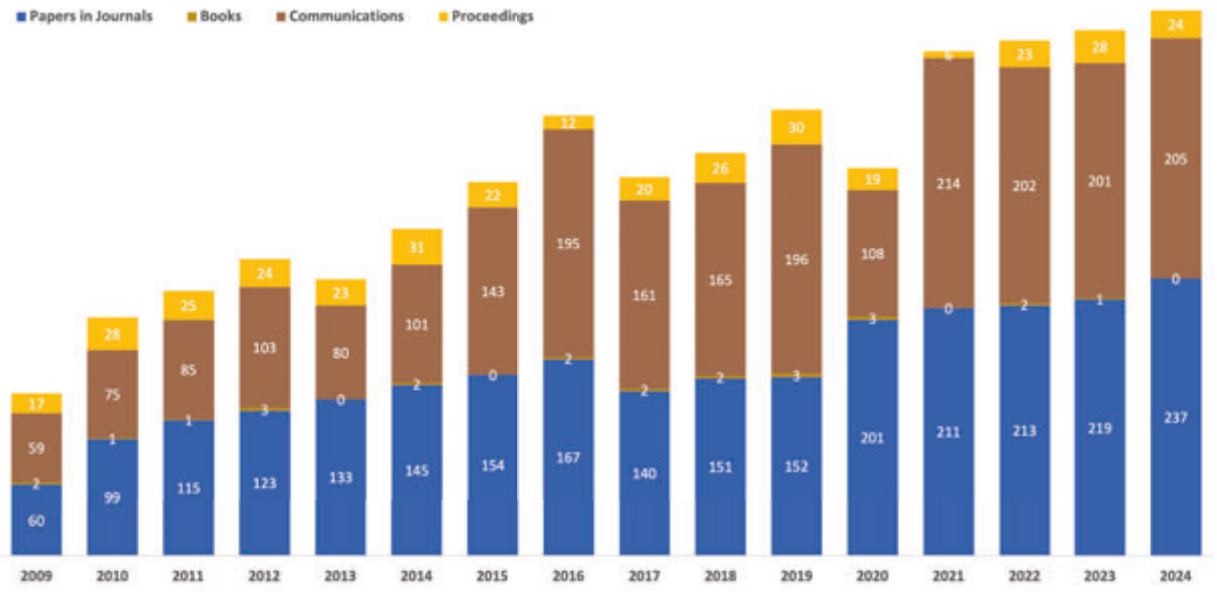
9
PhD thesis completed

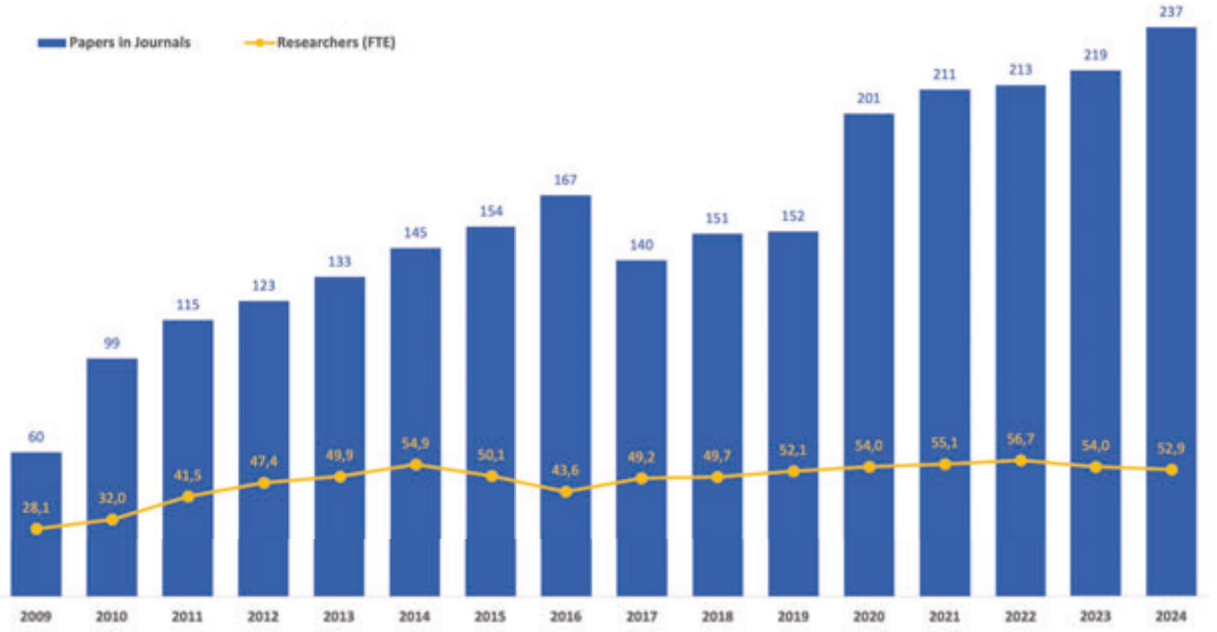
27
Observing runs

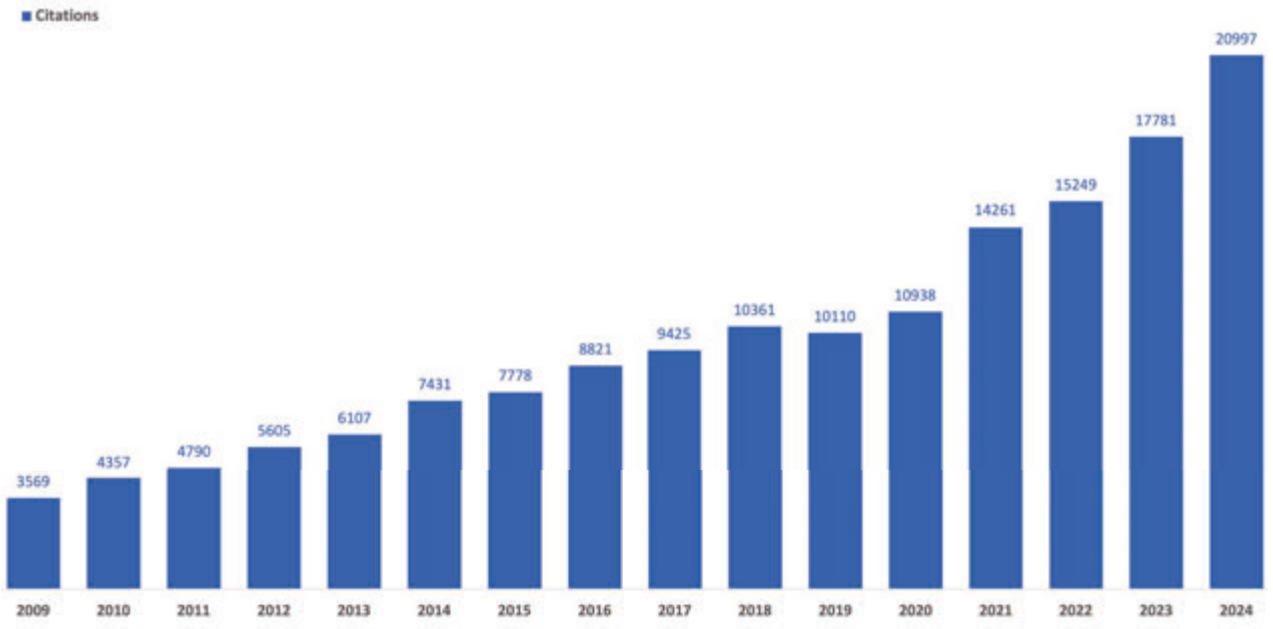
15
Organization of conferences

16
Reports

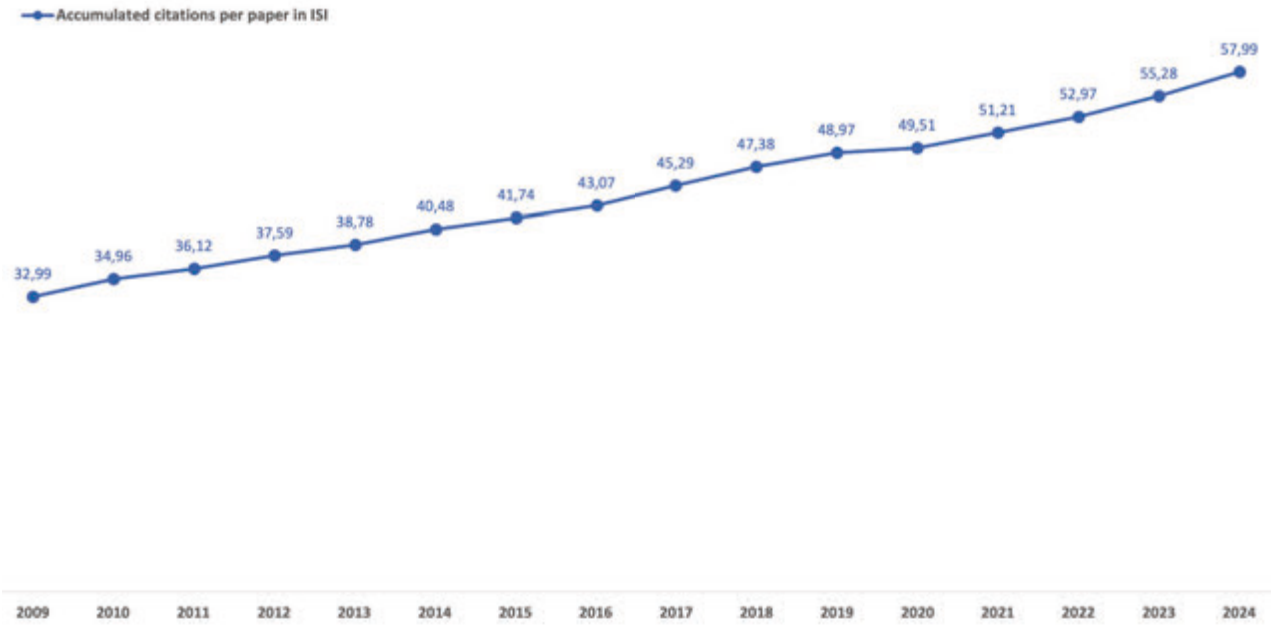
The figures below illustrate the institute's productivity during the past year. There is a clear and natural relation between the number of researchers and the number of papers in journals subject, understandably, with a small shift in time. The figures show a continuation of the increase in the number of publications and communications, which is a strong indication for the strong activity of the Institute. The number of citations also maintains an increasing trend which is not simply justified by an increase in the numbers or articles. Indeed, the figures show that the accumulated impact continues to grow.







The number of citations obtained in a given year for all the IA articles published since 1990 up to that year.



The accumulated impact in a given year is measured as the ratio between the sum of the number of citations up to that year since 1990 and the number of articles in the same period.

Report from the Thematic Line

Towards the detection and characterisation of other Earths

As in the past years, in 2024 the team focused its research on tackling high-impact questions such as: How diverse are planetary systems in the Galaxy? How frequent are rocky, temperate planets orbiting other Suns? Are there other habitable planets?

To answer these questions, the team's activities included:

1. the search and detailed characterization of exoplanets, including the study of their atmospheres, using state-of-the-art high-resolution spectroscopy and space-based photometric data;
2. the study of astrophysical sources of “noise” that hinder the detection and characterization of planets, as well as developing methods to correct/model them, keeping in mind the end goal of detecting and characterizing rocky planets orbiting other suns;
3. the study of the star-planet connection as a way to better characterize planetary systems, their properties, and formation processes;
4. the exploration of new avenues in the study of Solar System minor bodies (tracers of Solar System formation) as well as in planet atmospheres (focused on Venus, Mars, and Jupiter), aiming at understanding their dynamics and chemistry;
5. the understanding of habitability conditions as well as the study of extremophiles, interfacing Solar System/exoplanet research with microbiology.

This latter research activity has seen its debut in 2024, with the hiring of one researcher (microbiology) and one PhD student (working in the interface between exoplanet research and microbiology). This represents a significant step forward in the development of Astrobiology at IA.

A significant part of this research is based on our top-level (leading) scientific participation in different international consortia. While our participation in the ESPRESSO project is fading out (the GTO is now over), from the ongoing projects we highlight ESA's CHEOPS mission (now well within its first extension until 2026), the NIRPS spectrograph (@ESO's 3.6m), as well as the soon-to-be-commissioned (2025) PoET telescope (entirely led by IA and funded through an ERC grant). All these projects serve as stepping-stones for the science opportunities raised by future projects and missions (on which the team is also involved) including ESA's PLATO (2026), ANDES@ESO's ELT (2031), ESA's ARIEL (2029) and EnVision (2031), as well as (further ahead) NASA's Habitable Worlds Observatory (HWO) an ESO's PCS (for the ELT). Our high-level participation in all these projects assures continuity, reinforces the existing strategy, and allows the team to be at the forefront of planetary system's science for the next decade and beyond.

Scientific Highlights for 2024

In 2024, a total of 12 first-author papers were published by the team, and 7 Press-Releases were made by IA announcing scientific results or other major activities (e.g. issuing from ongoing instrumentation projects) with relevant scientific participation of the team. One of these Press-Releases was also issued by ESA and another one by ESO. Below we highlight 3 results.

Exo-climatology of the planet WASP76b

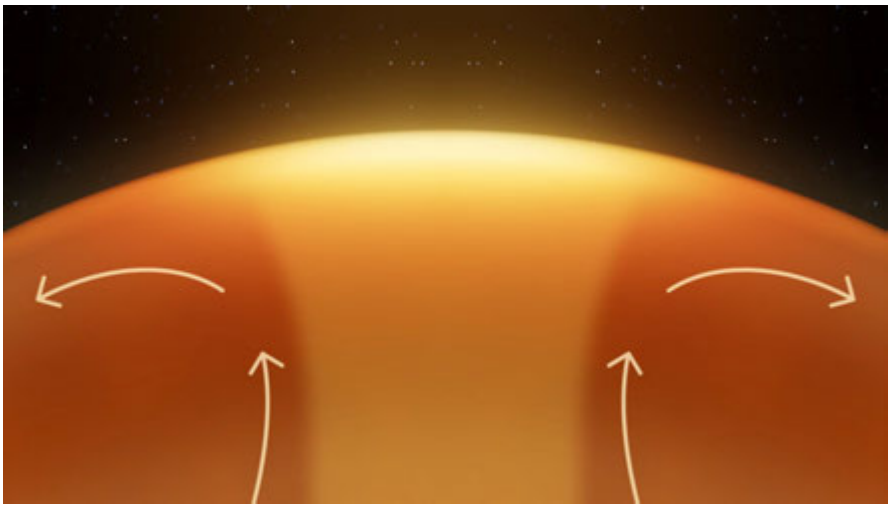
In the last few years, exoplanet WASP-76 b's has been thoroughly studied by researchers at IA. At 637 light years from us, WASP-76b orbits its host star 12 times closer than Mercury orbits the Sun, making of it one of the hottest exoplanets known to date. Due to tidal effects, WASP-76b is also tidally locked to its star, meaning that one of its sides is always facing it. Therein, given the very high temperatures (around 2400 K), elements like iron are expected to be in the gas state. These and other properties made WASP-76b particularly relevant to explore the physics of exoplanet atmospheres, and has already led to several results led by the IA team (including the unexpected detection of Barium).

In 2024, two new papers, both led by IA researchers, have set the foundation for understanding the global climate of this giant exoplanet.

The first of these studies (that led to an ESA Press Release), led by researcher O. Demangeon, was based on the analysis of exquisite photometric data obtained with the CHEOPS mission. In particular, the analysis of 3 phase curves, 20 occultations, and 6 transits of WASP-76b allowed to detect what may be the first signature of the “glory” effect in the atmosphere of an exoplanet. The effect, similar to a rainbow, occurs when light is reflected off clouds made up of a perfectly uniform but so far unknown substance. While the reason for the “glory” effect to be observed is not entirely clear, this detection exemplifies the state-of-the-art research presently possible with data from missions like CHEOPS.

A second paper, led by the PhD student Ana Rita Costa Silva, fused data obtained with the ESPRESSO spectrograph to investigate the light emitted by the dayside of the planet. In particular, inspired by previous studies where we found iron in other regions of the planet, the team searched for the signature of iron atoms in emission. To our surprise, we did not only found the presence of iron in the illuminated side of the planet, but also found that the iron lines are blue-shifted, evidence of iron winds in the region of the “Hot Spot” on this hot jupiter – a location highly irradiated by the star that accumulates a lot of heat.

All these studies open several questions about the mechanisms behind the observed signatures. New perspectives to study WASP-76b will come from future missions such as PLATO, ARIEL, and ANDES@ELT, all on which the team is strongly involved.



Schematic representation of the motion of iron winds in the hotspot of exoplanet WASP-76 b, moving from the lower to the upper layers of the atmosphere. (Credit: Tania Cunha (Planetário do Porto – Centro Ciência Viva)/Instituto de Astrofísica e Ciências do Espaço).

Three-dimensional atmosphere of Venus prepares future observations of rocky exoplanets

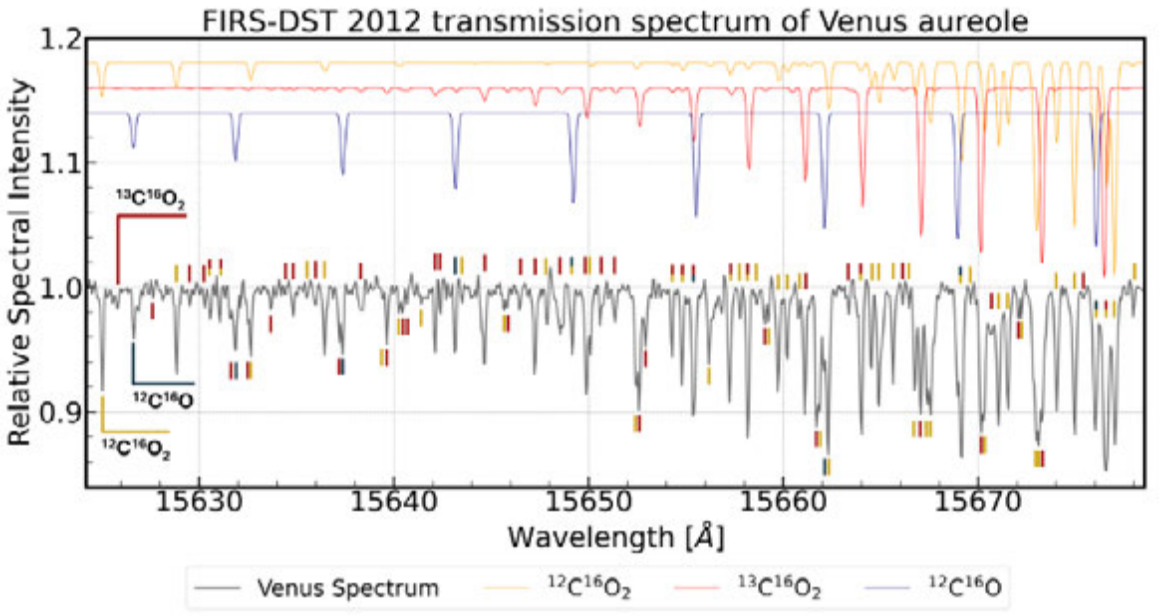
In a clear example of the collaboration between the study of Solar System and exoplanet atmospheres, a study led by MSc student Alexandre Branco analysed data from this century's last Venus solar transit and used this to validate methods to study the atmosphere of Earth-sized exoworlds.

In the next decades, researchers will start probing the atmosphere of planets as small as Earth and Venus orbiting nearby stars. But although these two Solar System planets are similar in size and bulk density, their atmospheres are nothing alike. Would scientists be able to set them apart if seen from light-years away?

To try to understand what would be the signature of a Venus like exoplanet, the IA team used data from the last transit of Venus to understand how such a planet would be seen when transiting another star. To observe Venus as an exoplanet, the team analysed a very rare set of data, collected on 5 and 6 June 2012, the last time in this century Venus crossed the disc of our Sun – much in the same way the atmospheres of exoplanets are probed when they pass in front of their host star from our point of view on Earth. They imprint their presence on the star's light as it passes on its way to Earth. Among the traces are signals left by molecules in their atmosphere that tell astrophysicists what it is made of.

The results have shown the presence of the two most abundant CO_2 isotopologues, and from the main isotopologue of CO in the retrieved spectrum of Venus. A more detailed analysis also allowed to retrieve a tentative signal for O_3 on Venus.s

In short, by applying the same techniques used for the analysis of transmission spectra of exoplanets, the team validated their future use with powerful facilities such as ANDES@ELT, a project in which IA is deeply involved.



The transmission spectrum of Venus as an exoplanet. From Branco et al. 2024.

A planet orbiting the closest single star to our Sun

Using the ESPRESSO spectrograph, a team with a strong contribution from IA researchers has discovered an exoplanet orbiting Barnard's star, the closest single star to our Sun. On this newly discovered exoplanet, which has at least half the mass of Venus, a year lasts just over three Earth days.

Barnard's star is the second-closest stellar system — only 6 light years away from us — and the closest individual star. In the context of our strong participation in the ESPRESSO project, Barnard's star has been one of our favourite targets. Owing to its proximity, it is a primary target in the search for Earth-like exoplanets.

The data, obtained between May 2019 and July 2023, was then analysed using a specific software developed by then IA's PhD student André Silva, allowing us to extract the best radial velocity information. Together with a detailed modelling of the timeseries, taking into account the signatures of stellar activity, these allowed to detect the presence of a sub-Earth mass planet with an orbital period of 3.15d in a closely circular orbit with a semi-major axis of 0.02 AU. Additional signals were found, but so far they are not significant.

This result illustrated both the capabilities of the ESPRESSO spectrograph, but also the relevance of the data analysis methods for the detection of the lowest mass planets.

Artist view of the planet Barnard b, with the star in the background. Credit: ESO/M- Kornmesser.

Thematic line meetings, Journal Clubs and other activities

In 2024, as for the previous years, the IA-planet line maintained a regular journal club and team meeting agenda. Team meetings and journal clubs are organized every two weeks. Meetings include a presentation of “general information”, as well as a short presentation of the work being carried out by one PhD student and one researcher, followed by a discussion. This format helps the whole team to be acquainted with the research that is being carried out and helps the students to develop presentation

skills and identify potential problems and solutions in their research projects. Journal clubs include the presentation of recent research papers, followed by discussions.

All this information is kept up-to-date in the new team web pages (http://planetas.iastro.pt).

All regular team meetings and journal clubs were performed remotely via Zoom, to assure a smooth participation from team members in all 3 nodes (Porto, Coimbra, and Lisboa). People in the Porto node usually attended the meetings together in the same room (and common Zoom connection).

We also organised our annual team meeting (called “2-DEMOC”). This year's event took place in Porto. A SWOT analysis was done and discussed, where the team strategy and plans (both scientific and organisational) were discussed.

Along with the participation in several Scientific Organizing Committees of international conferences, the team worked in the organization of 4 international conferences/workshops. The 2nd PoET workshop was organized in November. A Science Team Meeting of the ARIEL consortium was also organized in Lisbon (also in November). The organization of two major international conferences is also ongoing - Extreme Precision Radial Velocities 6 (Summer 2025) and Exoplanets 6 (Summer 2026).

Team members actively participated in different public outreach activities, including public talks and debates in schools and online, as well as other outreach events. In this context, the team has also kept updating a public outreach page on Planetary Systems (https://outrosmundos.iastro.pt), where information in Portuguese is provided about planetary system's science as well as the discoveries where the team is involved.

In 2024, 4 PhD and 6 MSc thesis were successfully concluded (several other PhD and MSc are ongoing):

- “A new paradigm for the estimation of precise stellar radial velocities” (PhD, André Silva)
- “Exoplanet atmospheres: reflected light studies” (PhD, Tomás Azevedo Silva)
- “High resolution studies of exoplanet atmospheres” (PhD, Eduardo Cristo)
- “NIR spectroscopic characterization of planet hosts stars” (PhD, Alexandros Antoniadis Karnavas)
- “Searching for new stellar activity indices for exoplanet research” (MSc, Pedro Branco)
- “Measuring the planetary shadow across the stellar disk” (MSc, Eduardo Gonçalves)
- “Transmission spectroscopy of ultra-hot jupiters” (MSc, Yuri Damasceno)
- “Exploring Titan's atmosphere composition and temporal evolution using high-resolution spectroscopy, and its interaction with the surface using atomistic molecular dynamics simulations” (MSc, Rafael Riançо Silva)
- “Characterising Atmospheric Waves on Mars Using Mars Express (ESA) HRSC Images” (MSc, Vasco Alexandre Cabo)
- “Origin of Theia, the last giant impactor on Earth” (MSc, Duarte Gerardo Branco)

A number of undergraduate students also worked with the IA team in different projects:

- “Assessment of potential biosignatures in alien atmospheres” (Maria Inês Alves Pereira)

- “In the quest for detecting other Earths. A test on Radial Velocity extraction” (Matilde Marinho Valente)
- “Probing the atmospheres of scorching exoplanets via spectroscopy” (Bárbara Oliveira)
- “Atmospheres of Young Planetary-Mass Objects” (Carolina Machado)
- “Deteção de exoplanetas através dum novo modelo para a correção de efeitos instrumentais” (João Nuno da Silva Freitas Cunha)
- “Exploring the impact of PoET's pointing error” (Inês de Sousa Pimenta)
- “The rotation velocity of stars with exoplanets” (Maria Carolina Malheiro Neto)
- “The stellar activity in stars with exoplanets” (Telmo Filipe Pereira Monteiro)

In 2024, team funding came mostly from IA “strategic funding” as well as from 2 running FCT (PEX) projects and one ERC Advanced Grant. An Advanced Computational Project was also approved. The team is presently waiting for the results of two application from the 2023 “FCT Research Projects call”. We also highlight that 2 ERC projects were submitted in 2024 (one for a Starting Grant and one for a Synergy Grant).

Furthermore, funding for our participation in the CHEOPS, PLATO, ARIEL, and ANDES projects was secured through PRODEX. We note, however, the PRODEX funding covers only the “project level activities”.

We would further like to highlight the strong collaborative work done in 2024 to foster collaborations of IA-Planet team members with other groups in the institute. This particularly concerns collaborations with the Stellar and Instrumentation groups. Collaborations with the stellar group include the characterisation of planet host stars, stellar spectroscopy, and asteroseismology, the study of solar and stellar activity, and Galactic chemical evolution. Instrumentation group collaborations touch on several aspects related to the development of new instruments and related software, such as PoET, NIRPS, CHEOPS, PLATO, ANDES, and PCS. Collaborations with other groups, namely cosmology and science communication, have also been done, respectively, through common instrumentation interests and through the communication of science results.

Nuno Santos
Group Leader

Report from the Group

Towards a comprehensive study of stars

Our activity during 2024 was distributed across three main research lines: Sun and Heliosphere, Stellar Physics, and Stellar Populations.

Sun and Heliosphere research line

This research line focuses on studying the solar atmosphere as well as the influence of solar activity on the heliosphere and the Earth's atmosphere, also known as Space Weather. We continued to participate and collaborate in several national and international projects. Group members lead the Portuguese participation in the SWATNet MSCA Innovative Training Network, are actively contributing to the European Solar Telescope, are developing a coupled thermosphere-ionosphere model for the Atlantic mid-latitude regions in a partnership with MIT, and are investigating the consequences of the rapid secular drift of the northern magnetic dip pole. Furthermore, we have been contributing to the definition of the scientific priorities of the PoET telescope concerning solar and stellar physics.

Stellar Physics research line

This research line focuses on understanding the physical processes that take place in stars, from the stellar interior to the surface. The exploitation of asteroseismic data from TESS (NASA) is being carried out in the context of the TESS Asteroseismic Science Consortium (TASC), in which our team is strongly involved, with representation on the Steering Committee and co-leadership of one of its working groups. Furthermore, our team continues to be strongly involved in the preparation of the stellar science component of PLATO (ESA), with responsibilities in the design, implementation, and validation of sections of the Stellar Analysis System (SAS) pipeline, leading work packages in the framework of both the PLATO Science Management (PSM) and the PLATO Data Center (PDC). The team also continued to actively contribute to the Ariel (ESA) consortium, in the context of which we coordinate a working group responsible for determining the fundamental parameters of the mission's target stars.

Our research also included studies of low-mass stellar and substellar populations in young clusters and star-forming regions in the Milky Way, with the goal of understanding the main formation channels of brown dwarfs and free-floating planetary-mass objects, together with their potential dependence on the star-forming environment.

Stellar Populations research line

This research line focuses on the precise characterisation of solar-type and red-giant stars, which provides valuable information that can be readily applied to several areas of research, including Galactic archaeology and Galactic chemical evolution. We continued to be actively engaged in several international consortia, including ANDES@ELT, the Maunakea Spectroscopic Explorer (MSE), ESPRESSO@VLT, and NIRPS@ESO 3.6-m Telescope. We highlight the team's involvement in ANDES@ELT, where we play a role in the development of the scientific priorities and the definition of top-level requirements for the instrumentation.

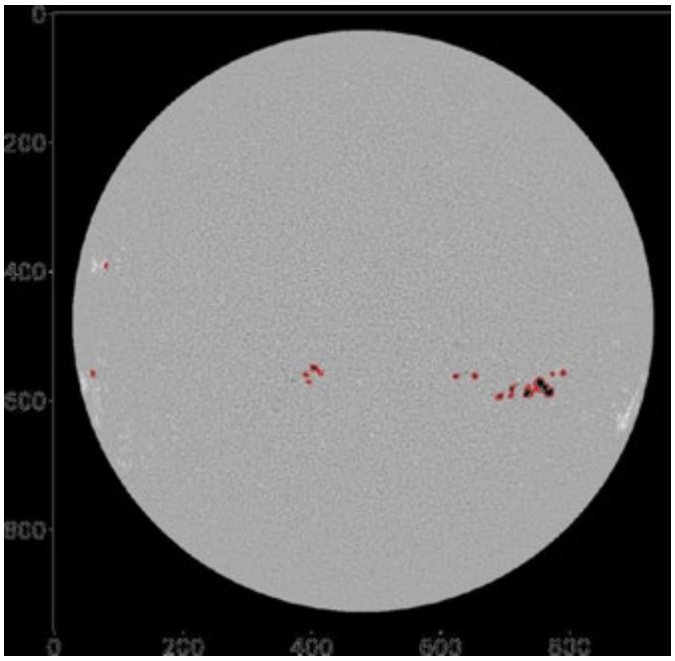
Scientific highlights for 2024[1]

Automated sunspot detection and solar wind forecasting

The implementation of automated methods for sunspot detection is essential to achieve better objectivity, efficiency, and accuracy in identifying sunspots and analyzing their morphological properties. A sought-for application is the contouring of sunspots. In Bourgeois et al. (2024), the authors constructed sunspot contours from Solar Dynamics Observatory (SDO)/Helioseismic and Magnetic Imager (HMI) intensity images by means of an automated method based on the application of mathematical morphology. The method was applied to high-resolution data (SDO intensitygrams), with a good agreement obtained between the measured sunspot areas and those provided by two standard reference catalogs. The method appears to be robust for sunspot identification, and the analysis suggests its application to more complex and irregular-shaped solar structures, such as polarity inversion lines inside delta-sunspots.

Solar wind forecasting is a core component of Space Weather, a field that has been the target of many novel machine-learning approaches. The continuous monitoring of the Sun has provided an ever-growing ensemble of observations, facilitating the development of forecasting models that predict solar wind properties on Earth and other celestial objects within the solar system. This enables us to prepare for and mitigate the effects of solar wind-related events on Earth and space. The performance of some simulation-based solar wind models, however, depends heavily on the quality of the initial guesses used as initial conditions. In Barros et al. (2024), the authors aimed at improving the accuracy of these initial conditions by employing a Recurrent Neural Network model. The study's findings confirmed that Recurrent Neural Networks can generate better initial guesses for the simulations, resulting in faster and more stable simulations.

We note that both these works were led by PhD students in our group.



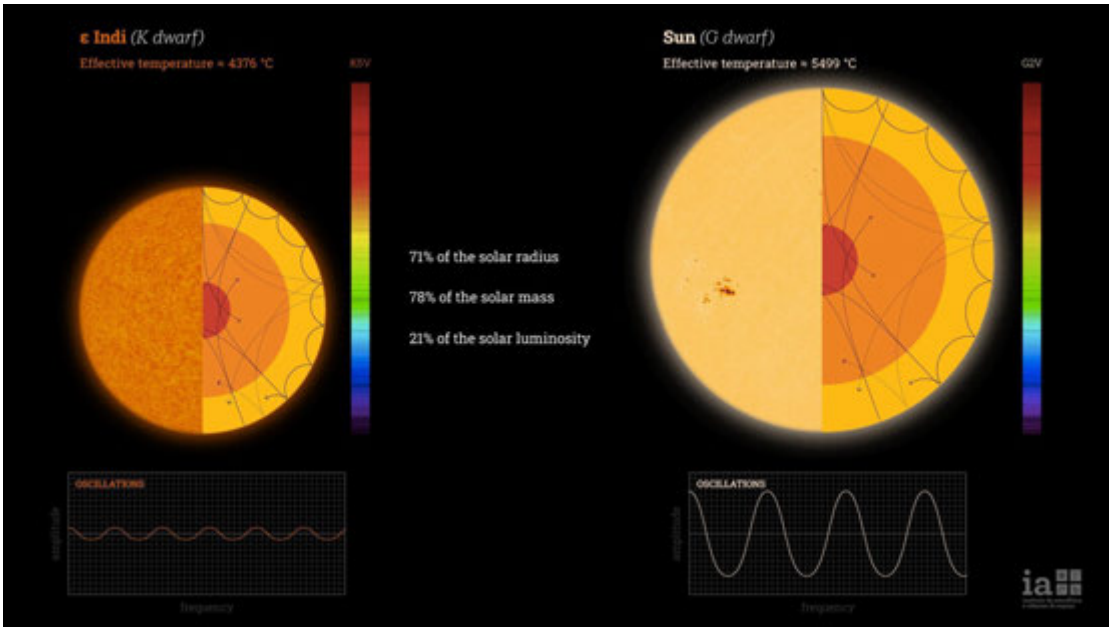
Sunspot contours overlaid on an SDO/HMI intensity image (based on Mathematical Morphology). From Bourgeois et al. (2024).

[1] When applicable, text from the corresponding journal abstract is used (and adapted).

Advances in observational and theoretical asteroseismology

Fueled by space photometry, asteroseismology is vastly benefiting the study of cool main-sequence stars, which exhibit convection-driven solar-like oscillations. Even so, the tiny oscillation amplitudes in K dwarfs continue to pose a challenge to space-based asteroseismology. A viable alternative is offered by the lower stellar noise in Doppler observations. In Campante et al. (2024), the authors presented the definite detection of solar-like oscillations in the bright K5 dwarf ε Indi based on time-intensive observations collected with the ESPRESSO spectrograph at the VLT, thus making it the coolest seismic dwarf ever observed. The peak amplitude of radial modes is 2.6±0.5 cm/s, or a mere 14% of the solar value. Measured mode amplitudes are ~2 times lower than predicted from a nominal L/M scaling relation and favor a scaling closer to (L/M)1.5 below 5500 K, carrying important implications for our understanding of the coupling efficiency between pulsations and near-surface convection in K dwarfs. This detection conclusively shows that precise asteroseismology of cool dwarfs is possible down to at least the mid-K regime using next-generation spectrographs on large-aperture telescopes, effectively opening up a new domain in observational asteroseismology. A press release was issued by IA accompanying the publication of this article.

Sharp structural variations induce specific signatures on stellar pulsations that can be studied to infer localized information on the stratification of a star. This information is key to improve our understanding of the physical processes that lead to these structural variations and how to model them. In Cunha et al. (2024), the authors revisited and extended the analysis of the signatures of different types of buoyancy glitches in gravity-mode and mixed-mode pulsators presented in earlier works, including glitches with step-like, Gaussian-like, and Dirac-δ-like shapes. In particular, they provided analytical expressions for the perturbations to the periods and showed that these can be reliably used in place of the expressions provided for the period spacings, with the advantage that the use of the new expressions does not require modes with consecutive radial orders to be observed. They further discussed the impact on the glitch signature of considering a glitch in the inner and outer half of the g-mode cavity, emphasizing the break of symmetry that takes place in the case of mixed-mode pulsators.



Infographics comparing ε Indi with the Sun. Credit: Paulo Pereira (IA).

Towards improved stellar models

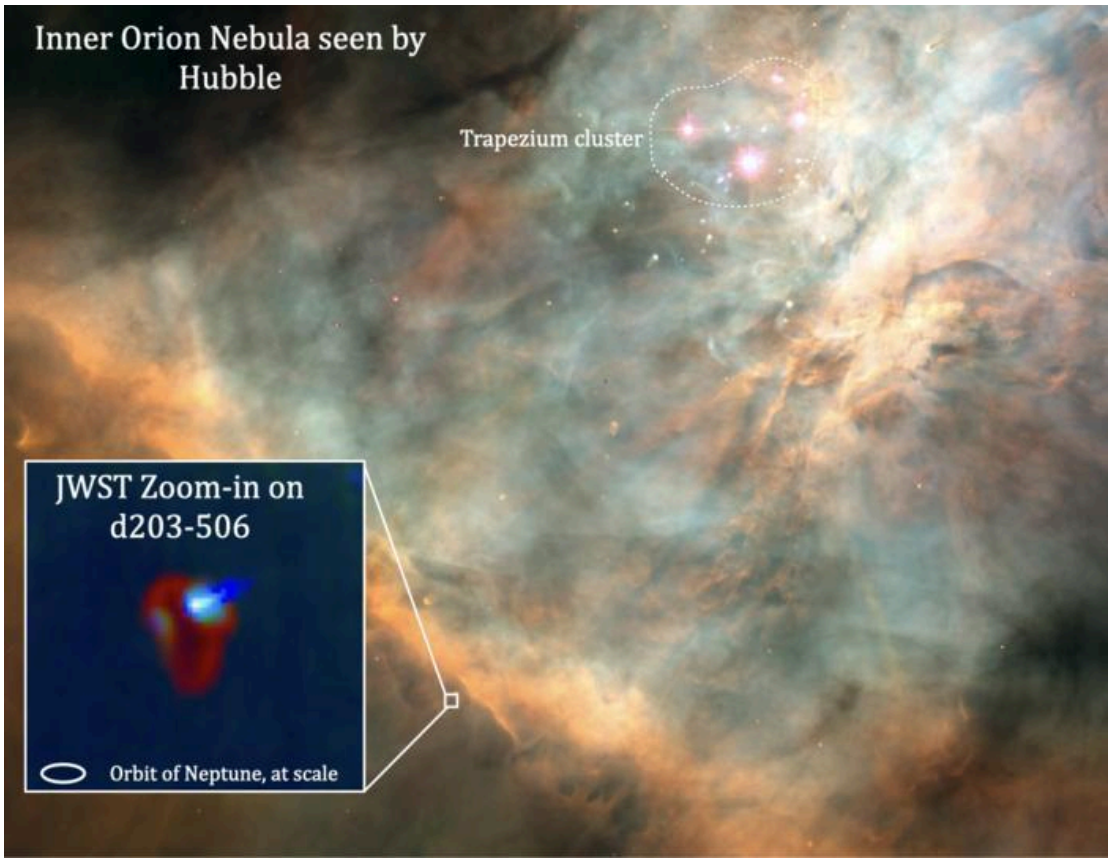
Modeling of chemical transport mechanisms is crucial for the accurate characterisation of stars. Atomic diffusion is one such process, being commonly included in stellar models. However, it is usually neglected for F-type or more massive stars because it produces surface abundance variations that are unrealistic. Additional mechanisms to counteract atomic diffusion must therefore be considered. It has been demonstrated that turbulent mixing can prevent excessive variation in surface abundances, while it can be calibrated to mimic the effect of radiative acceleration on iron. In Moedas et al. (2024), the authors evaluated the effect of calibrated turbulent mixing on the characterization of a sample of F-type stars and how stellar parameter estimates compare with those obtained when chemical transport mechanisms are neglected. They found a greater dispersion in the inferred values of mass, radius, and age for the more massive stars in their sample due to the absence of atomic diffusion in one of the two model grids used. This work ultimately shows that proper modeling of microscopic transport processes is crucial for the accurate estimation of stellar fundamental parameters, which is not only true for G-type stars but also for F-type stars. This work was led by a PhD student in our group.

Exploitation of James Webb Space Telescope (JWST) data

Two group members have succeeded in getting JWST programs approved as PI/Co-PI: Sílvia Vicente as PI during General Observer (GO) Cycle 2; and Koraljka Mužić as Co-PI during GO Cycles 1 and 3. As a result, the exploitation of JWST data by group members has seen its first published results in 2024.

Most low-mass stars form in stellar clusters that also contain massive stars, which are sources of far-ultraviolet (FUV) radiation. Theoretical models predict that this FUV radiation produces photodissociation regions (PDRs) on the surfaces of protoplanetary disks around low-mass stars, which affects planet formation within the disks. In Berné et al. (2024), which includes group member Sílvia Vicente, the authors reported James Webb Space Telescope and Atacama Large Millimeter Array observations of a FUV-irradiated protoplanetary disk in the Orion Nebula. They quantified the mass-loss rate induced by the FUV irradiation and found that it is sufficient to remove gas from the disk in less than a million years. This is rapid enough to affect giant planet formation in the disk. A research note (Portuguese only) was issued by IA accompanying the publication of this article.

The discovery and characterization of free-floating planetary-mass objects (FFPMOs) is fundamental to our understanding of star and planet formation. In Langeveld et al. (2024), which includes group members Koraljka Mužić and Daniel Capela, the authors reported results from an extremely deep spectroscopic survey of the young star cluster NGC 1333 using Near-InfraRed Imager and Slitless Spectrograph (NIRISS) wide field slitless spectroscopy on the James Webb Space Telescope. They discovered six new candidates with L-dwarf spectral types that are plausible planetary-mass members of NGC 1333, with estimated masses between 5 and 15 MJup. They did not find any objects later than mid-L spectral type ($\lesssim$ 4 MJup). The paucity of Jupiter-mass objects, despite the survey's unprecedented sensitivity, suggests that their observations reached the lowest-mass objects that formed like stars in NGC 1333. Their findings put the fraction of FFPMOs in NGC 1333 at ~10% of the number of cluster members, significantly more than expected from the typical log-normal stellar mass function. A research note (Portuguese only) was issued by IA accompanying the publication of this article.



Hubble image of the Orion Nebula and zoom-in on the d203-506 protoplanetary system with JWST. Credit: NASA/STScI/Rice Univ./C. O'Dell et al./O. Berné, I. Schrotter, PDRs4All.

Hosts of 3 international events on Asteroseismology and Space Weather

We organized the 8th TESS/15th Kepler Asteroseismic Science Consortium Workshop (TASC8/KASC15) in Porto. TASC8/KASC15 served as a platform for the comprehensive review and discussion of the latest findings in the field of asteroseismology, with the focus being placed on new ways of improving the physics in stellar models (aspects such as convection, angular momentum transport, magnetic fields, and mixing were thoroughly addressed). There were a total of 214 registered participants, of which 189 on-site and 25 online. Conference proceedings were published here.

The conference was followed by a Doctoral School, again organized by members of our research group. The Porto Summer School on Asteroseismology (PSSA) brought together 50 students and 13 invited lecturers. Students from institutes from all over the world attended the School, namely, from Europe (33), Oceania (6), North America (5), Asia (5), and Africa (1). School proceedings were published here.

Furthermore, we co-organized the European Space Weather Week 2024 (ESWW 2024) in Coimbra. The European Space Weather Week is the main annual event in the European Space Weather and Space Climate calendar. It began as a forum for the European Space Weather community and has since grown into an international event with global attendance. There were more than 600 registered participants at the event.

Other activities

We start by providing an overview of the group's internal procedures and meetings. Next, we present a number of indicators for the year 2024, namely, on funded projects, completed theses (PhD and MSc), organization of conferences and workshops, visiting scientists, and outreach activities.

Regular meetings and activities

We hold biweekly group meetings, a forum for discussing strategic decisions and everyday issues. These are held together with the Journal Club. Moreover, we hold science meetings on a biweekly basis (alternating them with the group meetings), a forum for presenting and discussing ongoing work. In 2024, we had two more installments of Stars Day (one in May and the other in December), a biannual in-person meeting with a strong social component. Stars Day events are fully organized by our students.

Communication

The group website is regularly updated, containing the latest news as well as information on research and activities.

Completed theses

PhD (3):

- Nuno Moedas. Title: Toward a new generation of stellar models: impact of physical ingredients on the accuracy of stellar parameter inferences. Supervisors: Diego Bossini and Morgan Deal.
- Alexandros Antoniadis Karnavas. Title: Derivation of M-dwarf stellar parameters in the optical and near-infrared. Supervisors: Sérgio Sousa and Elisa Delgado Mena.
- Grégoire Francisco. Title: Improving Solar Flare Forecasts with deep learning. Supervisors: Dario del Moro, Teresa Barata, João Fernandes.

MSc (3):

- Daniel Capela. Title: Early stages of star formation in the Rosette Nebula. Supervisors: Koraljka Mužić.
- Rúben Costa. Title: Pushing the boundaries of cool-dwarf asteroseismology with ESPRESSO. Supervisors: Tiago Campante and Mário João Monteiro.
- Carlos António. Title: Potential field source surface extrapolation constrained by coronal observations. Supervisors: João Lima, Iulia Chifu, and Ricardo Gafeira.

Organization of conferences/meetings/workshops (4)

- European Space Weather Week 2024 (ESWW 2024).
- Porto Summer School on Asteroseismology: From Pixels to Stellar Ages (PSSA).
- 8th TESS/15th Kepler Asteroseismic Science Consortium Workshop (TASC8/KASC15).
- Workshop on Ap stars.

Visiting scientists (9)

- November 14-15. Diego Godoy-Rivera (Instituto de Astrofísica de Canarias, Spain).

- November 4-8. Diego Bossini (Università degli Studi di Padova, Italy).
- July 22. Dennis Stello (UNSW Sydney, Australia).
- July 9-10. Daniel Holdsworth (University of Central Lancashire, UK).
- July 8-12. Joel Ong (University of Hawaii, USA).
- June 24-28. Ivan Milic (Leibniz-Institut für Sonnenphysik, Germany).
- June 3-7. Iulia Chifu (Max Planck Institute for Solar System Research, Germany).
- May 1-July 31. Juma Kamulali (Kyambogo University, Uganda).
- February 14-20. Victoria Antoci (Technical University of Denmark, Denmark).

Outreach (selected)

- 7 group-related press releases/research notes/news articles issued by the Science Communication Group at IA.
- Partnership with National Geographic Portugal: 2 articles published by group members.

Tiago Campante
Group Leader

Report from the Group

The assembly history of galaxies resolved in space and time

In 2024, the Group continued to successfully implement its scientific strategy, making significant progress in investigating the formation history of galaxies and their structural components, the genesis and growth of super-massive black holes (SMBHs) in galactic nuclei, and their influence on the assembly history of galaxies, the origin and implications of starburst activity and the role of the environment on galaxy evolution.

These scientific objectives, pursued by a team of 13 researchers, 13 collaborators, and 10 students, are served by the IA participation with leadership roles in the ESO instrument consortia of MOONS@VLT, BlueMUSE@VLT, MOSAIC@ELT of ESO, and ESA missions with key importance for the Group's strategy (Euclid, NewAthena), as well as by the parallel development of highly optimised computational tools for the scientific exploitation of multi-wavelength data for galaxies near and far.

The growth of SMBHs and their observational manifestations as Active Galactic Nuclei (AGN) is being investigated by the team both at the highest redshifts and in the nearby universe. The emergence of the very first powerful AGN in the Universe, and how they shaped the earliest galaxy evolution is being studied through sub-mm observations with IRAM and the revolutionary ALMA, and by post-processing cosmological simulations to obtain quantitative predictions on the number and detectability of early SMBHs at X-ray and radio wavelengths. Building upon its expertise in the analysis and interpretation of multi-wavelength data, and as part of a coherent strategic roadmap, the team has developed new observational discriminators for proto-AGN at the Epoch of Reionization (EoR) that are now successfully applied by the team. It also acts as a strong driver in the development of ASKAP's Evolutionary Map of the Universe survey, through the IA-lead Key Science Project “Radio AGN in the EoR” and is represented at the Board and Science team level in ESA's future X-ray mission, NewAthena.

At low and intermediate redshift (z), the AGN phenomenon is being studied using the currently most powerful telescopes and instruments, most notably the Multi Unit Spectroscopic Explorer (MUSE) at ESO-VLT. Special emphasis is being laid on the study of quasars surrounded by gigantic Lyman-α halos and the definition of new diagnostics for constraining the physical conditions and excitation mechanisms in the nebular component of these extreme environments. This line of research is further supported by a comparative analysis of gas kinematics and excitation properties obtained from integral field spectroscopy (IFS) with predictions from cosmological simulations incorporating AGN feedback and through IA's spectral synthesis code FADO. The latter, together with other IA-developed tools, are being used to prepare the scientific exploitation of MOONS (the Multi Object Optical and Near-infrared Spectrograph for the VLT), an instrument the IA co-leads and which is expected to start its operation at the end of 2025. During 2024, the team continued having a key involvement in the preparation of guaranteed time observations with MOONS and in the definition of strategies for the reduction and analysis of data from it. IA researchers assume major roles in several MOONS Science and Technical Working Groups (WGs), including the co-leadership of the AGN WG and the technical WG-1, and have an active role in the scientific WGs on Physics of the ISM, Passive galaxies and stellar continuum, Galaxy environment, Large-Scale Structures, High-z Universe and the EoR, Clusters/Protoclusters, and in the technical WGs on Mock Catalogues from Simulations, Determination of Redshift and Physical Parameters from Spectra, and on the Determination of Environmental Parameters.

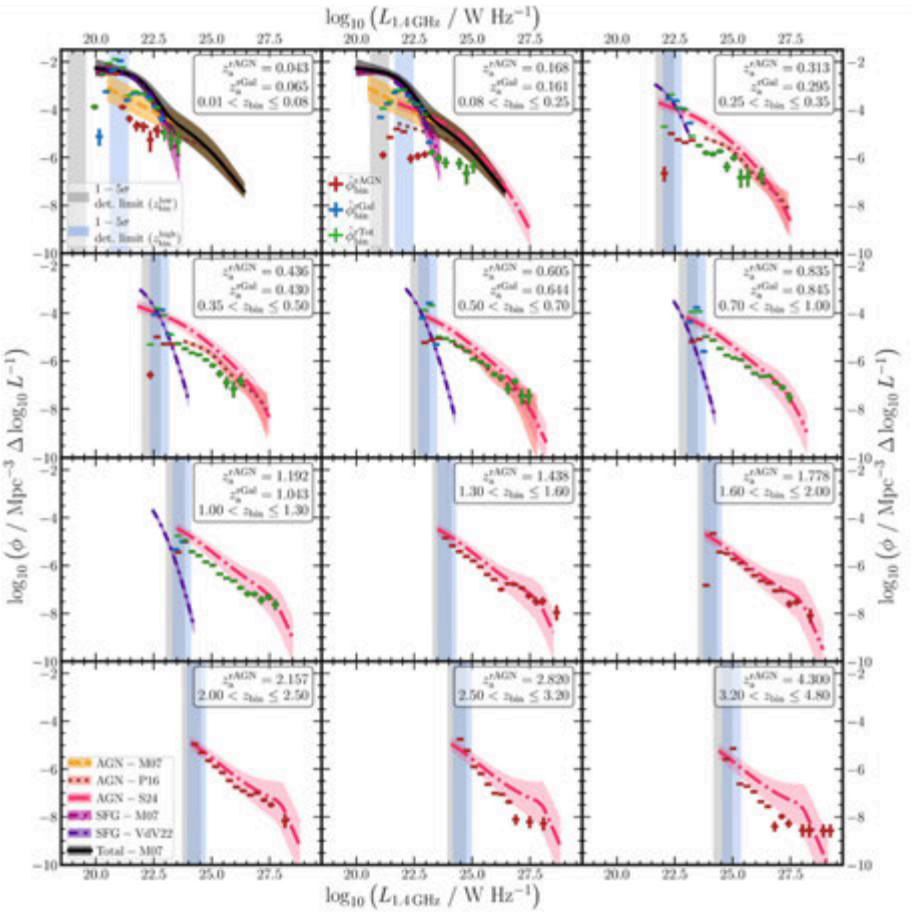
Another important field of the activities of the team centers on spatially resolved investigations of galaxies with IFS and deep multi-band photometry. For this undertaking the team members use data from MUSE as well as from the CALIFA and MaNGA IFS galaxy surveys, and also from the Hubble Space Telescope (HST) and the James Webb Space Telescope (JWST). These data are used to investigate a wide range of fundamental issues in extragalactic research, including the build-up history of galaxy bulges and the physical drivers of their inside-out star formation quenching, the spatial and temporal progression of starburst activity and starburst-driven feedback processes in galaxies, the mechanisms facilitating and regulating the escape of Lyman-α and Lyman-continuum radiation from galaxies, age and metallicity patterns in spiral and elliptical galaxies, cooling flows and ram pressure stripping effects in galaxy clusters, and the nature of ultra-faint galaxies. The activities of the team also encompass the development of Machine Learning tools for the identification of high-z AGN and the characterization of galaxies from the Euclid Galaxy Legacy Survey, which is co-led by IA.

Scientific Highlights for 2024

AGN and the growth of SMBHs since the Epoch of the Reionization

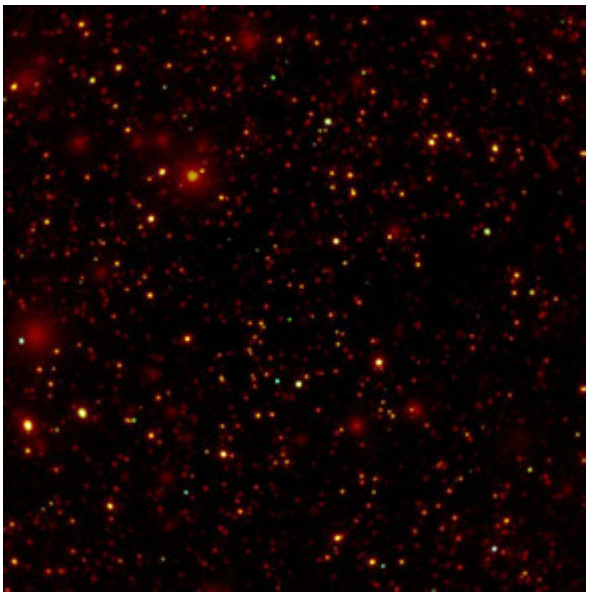
Based on the breakthrough development of a machine learning (ML) model by Carvajal et al. (2023) that is capable of predicting which sources, detected at infrared wavelengths, are likely to be AGN, our team has used these new ML algorithms and multiwavelength discriminators to identify and characterize high-z radio galaxies. In particular, we used these tools for the selection and comparative study of radio-detectable AGN and star-forming galaxies (SFGs) at different redshifts (Carvajal 2024, PhD thesis, University of Lisbon). Quite importantly, these selection methods were applied to the Evolutionary Map of the Universe (EMU) pilot survey to increase the number of radio-AGN and radio-SFG by more than an order of magnitude from known sources in the region. With this new sample, Carvajal (2024) has obtained a revised radio luminosity function for AGN and SFGs in several redshift bins, extending the existing knowledge to higher redshifts with unusual statistical robustness.

In parallel, the team has continued working on a logical optimization of the AGN selection criteria by Amarantidis et al. (2023) for the highest-redshift regime, with the exploration of ALMA observations, a capability we have already built-up between 2014 and 2020 through the establishment and management of the Portuguese ALMA Regional Center. Finally, a parallel project (Matute et al., in prep.) uses unsupervised ML, specifically, Self-Organizing Maps (SOMs) to unlock and decipher hidden patterns in massive astronomical data sets and gain insights into the processes driving accretion-powered nuclear activity from the earliest galaxies, now being detected by the JWST.



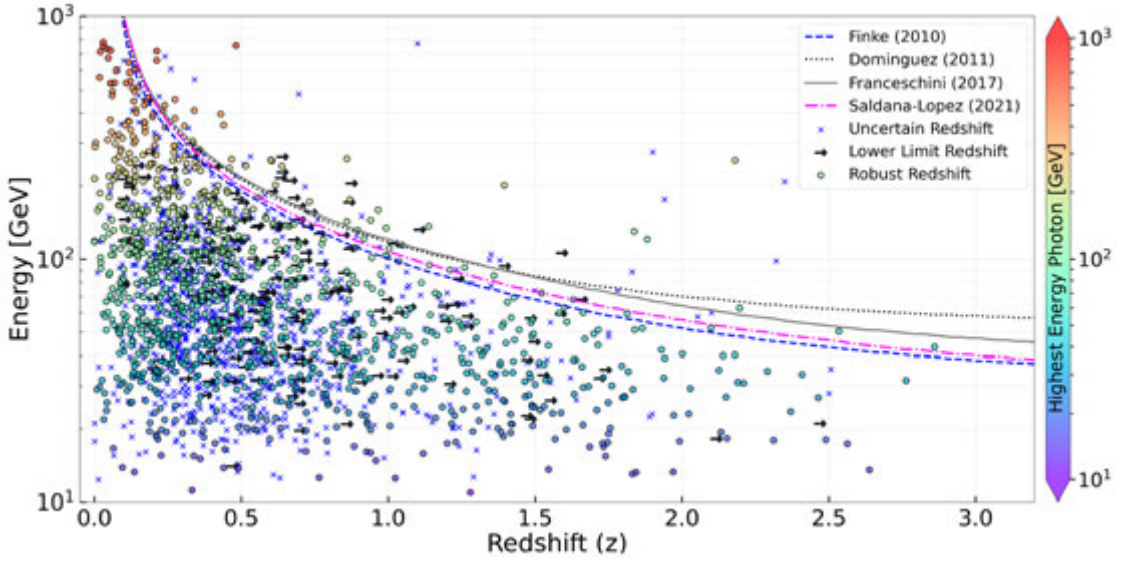
1.4 GHz radio luminosity function (RLF) in EMU-PS binned by predicted z values. Red symbols (and associated 1 σ error bars) indicate the values of predicted AGN RLF. Similarly, blue symbols show the RLF for star-forming galaxies (SFG), and green crosses the RLF for the full predicted sample. Horizontal uncertainties correspond to $\Delta \log L$= 0.3. Solid lines and shadowed regions show previous RLF determinations and their associated 1σ and 2σ uncertainties. Grey and blue regions show 1σ to 5σ detection levels from EMU-PS measurements calculated using the lower (grey) and upper (blue) limits of each redshift bin. The upper-right corner of each panel shows the median z of radio-AGN and radio-SFG, and z bin (from Carvajal 2024, PhD thesis, University of Lisbon).

Further developing the methods presented in Amarantidis et al. (2019,2023), which are based on state-of-the-art cosmological simulations and implemented additional prescriptions on the radio and X-ray emission of SMBHs, MSc student Nuno Covas has developed a physically motivated mock catalogue of X-ray AGN that leverages the IllustrisTNG cosmological simulation. Using this catalogue, future observations with NewATHENA's WFI were simulated through the SIXTE tool (Dauser et al. 2019). The primary aim of this work was to provide quantitative predictions for the WFI survey, following the rescoping of the original mission. By bridging the gap between theory and observations, our simulations are complementary to a purely observational approach and provide a comprehensive virtual laboratory to explore AGN characteristics and detectability. The resulting predictions will enhance NewATHENA's mission design, optimizing its ability to uncover and analyze high-redshift AGN, which are otherwise difficult to observe with existing X-ray telescopes.



Simulated RGB colour image of future observations with the NewAthena WFI (FOV: 40'×40'), with 200 ksec integration time (red: 0.5-2 keV, green: 2-4.5 keV and blue: 4.5-10 keV; the image is in a log scale). From Covas (2024, MSc thesis, University of Lisbon).

Finally, a parallel line of AGN research pursued by the team focuses on blazars. Arsioli et al. (2024, in press) presented the First Cosmic Gamma-ray Horizon (1CGH) catalogue, which contains γ-ray detections above 10 GeV based on 16 years of observations with the Fermi-LAT satellite. This study analysed the sample in the context of the cosmic γ-ray horizon and the γ-ray transparency of the Universe. To this end, by adopting a reference model for the Extragalactic Background Light (EBL), a subset of about 500 sources was identified in which moderate to strong γ-ray absorption could be detected across the redshift range of 0 to 3.0.

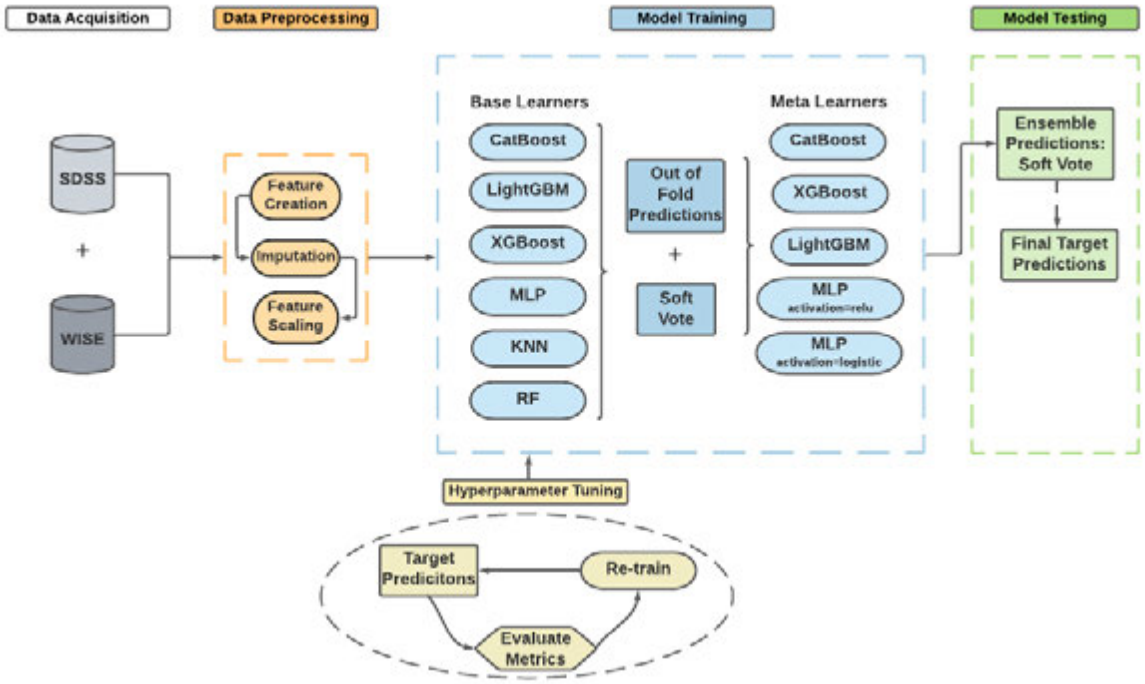


The cosmic gamma-ray horizon, showing the highest-energy photon versus redshift, based on Fermi-LAT. The EBL optical depth τ (E,z) = 1.0 is depicted for different models (from Arsioli et al. 2024, MNRAS, in press.).

Physical characterization of high-redshift galaxies in the era of Euclid and JWST

The advent of Euclid and JWST, and the availability of large multi-wavelength data sets for galaxies near and far have led to the intensification of team's activities toward the physical characterization of high-z galaxies and the exploration of the morphological and structural evolution of galaxies across z. Several parallel efforts of our team have focused on the development of ML tools for the unambiguous identification of high-z AGN and the automated characterization of galaxies on the basis of their morphology and spectral energy distribution (SED).

i) Building on ML techniques for the classification of astronomical sources in Humphrey et al. (2022,2023) and Cunha & Humphrey (2022), Cunha et al. (2024) have developed a 'few-shot' learning approach for the identification and classification of rare-object classes using limited training data (200 sources). This approach, integrated into the new AMELIA pipeline, uses a transfer-learning based approach with decision trees, distance-based, and deep learning methods to build a powerful new galaxy classifier. The performance of AMELIA was validated on the problem of identifying QSO2s at $1 \leq z \leq 2$ (in the so-called 'redshift desert') using SDSS and WISE photometry, achieving an F1-score above 0.8 in a supervised approach. In turn, the application of this new tool permitted the identification of a sub-population of dusty [NeV]λ3426Å emitters at $z \sim 1.1$, which are highly likely to contain obscured AGNs. This was confirmed using X-ray and radio cross-matching to validate the AGN classification.



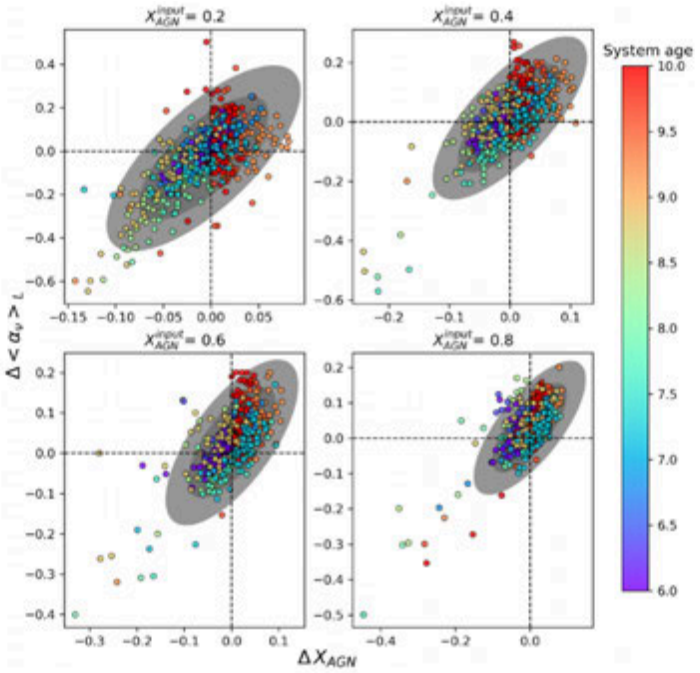
Flow diagram for the AMELIA pipeline. The process begins with the assembly of SDSS and WISE data. As seen in the orange box, feature creation is used to generate optical, optical-IR, and IR colours. The imputation method is applied to the training set and followed by feature scaling due to the use of different algorithms. The blue box shows a description of the model training: Each base learner is first loosely optimised for generalisation. Subsequently, out-of-fold predictions are combined with the average predictions from the base learners, utilising a soft-vote mechanism for the training of the meta-learners. The predictions from the meta-learners are then combined through ensembling, using a soft-vote fusion that results in the final predictions for the test set (from Cunha et al. 2024).

ii) Another line of ML-supported research by the team centers on Lyman-α-emitting (LAE) galaxies. Paulino-Afonso, in the framework of the FLAEMING project that she initiated in 2022, has trained ML algorithms on multi-band galaxy surveys like COSMOS towards the identification of high-z LAE candidates. This project proved to be particularly successful, as it allows LAE classification with an accuracy of about 90% using only optical and near-infrared fluxes. The application of this model to the COSMOS field allowed the prediction of the existence of ~3500 new LAE candidates not detected by the SC4K survey, effectively doubling the existing sample of such sources. Two parallel projects used a) gradient-boosting algorithms trained from COSMOS2020 and SC4K to improve LAE identification (Vale 2024, MSc thesis, University of Porto), and b) Convolutional Neural Networks for the search of LAEs from broadband image data. These research activities strongly benefit from GPUs awarded to Paulino-Afonso through the NVIDIA Academic Hardware Grant Program.

Studies of the star formation history of galaxies through spectral modeling

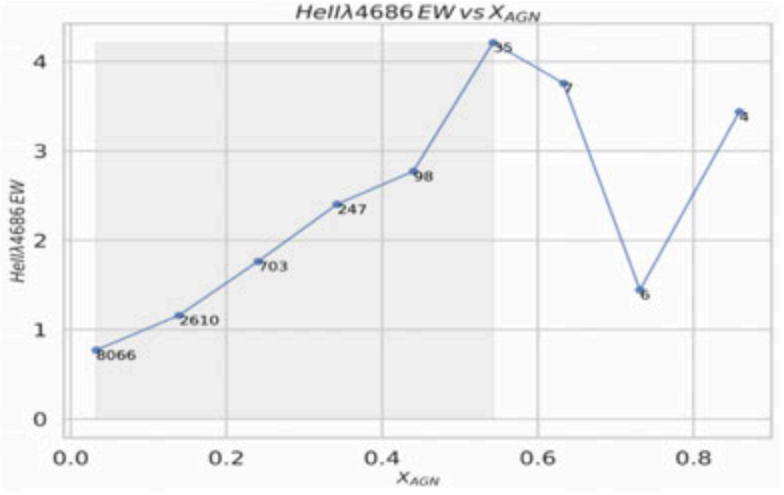
In anticipation of studies with MOONS@VLT of the physical mechanisms responsible for the gradual cessation (“quenching”) of star formation (SF) activity since z~1, it is of particular importance to develop spectral fitting tools capable of investigating the role of negative AGN feedback on the SFH of galaxies. For this reason, as part of a recently completed PhD project (Chougule 2024, PhD thesis, University of Porto), the team has continued the development and testing of a slightly modified version of FADO that allows a power-law component approximating the featureless AGN continuum to be self-consistently

included in the spectral fitting. This tool was tested on both synthetic and observed SDSS spectra of Seyfert 2 galaxies. Synthetic spectra were computed assuming two SFHs (instantaneous burst and continuous SF) and include a varying luminosity fraction XAGN (between 0 and 1) of the AGN power law at 4020 Å, for an AGN spectral index αv from 0 to -2. These synthetic spectra also included the kinematical broadening of emission lines arising from the AGN and were simulated for different signal-to-noise ratios.



Difference between the estimated and the true luminosity contribution ΔXAGN and the spectral index Δ<αv>L of an AGN component for synthetic spectra referring to an instantaneously formed galaxy with an age between 1 Myr and 10 Gyr. The top left, top right, bottom left and bottom right panels correspond to models with AGN fraction of 0.2, 0.4, 0.6, and 0.8, respectively. The ellipses show 1σ, 2σ and 3σ regions (darker to lighter) with their eccentricity being defined by the covariance of the variables. The colour bar shows the age of the system. (from Chougule 2024, PhD thesis, University of Porto).

A series of extensive tests, completed this year and summarized in the PhD thesis of A. Chougule, has shown that the self-consistency concept of FADO allows, in principle, first-order estimates of the AGN contribution XAGN when the spectral index αv is approximately known, and vice versa. The expectation that the self-consistency fitting concept of FADO can, after further refinements, be applied to Seyfert2 galaxy spectra is indirectly supported by the fact that fitting SDSS spectra reveals a trend towards an increasing equivalent width of high-excitation emission lines (HeIIλ4676 Å, [NeV]3426 Å) with increasing XAGN. These emission lines document the presence of hard ionizing radiation with a photon energy >54 eV, indicating an AGN.



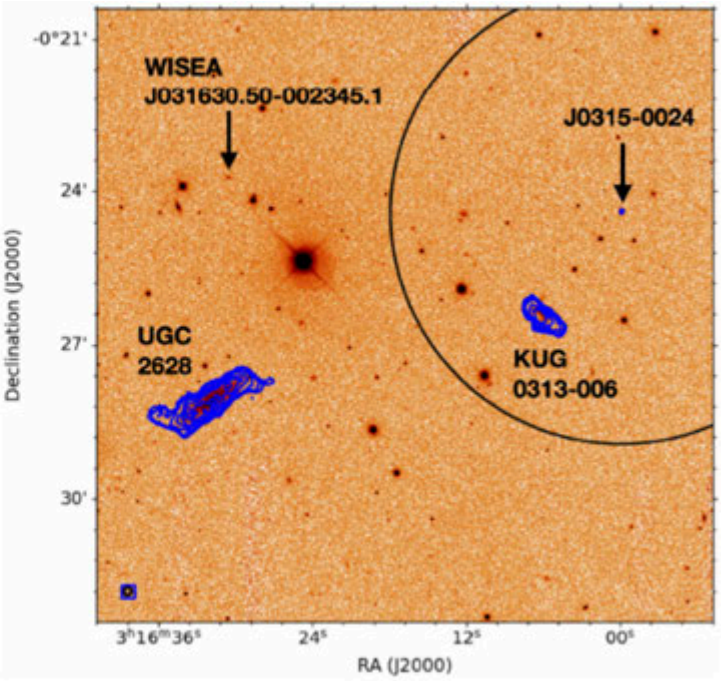
Equivalent width of the HeII 4686 Å emission line vs. luminosity contribution of the AGN component XAGN, as obtained from fitting SDSS spectra of Seyfert2 galaxies with a slightly modified version of FADO (from Chougule 2024, PhD thesis, University of Porto).

Role of the environment on galaxy evolution

The IA researcher C. Lobo participated in a study that is using S-PLUS data to map the Hα+[NII] emission in 77 Fornax galaxy members up to three virial radii of the cluster. These emission line maps, together with the results of a morphological analysis of the galaxies, aim at assessing the impact of environmental effects on cluster galaxies in different subregions of the cluster.

Analysis of a new catalogue of relatively isolated metal-rich BCDs from SDSS with the IA-developed spectral synthesis code FADO has inferred the position of these systems on the mass-metallicity relation and allowed the conclusion that the chemical self-enrichment of these systems is internally driven by mild episodes of SF rather than external interactions (Guo et al. 2024). In a parallel project, VLA B and C configuration data were used to study the HI kinematics of four extremely metal-poor BCDs with cometary morphology (Scott et al. 2024). These interferometric observations suggest that one of these systems is undergoing a merger, while the other three show signs of a weak tidal interaction with a nearby neighboor. These results reinforce the view that starburst activity in part of BCDs is triggered by gravitational perturbations.

On larger spatial scales, J. Brinchmann has been involved in a project using MUSE to study the properties of galaxies in cosmic filaments at intermediate redshift ($0.3 < z < 0.8$). A detailed analysis of 1419 galaxies in 14 such massive structures indicates that galaxies are preprocessed in groups of increasing mass before entering rich groups and clusters (Epinat et al. 2024).



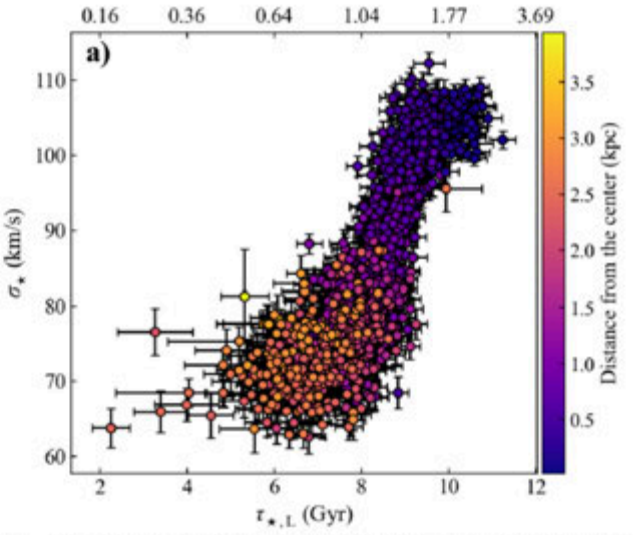
HI surface density and velocity map (left and right, respectively) of the BCD J0315–0024 and its companions KUG 0313–006, UGC 2628, and WISEA J031630.50–002345.1 (from Scott et al. 2024).

Structural and kinematical evolution of galaxies

The team has continued studies of the assembly history of galaxies and their structural components (bulge, bar, disk) using advanced image decomposition tools and high-quality data from HST, JWST and Euclid.

In Breda et al (2024), IA collaborator I. Breda (University of Vienna) and J. Brinchmann have used high-quality IFS data from MUSE of the nearby late-type spiral galaxy NGC 4030 to compare the stellar

velocity dispersion σ_* of the young stellar component in star-forming spiral arms with that in older intra-arm regions. This study has revealed for the first time in a galaxy outside the Local Group a striking grand design spiral pattern in the σ_* map, and found that young stars born in HII regions are characterized by a lower velocity dispersion than the surrounding older regions where star formation is less active. The age-velocity relation (AVR) derived in this study offers an important observational reference for evaluating various theoretical concepts about stellar-dynamical heating mechanisms in galaxies.



Age vs stellar velocity dispersion relation for the spiral galaxy NGC 4030 (from Breda et al. 2024).

Group meetings, Journal Clubs and other activities

In 2024, the team was able to significantly increase its productivity, further expand internal synergies, and enter into new collaborations. Throughout the year, the team maintained a busy schedule with weekly briefings to discuss its scientific work. In addition, the regular weekly Journal Clubs were continued, in which the latest scientific results, mostly non-IA, were discussed. In addition, the team organized a two-day internal workshop (November 2024) to discuss current research and key goals for the coming years.

Participants of the conference organized by the IA “Beyond the Edge of the Universe: Latest results from the deepest astronomical surveys” (Sintra, October 2024).

The dynamism of the team is also reflected in the continuous development and intensive scientific exploitation of machine learning tools with relevance to its scientific activities within Euclid, JWST, MOONS@VLT, MOSAIC@ELT and BlueMUSE@VLT, as well as in the organization of the conference “Beyond the Edge of the Universe: Latest results from the deepest astronomical surveys” (Sintra, 21-25 October 2024) and the co-organization of the conference “Science with the Hubble and James Webb Space Telescopes VII: Stars, Gas & Dust in the Universe” (Porto, April 29 to May 2).

Polychronis Papaderos
Group Leader

Report from the Group

Unveiling the dynamics of the Universe

The activity of the cosmology group was focused on testing the validity of the current standard cosmological model, looking to answer the question: Do we need new physics to understand the Universe? Specifically, does Einstein's general relativity accurately describe gravitation? Is a cosmological constant the correct explanation for the currently observed accelerated expansion of the Universe? Is the Standard Model of particle physics all we need to adequately describe the early Universe? We do this by exploring tests to Einstein's general relativity, delving into the detailed structure of the dark sector, and investigating observational signatures of topological defect networks. Our contributions involve our continuing participation in various international consortia. ESA's Euclid mission (in operation), LISA (2035 launch), ESO's ESPRESSO (in operation) and ANDES (2028). We are also looking to increase our participation in SKAO (2027).

This year the team centered its activities on:

1. Euclid is a mission dedicated to the exploration of the dark universe through the measurement of the properties of the cosmological large-scale structure. IA is strongly involved in this mission, participating in the consortium board, in various Science Working Groups and in the Survey Design. Euclid started to execute the Wide and Deep surveys in February 2024. Euclid members are now focusing on the preparation for the first Data Release using observations up to June 2025. Our team is involved in some of the theory key projects.

2. Putting the present standard cosmological constant model to the test is one of the strongest objectives of our group. Towards this goal, we explored extensions to Einstein's general relativity and their observational signatures and worked on observational signatures of dynamical dark energy models with couplings to the dark matter, or to neutrinos. Most of this work is aligned with the goals of the BEYLA FCT project.

3. The first detection of gravitational waves in 2015 opened a new era for astronomical observations. Several of our members have dedicated their time to studying the stochastic gravitational wave background that can be generated from topological defects, namely cosmic strings and domain wall networks. This background can possibly be detected by the LISA space telescope and building a database of cosmic string signals is crucial towards this goal.

4. The observational measurement of the fine structure constant at different redshifts presents a direct form of testing the validity of its constancy. This is something that the ESPRESSO spectrograph is particularly suited to doing and will be significantly improved with ANDES. With ANDES there is also the possibility of a direct measurement of the expansion rate of the Universe from observing the redshift drift. Several of our members are directly involved in exploring these possibilities.

Scientific highlights for 2023

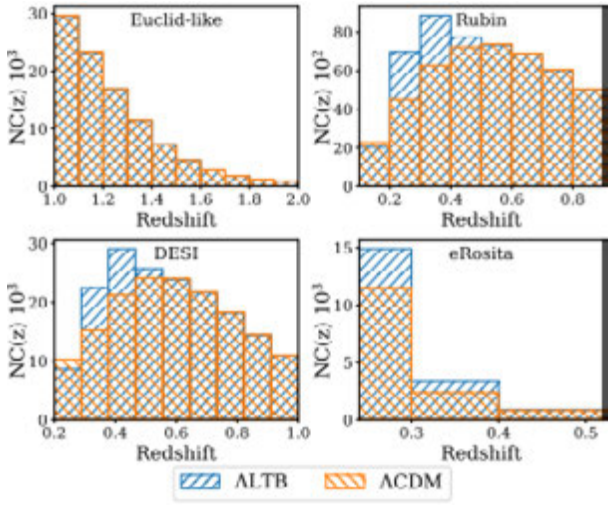
Large-scale structure constraints on cosmology

The cosmological principle —a fundamental assumption that the Universe is uniform and isotropic at large scales— is one of the cornerstones of the modern cosmology, making it of paramount importance to observationaly test its validity.

In a novel approach, a research team including IA members A. Carvalho, A. da Silva, J. P. Mimoso, C. J. A. P. Martins and N. J. Nunes, has used galaxy cluster counts to probe potential large-scale inhomogeneities in the Universe (Sakr et al., A&A, 2024). The study simulated future 'Stage-IV' galaxy surveys, and applied corrections to the mass function using N-body simulations of a Lemaître-Tolman-Bondi (LTB) cosmology.

Using this LTB model enhanced with a cosmological constant and cold dark matter, the team discovered that upcoming galaxy cluster surveys could improve constraints on cosmological parameters by approximately 50%. This significant advancement represents a ±20% improvement over previous methods using geometrical and structural growth probes.

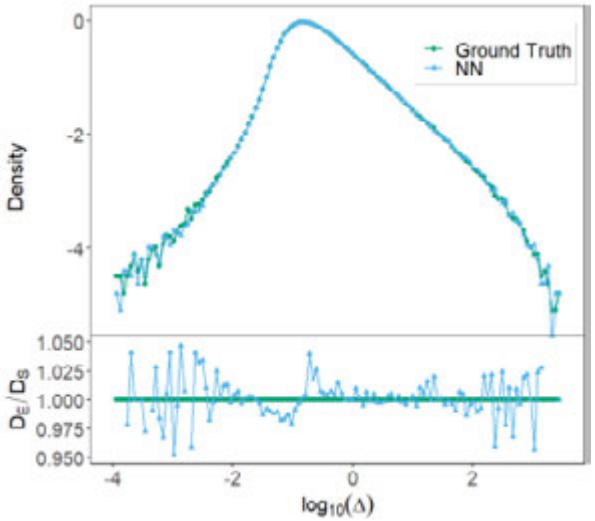
The research suggests that galaxy cluster abundances can serve as sensitive indicators of cosmic inhomogeneity. Next-generation surveys will provide unprecedented opportunities to scrutinize the cosmological principle, potentially revealing subtle deviations from the assumed universal uniformity that could revolutionize our understanding of cosmic structure.



Comparing the simulated cluster number counts in different redshift bins for different surveys between the standard ΛCDM model and a ΛLTB model. From Sakr et al. 2024.

N-body simulations are powerful for studying large-scale structure evolution but are computationally expensive, limiting their use in exploring broad parameter spaces. In a separate paper (Conceição et al. 2024), IA members M. Conceição and A. da Silva with collaborators have shown that machine learning can be used to create fast, accurate matter density field emulations. The authors developed an emulator that combines dimensionality reduction (via principal component analysis) and supervised learning to predict density fields based on cosmological parameters like dark matter density (Ωm) and redshift (z). The method reduces computation time by three orders of magnitude, achieving results within a few percent of N-body simulations for power spectra and bispectra. This approach could enable the rapid

generation of density cubes for various cosmological models, facilitating large-scale applications like parameter inference for missions such as ESA/NASA's Euclid.



Comparison of the overdensity contrast, ρ/<ρ>, between the Neural Network emulation (DE) and the ground truth coming from an N-body simulation (DS). From Conceição et al. 2024.

Unveiling Primordial Topological Defects: LISA's Gravitational Wave Template Databank

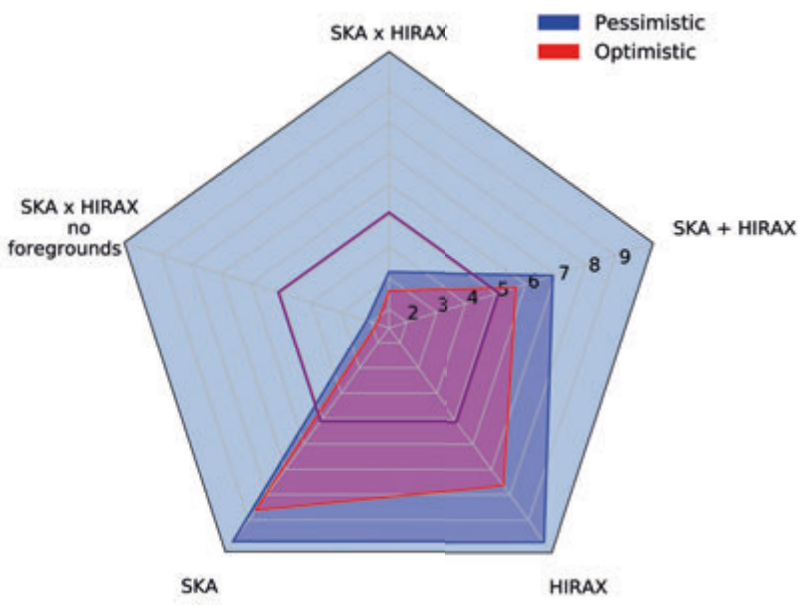
The Laser Interferometer Space Antenna (LISA) mission represents a pioneering approach to detecting gravitational wave backgrounds generated by cosmic strings—topological defects potentially formed during the universe's earliest moments. In a LISA article researchers, including IA member L. Sousa and collaborator I. Y. Rybak, have developed a comprehensive template databank for gravitational wave detection, incorporating both analytical and numerically simulated templates from advanced Nambu-Goto string network simulations.

This research is significant because it can forecast LISA's detection capabilities for these exotic gravitational wave signals. By constructing sophisticated search templates, the team can estimate the experimental reach and parameter reconstruction precision for potential cosmic string observations. Detecting these gravitational wave backgrounds could provide unprecedented insights into fundamental physics at extremely high energy scales, potentially probing conditions near the grand unification energy of approximately 10^{11} GeV.

The work demonstrates critical advancements in gravitational wave astronomy, showcasing LISA's potential to test fundamental models of cosmic string formation and reveal new relativistic degrees of freedom in the early universe. By developing flexible search strategies and assessing detection sensitivities down to incredibly low string tension levels, the research bridges theoretical predictions with observational constraints, offering a promising pathway to understanding the most fundamental aspects of cosmic evolution.

Probing the Primordial Universe with Next-Gen Radio Telescopes

The quest to understand cosmic inflation remains a central challenge in modern cosmology, with researchers developing innovative techniques to probe the fundamental physics of the universe's earliest moments. A study (Karagiannis et al. 2024) done with the participation of IA member J. Fonseca introduces a novel correlation statistic that significantly enhances our ability to measure primordial non-Gaussianity—a key characteristic of quantum fluctuations during the inflationary epoch.



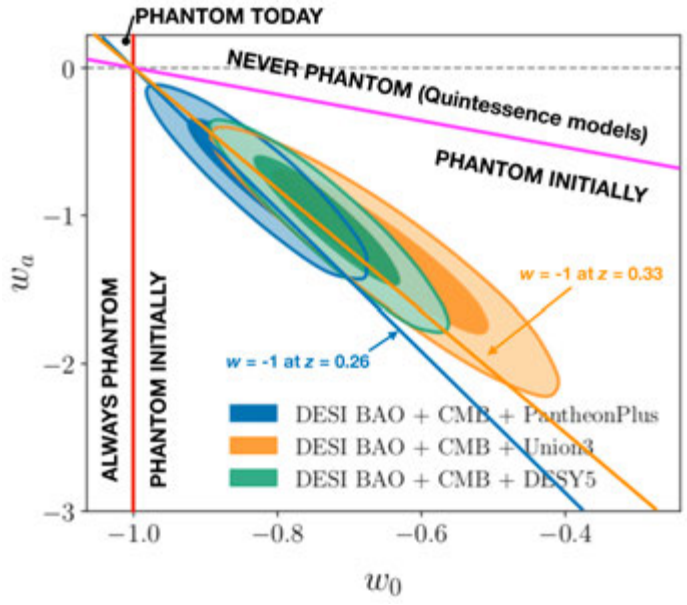
Marginalized forecasts of σ(flocNL) from the bimodal bispectrum (SKA x HIRAX) with and without foreground cut. Two versions are shown with an optimistic and a pessimistic kmax choice. For comparison, forecasts for each survey and for the summed signal (no cross corrrelation) are also shown. The purple line is the Planck 2018 constraint. From Karagiannis et al. 2024.

Next-generation radio telescope arrays offer unprecedented opportunities to map the universe's large-scale structure by examining neutral hydrogen distributions across different redshifts. By ingeniously combining interferometric and single-dish observational modes, researchers demonstrate here a method to measure the squeezed bispectrum with remarkable precision and efficiency.

The proposed approach promises to surpass existing measurements from missions like Planck and Euclid, potentially constraining primordial non-Gaussianity with unprecedented accuracy. By utilizing only a small subset of observable triangular configurations, the method could achieve a σ(flocNL) of approximately 3, opening new windows into understanding the quantum origins of cosmic structure.

This work represents a significant methodological advancement in cosmological observation, offering a flexible technique applicable to various signals that manifest in squeezed configuration measurements.

DESI's Dark Energy Puzzle



Observational constraints in the w0-wa plane combining DESI BAO and CMB observations with three different choices of supernova samples. The blue and orange lines mark parameter values where w crosses -1 at the pivot redshifts for the PantheonPlus and DESY5 supernova samples, illustrating the pantomX coincidence. From Cortês et al. 2024.

The Dark Energy Spectroscopic Instrument (DESI) has revealed intriguing new insights into the nature of dark energy, challenging our previous understanding of cosmic expansion. By combining data from baryon acoustic oscillations, cosmic microwave background, and supernova observations, researchers have detected subtle variations in dark energy's behavior that suggest it might be more dynamically complex than previously thought.

An article written by two IA researchers, M. Cortês and A. R. Liddle, (Cortês et al. 2024) focuses on a fascinating phenomenon dubbed the "PhantomX coincidence" (where X stands for crossing) where dark energy appears to reach its maximum potential within the observed cosmic window. Crucially, the research emphasizes how the observed deviation is concentrated in the derivative of dark energy's equation of state, rather than its mean value. This may indicate that previous conclusions on the dark energy evolution can be strongly driven by the assumed parameter priors. This work underscores the importance of carefully examining observational data and parameter priors, demonstrating how slight variations in analytical approach can reveal profound insights into the fundamental nature of our universe's expansion.

Modified Gravitational Lensing: Beyond Standard Black Hole Models

The fascinating world of black hole physics continues to challenge our understanding of gravity and spacetime. This research explores gravitational lensing—the bending of light—around a black hole situated in a unique theoretical context involving a Kalb-Ramond field, which introduces a novel parameter that could modify our standard understanding of gravitational interactions.

By precisely calculating how light and massive particles are deflected around this black hole, IA researchers F. S. N. Lobo and L. F. D. da Silva with collaborators (Junior et al. 2024) have uncovered intriguing insights into how symmetry-breaking effects might subtly alter gravitational behavior. The study focuses on the supermassive black hole at the center of our galaxy, Sagittarius A*, using its characteristics to explore potential observational signatures of these theoretical modifications.

Critically, the research reveals that increasing the novel parameter actually decreases the gravitational lensing effect—a counterintuitive finding that challenges existing models. While current observational technologies can detect these effects in weak gravitational fields, the researchers anticipate that next-generation interferometers will be crucial for exploring stronger field regimes.

This work represents an important step in bridging theoretical physics with observational astronomy, offering new perspectives on how fundamental symmetries might shape our universe's most extreme gravitational environments.

Other activities

The Cosmology Group maintained its dynamic research environment through weekly "Cosmoclub" journal discussions, fostering critical scientific discourse and keeping our team engaged with the latest developments in the field. These are always done with a zoom connection between all the nodes. Additionally, the group strengthened its internal collaboration through two dedicated in-person group

meetings, providing valuable opportunities for detailed discussion of ongoing research projects and future initiatives.

We also had in 2024 the organization of two significant international meetings at the Porto node: the 11th LISA Cosmology Working Group Meeting and the SKAO Cosmology Science Working Group Meeting. These events strengthened our role in two major upcoming observational facilities and enhanced our international research collaborations. We also organized in December the Cosmonata meeting with a Zoom link between the Lisbon and Porto nodes. In March 2024 we organized in the Lisbon node a meeting of the Survey Operations Support Team of Euclid (led by IA member I. Tereno).

The group demonstrated strong commitment to public engagement through various outreach activities in partnership with the Science Communication Team and Ciência Viva. The historic first public release of Euclid's images provided a unique opportunity for public engagement, with team members featuring in television appearances and participating in special outreach events to share these groundbreaking observations with the public.

Tiago Barreiro
Group Leader

Report from the Group

Astronomical Instrumentation and Systems

For the Instrumentation Group 2024 was somehow a consolidation year, especially in the area of software where the group had a significant increase. The group continues with a very intense level of activity in great part due to the way several project schedules change.

As seen in this report, there was significant progress during this year, achieving some important milestones in several projects and starting promising future ones.

During 2024, the following instruments had engineering and implementation activities at IA:

- For the European Southern Observatory (ESO): MOONS, ANDES, BlueMUSE and PoET.
- For the European Space Agency (ESA): EUCLID, CHEOPS, PLATO, ARIEL and ATHENA.

During this year, we also participated in the preparation of project applications or in the preliminary definition of concepts of a few projects,namely: HRMOS, RISTRETTO and PCS for ESO and ASSET-wE for the Subaru Telescope (Japan).

Currently, the AISG participates in a considerable number of projects, involving all its human resources. This includes not only the technical design of the instruments themselves but also the respective science exploration of the collected data through big collaboration projects such as consortiums and surveys. Its importance stems from the need to secure privileged access to existing and future facilities of the European Organization for Astronomical Research in the Southern Hemisphere (ESO) and of the European Space Agency (ESA) and to contribute to the long-term development of Astronomy in Portugal.

In terms of Human Resources, the team had the integration of a Mechanical Engineer (a need that was previously identified as a handicap). On the software side, 4 new (partial) members were integrated, and André Silva concluded his PhD and is now a researcher. Also, Ricardo Gafeira integrated (partially) the area of solar instrumentation.

In terms of themes of research, supported by background expertise in Astronomy Instruments / Space missions and consolidated by the work PhD students supervised by AISG researchers, the team is explored:

a) Stabilization of calibration light sources for High Accuracy Photometry Instruments resulting from research and develop a device that senses the light source fluctuations and modulates the beam, both in flux and in spectra, to produce a sufficiently stable source, a truly impressive challenge when stabilization levels of few ppm are required over long periods of observation.

b) Development of a solar telescope that will allow the detailed study of the Sun (using it as a proxy to understand the sources of noise that affect the observations of other stars). For that, it is fundamental to be able to obtain disc-resolved, HR spectra, opening a whole new path for the detection and characterisation of Earth-like planets orbiting other Suns. Implementation of seeing measurement techniques for daytime seeing for solar observations.

c) Development of miniaturised Cross dispersed echelle spectrographs operating in the VIS and UV with the Size Weight and Power (SWaP) requirements for a SmallSat solution and the required spectral resolution to allow the study of this less explored spectral range.

d) Study of space debris detection algorithms in a standalone platform, with the goal to implement and test a star tracker that can be used for space debris detection. The methodological approach consists of selecting the most appropriate debris detection algorithms, adding automatic photometry measurements, developing a standalone platform, implementing the algorithms in the platform, selecting the low-cost materials capable of withstanding the harsh space environment, and optimizing the algorithms to work in different scenarios.

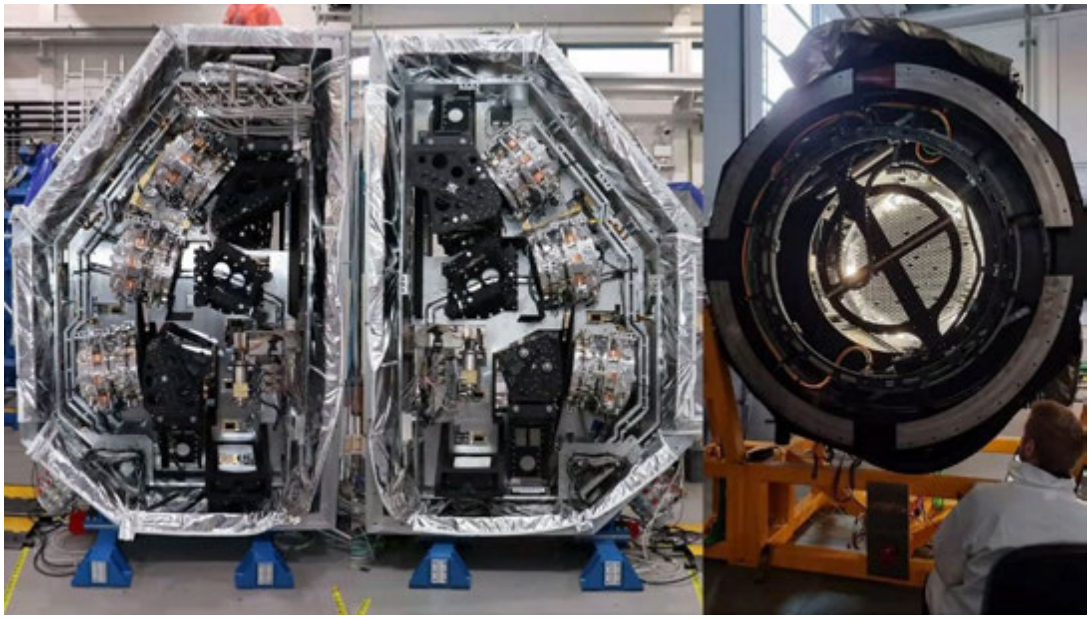
Summary of instrumentation projects

MOONS (ESO)

The Multi-Object Optical and Near-infrared Spectrograph (MOONS) is a future third-generation instrument for the Very Large Telescope (VLT) to have first light by 2023. It matches an enormous multiplexing capability, reaching up to 1000 positions being spectroscopically observed at the same time over a single telescope pointing, to the grasp of the 8.2m VLT, making it a unique instrument for deep galaxy surveys.

The subsystems under IA responsibility are the MOONS Rotating Front End (RFE) and the Field Corrector (1 m diameter set of two lenses).

In 2024, we had several integration and test missions in UKATC, Scotland, that concluded with the Preliminary Acceptance in Europe, by ESO, in December. The next year will comprise the preparation of the instrument for shipment and installation at the ESO Paranal Observatory.



The ESO MOONS Instrument with its Spectrograph and the RFE.

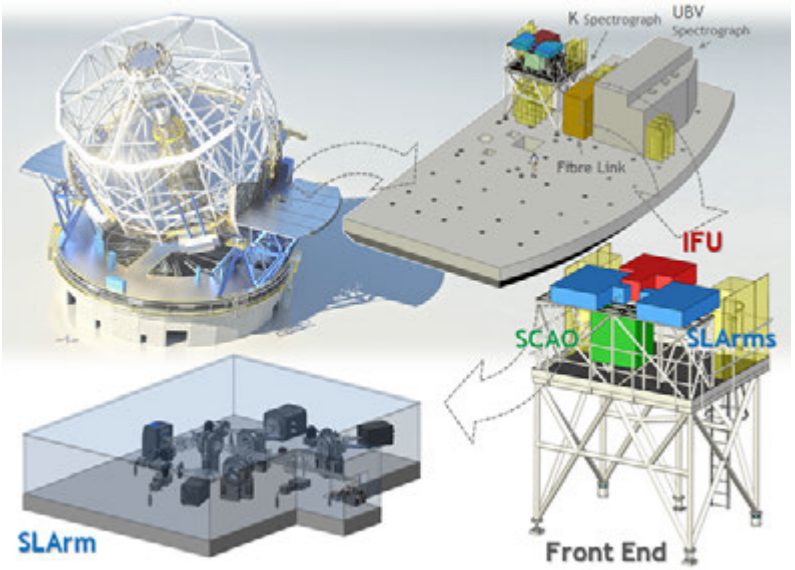
ANDES (ESO)

ANDES, formerly known as HIRES, is the project for a high-resolution spectrograph to be installed at the ESO E-ELT telescope. The concept of ANDES is being developed by a consortium that comprises several institutes in different European countries, as well as USA, Canada, Brazil and Chile. The Portuguese participation in this consortium is done through IA that is leading the “front end” subsystem component of the instrument, the data reduction and analysis software, the software system architecture, and the science drivers for the project. The group also participates in the management of the consortium, having several key persons.

2024 was a very busy successful year for ANDES. The team participated/organized the system engineering meeting to prepare for the subsystems Preliminary Design Review (PDR). The meeting was held in Lisbon at the faculty of sciences between 9 and 11 of July 2024.

On October 3, 2024, the Front-End team had a pre-subsytem PDR with ESA, in the context of the Prodex fundings. The review was held in Lisbon at the faculty of sciences. The review was successful and essential to prepare to the main PDR.

On October 29-30, 2024, the Front-End PDR was held in Lisbon at the faculty of sciences. The PDR was successful as it was the first time such an experiment is held at the level of ANDES, and ESO. We are currently taking care of all the action items to be prepared for the ANDES system PDR, to be held in October 2025 (TBC).



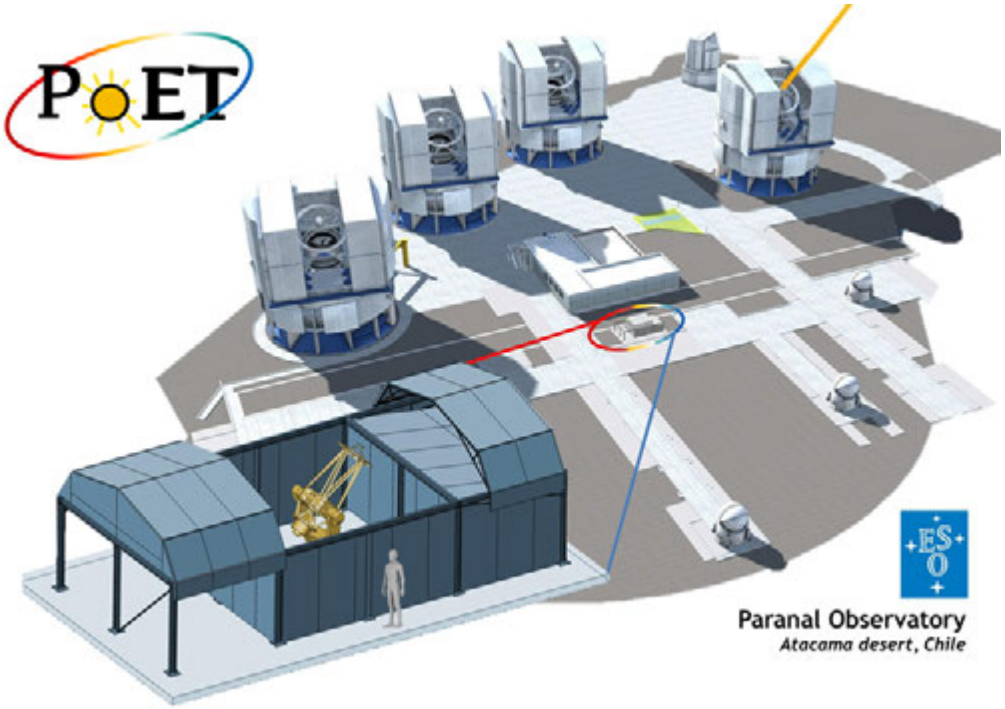
ANDES, with its Front End, at the ESO Extremely Large Telescope.

PoET (ESO)

The detection and characterisation of other Earths, planets with the physical conditions to hold liquid water and thus potential life-sustaining environments, is a bold objective of present-day astrophysics. This quest is however severely challenged by astrophysical “noise” from the host stars. To approach this problem, we started in 2022 a new project to build a dedicated facility, the Paranal solar Espresso Telescope (PoET). This telescope will be linked to the ESPRESSO spectrograph (ESO) and allow simultaneous acquisition of disk-integrated (sun-as-a-star) and

arcsecond level disk-resolved observations of the Sun at a spectral resolution R~200000. The project is funded by the European Union (ERC, FIERCE, 101052347). And it is a Portuguese project.

During 2024, the project had its preliminary design concluded, comprising the telescope, its dome and the front ends (scientific payloads developed by IA). The Detailed Design phase started at the end of 2024 and will be concluded in the first trimester of 2025 where the payload parts will start the integration and tests. The telescope was already procured and is currently being built at Officina Stellare in Italy.



PoET at the ESO Paranal Observatory in Chile.

BlueMUSE (ESO)

IA has been invited to participate in the ESO-BLueMUSE instrument, which is a blue-optimized, medium spectral resolution, panoramic integral field spectrograph based on the MUSE instrument, proposed for the Very Large Telescope (installed at Nasmith platform level). Phase A of this project is scheduled for the beginning of 2024, but preparatory works already took place during 2023.

With an optimised transmission down to 350 nm, BlueMUSE builds upon the heritage of MUSE but includes both obvious and novel improvements (e.g., improved stability with better temperature control and automated alignment processes). Along with all the core subsystems supporting the increased performance of BlueMUSE, the instrument shall be managed at the hardware and software level according to the new standards currently in use at the VLT.

The team's main activities were carried out within the scope of the Instrument Control Software and Instrument Control Electronics work packages. They participated in one in-person consortium meeting and several remote conferences, supporting efforts leading to the PHASE A milestone review, which is scheduled for February 2025.

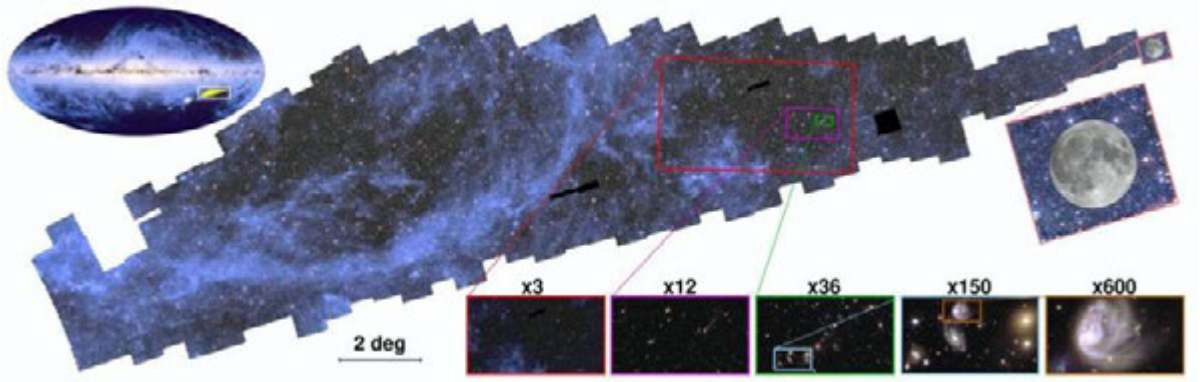
Euclid (ESA)

Euclid is ESA's mission dedicated to the exploration of the dark universe through the measurement of the properties of the cosmological large-scale structure. IA is strongly involved in this mission, participating in the consortium board, in the consortium coordination group, in the publication groups, in various science working groups, and leading the survey operations support team.

In 2024, IA's Instrumentation and Systems Group continued its long-standing participation in the preparation of the Survey Design, focusing on the development of the ECTile software. This software computes the mission's Reference Survey Definition (RSD), i.e., it produces schedules of the Euclid Deep and Wide surveys, including implementation of all calibrations, compliant with all constraints and requirements. The IA-computed reference survey is the basis of the operational survey to be executed by the Euclid satellite during the nominal science observations phase (NSOP).

February 14th marked the start of the NSOP, and the activities in 2024 started with the computation of RSD_2024A in January, the first computed survey to be used in actual observations. A satellite in space is subject to adversities of various sources including solar activity, ice contamination produced by out-gassing, guiding problems, or instrument commanding issues, resulting in a number of failed observations or images of degraded quality. The activities in 2024 were mostly focused on developing a new version of ECTile capable of copying with the NSOP critical needs of survey repairing and rescheduling. First, a survey repair tool was implemented to surgically correct patches from the previously computed survey. This tool was used to generate the second survey RSD_2024B. Then, a survey replanning capability was implemented, now to enable the computation of a new survey taking into account the observations already acquired. This tool was used in the generation of the third survey RSD_2024C. Finally, the survey recovery capability was added to ECTile, enabling the re-scheduling of failed observations when computing a new survey. At the end of the year, all these new functionalities are tested and ready to use in the generation of the fourth reference survey, to be named RSD_2025A and to be delivered in January 2025, just in time for the forthcoming Euclid first data release.

A second workshop on ECTile usage and survey generation was organized in FCUL (March 2024). In October, ESA announced the first page of Euclid's cosmic atlas obtained from the NSOP images. In terms of funding, the development of the new version of ECTile was made in the framework of a specific contract with ESA, and SOST is funded through PRODEX.



The first page of Euclid's cosmic atlas covering 132 deg2 of the Southern Sky with data acquired during two weeks of the NSOP.

CHEOPS (ESA)

The Characterising Exoplanet Satellite (CHEOPS) is the first mission dedicated to search for transits of exoplanets by means of ultrahigh precision photometry on bright stars already known to host planets. It will provide the unique capability of determining accurate radii for a subset of those planets for which the mass has already been estimated from ground-based spectroscopic surveys. CHEOPS will also provide prime targets for future instruments suited to the spectroscopic characterization of exoplanetary atmospheres. IA is strongly contributing for this mission participating both in the board and the core science team of the mission. This work is also closely related with the science data archive which is being developed by our industry partners (DEIMOS), contributing to the development of stronger relations with the Portuguese industry in the area of scientific-related software.

Moreover there is a contribution for the mission science operation centre, more specifically for the CHEOPS data reduction pipeline where we were responsible for the calibration of the pipeline until the end of the nominal mission.

In 2024, CHEOPS continues to run well within specifications and continues to get scientific observations of high precision. IA gave full maintenance support to the data reduction pipeline during the CHEOPS extension of the mission. At the beginning of 2024, we have identified and hired the person to be dedicated to this task. We have also updated and performed the release 15.0.0 of the pipeline which allowed the change of the reference platform on a new server to process all the CHEOPS data. In the last trimester of 2024, we have also signed a change request that allowed us to adjust the funding for our participation in the first extension of the mission which ends in 2026 instead of 2025 which was initially defined.

PLATO (ESA)

The PLATO mission, whose main scientific focus is the detection and characterization of extra-solar planets orbiting nearby, bright stars, using the transit method, as well as the detailed characterization of their host stars through asteroseismology, has been adopted by ESA in June 2017. The instrumentation team has leadership of several work packages for the development of software for the Plato Data Centre (PDC) as well as in the development of the Optical Ground Segment (OGSE) component to test and calibrate the PLATO cameras on the ground.

On the hardware side, our participation includes the development of the OGSE. In 2024, the team has most of all supported the activities concerning the OGSE previously delivered to CSL (Belgium), as well as (through a direct contract with ESA) the development of a second OGSE, which was already commissioned to ESTEC. Small adaptations to the light source are now on course, in order to be able to use this system to perform tests and verification with the Plato FM telescopes.

On the software side, the team kept developing four different components (and leadership of respective work packages) related to the Plato Data Centre (PDC): Target star CCD position calculation, Planet candidate ranking and false positive modelling, Model Grid Acquisition, and Target Preparation Tool. All activities went smoothly.

ARIEL (ESA)

ARIEL (Atmospheric Remote-sensing Exoplanet Large-survey) was one of the three candidate missions selected by the European Space Agency (ESA) for its next medium-class science mission due for launch in 2028. The goal of the ARIEL mission is to investigate the atmospheres of several hundred planets orbiting distant stars in order to address the fundamental questions on how planetary systems form and evolve.

The main activities Instrumentation group in ARIEL, and together with the OGSE team led by Oxford University, were associated to the design of part of OGSE system, associated to the illumination module and reference detector subsystem working in the Visible /Near Infrared part of the spectrum. The reference detector function is to monitor the light source fluctuations and to provide source stability data required to detrend the results from the ARIEL instruments during calibration and verification procedure.

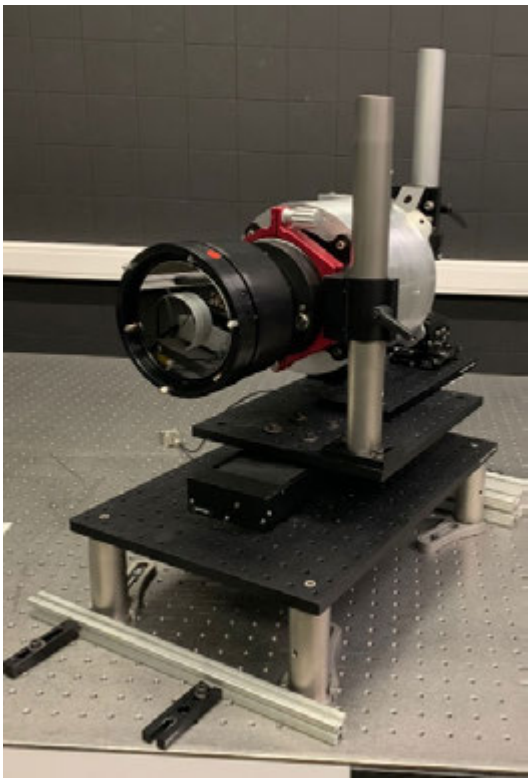
The main focus of this project was focused on the development and design activities of the OGSE, leading to the Critical Design Review milestone that took place (with success) in October 2024.

ATHENA (ESA)

The group of Instrumentation of IA is leading the international consortium for the development of the Athena mission on-board metrology system, in the sequence of the approval of activity proposal to the ESA tender, which had the kick-off in June 2020.

The function of the system being developed by the IA team is measuring the exact pointing of the Athena mirror during the process of switching focus between the X-IFU and WFI Athena instruments. The level of accuracy required for this task is at the level of a fraction of an arcsecond.

The Athena OBM project had its final presentation and final review in December 2024. The review took place at ESA and was considered successful, with the indication that the current contract could be extended next year (2025) with studies and development activities in the scope of the NewAthena mission.



OBM camera during the verification tests

Starting projects and preparations for the future

RISTRETTO & PCS. These are two similar projects for ESO where our activities started at the end of 2024. In the context of RISTRETTO (a high-resolution spectrograph equipped with extreme adaptive optics) a new visitor instrument at ESO, led by the Geneva University, the IA Instrumentation team is leading the work package related to the ADC where residuals at the level of sub-mas are requested.

RISTRETTO is now in the design phase, where we participated (remotely) in a consortium meeting in October 2024 (where IA officially entered the consortium).

RISTRETTO is considered as a pathfinder instrument for PCS, the Planetary Camera and Spectrograph (an ESO-led instrument for the ELT), where the IA Instrumentation team is leading the work package related to the ADC. In September 2024, I participated in a consortium meeting at ESO-Garching.

Quantum Comm. The year of 2024 was marked with some several studies and documentation preparation for the technical proposal submitted by our contractor to ESA. The project was approved and the KickOf meeting will take place early 2025.

Spectro-Heliograph. Development of a robotic solar full disk spectro-polarimeter installed at the Geophysical and Astronomical Observatory of Coimbra. This instrument will record full Stokes parameters of the full disk with a resolution of 2" at three different spectral regions, probing the solar photosphere and chromosphere at a cadence of <5 min. This data will allow studying the solar atmosphere by analyzing their produced I, Q, U, and V Stokes parameters maps and the Temperature, LOS velocity, and Magnetic field vector, which will be produced by applying non-local thermodynamic equilibrium spectro-polarimetric inversion at several layers of the solar atmosphere.

SpaDeLab. Development of a space debris characterization laboratory where integrated visible absolute brightness and differential brightness using standard filters SLOAN-i,r,g and UBVRI-B, I, R,V, and the entire visible spectra is measured in function of the phase angle using real Sunlight. This device will contribute to increasing the precision of estimating the size and shape of space debris by comprehensively characterizing those variations and correlating them with the sample/analogs that are being measured, creating models that can be applied to the data recorded by tracking telescopes.

Radion. The goal of this device is to record absolute signal variations in VLF (Very Low Frequency) radio waves in order to estimate perturbation in the Ionosphere caused by solar storms. The device is controlled by a single board computer, which is connected to an ADC that allows the conversion, in 8 different channels, of the analog signals to digital, with a maximum sampling rate of 192 kHz at 24 bits. One of the input channels is then connected to a pre-amplifier that receives the antenna's signal. The antenna that equips the device is a multispectral antenna specifically designed for the device, covering the frequency range from 90 Hz up to 90 kHz.

Whisper. IA participated in a Work Package of the project Wide-band High-resolution Imaging Spectro-Polarimetric Explorer (WHISPER) for the Goode Solar Telescope (GST) operating at the Big Bear Solar Observatory (BBSO), related to inversions and data reduction.

HRMOS. High Resolution Multi Object Spectrograph is an instrument that is being proposed for ESO VLT in the framework of the new instrumentation expected for the decade 2030s. The key science areas that will be addressed include Nucleocosmochronology, Galactic Science, Dwarf galaxies and Local Group, Star clusters and Stellar astrophysics, Exoplanets in crowded environments, and young stars. The preliminary designs point to a spectrograph covering significant wavelength regions in the bands U, V, and R, reaching a resolution of 80000 with the multiplexing of 50-100 stars simultaneously.

In 2024 we were invited and became part of the HRMOS consortium. During this year we have mostly worked on scientific motivation but have also started to participate in the technical meetings. For the development of this instrument, we will be managing the work package dedicated to the software data reduction of the instrument and possibly some work package in the Front-End.

ASSET-wE. Approaching Systematic characteriSation of Earth-Twins with ESPRESSO is a project that aims at providing a comprehensive program to well characterise sub-Neptunes and Earth-like planets in both hemispheres, and for that proposes to build a new ESPRESSO-like facility for the Subaru@Hawaii telescope in the northern hemisphere. The consortium is led by the Swiss Geneva Observatory and includes INAF from Italy ABC from Japan and IA. An ERC-Synergy grant was submitted at the end of 2024.

Highlights for 2023

- In December 2024, MOONS had its Preliminary Acceptance in Europe Review, approved by ESO, concluding the integration and test phase, that will be followed by the shipment and installation in the ESO Paranal Observatory.
- ANDES Front-End, under IA responsibility, has his Sub-System Preliminary Design Review (first subsystem in the ANDES instrument) in November 2024, a milestone that will be followed by the full system PDR mid-2025.
- On November 24th, 2024, the team from the instrumentation group of IA delivered a final presentation at ESA-ESTEC, marking the conclusion of an activity that led to the development of an onboard metrology system prototype for the Athena instrument. ESA's board deemed the work highly successful and mentioned the possibility of continuing the project for the New Athena mission.

Alexandre Cabral
Group Leader

Report from the Group

Science Communication

For the Science Communication Group (SCG), the year 2024 had different realities at the various poles. In Porto, a new high was set with 71,384 participants in the activities held at the **Porto Planetarium**. In Lisbon, due to the departure of human resources, there was a significant drop in activities. At the end of the year, the Porto Planetarium upgraded its multimedia projection system. New laser projectors, brighter and with more colour depth, and new computer servers were installed. This refurbishment represented an investment of around 230,000 euros by the University of Porto and will ensure that the Planetarium can function for the next 10 years.

During 2024, the Science Communication Group produced and made available to the media **14 press releases (4 of which were international)**. We also made available through our webpage and partners, **5 news releases** and sent **3 press notes**. IA has been mentioned by international news media, for example: **Quanta Magazine, Universe Today, Phys.org, and Space.com.**

During 2024, IA produced 244 **Facebook** posts, a 5.8% decrease over 2023 with a total reach of 180,722 unique users, which corresponds to an increase of 18.6% relative to 2023. By January 2025, the number of Facebook followers had increased by 334 to 10,134 (an increase of 3.4%). On **X (ex-Twitter),** IA produced 56 publications, a 74% decrease over the previous year, which was 215. With the removal of the metrics dashboard for the basic account on X, it is not possible to know the number of views of IA posts on the X platform but IA's profile has 842 followers (13 more than last year). IA produced 192 publications on **Instagram** in 2024, a decrease of -22.3% over 2023. These publications reached 64,453 Instagram users, a 36% decrease relative to 2023's reach, but still higher than 2022. The IA Instagram account now has 1768 followers, an increase of 13.6% over 2023. In 2024, IA's channel on **YouTube** got 5041 views. This was a 19% decrease relative to the previous period, which was 6223 views. IA's YouTube channel now has 2415 subscribers. This is a 2.9% increase over the number of subscribers a year ago, which was 2348. In 2024, IA uploaded 1 video (excluding short video material for link-press folders) and streamed no live sessions (in 2023 IA uploaded 4 vídeos also and did not stream). IA now has 4962 subscribers to the monthly **IAstro Newsletter**, 5.7% more than in 2023. In total, IA sent 17 newsletters during 2024, the same as in 2024.

IA's Science Communication Group, organised and participated in several public science communication initiatives (online and presential) which reached in total about **71,384 people (65,582 Porto, Lisboa 3,567 and Coimbra 2,235)**, in 2024.

All the planetarium sessions offered by Planetário do Porto – Centro Ciência Viva, both at the fixed dome and at the portable dome, are organised and presented by elements of the IA Science Communication Group. In 2024, the Portuguese session of "Supermassive Black Holes: Uncovering the Invisible" was produced, thus 11 shows were offered in full dome, reaching **32 304 attendees**. Sessions presented at schools with the portable planetarium reached a total of **9770 children**. Hands-on laboratories at the planetarium had **16,435 visitors**, all of whom also attended fixed dome planetarium sessions. Additionally, a total of **6197** participated in workshops, observations in schools and the monthly "Mais Perto das Estrelas" sessions. The Porto Planetarium has also organised several free training courses for teachers. In 2024 we had 806 applicants and 290 were selected. The planetarium session "O Céu d'Os Lusíadas" was presented at the Óbidos International Literature Festival, commemorating the 500th anniversary of the birth of Camões.

In 2024, IA co-organised with Culturgest, a cultural centre in Lisbon, a series of four talks with IA researchers and other invited researchers, moderated by science communicators. The talks on topics ("The Earth under the light of other planets", "Excess of light", "Beyond light", "Since the dawn of time") connected astronomy to other science or societal fields, and a total of **621** attended these events**.**

The SCG also helped organise the IAstro Summer Research Programme. The 2024 edition offered a total of **11 projects**, involving **18 researchers**. **257 applications** were received and **45 students** participated in the training, including from abroad through remote participation.

IA organises in-person introductory courses in astronomy and basic astrophysics on weekends, for the general public, given by IA researchers. In 2024, **9 courses** were lectured, and were attended by **89 participants**.

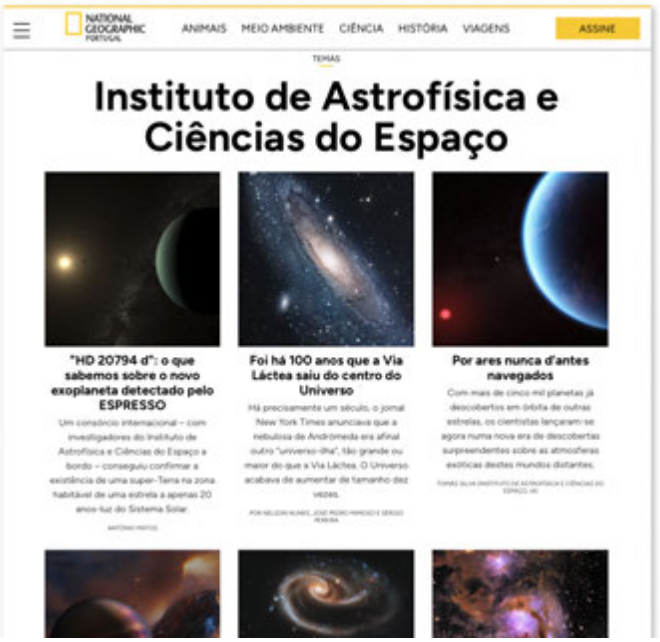
IA co-organised once more "A Criar com Scratch" with Centro de Competências TIC of Escola Superior de Educação of Instituto Politécnico de Setúbal (CCTICESE/IPS). IA contributed with the definition of the general theme, suggested supporting educational resources, and researchers integrated the team that evaluated the submitted work. The 2024 edition reached 232 students and 22 teachers, with 70 projects submitted.

World Children's Day was celebrated at the Porto Planetarium on June 1st, accompanied by the exhibition “Explora o Espaço com LEGO SPACE”, the International Council of Museums on May 18 with 500 participants and various activities to celebrate the International Day of Light. IA organised a public event on 25 May 2024 to present the institute's participation in ESA's Euclid space mission. The event included the screening of a documentary made in-house with interviews to IA researchers, a short talk and a panel discussion with IA researchers and a Portuguese Space Agency invited representative, moderated by an external science communicator. The event was hosted at the Faculty of Sciences of the University of Lisbon and received **113 participants**.

In 2024, the planetarium hosted two musical shows, one of them a post-techno opera. In total we had 270 visitors.

The SCG and IA also participated in a number of activities organised by others, such as the “Espaço vai à Escola” talk series in schools, the “Dia Aberto Ciências” and Ciências Jobshop 2024 in Lisbon, Astrofesta at the Centro Ciência Viva de Constância, European Researchers Night 2024, On September 21, IA along with Arma-Sci organized an Ignite IAstro event in preparation for the European Researchers Night 2024, followed by a night sky observation by the Porto Planetarium team. IA also had two talks and activities for families at the Lisbon Book Fair.

In 2024, IA continued the partnership with National Geographic Portugal, writing articles for the NG PT website. During this year, IA published **6 science communication articles** on the NG website.



OGA – Observatório Geofísico e Astronómico da Universidade de Coimbra

The University of Coimbra node of the IA was created on 1/04/2021, with its local headquarters located at the Geophysical and Astronomical Observatory (OGA) of the University of Coimbra (UC). OGA possesses an almost centennial spectroheliograph, technologically updated but preserving its museum-like collection of equipment and solar photographic plates, a museum, a modern 14-inch

telescope, and a digital planetarium. OGA has a set of education and outreach activities led by the Astronomy and Space Sciences Promotion Unit (UPACE) which, **although a formal protocol between IA and OGA has not been formalised yet, is led by an IA member**.

A monthly public guided tour "À Descoberta do Observatório" is made to the Observatory on the first Saturday of every month (except August and September), including the museum, the spectroheliograph, and the planetarium. On the third Saturday of every month (except July and August) a public planetarium session is also presented. Every month, on the Friday closest to the Crescent Moon (except August), a free public session of astronomical observations is offered with the 14-inch fixed telescope in the telescope dome building, and an 11-inch and an 8-inch telescope in the yard, in cooperation with the amateur astronomer's association "Alpha-Centauri" and the Section for Astronomy, Astrophysics, and Astronautics of Coimbra's Academic Association.

In 2024 the OGA organised **activities**, between planetarium sessions, museum and spectroheliograph guided visits, astronomical observations with telescopes, among others. Around 70% of these activities were conducted by IA members, investigators or students. In 2024 Coimbra had 80 activities, with a total of 2,235 visitors.

Astronomy Literacy

IA has an ongoing partnership with the Leiden Observatory/ University of Leiden for the development of an Astronomy Literacy Project. This project aims to define global goals in astronomy education to be applied in school curricula worldwide. It also contemplates the development of new resources for astronomy education and provides a framework for recommendations on governmental education policies

IA continues with a strong involvement with the "Portuguese Language Expertise Centre for the Office of Astronomy for Development (of the International Astronomical Union)" – PLOAD. It is hosted by Núcleo Interativo de Astronomia (NUCLIO), in collaboration with IA. The PLOAD's main objectives are to establish a strong collaborative network between Portuguese-speaking countries and communities and empower these countries and communities with the necessary tools to build their own local support structures and strategy development in Astronomy and Space Sciences.

IA also participates in the European Regional Office of Astronomy for Development (EROAD), the Pale Blue Dot which is an education project that uses astronomy to promote a sense of global citizenship in young children.

IA's science communication and science education researchers cooperate with the SKU Leuven & IAU Office of Astronomy for Education, in a demographic survey of planetarium operators, who they are, what they do, and how they interact with their audiences. The researchers also work with the Sloan

Digital Sky Survey, through the St Andrews University to assess The Impact of Career-Long Professional Learning on Physics Teacher Identity, Wellbeing and Self Efficacy.

There were also efforts together with the European Association for Astronomy Education (EAAE) in the Space Art Project, the Catch a Star Project, and the All Seasons: Looking for Sundials, projects

Within Portugal, IA is involved in the Viver Astronomia project which has more than **90 students** (High school, Bachelor, MSc, PhD) from several faculties and universities in the region of Lisbon, and in a joint project with the Universidade Lusófona de Lisboa, internships for the creation of educational short film animations in Astronomy Literacy are hosted – internships of bachelor students in Animation Arts. In 2024, one internee completed a three-month internship at IA.

IA's science communication and science education researchers led a team that published the PP-CC's science education strategy, in the CAP journal special issue related to the "Planetariums Centennial". These researchers also studied the presence of Astronomy in the Portuguese school syllabus, as well as a study of the Portuguese regions with low spontaneous engagement with astronomy and a beta version of a survey based on "Big Ideas in Astronomy".

The SCG (co-)organised three conferences in 2024.

Filipe Pires
Group Leader

Scientific Output

Published articles [217]

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2. M. Deliyergiyev, A. Del Popolo, **M. Le Delliou**, 2024; *Neutron star mass in dark matter clumps*; Monthly Notices of the Royal Astronomical Society, 527, 3, 21
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9. **D. S. Pereira**, **J. Ferraz**, **F. S. N. Lobo**, **J. P. Mimoso**, 2024; *Baryogenesis: A Symmetry Breaking in the Primordial Universe Revisited*; Symmetry, 16, 1, 29
10. Z. Liu, Sean D. Johnson, J. I. -. Li, G. C. Rudie, J. Schaye, H.-W. Chen, **J. Brinchmann**, S. Cantalupo, M. C. Chen, W. Kollatschny, 2024; *The first comprehensive study of a giant nebula around a radio-quiet quasar in the z < 1 Universe*; Monthly Notices of the Royal Astronomical Society, 527, 3, 5429
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58. **J. Gomes da Silva**; 2024; *Magnetochronology in the age of PLATO*; PLATO WP120 Hands-On Workshop #4 (HOW#4), , Online
59. **N. M. Gonçalves**, **A. Cabral**, **M. Abreu**; 2024; *Design trade-offs for a reduced-size cross-dispersed echelle spectrograph with a Cassegrain collimator*; SPIE Astronomical Telescopes and Instrumentation – Ground-based and Airborne Instrumentation for Astronomy X, Yokohama, Japan
60. **T. B. Gonçalves**, **J. P. Mimoso**; 2024; *To be curved or not curved: A study on curvature modulation*; 18th Iberian Cosmology Meeting (IberiCOS2024), Salamanca, Spain
61. **T. B. Gonçalves**, L. Atayde, N. Frusciante; 2024; *Cosmological study of a symmetric teleparallel gravity model*; Spanish and Portuguese Relativity Meeting (EREP 2024), Coimbra, Portugal
62. **T. B. Gonçalves**, **J. P. Mimoso**; 2024; *To be curved or not curved: A study on curvature modulation*; BEYLA Group Meeting, Naples, Italy
63. **D. Grüber**; 2024; *Stochastic Gravitational Wave Background Generated by domain wall networks*; 18th Iberian Cosmology Meeting (IberiCOS2024), Salamanca, Spain
64. **R. Heilemann**; 2024; *Simulations of Black Hole Clusters with Spins, Mergers and Recoil Kicks*; 18th Iberian Cosmology Meeting (IberiCOS2024), Salamanca, Spain
65. **R. Heilemann**; 2024; *Domain wall evolution beyond quartic potentials: The Christ-Lee and the Sine-Gordon potential*; VIII Cosmological Olentzero, Bilbao, Spain
66. J. Latas, **J. B. V. Marques**, M. Silva, E. Jaquecene, M. F. Simões; 2024; *Interculturalidade na ação da Astronomia para o Desenvolvimento em Língua Portuguesa*; Global Hands-On Universe Conference 2024, , Online

67. J. Latas, P. F. Spinelli, **J. B. V. Marques**, da Silva,J. M., R. Doran; 2024; *PLOAD Special Days and its non-formal education activities in virtual mode*; XXXII International Astronomical Union General Assembly, Cape Town, South Africa

68. **I. M. Leite**, **A. Cabral**, **N. C. Santos**, **A. M. A. C. V. Silva**, **A. Oliveira**, **B. Wehbe**, **D. Castro Alves**, **J. H. C. Martins**, **M. Abreu**, **M. A. Monteiro**, **P. Moreno**, **R. Gafeira**; 2024; *PoET, the Paranal solar ESPRESSO Telescope: a spatially resolved Sun in a high-resolution spectrograph*; SPIE Astronomical Telescopes and Instrumentation – Ground-based and Airborne Instrumentation for Astronomy X, Yokohama, Japan

69. **A. R. Liddle**; 2024; *Interpreting DESI's evidence for evolving dark energy*; Cosmology from Home 2024, , Online

70. **F. S. N. Lobo**; 2024; *Hybrid metric-Palatini gravity: Astrophysical and cosmological applications*; International Joint Meeting on Cosmology and Gravitation, Arica y Parinacota, Chile

71. **F. S. N. Lobo**; 2024; *Non-exotic modified gravity wormholes and closed timelike curves*; Time Machine Factory [unspeakable, speakable] on Time Travel – 2024, Turin, Italy

72. **F. S. N. Lobo**; 2024; *Beyond Einstein's General Relativity: Hybrid Metric-Palatini Gravity*; XII Bolyai–Gauss–Lobachevskii (BGL-2024), Budapest, Hungary

73. **F. S. N. Lobo**; 2024; *Wormholes geometries in f(R,T2) gravity satisfying the energy conditions*; 17th Marcel Grossmann Meeting, Pescara, Italy

74. M. Lykke Winther, J. L. Rørsted, I. W. Roxburgh, K. Verma, **M. S. Cunha**, A. Stokholm; 2024; *Epsilon differences, an improved surface-independent asteroseismic method*; 8th TESS/15th Kepler Asteroseismic Science Consortium Workshop, Porto, Portugal

75. **P. Machado**; 2024; *Transmission spectroscopy along the transit of Venus used for probing the atmosphere's upper layers and as a proxy for exoplanets atmosphere characterization*; Workshop on Venus and other related atmospheres (2024.03.25-29), Kobe, Japan

76. **P. Machado**; 2024; *Transmission spectroscopy along the transit of Venus used for probing the atmosphere's upper layers and as a proxy for exoplanets atmosphere characterization*; Japan and Portugal Collaboration on Venus' Atmosphere Research in the framework of Akatsuki space mission, Lisboa, Portugal

77. **P. Machado**; 2024; *Venus' transmission spectroscopy probing the atmosphere's upper layers and used as a proxy for exoplanets characterization*; Planetary Science and Space Exploration 2024, Daejeon, South Korea

78. **P. Machado**, L. Bernardo, M. S. Encarnação, **F. Brasil**, H. Eira, F. Rodrigues, E. Caetano; 2024; *Follow the Water... on Mars*; Europlanet Science Congress 2024, Berlin, Germany

79. **P. Machado**, **F. Brasil**, L. Bernardo, M. S. Encarnação, H. Eira, V. Lourenço, F. Rodrigues, E. Caetano; 2024; *A study of Martian fluvial-marine environments using reflectance and DTM*; HRSC Team Meeting, Venice, Italy

80. **P. Machado**, **F. Brasil**; 2024; *MWWM – Mars Wind & Wave Mapping*; HRSC Team Meeting, Venice, Italy

81. **P. Machado**, A. Branco, **O. Demangeon**, T. de Azevedo Silva, S. Jaeggli, T. Widemann, P. Tanga; 2024; *Transmission spectroscopy along the transit of Venus used for probing the atmosphere's upper layers and as a proxy for exoplanets atmosphere characterization*; Ariel Consortium Meeting 2024, Tartu, Estonia

82. **P. Machado**, **F. Brasil**, A. Cardesín-Moinelo, G. Gilli, J. Silva, L. Riu, J. Carter, D. Tirsch, C. Wilson; 2024; *Mars Wind and Wave Mapping (MWWM)*; COSPAR 2024, Busan, South Korea

83. L. Malo, F. Baron, A.-S. Poulin-Girard, P. Vallée, J. St-Antoine, D. Brousseau, H. Auger, V. Reshetov, F. Wildi, M. Sordet, E. Artigau, R. Doyon, S. Thibault, F. Bouchy, N. J. Cook, Y. G. C. Frensch, G. Lo Curto, G. Zins, D. Sosnowska, I. Wevers, D. Kerley, G. Allain, R. Allart, N. Hubin, C. Cadieux, A. Carmona, Z. Challita, N. Grieves, O. Hernandez, T. Vandal, N. Blind, L. Mignon, L. D. Nielsen, F. Pepe, X. Dumusque, C. Lovis, B. L. Canto Martins, J. R. de Medeiros, X. Delfosse, **N. C. Santos**, J. I. González Hernández, R. Rebolo López, G. A. Wade, **M. Abreu**, **S. C. C. Barros**, L. Bazinet, I. Boisse, X. Bonfils, V. Bourrier, S. Bovay, C. H. Broeg, V. Bruniquel, **A. Cabral**, Y. Carteret, B. Chazelas, R. Cloutier, **J. P. Coelho**, M. Cointepas, U. Conod, N. B. Cowan, **E. A. S. Cristo**, **J. Gomes da Silva**, L. Dauplaise, R. Lima Gomes, **E. Delgado Mena**, D. Ehrenreich, **J. P. Faria**, **P. Figuera**, T. Forveille, J. Gagné, F. Genest, L. Genolet, F. Gracia Témich, M. J. Hobson, J. Hoeijmakers, V. Krishnamurthy, D. Lafreniere, P. Lamontagne, P. Larue, H. Leath, I. C. Leão, O. Lim, A. M. Martins, C. Melo, Y. Messias, L. Moranta, C. Mordasini, K. Al Moulla, D. Mounzer, A. L'Heureux, N. Nari, A. Osborn, L. Parc, L. Pasquini, V. M. Passegger, S. Pelletier, C. Péroux, C. Piaulet, M. Plotnykov, J. L. Rasilla, M. Sarajlic, A. G. Segovia Milla, J. V. Seidel, D. Ségransan, **A. R. Costa Silva**, A. Srivastava, A. K. Stefanov, A. Suárez Mascareño, M. A. Teixeira, S. Udry, D. Valencia, V. Vaulato, J. P. Wardenier, **B. Wehbe**, D. Weisserman, B. Kung, A. Boucher, R. Schnell, A. Silber, I. Saviane, E. Pompei, P. Sinclaire; 2024; *NIRPS near-infrared spectrograph: AITV phase at ESO3.6m/La Silla*; SPIE Astronomical Telescopes and Instrumentation – Ground-based and Airborne Instrumentation for Astronomy X, Yokohama, Japan

84. **C. M. J. Marques**; 2024; *Detailed spectral modelling of the superbright quasar J2125-1719*; 18th Iberian Cosmology Meeting (IberiCOS2024), Salamanca, Spain

85. **J. B. V. Marques**, C. Prudêncio, G. Calafell; 2024; *Potencialidades de utilização de uma ferramenta para avaliar práticas de educação não-formal para o ensino de astronomia em planetários*; IX Seminário Ibero-Americano CTS, Aveiro, Portugal

86. **J. B. V. Marques**, A. P. Carlin; 2024; *Emotions in Observations of the Sky with the Public: Enthusiasm or Disappointment?*; Communicating Astronomy with the Public (CAP), Toulouse, France

87. **C. J. A. P. Martins**; 2024; *The ESPRESSO Redshift Drift Experiment*; 18th Iberian Cosmology Meeting (IberiCOS2024), Salamanca, Spain

88. **C. J. A. P. Martins**; 2024; *Cosmological impact of SKA redshift drift measurements*; SKA Cosmology SWG meeting 2024, Nice, France

89. **C. J. A. P. Martins**; 2024; *Phi in the Sky: On the Cosmological Evolution of Domain Walls*; VIII Cosmological Olentzero, Bilbao, Spain

90. **C. J. A. P. Martins**; 2024; *To Scale or Not To Scale*; Topological Defects in Cosmology, Manchester, UK

91. **C. J. A. P. Martins**; 2024; *Watching the Universe's acceleration era with the SKA*; SKA Cosmology SWG annual meeting, Porto, Portugal

92. **P. M. N. M. G. Martins**, **J. Afonso**, V. Cuambe, **I. Matute**; 2024; *Exploration of radio powerful Active Galactic Nuclei*; 53rd Young European Radio Astronomers Conference (YERAC 2024), Madrid, Spain

93. **P. M. N. M. G. Martins**, **J. Afonso**, V. Cuambe, **I. Matute**; 2024; *The Astronomical Potential of the*

RAEGE-Az Radio Telescope: Probing AGN nature from variability studies; Deep24, Sintra, Portugal

94. **I. Matute**; 2024; *A Self-Organized View of the Multi-Wavelength Sky*; International EMU Collaboration Meeting 2024, Perth, Australia
95. L. Mendoza, **C. Sousa-Silva**, G. Sanger-Johnson, S. Fay, J. A. Dittman, R. Giles, T. Greathouse, **P. Machado**, E. Montiel, T. Encrenaz, S. Aoki, C. DeWitt; 2024; *Venus in the Last Decade: A Spectral Mystery*; AGU 2024, Washington, D.C., USA
96. **J. P. Mimoso**, S. Cotsakis, J. Miritzis; 2024; *Einstein-Legendre F(R) gravity*; 18th Iberian Cosmology Meeting (IberiCOS2024), Salamanca, Spain
97. **H. Miranda**, **C. Pappalardo**, **J. Afonso**, **P. Papaderos**, **C. Lobo**, **A. Paulino-Afonso**, **R. Carvajal**, **I. Matute**, **P. Lagos**, **D. D. Barbosa**; 2024; *To model or not to model: nebular continuum in galaxy spectra*; Deep24, Sintra, Portugal
98. **N. A. M. Moedas**; 2024; *Exploring 94 Ceti System*; 11th Iberian Meeting on Asteroseismology, Lluc, Balearic Islands, Spain
99. **N. A. M. Moedas**, R. A. Garcia, **D. Bossini**, M. Deal, **O. Demangeon**; 2024; *Unveiling the secrets of the 94 Ceti exoplanet-host system with TESS*; 8th TESS/15th Kepler Asteroseismic Science Consortium Workshop, Porto, Portugal
100. **N. A. M. Moedas**, **D. Bossini**, M. Deal; 2024; *Stellar Characterisation using Single Value Parameter Method*; 8th TESS/15th Kepler Asteroseismic Science Consortium Workshop, Porto, Portugal
101. **A. L. Morozova**; 2024; *Scintillations in the Southern Europe during the geomagnetic storm of June 2015: analysis of a plasma bubbles spill-off using local data*; EGU General Assembly 2024, Vienna, Austria
102. **A. L. Morozova**, L. Spogli, R. Imam, E. Pica, J. A. Cahuasquí, M. M. Hoque, N. Jakowski, D. Estaço; 2024; *Scintillations in the southern Europe during the geomagnetic storm of June 2015: analysis of a plasma bubbles spill-over using ground-based data*; ESWW2024, Coimbra, Portugal
103. **A. L. Morozova**; 2024; *The 3rd Iberian Space Science Summer School (i4s)*; ISWI Steering Committee Annual Meeting, Vienna, Austria
104. B. Mosser, K. Belkacem, **M. S. Cunha**, S. Deheuvels, M. Matteuzzi, C. Pinçon, M. Takata; 2024; *New trees in the mixed-mode forest*; 8th TESS/15th Kepler Asteroseismic Science Consortium Workshop, Porto, Portugal
105. **S. Mukovnikov**, **L. Sousa**; 2024; *Gravitational waves from cosmic strings with friction*; 18th Iberian Cosmology Meeting (IberiCOS2024), Salamanca, Spain
106. **S. Mukovnikov**, **L. Sousa**; 2024; *Gravitational waves from cosmic strings with friction*; BSM^2 – Beyond the Standard Model BrainStorming Meeting: Particle Physics and Cosmology interface, Vila do Conde, Portugal
107. **K. Muzic**; 2024; *The future of brown dwarf science: Synergies between JWST and the ELTs*; Unveiling the Origins of Brown Dwarfs: Current Understanding, Open Questions, and Future Exploration, Santiago, Chile
108. **A. W. Neitzel**, **T. L. Campante**, **D. Bossini**, A. Miglio; 2024; *Intelligent Identification of Stellar Populations with Manifold Learning*; 11th Iberian Meeting on Asteroseismology, Lluc, Balearic Islands, Spain
109. **A. W. Neitzel**, **T. L. Campante**, **D. Bossini**, A. Miglio; 2024; *Identification of stellar populations through latent space projection*; 8th TESS/15th Kepler Asteroseismic Science Consortium Workshop, Porto, Portugal
110. V. A. Oliveira, **J. B. V. Marques**, J. Latas, I. Cabral, M. Silva; 2024; *Lusophone Constellation: A Project of Astronomy Communication in Portuguese*; Communicating Astronomy with the Public conference – CAP2024, Toulouse, France
111. **P. Papaderos**; 2024; *Self-consistent spectral modeling of starburst galaxies in the era of integral field spectroscopy: some challenges*; CHEMICAL ABUNDANCES IN GASEOUS NEBULAE: Multi-Scale Metals Throughout the Universe, Sao Jose dos Campos, Brazil
112. **P. Papaderos**, G. Östlin; 2024; *On the challenge of interpreting color maps of high-z starburst galaxies with the JWST and Euclid*; Deep24, Sintra, Portugal
113. **P. Papaderos**; 2024; *On the challenge of interpreting color maps of high-z starburst galaxies with JWS*; Science with the Hubble and James Webb Space Telescopes VII: Stars, Gas & Dust in the Universe, Porto, Portugal
114. **C. Pappalardo**; 2024; *Nebular continuum in the EELT era*; EAS 2024, Padova, Italy
115. **C. Pappalardo**; 2024; *Impact of nebular contribution to stellar mass determination*; EAS 2024, Padova, Italy
116. **N. Peixinho**; 2024; *Myths Associated with Astronomy*; FÍSICA 2024 – 24ª Conferência Nacional de Física e 34º Encontro Ibérico para o Ensino da Física, Coimbra, Portugal
117. **C. P. Pereira**, **M. Abreu**, **D. Castro Alves**, **A. Cabral**, R. Spry, N. E. Bowles, K. Nowicki; 2024; *Stability of the OGSE Vis-NIR illumination sub-system for the future ARIEL space mission*; SPIE Astronomical Telescopes and Instrumentation – Ground-based and Airborne Instrumentation for Astronomy X, Yokohama, Japan
118. **S. Pereira**; 2024; *Astronomy Literacy animations through internship collaboration*; Communicating Astronomy with the Public conference – CAP2024, Toulouse, France
119. **M. Pinto**; 2024; *Physical and cosmological implications of non-minimal geometry-matter coupling*; XII Bolyai–Gauss–Lobachevskii (BGL-2024), Budapest, Hungary
120. **D. Quirino**, J. C. Duarte, **P. Machado**; 2024; *Ocean circulation on the paleo Venus with ROCKE-3D*; Europlanet Science Congress 2024, Berlin, Germany
121. **D. Quirino**, J. C. Duarte, **P. Machado**; 2024; *The southern volcanic rises of Venus and the prospect for discovery*; Japan and Portugal Collaboration on Venus' Atmosphere Research in the framework of Akatsuki space mission, Lisboa, Portugal
122. **D. Quirino**, **G. Gilli**, M. Turbet, T. J. Fauchez, T. Navarro, **P. Machado**; 2024; *No Venus-like atmosphere on TRAPPIST-1 c: confirmation from 3D climate modelling*; EGU General Assembly 2024, Vienna, Austria
123. **D. Quirino**, M. Way, M. Green, J. C. Duarte, **P. Machado**; 2024; *Ocean circulation on the paleo-Venus with ROCKE-3D*; ROCKE-3D Annual meeting 2024, New York, USA
124. **R. Rianço-Silva**, **P. Machado**, Z. Martins, E. Lellouch, J. Loison, M. Dobrijévic, **J. A. Dias**, **J. Ribeiro**; 2024; *A study of very high resolution visible spectra of Titan: Line characterisation in visible CH4 bands and the search for C3*; EGU General Assembly 2024, Vienna, Austria
125. **R. Rianço-Silva**, **P. Machado**, Z. Martins, E. Lellouch, J. Loison, M. Dobrijévic, **J. A. Dias**, **J. Ribeiro**; 2024; *A study of very high resolution visible spectra of Titan – Caracterization of visible CH4 bands and the search for C3*; ARIEL Consortium Meeting, Lisboa, Portugal

126. **R. Rianço-Silva**, **P. Machado**, Z. Martins, E. Lellouch, J. Loison, M. Dobrijévic, **J. A. Dias**, **J. Ribeiro**; 2024; *A study of very high resolution visible spectra of Titan: Line characterisation in visible CH4 bands and the search for C3*; Japan and Portugal Collaboration on Venus' Atmosphere Research in the framework of Akatsuki space mission, Lisboa, Portugal
127. **R. Rianço-Silva**, **P. Machado**, Z. Martins, E. Lellouch, J. Loison, M. Dobrijévic, **J. A. Dias**, **J. Ribeiro**; 2024; *A study of very high resolution visible spectra of Titan – Caracterization of visible CH4 bands and the search for C3*; Europlanet Science Congress 2024, Berlin, Germany
128. **R. Rianço-Silva**; 2024; *Planetary Spectrum Generator – Modelling Planetary Atmosphere Spectra*; 1st Europlanet Planetary Science Workshop in Bolivia, La Paz, Bolivia
129. **J. Ribeiro**, **P. Machado**, S. Pérez-Hoyos, P. G. J. Irwin; 2024; *Retrieving Jovian aerosol properties from CARMENES spectra: exploratory results*; Europlanet Science Congress 2024, Berlin, Germany
130. **J. Ribeiro**, **P. Machado**, S. Pérez-Hoyos, **J. A. Dias**, P. G. J. Irwin; 2024; *Reanalyzing Jupiter ISO/SWS Data through a More Recent Atmospheric Model*; Japan and Portugal Collaboration on Venus' Atmosphere Research in the framework of Akatsuki space mission, Lisboa, Portugal
131. **I. M. Rolo**, **M. S. Cunha**, D. L. Holdsworth, **A. R. G. Santos**; 2024; *Finding and Characterizing Chemically Peculiar Stars with TESS*; 11th Iberian Meeting on Asteroseismology, Lluc, Balearic Islands, Spain
132. **I. M. Rolo**, **E. Delgado Mena**, M. Tsantaki, **J. Gomes da Silva**; 2024; *The Enigma of Li-Rich Giants and its Relation with RV and Stellar Activity Variations*; Cool Stars 22, San Diego, USA
133. **I. M. Rolo**, **M. S. Cunha**, D. L. Holdsworth, **A. R. G. Santos**; 2024; *Exploring the Properties of TESS Chemically Peculiar Stars*; 8th TESS/15th Kepler Asteroseismic Science Consortium Workshop, Porto, Portugal
134. **C. San Nicolas Martinez**; 2024; *Refining the radial velocity method to uncover other Earths*; PoET workshop #2, Porto, Portugal
135. **A. R. G. Santos**; 2024; *Stellar Physics @ Institute of Astrophysics and Space Sciences*; 11th Iberian Meeting on Asteroseismology, Lluc, Balearic Islands, Spain
136. **A. R. G. Santos**; 2024; *The Paranal solar ESPRESSO Telescope: PoET*; ONG Science Meeting 2024, Tenerife, Spain
137. **A. R. G. Santos**; 2024; *Stochastic solar phenomena: insights into granulation and oscillation properties*; PoET Workshop #2, Porto, Portugal
138. **A. R. G. Santos**, S. Mathur, R. A. Garcia, A. -. Broomhall, R. Egeland, A. Jiménez, D. Godoy-Rivera, S. N. Breton, Z. R. Claytor, T. S. Metcalfe, **M. S. Cunha**, L. Amard; 2024; *Magnetic activity and its variability in the Sun and Solar-like stars*; 8th TESS/15th Kepler Asteroseismic Science Consortium Workshop, Porto, Portugal
139. **A. R. G. Santos**, D. Godoy-Rivera, S. Mathur, **M. S. Cunha**, R. A. Garcia; 2024; *Signature of the spin-down stalling in the Stellar magnetic activity*; 8th TESS/15th Kepler Asteroseismic Science Consortium Workshop, Porto, Portugal
140. **N. C. Santos**; 2024; *PoET: tackling the problem of stellar noise for the PLATO ground-based observation program*; ESP2024: PLATO Planetary Systems – Formation to observed architectures, Catania, Italy
141. **N. C. Santos**; 2024; *PoET: an overview*; PoET workshop #2, Porto, Portugal
142. **N. C. Santos**; 2024; *Tackling the challenges of stellar noise with PoET*; ARIEL Consortium Meeting, Lisboa, Portugal
143. **A. M. Silva**; 2024; *A fully-Bayesian model for RV extraction*; Exoplanets5, Leiden, Netherlands
144. **A. M. Silva**; 2024; *Observing strategies and their role in the improvement of RV analysis*; PoET workshop #2, Porto, Portugal
145. **A. M. Silva**; 2024; *The Paranal solar ESPRESSO Telescope – towards a resolved view of the Sun*; Exoplanets5, Leiden, Netherlands
146. M. F. Simões, P. F. Spinelli, da Silva,J. M., J. Latas, **J. B. V. Marques**, V. A. Oliveira; 2024; *PLOAD: Igniting Stellar Passions in Portuguese-speaking Communities*; Goldschmidt2024, Chicago, USA
147. **B. Soares**, **V. Zh. Adibekyan**; 2024; *From primordial composition of stars to the present-day compo- sition of their rocky exoplanets*; Molecules and planets in the outer Galaxy: is there a boundary of the Galactic Habitable Zone?, Florence, Italy
148. **B. Soares**; 2024; *Assessing the processes behind planet engulfment and its imprints*; Rocky Worlds III, Zurich, Switzerland
149. **B. Soares**; 2024; *Exploring the processes and consequences of planet engulfment*; PLANETS Kick-off Meeting, Torun, Poland
150. **L. Sousa**; 2024; *Modelling the Stochastic Gravitational Wave Background Generated by domain wall networks*; VIII Cosmological Olentzero, Bilbao, Spain
151. **S. G. Sousa**; 2024; *CHEOPS TS3 report*; CHEOPS Science Team Meeting #30, Marseille, France
152. **S. G. Sousa**; 2024; *CHEOPS TS3 report*; CHEOPS Science Team Meeting #31, , Online
153. **S. G. Sousa**; 2024; *CHEOPS TS3 report*; CHEOPS Science Team Meeting #32, Warwick, UK
154. **S. G. Sousa**; 2024; *CHEOPS TS3 report*; CHEOPS Science Team Meeting #33, , Online
155. **S. G. Sousa**; 2024; *Spectra from public archives*; PLATO WP120 Hands-On Workshop #4 (HOW#4), , Online
156. **S. G. Sousa**; 2024; *Spectra from PLATO FU and public archives*; PLATO WP122 ("Non-seismic parameters and model atmospheres") workshop, , Online
157. **C. Sousa-Silva**; 2024; *Spectroscopic Data: Promises and Problems for Planetary Atmospheres*; Two HoRSEs, Berlin, Germany
158. **C. Sousa-Silva**; 2024; *Spectroscopic Data: Promises and Problems for Atmospheric Studies*; New York Area Exoplanets Meeting, New York, USA
159. A. C. Souza-Feliciano, B. Holler, N. Pinilla-Alonso, M. De Pra, R. Brunetto, J. Stansberry, T. Muller, J. Licandro Goldaracena, J. Emery, E. Henault, A. Guilbert-Lepoutre, Y. J. Pendleton, D. P. Cruikshank, M. T. Bannister, **N. Peixinho**, L. McClure, B. Harvison, V. Lorenzi; 2024; *Spectroscopy of the binary TNO Mors-Somnus with JWST and its relationship to the cold classical and plutino subpopulations observed in the DiSCo-TNO project*; TNO2024 The Trans-Neptunian Solar System, Taipei, Taiwan
160. **I. Tereno**; 2024; *Survey Status*; Euclid Consortium Meeting 2024, Rome, Italy
161. **I. Tereno**; 2024; *The Euclid Deep Fields*; Deep24, Sintra, Portugal
162. D. Tirsch, **P. Machado**, **F. Brasil**, J. Hernández-Bernal, A. Sánchez-Lavega, J. Carter, F. Montmessin, E. Hauber, K.-D. Matz, A. Nair; 2024; *Clouds and Storms as seen by HRSC – A catalogue of atmospheric*

phenomena on Mars; Europlanet Science Congress 2024, Berlin, Germany

163. **D. A. D. Vaz**; 2024; *Dancing in the Dark: Exploring the Impact of Binary Stars on Understanding the Properties of the Faintest Galaxies*; Small Galaxies, Cosmic Questions – II, Durham, UK
164. **D. A. D. Vaz**; 2024; *Dancing in the Dark: Exploring the Impact of Binary Stars on Understanding the Properties of the Faintest Galaxies*; A decade of discoveries with MUSE and beyond, Garching, Germany
165. **D. A. D. Vaz**; 2024; *The Binary Fraction of Leo T*; 26th MUSE Consortium Science Busy Week, Liverpool, UK
166. **D. A. D. Vaz**; 2024; *Leo T Dissected with HST and MUSE*; Science with the Hubble and James Webb Space Telescopes VII: Stars, Gas & Dust in the Universe, Porto, Portugal
167. **S. Vicente**, W.-F. Thi, I. Kamp, E. Peeters, M. Robberto, A. G. G. M. Tielens, É. Habart, O. Berné, K. D. Gordon, A. Carmona, E. Pantin, C. F. Manara, D. Van De Putte; 2024; *Proplyds Insights*; The Role of Environment in Planet Formation, Paris, France
168. **S. Vicente**, W.-F. Thi, I. Kamp, M. Robberto, M. J. Peatt, E. Peeters, A. G. G. M. Tielens, É. Habart, O. Berné, K. D. Gordon, A. Carmona, E. Pantin, C. F. Manara; 2024; *A JWST IFU deep study of gas, dust, and PAHs in a prototypical externally illuminated protoplanetary disk*; Science with the Hubble and James Webb Space Telescopes VII: Stars, Gas & Dust in the Universe, Porto, Portugal
169. **B. Wehbe**, **M. Abreu**, **A. M. A. C. V. Silva**, **A. Cabral**, **N. C. Santos**; 2024; *Implementation of a seeing measurement device for the PoET solar telescope*; SPIE Astronomical Telescopes and Instrumentation – Ground-based and Airborne Instrumentation for Astronomy X, Yokohama, Japan

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1. **B. Arsioli**; 2024; *The Very High Energy Horizon*; ENAA XXXIV, Guimarães, Portugal
2. **D. D. Barbosa**; 2024; *A complete characterisation of ultra steep spectrum sources in the COSMOS field*; ENAA XXXIV, Guimarães, Portugal
3. **A. Barka**, **N. C. Santos**, **E. A. S. Cristo**, **A. R. G. Santos**, **J. Gomes da Silva**, **J. H. C. Martins**; 2024; *Modeling the Sun's Radial Velocity with SOAP using SDO observations: comparison With Helios Radial Velocity Data*; ENAA XXXIV, Guimarães, Portugal
4. **T. Barreiro**; 2024; *Relaxing constraints on neutrino masses*; ENAA XXXIV, Guimarães, Portugal
5. **R. Carvajal**; 2024; *Feeding radio luminosity functions with machine learning predictions*; ENAA XXXIV, Guimarães, Portugal
6. **R. Carvajal**, **I. Matute**, **J. Afonso**, R. P. Norris, K. J. Luken, P. Sánchez-Sáez, **P. A. C. Cunha**, A. Humphrey, **H. Messias**, **S. Amarantidis**, **D. D. Barbosa**, H. A. Cruz, **H. Miranda**, **A. Paulino-Afonso**, **C. Pappalardo**; 2024; *Prediction of Radio AGN with Ensemble Machine Learning in multi-survey data*; Encontro Ciência 2024, Porto, Portugal
7. **R. Costa**, **T. L. Campante**, **M. J. P. F. G. Monteiro**; 2024; *Pushing the boundaries of cool-dwarf asteroseismology with ESPRESSO*; ENAA XXXIV, Guimarães, Portugal
8. **R. Costa**, **T. L. Campante**, **M. J. P. F. G. Monteiro**, **N. A. M. Moedas**; 2024; *Oscillations in cool-dwarf stars through the spectrograph ESPRESSO*; IJUP 2024, Porto, Portugal
9. **N. M. Gonçalves**, **A. Cabral**, **M. Abreu**; 2024; *Design trade-offs for a reduced-size cross-dispersed echelle spectrograph with a Cassegrain collimator*; ENAA XXXIV, Guimarães, Portugal
10. **T. B. Gonçalves**, L. Atayde, N. Frusciante; 2024; *Cosmological study of a symmetric teleparallel gravity model*; ENAA XXXIV, Guimarães, Portugal
11. **D. Grüber**; 2024; *About Domain Walls and Gravitational Waves*; IA-ON11, Lisboa, Portugal
12. **I. M. Leite**, **A. Cabral**, **N. C. Santos**, **A. M. Silva**, **A. Oliveira**, **B. Wehbe**, **D. Castro Alves**, **J. H. C. Martins**, **M. Abreu**, **M. A. Monteiro**, **P. Moreno**, **R. Gafeira**; 2024; *PoET, the Paranal solar ESPRESSO Telescope: a spatially resolved Sun in a high resolution spectrograph*; ENAA XXXIV, Guimarães, Portugal
13. **I. M. Leite**, **A. Cabral**, **N. C. Santos**, **A. M. Silva**, **A. Oliveira**, **B. Wehbe**, **D. Castro Alves**, **J. H. C. Martins**, **M. Abreu**, **M. A. Monteiro**, **P. Moreno**, **R. Gafeira**; 2024; *PoET, the Paranal solar ESPRESSO Telescope: a spatially resolved Sun in a high-resolution spectrograph*; Encontro Ciência 2024, Porto, Portugal
14. **P. M. N. M. G. Martins**; 2024; *Exploration of Radio Powerful Active Galactic Nuclei*; IA-ON11, Lisboa, Portugal
15. **P. M. N. M. G. Martins**, **J. Afonso**, V. Cuambe, **I. Matute**; 2024; *On the selection and exploration of radio powerful Active Galactic Nuclei*; ENAA XXXIV, Guimarães, Portugal
16. **P. M. N. M. G. Martins**, **J. Afonso**, V. Cuambe, **I. Matute**; 2024; *The Astronomical Potential of the RAEGE-Az Radio Telescope*; Encontro Ciência 2024, Porto, Portugal
17. **P. M. N. M. G. Martins**, **J. Afonso**, V. Cuambe, **I. Matute**; 2024; *The Astronomical Potential of the RAEGE-Az Radio Telescope*; Ciências Research and Innovation Day 2024, Lisboa, Portugal
18. **H. Miranda**, **C. Pappalardo**, **J. Afonso**; 2024; *The Birth of the Galaxy Main Sequence in the Young Universe*; Encontro Ciência 2024, Porto, Portugal
19. **T. O. Miranda**, **L. Sousa**; 2024; *Impact of small-scale structure on the stochastic gravitational wave background generated by cosmic strings*; IJUP 2024, Porto, Portugal
20. **A. Mota**, **N. C. Santos**, **M. Cortesão**; 2024; *Polar Environments and Radiation Resistance on Exoplanets: Implications for Astrobiology*; XVI Portuguese Conference of Polar Sciences, Guarda, Portugal
21. **K. Muzic**; 2024; *Planetary-mass objects in NGC 1333: Have we reached the bottom of the IMF?*; ENAA XXXIV, Guimarães, Portugal
22. **A. W. Neitzel**, **T. L. Campante**, **D. Bossini**, A. Miglio; 2024; *Dissecting Stellar Populations with Manifold Learning*; ENAA XXXIV, Guimarães, Portugal
23. **C. Pappalardo**; 2024; *The importance of being nebular*; ENEF24, Lisboa, Portugal
24. **C. Pappalardo**; 2024; *Impact of nebular contribution to stellar mass determination*; ENAA XXXIV, Guimarães, Portugal
25. **C. P. Pereira**; 2024; *A lamp to calibrate the ARIEL Space Mission*; IA-ON11, Lisboa, Portugal
26. **C. P. Pereira**; 2024; *Stability of the OGSE Vis-NIR illumination sub-system for the future ARIEL Space Mission*; ENAA XXXIV, Guimarães, Portugal
27. **C. P. Pereira**, **M. Abreu**, **A. Cabral**; 2024; *Stability of the OGSE Vis-NIR illumination sub-system for the future ARIEL space mission*; Encontro Ciência 2024, Porto, Portugal

28. D. S. Pereira, **J. P. Mimoso**, **F. S. N. Lobo**; 2024; *Matter and Anti-matter asymmetry dilemma, a possible solution from modified gravity*; ENAA XXXIV, Guimarães, Portugal
29. **J. Ribeiro**, **P. Machado**, S. Pérez-Hoyos, **J. A. Dias**, P. G. J. Irwin; 2024; *Reanalyzing Jupiter ISO/SWS Data through a More Recent Atmospheric Model*; 4th Planet Systems Day @ IA, Porto, Portugal
30. **I. M. Rolo**, **M. S. Cunha**, D. L. Holdsworth, **A. R. G. Santos**; 2024; *Exploring Chemically Peculiar Stars with Space Based Data from NASAs TESS Mission*; ENAA XXXIV, Guimarães, Portugal
31. **I. M. Rolo**, **E. Delgado Mena**, M. Tsantaki, **J. Gomes da Silva**; 2024; *The Enigma of Li-Rich Giants and its Relation with Radial Velocity and Stellar Activity Variations*; Encontro Ciência 2024, Porto, Portugal
32. **P. M. Sá**; 2024; *Interaction between dark energy and dark matter*; CIDMA—University of Algarve Meeting 2024, Aveiro, Portugal
33. **C. San Nicolas Martinez**; 2024; *Refining the radial velocity method to uncover other Earths*; ENAA XXXIV, Guimarães, Portugal
34. **A. R. G. Santos**; 2024; *Stellar rotation and magnetism*; Dias da Física, Porto, Portugal
35. **B. Soares**; 2024; *Neither icy nor terrestrial: Exploring the nature of steam worlds*; ENAA XXXIV, Guimarães, Portugal
36. J. Vila-Perez, N. C. Nguyen, J. Peraire, **A. L. Morozova**, **T. Barata**; 2024; *High-Fidelity Ionosphere-Thermosphere Modeling: a Physics-Based Discontinuous Galerkin Approach*; MIT Portugal, 2024 Annual conference, Coimbra, Portugal

Seminars at IA [24]

1. Achúcarro, A.; 2024; *Cosmic inflation, an update*
2. Antoci, V.; 2024; *A&F Stars as Astrophysical Laboratories*
3. Binette, L.; 2024; *The recently confirmed problem of gas temperature in active galactic nuclei*
4. Cabral, A.; 2024; *MOONS: the next ESO VLT's multi-object spectrograph*
5. Chang, Y.; 2024; *The co-evolution of massive galaxies and their CGM*
6. Chifu, I.; 2024; *Exploring solar wind and corona with Parker Solar Probe*
7. Cunnington, S.; 2024; *Launching the ultra-large-scale era with the SKAO*
8. Eskandarlou, S.; 2024; *J-PAS: A journey through the halo of Alba, from tidal stars to ionized Gas*
9. Godoy-Rivera, D.; 2024; *Stellar Rotation: Calibrations, Applications, and Challenges of Gyrochronology*
10. Guzmán, R.; 2024; *The New ESA F-Class Mission to Investigate the Nature of Dark Matter*
11. Huertas-Company, M.; 2024; *Deep learning the physics of galaxy formation?*
12. Ighina, L.; 2024; *Relativistic jets from QSOs in the early Universe*
13. Karapetyan, A. G.; 2024; *Constraining supernova Ia progenitors through their positions relative to host galaxy spiral arms*
14. Liske, J.; 2024; *Cosmological Conundrums*
15. Magalhães, S. I.; 2024; *Everyone is invited!: Gender and diversity take inclusion to another level*
16. Mantziris, A.; 2024; *From Hubble to Bubble – gravitational waves from phase transitions after inflation*
17. Martins, C. J. A. P.; 2024; *Reaching new hights in fundmental cosmology with ANDES*
18. Milic, I.; 2024; *Understanding solar atmosphere through high-resolution spectropolarimetry*
19. Muzic, K.; 2024; *Milky Way's substellar population*
20. Neves, R. B.; 2024; *An adiabatic approach to the trans-Planckian problem in loop quantum cosmology*
21. Palle, E.; 2024; *Revolutionizing exoplanet science with ANDES at the ELT*
22. Rodriguez Del Pino, B.; 2024; *Resolving the interstellar medium in star-forming galaxies at z>3 with the GA-NIFS survey*
23. Sanchez, M.; 2024; *Rocky planets around M dwarfs: formation, evolution and probability of detection*
24. Venturini, J.; 2024; *The radius valley across spectral types and stellar multiplicity*

Organization of Conferences [15]

1. *MOONS Science Consortium Meeting 2024*; 8 to 10 January 2024; Lisboa, Portugal
2. *SKA Cosmology SWG Annual Meeting*; 15 to 17 January 2024; Porto, Portugal
3. *IA-ON11; Instituto de Astrofísica e Ciências do Espaço 11th internal workshop*; 24 to 25 January 2024; Lisboa, Portugal
4. *4th Planetary Systems Day @IA*; 30 January 2024; Porto, Portugal
5. *Stars Day 3.5*; 24 May 2024; Observatório Geofísico e Astronómico da Universidade de Coimbra, Portugal
6. *11th LISA Cosmology Working Group Workshop*; 17 to 21 June 2024; Porto, Portugal
7. *ANDES System Engineering meeting; Towards system and subsystem PDR*; 9 to 11 July 2024; Lisboa, Portugal
8. *ApLAB Workshop*; 11 to 12 July 2024; Porto, Portugal
9. *8th TESS/15th Kepler Asteroseismic Science Consortium Workshop*; 15 to 19 July 2024; Porto, Portugal
10. *Porto Summer School on Asteroseismology; From Pixels to Stellar Ages*; 21 to 26 July 2024; Azurara, Vila do Conde, Portugal
11. *Beyond ΛCDM with the ELT and space facilities; 5th Azores School on Observational Cosmology 7th Azores International Advanced School in Space Sciences*; 2 to 8 September 2024; Angra do Heroísmo, Açores, Portugal
12. *Beyond the Edge of the Universe; Latest results from the deepest astronomical surveys*; 21 to 25 October 2024; Sintra, Portugal
13. *PoET Workshop #2*; 23 to 25 October 2024; Porto, Portugal
14. *Stars Day 2024*; 20 December 2024; Porto, Portugal
15. *COSMONATA 2024*; 23 December 2024; Porto/Lisboa/Online, Portugal

Observing runs [27]

1. **A. R. Costa Silva (PI)**, R. Allart, **O. D. S. Demangeon**, F. Borsa, E. Palle, J. Lillo-Box, E. Herrero-Cisneros, M. R. Zapatero-Osorio, C. Lovis, H. Tabernero, **N. C. Santos**, **V. Adibekyan**, D. Ehrenreich, M. Steiner, **T.**

Azevedo Silva, F. Pepe; *Emission spectroscopy survey of ultra hot Jupiters*; 112.25UT; ESPRESSO, Very Large Telescope (Paranal, European Southern Observatory); 7 February 2024, 10 March 2024, 31 March 2024, 1.34 nights (out of 3.55 nights in ESO P112) October 2023 – March 2024

2. **A. R. Costa Silva;** NIRPS Consortium; guaranteed time observations; NIRPS+HARPS, 3.6m telescope (La Silla, European Southern Observatory); 8 nights, 18-26 March 2024
3. **Scott T.C.**, Brinks E., Deshev B., Gyula J., **Lagos P.**, Minchin R., Sengupta C., Taylor R.; Abell 1367: *pre-processing in a cosmic filament*; MKT-23054, MeerKAT, 1 March 2024
4. **Machado, P.**, **Espadinha, D.**, **Dias, J.**, Widemann, T., **Peralta, J.**, **Brasil, F.**, **Quirino, D.**, **Ribeiro, J.**; *A High Spectral Resolution study of the cross-terminator winds and chemical-dynamical tracers on the lower atmosphere of Venus*; IRTF Observational Proposal: 2024A046; IRTF/iSHELL observations of Venus; 1-3 Feb 2024 (12h).
5. **Machado, P.**, **Silva, R.**, Martins, Z., **Sousa-Silva, C.**, **Brasil, F.**, **Dias, J.**, **Quirino, D.**, **Ribeiro, J.**, **Espadinha, D.**; *Unveiling Organic Chemistry on Enceladus' Water Ocean with High Resolution Spectroscopy*; ESO Observational Proposal: 114.279K.002; VLT/CRIRES+ observations of Enceladus; 18 October 2024 (1.5h).
6. **Machado, P.**, **Silva, R.**, Loison, J.C., Rannou, P., Oliva, F., D'Aversa, E., **Dias, J.**, **Quirino, D.**, **Ribeiro, J.**, **Brasil, F**, Dobrijevic, M.; *Investigating the production of aromatic organic compounds in Titan's atmosphere with VLT-ESPRESSO*; ESO Observational Proposal: 114.277N.001; VLT/ESPRESSO observations of Titan; 3 December 2024 (4.2h).
7. **Carlos Martins**, Stefano Cristiani, Valentina D'Odorico, Paolo Molaro, Francesco Guarneri, Michael Murphy, Tobias Schmidt, Dinko Milakovic, L. Pasquini, Gaspare Lo Curto, **Catarina Marques**, Ricardo Genova-Santos, Guido Cupani, Carlos Allende Prieto, David Ehrenreich, **Pedro Figueira**, Jonay I. Gonzalez Hernandez, Christophe Lovis, Andrea Mehner, **Nelson Nunes**, Francesco Pepe, Rafael Rebolo, **Sergio Sousa**, Alessandro Sozzetti, S. Udry, Alejandro Suárez Mascareño, María Rosa Zapatero Osorio, **N.C. Santos**, Ennio Poretti, Giorgio Calderone, Andrea Grazian, Andrea Trost; *An ESPRESSO Redshift Drift Experiment*, Part IIa; 112.25K7; ESPRESSO – VLT; P112
8. **Carlos Martins**, Stefano Cristiani, Valentina D'Odorico, Paolo Molaro, Francesco Guarneri, Michael Murphy, Tobias Schmidt, Dinko Milakovic, L. Pasquini, Gaspare Lo Curto, **Catarina Marques**, Ricardo Genova-Santos, Guido Cupani, Carlos Allende Prieto, David Ehrenreich, **Pedro Figueira**, Jonay I. Gonzalez Hernandez, Christophe Lovis, Andrea Mehner, **Nelson Nunes**, Francesco Pepe, Rafael Rebolo, **Sergio Sousa**, Alessandro Sozzetti, S. Udry, Alejandro Suárez Mascareño, María Rosa Zapatero Osorio, **N.C. Santos**, Ennio Poretti, Giorgio Calderone, Andrea Grazian, Andrea Trost; *An ESPRESSO Redshift Drift Experiment*, Part IIb; 113.26FY; ESPRESSO – VLT; P113
9. Andrea Trost, Stefano Cristiani, Dinko Milakovic, Simona Di Stefano, **Catarina Marques**, Francesco Guarneri, Guido Cupani, Louise Welsh**, Carlos Martins**, Matteo Viel, Prakash Gaikwad, Andrea Grazian, Michael Murphy, Tobias Schmidt, Valentina D'Odorico, L. Pasquini, Vieri Cammelli; *ESPRESSO in the sky with diamonds: the small scale structure of the IGM with spectroscopy of lensed quasars*; 115.28E5; ESPRESSO – VLT; P115
10. M. Guarcello et al. incl. **K. Muzic**; *Evolution of protoplanetary disks and early stellar evolution in starburst: A NIRCam and MIRI observation of the young starburst cluster Westerlund 2*; GO 3523; NIRCAM and MIRI at JWST; March – July 2024
11. A. Scholz, **K. Muzic**, V. Almendros-Abad, P. Pinilla, R. Jayawardhana, A. Natta, L. Testi; *Exploring planetary nurseries around free-floating planetary mass objects*; GO 4583; NIRSPEC and MIRI at JWST; August – October 2024
12. N. Sabha, R. Schoedel, **K. Muzic**; *A VLT/VISIR Census of Disks in the Arches and Quintuplet Stellar Clusters*; 113.26K1.001; VISIR/VLT; May – July 2024
13. C. Fontanive et al., incl. **K. Muzic**; Imaging hidden brown dwarfs around accelerating stars; 112.25BX.001; SPHERE/VLT; January – February 2024
14. **Sousa**/ Mortier/ **Santos**/ Rojas Ayala/ **Adibekyan**/ Israelian/ **Demangeon**/ **Barros**/ Antoniadis Karnavas/ **Delgado Mena**/ Tsantaki/ **Soares**; *Know The Star To Know The Planet: Improving Sweet-Cat With Homogeneous Planet-Host Parameters*; Uves, Vlt Ut2, Sm 113.26aq.001; 112.25cz.001
15. **Delgado Mena** et al. (as part of the NIRPS GTO Other Science proposals); *"NIRPS GTO – Other Science 3: Stellar activity impact on radial-velocity variations in K stars"*; 113.26KW-114.279B, NIRPS-ESO-3.6m; ESO period 113 and 114
16. **S. Sousa,** et al. (including, **Elisa Delgado Mena**); *"Know the star to know the planet: improving SWEET-CAT with homogeneous planet-host parameters"*; 112.25CZ-113.26AQ; UVES/VLT; period 112-113 service mode
17. K. Hełminiak et al. (including, **Elisa Delgado Mena**); "*A precise characterisation of the ARIEL stars*"; 2024-1-MLT-010; SALT/HRS; period 2024B
18. **A. R. G. Santos**, T. S. Metcalfe, O. Kochukhov, **Tiago L. Campante**, **R. Gafeira**; *Constraints on Magnetic Braking and Dynamo Evolution from Spectropolarimetry of β Hydri*; ESO/HARPS; P113
19. Mousumi Das, **Daniel Vaz**, Amrutha S.; Observations of Leo T; Astrosat-UVIT; Cycle A13
20. **Cirino Pappalardo**, PI: Lorenzon; ALMA, Proposal 2024.1.00814.S `*Hunting the prolonged dust growth in dusty quiescent galaxies at intermediate redshift*` accepted for observation, July
21. **Tiago Campante; Rúben A. R. Costa**; Observation of the star HD 191408; ESPRESSO at the Paranal observatory; 17 September – 26 September 2024
22. **S. Vicente** (PI) , W. Thi (Co-PI), I. Kamp, E. Peeters, A. Tielens, M. Robberto, A. Carmona, E. Habart, C. Manara, E. Pantin, K. Gordon; *A JWST IFU deep study of gas, dust, and PAHs in a prototypical externally illuminated protoplanetary disk*; MIRI-MRS and NIRSpec instruments at the JWST; Cycle 2 – observations executed in March – September 2024.
23. C. Manara (PI), Aru, Haworth, Facchini, Robberto, Rosotti, Petr-Gotzens, MCleod, Winter, Miotello, Cleeves, Boyden, Maucó, Campbell-White, **S. Vicente**, Ballering, Ballabio; *Spectrally Resolving The [CI]8727, 9824, and 9850 AA Lines With Uves To Decipher External Photoevaporation*; UVES/VLT; November 2024 – January 2025
24. **Rodrigo Carvajal**, **Jose Afonso**, Ricardo Demarco, Evanthia Hatziminaoglou, Ruediger Kneissl, **Israel Matute**, Hugo Messias, Joleen Teo; *How rich are the environments of high redshift radio galaxies?*; ACA, ALMA; Cycle 11 10 December 2024
25. **Campante, T. L**. (PI); Co-Is: **Santos, N. C., Adibekyan, V.**, **Cunha, M. S.**, et al.; *Expanding the frontiers of cooldwarf asteroseismology with ESPRESSO*; Program ID: 113.26FX; Echelle SPectrograph for Rocky Exoplanets and Stable Spectroscopic Observations

(ESPRESSO) at the Very Large Telescope (VLT); Period 113

26. Rogerio Riffel, **Pedro Cunha**, Thaisa Storchi Bergmann, Alberto Rodriguez Ardila, **Jean Gomes**, **Andrew Humphrey**, **Jarle Brinchmann**, Luis Hahn, Marckelson Silva; *Studying emission line activity in a sample of machine learning-selected QSO2 in the redshift desert*; SOAR SO2024B-010, GOODMAN spectrograph at SOAR telescope; 1 September 2024, 3 September 2024, and 28 September 2024
27. Holdsworth, **Cunha** et al., *Defining a new chemically peculiar star catalogue*, HRS@SALT, January – December 2024 (128h); This is long-term programme to be continued over several semesters

Outreach talks [143]

1. Catarina Lobo, "A nossa galáxia e as outras: uma viagem através do Universo", Escola Básica de Valadares, Vila Nova de Gaia, 24 October 2024
2. Catarina Lobo, "Dentro de um enxame... de galáxias!", Centro Interpretativo da Mulher Duriense, Armamar, 21 September 2024
3. Ana Rita Costa Silva, Talk at conference: Astronomy communication and influencing, Instagram, 24 de June 2024
4. Ana Rita Costa Silva, Communicating Astronomy with the Public 2024, Toulouse + online, France, 24 – 28 June 2024
5. Ana Rita Costa Silva, Poster at conference: Astronomy communication and influencing via Instagram, International Astronomical Union General Assembly 2024, Cape Town + online, South Africa, 6 – 15 August 2024
6. Ana Rita Costa Silva, Exoplanetas e a Procura por Vida Extraterrestre, O Espaço Vai À Escola (Ciência Viva/ESERO), Escola Básica Frei Bartolomeu dos Mártires, Viana do Castelo, 5 November 2024
7. Ana Rita Costa Silva, Exoplanetas e a Procura por Vida Extraterrestre, O Espaço Vai À Escola (Ciência Viva/ESERO), Escola Básica das Naus, Lagos, 5 November 2024
8. Ana Rita Costa Silva, Exoplanetas e a Procura por Vida Extraterrestre, O Espaço Vai À Escola (Ciência Viva/ESERO), Escola Secundária de Molelos, Tondela, 5 November 2024
9. Ana Rita Costa Silva, Exoplanetas e a Procura por Vida Extraterrestre, O Espaço Vai À Escola (Ciência Viva/ESERO), Escola Básica de Pevidém, Selho – São Jorge, Guimarães, 7 November 2024
10. Ana Rita Costa Silva, Exoplanetas e a Procura por Vida Extraterrestre, O Espaço Vai À Escola (Ciência Viva/ESERO), Escola Básica Sophia de Mello Breyner Andresen, Brandoa, Amadora, 7 November 2024
11. Ana Rita Costa Silva, Exoplanetas e a Procura por Vida Extraterrestre, O Espaço Vai À Escola (Ciência Viva/ESERO), Escola Básica Padre Alberto Neto, Rio de Mouro, Sintra, 8 November 2024
12. Ana Rita Costa Silva, Talk about the IA research group "Planetary Systems", Encontro Clubes Ciência Viva, Planetário do Porto/FCUP, Porto, Portugal, 7 December 2024
13. Carlos J. A. P. Martins, Testing General Relativity with the Eddington Experiment, CEIA-PPCB, 16 August 2024
14. Carlos J. A. P. Martins, A Física da Energia e do Aquecimento Global, ES Clara de Resende, Porto, 9 October 2024
15. Carlos J. A. P. Martins, A Física da Energia e do Aquecimento Global, ES de Rio Tinto, 11 October 2024
16. Carlos J. A. P. Martins, A Física da Gravidade e dos Satélites, ES de Vilela, Paredes, 11 October 2024
17. Carlos J. A. P. Martins, A Física da Radioactividade e do Cancro, ES de Vouzela, 14 October 2024
18. Carlos J. A. P. Martins, A Física da Gravidade e dos Satélites, ES Camilo Castelo Branco, Famalicão, 15 October 2024
19. Carlos J. A. P. Martins, A Física da Radioactividade e do Cancro, ES Fornos de Algodres, 16 October 2024
20. Carlos J. A. P. Martins, A Física da Gravidade e dos Satélites, ES S. Pedro do Sul, 16 October 2024
21. Carlos J. A. P. Martins, A Física da Energia e do Aquecimento Global, ES Rocha Peixoto, Póvoa de Varzim, 17 October 2024
22. Carlos J. A. P. Martins, A Física do Big Bang, ES Aurélia de Sousa, Porto, 17 October 2024
23. Carlos J. A. P. Martins, A Física da Gravidade e dos Satélites, ES de Pinhal de Rei, Marchinha Grande, 21 October 2024
24. Carlos J. A. P. Martins, A Física do Big Bang, ES Sebastião da Gama, Setúbal, 29 October 2024
25. Carlos J. A. P. Martins, A Física da Gravidade e dos Satélites, ES Emídio Navarro, Almada, 29 October 2024
26. Carlos J. A. P. Martins, A Física da Radioactividade e do Cancro, Colégio Marista de Carcavelos, 30 October 2024
27. Carlos J. A. P. Martins, A Física da Gravidade e dos Satélites, ES José Gomes Ferreira, Lisboa, 31 October 2024
28. Carlos J. A. P. Martins, A Física da Energia e do Aquecimento Global, ES Martinho Vaz de Castelo Branco, Póvoa de Sta. Iria, 31 October 2024
29. Carlos J. A. P. Martins, A Física da Energia e do Aquecimento Global, ES Públia Hortênsia Castro, Vila Viçosa, 4 November 2024
30. Carlos J. A. P. Martins, A Física da Gravidade e dos Satélites, ES Fernando Namora, Amadora, 5 November 2024
31. Carlos J. A. P. Martins, A Física da Energia e do Aquecimento Global, ES de Castro Verde, 5 November 2024
32. Carlos J. A. P. Martins, A Física da Radioactividade e do Cancro, ES de Arga e Lima, Lanheses, 6 November 2024
33. Carlos J. A. P. Martins, A Física da Gravidade e dos Satélites, ES Quinta das Palmeiras, Covilhã, 11 November 2024
34. Carlos J. A. P. Martins, A Física da Gravidade e dos Satélites, ES João Gonçalves Zarco, Matosinhos, 12 November 2024
35. Carlos J. A. P. Martins, A Física da Gravidade e dos Satélites, ES de Molelos, Tondela, 13 November 2024
36. Carlos J. A. P. Martins, A Física do Big Bang, ES de Airães, Felgueiras, 14 November 2024
37. Carlos J. A. P. Martins, A Física da Gravidade e dos Satélites, ES À Beira Douro, Gondomar, 14 November 2024
38. Carlos J. A. P. Martins, A Física da Energia e do Aquecimento Global, ES António Aleixo, Portimão, 18 November 2024
39. Carlos J. A. P. Martins, A Física da Radioactividade e do Cancro, ES de Santa Maria Maior, Viana do Castelo, 19 November 2024

40. Carlos J. A. P. Martins, A Física da Gravidade e dos Satélites, ES Gaia Nascente, Oliveira do Douro, 25 November 2024
41. Tiago Barreiro Gonçalves, O Estado Atual da Cosmologia (moderator), Encontro Nacional de Estudantes de Física (ENEF), Faculdade de Ciências da Universidade de Lisboa, Portugal, 17 February 2024
42. Tiago Barreiro Gonçalves, Os invisíveis e imparáveis neutrinos, Ignite IAstro, Sintra, Portugal, 26 October 2024
43. Catarina M. J. Marques, Os Mistérios do nosso Universo: Em busca das respostas (O Espaço vai à Escola – ESERO), Remote, Escola Secundária de Alcanena, 14 October 2024
44. Catarina M. J. Marques, Os Mistérios do nosso Universo: Em busca das respostas (O Espaço vai à Escola – ESERO), Remote, Externato Liceal de Albergaria dos Doze, 16 October 2024
45. Catarina M. J. Marques, Os Mistérios do nosso Universo: Em busca das respostas (O Espaço vai à Escola – ESERO), Remote, Colégio da Trofa, 17 October 2024
46. Catarina M. J. Marques, Os Mistérios do nosso Universo: Em busca das respostas (O Espaço vai à Escola – ESERO), Remote, Escola Básica das Naus, 24 October 2024
47. Catarina M. J. Marques, Os Mistérios do nosso Universo: Em busca das respostas (O Espaço vai à Escola – ESERO), Remote, Escola Secundária Rainha Dona, 25 October 2024
48. Catarina M. J. Marques, Os Mistérios do nosso Universo: Em busca das respostas (O Espaço vai à Escola – ESERO), Remote, Colégio Casa Mãe, 5 November 2024
49. Catarina M. J. Marques, Os Mistérios do nosso Universo: Em busca das respostas (O Espaço vai à Escola – ESERO), Remote, Escola Secundária de São Pedro do Sul, 15 November 2024
50. Catarina M. J. Marques, Os Mistérios do nosso Universo: Em busca das respostas (O Espaço vai à Escola – ESERO), Remote, Escola Básica de Montenegro, 27 November 2024
51. Inês Martins Rolo, Receita para fazer uma estrela peculiar, Ignite IAstro – ArmaMarch, 21 September 2024
52. Nuno C. Santos, Palestra: "À procura de outras Terras", no âmbito das "Conferências de Arouca" (organização: Círculo Cultura e Democracia), 29 de November 2024
53. Nuno C. Santos, Palestra: "À procura de Novos mundos", Escola Secundária de Alfena – Valongo, 26 de November 2024
54. Nuno C. Santos, Palestra: "Outras terras no Universo?", Escola Secundária Serafim Leite, São João da Madeira, 22 November 2024
55. Nuno C. Santos, Mesa redonda: "Tecnologias e INovação", III Congresso de Ciências, FCUP, Porto, 31 October 2024
56. Nuno C. Santos, Palestra: "Outras terras no Universo?", Pavilhão do Conhecimento (no âmbito do ARIEL Consortium (remote participation), Lisboa, 30 October 2024
57. Nuno C. Santos, Palestra: "Um ESPRESSO para outros mundos", no evento Ignite Astro, Armamar, 21 September 2024
58. Nuno C. Santos, Mesa redonda: "À procura de outras terras no Universo", em "Noites no Pátio do Museu", 6.ª edição da Escola de Verão de Astronomia, IST, Portugal, (participação via Zoom), 3 September 2024
59. Nuno C. Santos, Palestra: "Outras Terras no Universo: uma aventura em Português"; na 8a Concentração de Telescópios de Moimenta da Beira, Portugal, 11 May 2024
60. Alexandre Cabral, Palestra em Centro Ciência: "A Luz", Centro Ciência Viva do Lousal; 08 February 2024
61. Alexandre Cabral, Palestra convidada: "Nas entranhas dos maiores telescópio do mundo", Encontro Nacional de Estudantes de Física (ENEF2024), FCUL – Lisboa, 16 February 2024
62. Alexandre Cabral, Palestra em Centro Ciência: "Encontro com o Cientista", Pavilhão do Conhecimento – Ciência Viva – Pré Escolar, 11 April 2024
63. Alexandre Cabral, Palestra em Centro Ciência: "Encontro com o Cientista", Pavilhão do Conhecimento – Ciência Viva – Ensino Básico, 11 April 2024
64. Alexandre Cabral, Palestra Pública: "Astronomia XXL: A Instrumentação na deteção de exoplanetas e no estudos da formação de estrelas e galáxias", Centro Ciência Viva do Lousal, dia Nacional dos Cientistas, 16 May 2024
65. Alexandre Cabral, Palestra Pública: "Portugal nos grandes telescópios do ESO", Astrofesta 2024, 10 July 2024
66. Alexandre Cabral, Palestra em Escola: "Grandes telescópios, espectrógrafos e a luz em busca de planetas extra solares", Colégio Pedro Arrupe, Lisboa, 28 November 2024
67. Alexandre Cabral, Palestra Pública e Painel: "A ciência da Astronomia Contemporânea", Encontro Regional dos Clubes Ciência Viva do Planetário do Porto – CCV 2024; 07 December 2024
68. Koraljka Mužic, James-Webb Space Telescope: In search for planets that do not orbit stars, Visit of a group of french high-school students, Astronomical Observatory, Lisbon, 29 January 2024
69. Koraljka Mužic, Brown dwarfs and rogue planets in the Milky Way, iniciativa Viver Astronomia, Astronomical Observatory, Lisbon, 24 February 2024
70. Sérgio A. G. Sousa, Palestra Espaço vai à Escola: À descoberta de Exoplanetas com o CHEOPS e o ESPRESSO, Escola Básica Padre António Luis Moreira, Carvalhos, Vila Nova de Gaia, 9 October 2024
71. Sérgio A. G. Sousa, Palestra Espaço vai à Escola: À descoberta de Exoplanetas com o CHEOPS e o ESPRESSO, Escola Básica e Secundária À Beira Douro, Gondomar, 15 October 2024
72. Sérgio A. G. Sousa, Palestra Espaço vai à Escola, À descoberta de Exoplanetas com o CHEOPS e o ESPRESSO, Escola Secundária António Nobre, Porto, 17 October 2024
73. Sérgio A. G. Sousa, Palestra Espaço vai à Escola: À descoberta de Exoplanetas com o CHEOPS e o ESPRESSO, Colégio "Casa Mãe", Baltar, 21 October 2024
74. Sérgio A. G. Sousa, Palestra Espaço vai à Escola: À descoberta de Exoplanetas com o CHEOPS e o ESPRESSO, Escola Básica da Areosa, Porto, 14 November 2024
75. Sérgio A. G. Sousa, Palestra Espaço vai à Escola: À descoberta de Exoplanetas com o CHEOPS e o ESPRESSO, Escola Secundária de Senhora da Hora, Matosinhos, 21 November 2024
76. Sérgio A. G. Sousa, Palestra Ignite Astro: Tirar as medidas a exoplanetas, Armamar; 21 September 2024
77. Ângela R. G. Santos, No Mundo das Estrelas, Escola Ciência Viva – Encontro com o Cientista, Galeria da Biodiversidade, Porto, Portugal; 04 October 2024

78. Ângela R. G. Santos, No Mundo das Estrelas, Escola Ciência Viva – Encontro com o Cientista, Galeria da Biodiversidade, Porto Portugal; 07 June 2024
79. Ângela R. G. Santos, Astronomia de Carne e Osso, Masterclass – Com a verdade me enganas: a astronomia escondida, Portugal, 15 February 2024
80. José Pedro Mimoso, "IgNobel Talk", Talk at ENEF national meeting (Encontro Nacional dos Estudantes de Física), FCUL, 15 February 2024
81. José Pedro Mimoso, "Encontro com o Cientista", Talk and activity at the Centro de Ciencia Viva, 29 February 2024
82. Vitor da Fonseca, Unveiling the dark side of the Universe, Cafe Scientifique in Vilnius (Lithuania), 22 February 2024
83. Vitor da Fonseca, Quintessence in modern Cosmology, Annual gathering of the Classical Association at the university of Vilnius (Lithuania), 13 December 2024
84. Susana C. C. Barros, The solar system, Tangerina School, Porto, 19 of April 2024
85. Tiago Barreiro, BarranCosmos, 14 September 2024
86. Tiago Barreiro¸Ignite IAstro, Sintra, 26 October 2024
87. Jorge H. C. Martins, Hora do Cientista, Galeria da biodiversidade da UP, 24 June 2024
88. Inês S. Albuquerque, O estranho caso do espaço que aumenta, Feira do Livro de Lisboa 2024, 1 June 2024
89. Inês S. Albuquerque, O estranho caso do espaço que aumenta, XXIX Astrofesta, 10 August 2024
90. Inês S. Albuquerque, Desvendando o lado escuro do Universo, Biblioteca Municipal de Beja – José Saramago, 21 September 2024
91. André Miguel A. C. V. Silva, Palestra "Espaço vai à Escola 23" presencial, Escola secundária Gonçalves Zarco, 16 October 2024
92. André Miguel A. C. V. Silva, Palestra "Espaço vai à Escola 23" presencial, Escola Básica de Aver-o-Mar, Póvoa de Varzim, 6 de November 2024
93. André Miguel A. C. V. Silva, Palestra "Espaço vai à Escola 23" presencial, Escola Básica de Aver-o-Mar, Póvoa de Varzim, 6 de November 2024
94. André Miguel A. C. V. Silva, Palestra "Espaço vai à Escola 23" presencial, Escola Básica Dr. Carlos Pinto Ferreira, Junqueira Vila do Conde, 6 November 2024
95. André Miguel A. C. V. Silva, Palestra "Espaço vai à Escola 23" online, Centro de Educação e Desenvolvimento Pina Manique – Casa Pia de Lisboa, 15 October 2024
96. André Miguel A. C. V. Silva, Palestra "Espaço vai à Escola 23" online, Escola Secundária Viriato, Abraveses, Viseu, 28 October 2024
97. André Miguel A. C. V. Silva, Palestra "Espaço vai à Escola 23" online, Escola Secundária Padre António Macedo, Santiago do Cacém, 30 October 2024
98. André Miguel A. C. V. Silva, Palestra "Espaço vai à Escola 23" online, Escola Secundária Públia Hortênsia de Castro, Vila Viçosa, 4 November 2024
99. André Miguel A. C. V. Silva, Palestra "Espaço vai à Escola 23" online, Escola Básica de Corroios, Seixal, 5 November 2024
100. André Miguel A. C. V. Silva, Palestra "Espaço vai à Escola 23" online, Escola Secundária de São Pedro do Sul;15 November 2024
101. Afonso Morgado Mota, As Ciências do Espaço e a Astrobiologia: Há vida noutros planetas?, Colégio Valsassina, Lisboa (80 participants), 25 November 2024
102. Afonso Morgado Mota, As Ciências do Espaço e a Astrobiologia: Há vida noutros planetas?, Escola EB2/3 Eugénio de Andrade, Porto (50 participants), 28 November 2024
103. Ricardo Jorge Gafeira, Understanding the Solar Atmosphere: Progress and Implications for Modern Society, Lisbon, 7 December 2024
104. Cédric P. Pereira, XXIX ASTROFESTA Outreach activities and talk entitled “Mergulhos no Oceano Cósmico”, Centro Ciência Viva de Constância, Portugal, 10 August 2024
105. Yuri C. Damasceno, Como procurar átomos nas profundezas do Universo, Maputo; 09 February 2024
106. José Fonseca, De onde viemos? O que somos? Para onde vamos?: Uma viagem sobre a percepção do Cosmos, Departamento de Física e Astronomia, Olimpíadas Nacionais De Física 2024, 20 April 2024
107. Nuno Miguel Gonçalves, "O poder dos Arco-Íris", Museu de Historial Natural, Lisboa, Portugal, 6 June 2024
108. Diogo Quirino, No limite do Amanhã: Io e Europa, Seixal, 6 July 2024
109. Pedro Machado, "Do Sistema Solar aos Exoplanetas", ENEF FCUL, 17 February 2024
110. Pedro Machado, "Sistemas Planetários", Escola Pedro Arrupe, 3 June 2024
111. Pedro Machado, A Terra à Luz de outros Planetas, CulturGest, 30 de January 2024
112. Ricardo S. S. C. Reis, O Céu dos Lusíadas, Escola Secundária Carolina Michaelis, Porto, 22 March 2024
113. Raul Cerveira Lima, Talk – Excesso de luz / Excess of light, integrated in the cycle Aqui, no Universo (Here, in the Universe), a collaboration between the IA and Culturgest With Marchtin Pawley (Agrupación Astronómica Coruñesa Io), Auditório Rui Vilar, Culturgest, Lisboa, 20 February 2024
114. Raul Cerveira Lima, Talk – Poluição luminosa/Light Pollution, Associação Campo Aberto, Porto, 4 April 2024
115. Raul Cerveira Lima, Talk – Poluição luminosa: Extinguimos a noite. Vamos recuperá-la?, Eco-Escolas de Braga, Escola Profissional de Braga, Braga, 29 May 2024
116. Raul Cerveira Lima, Talk – The project Stars4All Education on Light Pollution at the school4all, Ponte de Lima, 13 February 2024
117. Tiago J. L. C. E. Campante, Grupo de Investigação de Estrelas – Rumo a um estudo abrangente de estrelas (as part of the panel discussion on A ciência da Astronomia Contemporânea), Encontro Regional dos Clubes Ciência Viva do Planetário do Porto – CCV 2024, Porto, Portugal, 7 December 2024
118. Bárbara M. T. B. Soares, Conhecer as estrelas do nosso céu!, Ribeirão, 21 October 2024
119. Bárbara M. T. B. Soares, Conhecer as estrelas do nosso céu!, Póvoa de Varzim, 28 October 2024
120. Bárbara M. T. B. Soares, Conhecer as estrelas do nosso céu!, Trofa, 29 October 2024
121. Bárbara M. T. B. Soares, Conhecer as estrelas do nosso céu!, Trofa, 29 October 2024
122. Bárbara M. T. B. Soares, Conhecer as estrelas do nosso céu!, Felgueiras,;30 October 2024
123. Bárbara M. T. B. Soares¸ Conhecer as estrelas do nosso céu!, Vila Nova de Gaia, 5 November 2024
124. Bárbara M. T. B. Soares, Conhecer as estrelas do nosso céu!, Maia, 6 November 2024

125. Bárbara M. T. B. Soares, Conhecer as estrelas do nosso céu!, Grijó, 18 November 2024
126. Bárbara M. T. B. Soares, Conhecer as estrelas do nosso céu!, Póvoa de Varzim, 19 November 2024
127. Bárbara M. T. B. Soares, Conhecer as estrelas do nosso céu!, Porto, 20 November 2024
128. Bárbara M. T. B. Soares, Conhecer as estrelas do nosso céu!, Porto, 22 November 2024
129. Ilídio André P. M. Costa, O Espaço vai à Escola, Escola Básica de São Paio, 14 November 2024
130. Ilídio André P. M. Costa, O Espaço vai à Escola, Escola Básica e Secundária de Albufeira, 29 October 2024
131. Ilídio André P. M. Costa, O Espaço vai à Escola, Escola Básica de Vouzela, 7 November 2024
132. Ilídio André P. M. Costa, O Espaço vai à Escola, Colégio de Lourdes, 31 October 2024
133. Ilídio André P. M. Costa, O Espaço vai à Escola, Escola Básica Júlio Dinis, Grijó, Vila Nova de Gaia, 11 November 2024
134. Ilídio André P. M. Costa, O Espaço vai à Escola, Jardim de Infância da Portelinha, 8 November 2024
135. Ilídio André P. M. Costa, O Espaço vai à Escola, Escola Secundária da Senhora da Hora, Matosinhos, 15 November 2024
136. Ilídio André P. M. Costa, O Espaço vai à Escola, Externato "Ribadouro", 15 November 2024
137. Jennifer Peralta Lucero, Pre-NEI, Ignite Astro, Armamar, 21 September 2024 2024
138. Nelson J. Nunes, The sky tonight, Escola Pedro Jacques, Alverca, 16 November 2024
139. Nelson J. Nunes, The sky tonight, Escola Básica e Secundária D. Miguel de Almeida, Abrantes, 12 November 2024
140. José Afonso, O Big Bang e a primeira luz do Universo, Banco de Portugal (Associação de Trabalhadores), 19 March 2024
141. Marchina Cortês, Interviewed by The DemystifySci Podcast (science podcast, Oregon, United States), Presenters: Dr. Anastasia Bendebury & Dr. Michael Shilo DeLay, 18 July 2024
142. António C. da Silva, Haja Luz: Desvendando a aceleração cósmica com Euclides, Banco de Portugal, Lisboa, 15 May 2024
143. Slava L. L. Bourgeois, Talk in the framework of the Three Minute Thesis Competition (outreach activity presenting PhD research), Coimbra, Portugal, 8 March 2024

Reports [16]

1. **E. Duarte**; PLATO-UOL-PDC-DD-0006; *Centers of Brightness Calculation*; issue 2; 2024
2. **D. Barbosa**; *Asiago Spectroscopic classification of SN 2024cao and AT 2024ccb within the 2023 NEON Observing School,* 2024
3. **R. C. Lima**; Relatório da 1. ª campanha de verificação e monitorização da luminância dos suportes publicitários luminosos instalados no município do Porto, maio de 2024. Escola Superior de Saúde do Politécnico do Porto/Universidade de Santiago de Compostela, 2024
4. **R. C. Lima**; Relatório da 2. ª campanha de verificação e monitorização da luminância dos suportes publicitários luminosos instalados no município do Porto, maio de 2024. Escola Superior de Saúde do Politécnico do Porto/Universidade de Santiago de Compostela, 2024
5. **M. Cortês, A. R. Liddle**; *AI Horizon Scanning – White Paper p3395 Part I. Areas of Attention*; 2024
6. **M. Cortês, A. R. Liddle**; *AI Horizon Scanning -- White Paper p3395, IEEE-SA. Part III: Technology Watch: a selection of key developments, emerging technologies, and industry trends in Artificial Intelligence*; 2024
7. **M. Abreu, A. Cabral, B. Whebe, R. Clara**; E-AND-FE-DER-03-00-001; FE Subsystem Overview; version 2; 2024
8. **M. Abreu, A. Cabral, B. Whebe, R. Clara;** E-AND-FE-DER-05-00-001; FE Optical Design and Analysis Report; version 2; 2024
9. **M. Abreu, A. Cabral, B. Whebe, R. Clara;** E-AND-FE-DER-04-00-003; FE Mechanical Design and Analysis Report; version 2; 2024
10. **M. Abreu, A. Cabral, B. Whebe, R. Clara;** E-AND-FE-SPE-03-00-001; FE Elements Technical Requirements Specification; version 2; 2024
11. **M. Abreu, A. Cabral, B. Whebe;** E-AND-FE-DER-08-00-004; FE Control Design and Analysis Report; version 2; 2024
12. **A. Cabral, B. Whebe;** E-AND-FE-PLA-01-00-005; ANDES FE Review Plan; version 1; 2024
13. **M. Abreu, A. Cabral, B. Whebe, R. Clara;** E-AND-FE-ICD-03-00-001; FE Interface Control Document; version 2; 2024
14. **M. Abreu, A. Cabral, B. Whebe, R. Clara;** E-AND-FE-DER-08-00-005; FE Technical Detectors; version 1; 2024
15. **M. A. Monteiro**; E-AND-FE-SPE-07-00-003; FE Software User Requirements Specifications; version 1.0; 2024
16. **M. A. Monteiro**; E-AND-FE-SPE-07-00-004; FE Instrument Software Functional Specifications; version 1.0; 2024

External seminars by IA researchers [43]

1. **João L. Yun**; *A diamond-ring star: the unusual morphology of a young (multiple?) object*; Faculdade de Ciências da Universidade de Lisboa, Portugal; 27 November 2024
2. **Ana Rita Costa Silva**; *The dayside of WASP-76 b investigated with ESPRESSO*; Observatory of Geneva, Versoix, Switzerland; 14 June 2024
3. **Carlos J. A. P. Martins**; *Reaching new heights in fundamental cosmology with ANDES*; CAUP Seminar; 22 March 2024
4. **Carlos J. A. P. Martins;** *Does light gravitate?*; Cookie seminar; 25 September 2024
5. **Tiago Barreiro Gonçalves**; *(Mo)defying Gravity; Particle Cosmology Group;* Centre for Astronomy and Particle Theory, School of Physics and Astronomy, University of Nottingham, United Kingdom; 25 April 2024
6. **Nuno C. Santos;** *"Un Nobel à procura de outros mundos"*; ISEP, Porto; 5 June 2024
7. **Nuno C. Santos**; *"À descoberta de outros mundos habitáveis"*; University of Porto, Departamento de Biologia (ciclo Biologia ao fim da tarde); 3 April 2024
8. **Nuno C. Santos**; *"Towards other Earths: some highlights and a few challenges"*, University of Porto, Departamento de Física e Astronomia, 28 February 2024
9. **Nuno C. Santos**; *"Exoplanet research with high resolution spectroscopy: some highlights and a few*

challenges", University of Tartu, Estonia, 18 January 2024

10. **Alexandre Cabral**; *MOONS: the next ESO VLT's multi-object spectrograph*; IA; Portugal
11. **K. Muzic**; *Milky Way's substellar population*; IA; Portugal
12. **K. Muzic**; *Young brown dwarfs and rogue planets in the Milky Way*; FCUL; May 2024
13. **K. Muzic**; *Young brown dwarfs and rogue planets in the Milky Way*; Gr@v seminar at the Univeristy of Aveiro; April 2024
14. **K. Muzic**; *Young brown dwarfs and rogue planets in the Milky Way*; Encontro Nacional de Estudantes de Física, FCUL; February 2024
15. **K. Muzic**; *Young brown dwarfs and rogue planets in the Milky Way*; IPAG, University of Grenoble, France; January 2024
16. **Dias, J.**; *"A journey into Venus' Volcanoes: Is There Active Volcanism?"*; Konkoly Thege Miklós Astronomical Institute, Budapest; 11 January 2024
17. **Miguel A. S. Pinto;** *Cosmology, matter creation, and regular black holes in non-minimal geometry-matter coupling theories*; CosmoVerse Journal Club (online); 7 May 2024
18. **Miguel A. S. Pinto;** *Cosmology and gravitational physics in f(R,Matter) type theories;* Instytut Fizyki Teoretycznej i Astrofizyki, Uniwersytet Gdanski, Gdansk, Poland; 15 October 2024
19. **Joel Filho**; *Space debris algorithms on satellite constellation pictures for debris characterisation and orbit determination*; ESA-ESTEC and online, the Netherlands; 21 May 2024
20. **Susana C. C. Barros**; *Detecting tidal deformation and decay*; Ahmedabad, India; January 2024
21. **Vitor da Fonseca**; *Can interacting dark energy resolve cosmological tensions?*; Institute of Theoretical Astrophysics at the University of Oslo, Norway; 23 April 2024
22. **Vitor da Fonseca**; *Interacting dark energy vs neutrino tension*; University of the Basque Country, Spain; 2 October 2024
23. **Rodrigo A. Carvajal Pizarro**; *Identifying giants in ELAIS-S1 with machine learning; ALMA Joint Observatory*, Chile; 30 May 2024
24. **Rodrigo A. Carvajal Pizarro**; *How confident can you be? Calibrating probabilities for AGN selection (and any other classification)*; European Southern Observatory, Garching, Germany; 25 June 2024
25. **André Miguel A. C. V. Silva**; *Towards an improvement in the characterization of stellar radial velocities*; ESA research seminar , European Space Agency (Madrid), Spain; May 2024
26. **André Miguel A. C. V. Silva**; *The (radial) velocity of stars – detection and characterization of exoplanets*; Café com Física, Departamento de Física da Universidade de Coimbra, Portugal; March 2024
27. **Afonso Morgado Mota**; *An Integrative Approach to Exoplanet Habitability: Joining Biology and Astrophysics*; University of Naples Federico II (online), Italy; 12 December 2024
28. **José Pedro Mimoso**; "*Quintessential Einstein-Legendre modified f(R) gravity theory*"*;* CENTRA-IST, Portugal; 4 April 2024
29. **Olivier D. S. Demangeon**; *Asymmetry in the atmosphere of the ultra-hot Jupiter WASP-76 b*; Stockholm University (via zoom), Sweden; 4 December 2024
30. **Rúben A. R. Costa**; *From Pixels to Stellar Ages*; Porto Summer School on Asteroseismology, Vila do Conde, Portugal; 21 – 26 July 2024
31. **Rúben A. R. Costa**; *CESAM2K20 WORKSHOP II: Transport processes*; Paris, France; 14- 15 November 2024
32. **Diogo Quirino**; *Ocean circulation on a temperate paleo-Venus*; School of Ocean Sciences, Bangor University, Wales, UK; 11 December 2024
33. **Diogo Quirino**; *Ocean circulation on a temperate paleo-Venus*; Earth Systems seminar at Instituto Dom Luiz, FCUL, Lisbon, Portugal; 4 December 2024
34. **Ismael Tereno**; *Euclid survey status and planning activities*; Euclid Science Team meeting (zoom); 08 March 2024
35. **Pedro Machado**; *Transmission spectroscopy along the transit of Venus used for probing the atmosphere's upper layers and as a proxy for exoplanets atmosphere characterization*; Center for Planetary Science, Kobe U., Japan; 25-29 March 2024
36. **Bárbara M. T. B. Soares;** *Assessing the processes behind planet engulfment and its imprints*; Centre for Origin and Prevalence of Life (COPL) at ETH Zurich, Switzerland; 15 January 2024
37. **Bárbara M. T. B. Soares**; *How to swallow a planet: processes and consequences of planet engulfment*; St Andrews Centre for Exoplanetary Sciences (StACES) at the University of St Andrews, United Kingdom; 15 April 2024
38. **Andrew R. Liddle**; *Tensions, DESI, and new cosmological physics*; University of California at Davis (delivered online); April 2024
39. **Marina Cortês**; *AI risk assessment in Cosmology*; online, Cosmology From Home; June 2024 (https://www.youtube.com/watch?v=wi3GKkkO94k)
40. **Slava L. L. Bourgeois**; *Space Webinar: Exploring Solar Dynamics with Morphological Algorithms*; Instituto Pedro Nunes (IPN), Coimbra, Portugal; 1 February 2024
41. **Margarida S. Cunha**; *Stars as physics laboratories*; Observatoire de la Côte d'Azur, Nice, France; 13 June 2024
42. **Jarle Brinchmann;** "*MUSE-Faint – Dissecting the faintest galaxies with MUSE*"; MPE Garching, Germany; 24 October 2024
43. **Jarle Brinchmann**; "*MUSE-Faint – Dissecting the faintest galaxies with MUSE*"; DFA Porto, Portugal; 27 November 2024

PhD Completed [9]

1. A. Antoniadis-Karnavas, 2024, *Derivation of M-Dwarf stellar parameters in the optical and near-infrared*, Doctoral Program in Astronomy (3rd cycle), Supervisor(s): **S. G. Sousa**, **E. Delgado Mena**
2. S. G. Morais, 2024, *IFU Observations and Ionization Modeling of Extended Halos in High Redshift Active Galaxies*, Doctoral Program in Astronomy (3rd cycle), Supervisor(s): **A. Humphrey**, M. Villar Martín
3. A. Chougule, 2024, *Steps toward the reconstruction of the mass assembly history of Active Galactic Nuclei with FADO*, Doctoral Program in Astronomy (3rd cycle), Supervisor(s): **J. M. Gomes**, **P. Papaderos**
4. T. de Azevedo Silva, 2024, *Characterising the hottest Exoplanets at high spectral resolution*, Doctoral Program in Astronomy (3rd cycle), Supervisor(s): **O. Demangeon, N. C. Santos, G. Gilli**

5. A. M. Silva, 2024, *A new paradigm for the estimation of precise stellar radial velocities*, Doctoral Program in Astronomy (3rd cycle), Supervisor(s): **S. G. Sousa, N. C. Santos, P. T. P. Viana**
6. E. A. S. Cristo, 2024, *Towards the detection of exoplanet atmosphere' spectral features using high resolution spectroscopy*, Doctoral Program in Astronomy (3rd cycle), Supervisor(s): **N. C. Santos**, **O. Demangeon**
7. N. A. M. Moedas, 2024, *Toward a New Generation of Stellar Models: Impact of Physical Ingredients on the Accuracy of Stellar Parameter Inferences*, Doctoral Program in Astronomy (3rd cycle), Supervisor(s): **D. Bossini**, M. Deal
8. G. Francisco, 2024, *Improving Solar Flare Forecasts with Deep Learnin*g, PhD in Astrophysics Supervisor(s): D. Del Moro, **M. T. Barata**, J. Fernandes
9. R. A. Carvajal Pizarro, 2024, *Towards better selection and characterisation criteria for high-redshift radio galaxies using machine-assisted pattern recognition*, PhD Programme in Physics and Astrophysics, Supervisor(s): **J. Afonso, I. Matute, H. G. Messias**

MSc Projects Completed [22]

1. C.A Chaves; 2024; *Koehler illumination system for injection in a light pipe*; Master in Engineering Physics; Supervisor(s): **M. A. S. de Abreu, A. P. Cabral**
2. C. T. Iu; 2024; *Cosmological propagation of astrophysical gravitational waves*; Master in Physics; Supervisor(s): **N. G. C. Nunes, A. J. C. da Silva**
3. J. D. C. M. Pestana; *Challenging ΛCDM with new observational probes*; Master in Physics, Supervisor(s): **C. J. A. P. Martins**
4. F. G. P. R. Correia; 2024; *Q-Matter Coupling in Modified Gravity*; Master in Physics; **F. S. N. Lobo, N. Frusciante**
5. R. A. C. Cipriano; 2024; *Gravitationally induced matter creation and cosmological applications in energy momentum squared gravity*; Master in Physics; Supervisor(s): **F. S. N. Lobo**
6. D. S. Pereira; 2024; *Modified gravity in the primordial Universe*; Master in Physics; Supervisor(s): **F. S. N. Lobo, J. P. O. Mimoso**
7. D. S. J. Cordeiro; 2024; *Observational signatures of hot spots orbiting black hole mimickers*; Master in Physics; Supervisor(s): **F. S. N. Lobo, J. L. Rosa**
8. L. F. D. da Silva; 2024; *Compact object shadows and photon rings: a study of light intensity profiles for different accretion disk models*; Master in Physics; Supervisor(s): **F. S. N. Lobo, D. Rubiera-Garcia**
9. N. Ganiyeva; 2024; *Wormhole geometries in modified gravity*; Master in Physics; Supervisor(s): **F. S. N. Lobo, J. L. Rosa**
10. N. M. A. O. Covas; 2024; *Unveiling the faintest X-ray AGN populations in the NewATHENA Era: Insights from Cosmological Simulations*; Master in Engineering Physics; Supervisor(s): **I. M. Troncoso,** S. Amarantidis
11. C. António; 2024; *Potential Field Source Surface Extrapolation Constrained by Coronal Observations;* Master in Astronomy and Astrophysics; Supervisor(s): **J .J. G. Lima**, I. Chifu, **R. Gafeira**
12. P. M. H. Branco; 2024; *Looking for new stellar activity proxies using HELIOS data: towards other Earths*; Master in Astronomy and Astrophysics; Supervisor(s): **N. C. Santos, J. N. T. Gomes da Silva**, X. Dumusque
13. R. A. R. Costa; 2024; *Pushing the boundaries of cool-dwarf asteroseismology with ESPRESSO*; Master in Physics; Supervisor(s): **T. J. L. C. E. Campante, M. J. P. F. G. Monteiro**
14. E. C. Gonçalves; 2024; *Seeing behind the planets: probing the surface of distant stars using planetary transits*; Master in Astronomy and Astrophysics; Supervisor(s): **N. M. C. Santos, S. A. G. Sousa**
15. C. M. F. António; 2024; *Potential Field Source Surface Extrapolation Constrained by Coronal Observations*; Master in Astronomy and Astrophysics; Supervisor(s): **J. Lima, R. Gafeira**
16. S. R. P. Veiga; 2024; *The von Laue condition in general relativity and modified gravity theories*; Master in Astronomy and Astrophysics; Supervisor(s): **P. P. Avelino**
17. R. D. R. G. da Silva; 2024; *Exploring Titan's Atmosphere Composition and Temporal Evolution using High-Resolution Spectroscopy, and its Interaction with the Surface using Atomistic Molecular Dynamics Simulations*; Master in Physics; Supervisor(s): **P. Machado**
18. Y. C. Damasceno; 2024; *Determining the atmospheric composition of the ultra-hot Jupiter WASP-178b with ESPRESSO*; Master in Astronomy and Astrophysics; Supervisor(s): **N. M. C. Santos**
19. V. A. C. Silva; *Characterising Atmospheric Waves on Mars using Mars Express (ESA) HRSC images*; Master in Physics; Supervisor(s): **P. Machado**
20. A. M. A. Vale; 2024; *Boosting Lyman-α Identification and Characterization in the Era of Large Surveys;* Master in Astronomy and Astrophysics; Supervisor(s): **A. Paulino-Afonso, J. Fonseca**
21. D. F. D. Capela; 2024; *Early stages of star formation in the Rosette Nebula;* Master in Physics; Supervisor(s): **K. Mužić**
22. T. O. Miranda; 2024; *Impact of Small-Scale Structure on the Stochastic Gravitational Wave Background Generated by Cosmic Strings*; Master in Physics; Supervisor(s): **L. G. Sousa**

BSc Traineeships/Projects completed [93]

1. Gorka Zubiri Elso, Estudio infrarrojo/milimétrico de cúmulos estelares jóvenes y sus nubes moleculares associadas, student research project; Supervisor – João L. Yun, January – June 2024
2. Eleanna Kolonia (U. Patras Graduation Thesis), Probing Fundamental Physics using Compact Objects; Supervisor – Carlos J. A. P. Martins, 2023-2024
3. José Gomes (FCUP, FCG New Talents Project), Looking for Lambda; Supervisor – Carlos J. A. P. Martins, 15 October 2024 – Ongoing
4. Mariana Melo e Sousa: Forecasts for the redshift drift with curvature, PEEC; Supervisor – Carlos J. A. P. Martins, January – July 2024
5. Pedro Barbosa: Varying constants and dark matter, PEEC; Supervisor – Carlos J. A. P. Martins, January – July 2024
6. Paulo Monteiro: Geometric modified gravity models, PEECs; Supervisor – Carlos J. A. P. Martins, January – July 2024
7. David Santos: Darke energy and modified gravity; Supervisor – Carlos J. A. P. Martins, January – July 2024
8. Rafael Bento (ES José Falcão, Coimbra): Paleontologia Cósmica, OCJF Internships; Supervisor – Carlos J. A. P. Martins, July 2024

9. Ricardo Ferreira (ES de Rio Tinto): Paleontologia Cósmica, OCJF Internships; Supervisor – Carlos J. A. P. Martins, July 2024
10. Anna-Lena Gschrey: Vector dark energy, AstroCamp internships; Supervisor – Carlos J. A. P. Martins, January – December, in situ in July 2024
11. Carolina Coelho: Vector dark energy, AstroCamp internships; Supervisor – Carlos J. A. P. Martins, January – December, in situ in July 2024
12. Mar Artigas: Varying constants cosmography, Joves i Ciencia internships; Supervisor – Carlos J. A. P. Martins, April – December, in situ in July 2024
13. Noelia Vadillo: Varying constants cosmography, Joves i Ciencia internships; Supervisor – Carlos J. A. P. Martins, April – December, in situ in July 2024
14. João Nuno da Silva Freitas Cunha, Deteção de exoplanetas através dum novo modelo para a correção de efeitos instrumentais, PEEC; Supervisor – Pedro T. P. Viana, February – June 2024
15. Julia Mestre, Deciphering Planetary Atmospheres Through Transit Spectroscopy, IA summer program; Supervisor – William Dethier, July 2024
16. Anthony Brandon Arenas Martinez, Deciphering Planetary Atmospheres Through Transit Spectroscopy, IA summer program; Supervisor – William Dethier, July 2024
17. Joana Raquel Aguiar Teixeira, Deciphering Planetary Atmospheres Through Transit Spectroscopy, IA summer program; Supervisor – William Dethier, July 2024
18. Micah Navia, Deciphering Planetary Atmospheres Through Transit Spectroscopy, IA summer program; Supervisor – William Dethier, July 2024
19. Juan José Garcia Delgado, Deciphering Planetary Atmospheres Through Transit Spectroscopy, IA summer program; Supervisor – William Dethier, July 2024
20. Jesús Gonzalez, Estágio de Verão, UC DF; Supervisor – Anna Morozova, May – October 2024
21. Bhupendra Kumar (India), EGU 2024 mentoring program; Supervisor – Anna Morozova, 2024
22. Dra. Maria Inês Alves Pereira, "Assessment of potential biosignatures in alien atmospheres"- Projeto em Astrofísica; Supervisor – Nuno C. Santos, Dra. Clara Sousa Silva, February – June 2024
23. Matilde Marinho Valente, “In the quest for detecting other Earths. A test on Radial Velocity extraction” – Projeto em Astrofísica; Supervisor – Nuno C. Santos, Sérgio Sousa, February – June 2024
24. Carolina Machado, Atmospheres of Young Planetary-Mass Objects, Laboratorio de Astrofisica; Supervisor – Koraljka Mužic, March – July 2024
25. Matilde Marinho Valente – In The Quest For Detecting Other Earths. A Test On Radial Velocity Extraction – PEEC-Extra-curricular project FCUP; Supervisor – Sérgio A. G. Sousa, 1 February – 31 July 2024
26. Maria Carolina Malheiro Neto – THE ROTATION VELOCITY OF STARS WITH EXOPLANETS – PEEC-Extra-curricular project FCUP; Supervisor – Sérgio A. G. Sousa, 1 February – 31 July 2024
27. Telmo Filipe Pereira Monteiro – THE STELLAR ACTIVITY IN STARS WITH EXOPLANETS – PEEC-Extra-curricular project FCUP; Supervisor – Sérgio A. G. Sousa, 1 February – 31 July 2024
28. Francisco Ferreira, Untangle the properties of rotation and magnetic activity from stellar light curves, PEEC; Supervisor – Ângela R. G. Santos, 12 February – 05 July 2024
29. Sofia Matos, Convection in solar-like stars, Astrophysics project (AST3018); Supervisor – Ângela R. G. Santos, 19 February – 22 July 2024
30. Caetano Ramos, "Testing the Universe's fractal dimension with large galaxy surveys”; Supervisor – José Pedro Mimoso, António C. da Silva
31. J. Castelo, Supermassive Black Hole growth on galaxies: Linking AGN phases through Cosmic Time, IA Summer Internship; Supervisor – Rodrigo A. Carvajal Pizarro, 8 – 26 July 2024
32. F. Rosado, Supermassive Black Hole growth on galaxies: Linking AGN phases through Cosmic Time, IA Summer Internship; Supervisor – Rodrigo A. Carvajal Pizarro, 8 – 26 July 2024
33. Carmen San-Nicolas, The Influence of Telluric Lines on High-Precision Radial Velocities using ESPRESSO data, FCUP PDA Research Seminar in Astronomy; Supervisor – Jorge H. C. Martins, 2023 – 2024
34. Martim Pinto Paiva, Solar-to-sky coordinate conversion for PoET, FCUP PEEC; Supervisor – Jorge H. C. Martins, André Silva, 12 February – 05 July 2024
35. Carla Elisabeth Hirano Henriques, Development of a GUI interface for the exploitation of data from the s-BART pipeline, FCUP PEEC; Supervisor – Jorge H. C. Martins, André Silva, 12 February – 05 July 2024
36. Fabian Guse – Interstellar gas properties in childhood galaxies’’ ERASMUS Internship; Supervisor – Cirino Pappalardo, February 2024
37. Diogo Gil – A spectral catalogue in COSMOS’ Project for the ‘Laboratorio de Astrofisica’ Topic; Supervisor – Cirino Pappalardo, March – July 2024
38. Ana Trigo – A chirping CIGALE in COSMOS’ Project for the ‘Laboratorio de Astrofisica’ Topic; Supervisor – Cirino Pappalardo, March – July 2024
39. Ayush Mokashi, Diving in the early Universe with Webb; Supervisor – Henrique B. Miranda, 08 July – 26 July 2024
40. Joydeep Das, Diving in the early Universe with Webb; Supervisor – Henrique B. Miranda, 08 July – 26 July 2024
41. Saptarshi Pandey, Diving in the early Universe with Webb; Supervisor – Henrique B. Miranda, 08 July – 26 July 2024
42. Sai Shanmukh, Diving in the early Universe with Webb; Supervisor – Henrique B. Miranda, 08 July – 26 July 2024
43. Tiago Sinde, Estimating the effect of Lensing in photometric galaxy surveys, PEEC; Supervisor – José Fonseca, February – June 2024
44. Beatriz Neto, creation of educational short film animation in Astronomy Literacy, internship of bachelor students in Digital Animation of Lusófona University; Supervisor – Sérgio Pereira, October 2023 – January 2024
45. Kaique Cruz Rodrigues, strategic communication in astronomy, internship of Professional Course in Digital Marketing at IPLuso; Supervisor – Sérgio Pereira, February – September 2024
46. José Miguel da Costa Vaz, Empirical model for estimating properties of Interplanetary Coronal Mass Ejections based on solar activity data and their relation to geomagnetic storms, Project in Astrophysics (1st degree); Supervisor – João J. G. Lima, February – July 2024
47. Theoretical-Pratical summer internship, IAstro Summer Internships – Virtual summer internship given by the IA, Reflectance studies of minerals on Mars; Supervisor – Pedro Machado, July 2024

48. Vasco Guimarães, Atmospheric Gravity Waves: a key process in Mars and Venus atmospheres, PIC IST; Supervisor – Pedro Machado, July 2024
49. Gustavo Maia, Atmospheric Gravity Waves: a key process in Mars and Venus atmospheres, PIC IST; Supervisor – Pedro Machado, July 2024
50. Hanna Kasperer (MSc Student), "Dynamics of winds and jets in a proplyd in the Orion Nebula cluster: reduction of high-resolution spectroscopy data obtained with ESO's CRIRES/VLT instrument", Extra-Curricular Internship Program (PEEC); Supervisor – Sílvia Vicente, February – June 2024
51. Ana Sofia Martins (undergraduate student), Impacto da exposição à luz na qualidade do sono em jovens adultos: Estudo observacional. Final project (conclusion of 4-year degree), Escola Superior de Saúde do Politécnico do Porto; Supervisor – Raul Cerveira Lima, Liliana Leite, 2024 – 2025
52. Nicolas Obrier, Enhancing Knowledge Projection of Astrophysical Data onto Self-Organizing Maps, ERASMUS+ internship; Supervisor – Israel Matute, 01 June – 31 August 2024
53. Rita Vieira, Crafting the Athena X-ray Sky: Simulations for AGN Detection, Short-Project; Supervisor – Israel Matute, 01 March – 30 June 2024
54. Leonor Pereira, Data-Driven Discovery of SuperMassive Black Hole Trends, Short-Project; Supervisor – Israel Matute, 01 March – 30 June 2024
55. Francisco Rosado, Supermassive Black Hole growth on galaxies: Linking AGN phases through Cosmic Time, IA Summer Internship; Supervisor – Israel Matute, 08 July – 26 July 2024
56. João Castelo, Supermassive Black Hole growth on galaxies: Linking AGN phases through Cosmic Time, IA Summer Internship; Supervisor – Israel Matute, 08 July – 26 July 2024
57. João Pinto; IA Summer Program 2024; Project title: Hands-on Galactic archaeology and Machine Learning using synthetic data; Instituto de Astrofísica e Ciências do Espaço, Portugal; Supervisor – Tiago J. L. C. E. Campante, 2024
58. Soumyadeep Sarkar; IA Summer Program 2024; Project title: Hands-on Galactic archaeology and Machine Learning using synthetic data; Instituto de Astrofísica e Ciências do Espaço, Portugal; Supervisor – Tiago J. L. C. E. Campante, 2024
59. Rafaela Rodrigues Carvalhais, Contributos para a investigação em ensino e divulgação das ciências I – Planos de aula em Inquiry Based Learning (IBL), PEEC; Supervisor – Ilídio André P. M. Costa, January – July 2024
60. Hugo Henrique Soares Lopes, Contributos para a investigação em ensino e divulgação das ciências I – Aprendizagens Essenciais em Astronomia, PEEC; Supervisor – Ilídio André P. M. Costa, January – July 2024
61. Laura Viana Haeitmann, Contributos para a investigação em ensino e divulgação das ciências I – Recursos Educativos Digitais no IBL, PEEC; Supervisor – Ilídio André P. M. Costa, January – July 2024
62. Ayush Gupta, Contributos para a investigação em ensino e divulgação das ciências – IBL educational resources, IA Summer School; Supervisor – Ilídio André P. M. Costa, July 2024
63. Lucas Batista, Contributos para a investigação em ensino e divulgação das ciências – IBL educational resources, IA Summer School; Supervisor – Ilídio André P. M. Costa, July 2024
64. Safeya Zawath, Contributos para a investigação em ensino e divulgação das ciências – IBL educational resources, IA Summer School; Supervisor – Ilídio André P. M. Costa, July 2024
65. Alunos das turmas do 7º ano do Conservatório de Música do Porto, Astronomia de Bolso, Projeto SEI (Sociedade, Escola, Investigação); Supervisor – Ilídio André P. M. Costa, January – May 2024
66. Inês Rocha, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
67. Cátia Rocha, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
68. Inês Pacheco, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
69. Jéssica Vasques, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
70. Rui Cruz, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
71. Sara Ribeiro, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
72. Sílvia Pereira, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
73. Ana Luísa Machado, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
74. Ana Rita Sousa, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
75. Beatriz Vieira, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
76. Eduarda Ramos, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
77. Francisca Sil, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
78. Maria João Santos, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
79. Ana Gama, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
80. Catarina Galante, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024

81. Cristina González, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
82. Filipa Osório, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
83. Inês Santos, Contextos e perfis da educação não formal, Iniciação às práticas profissionais (Licenciatura em Educação Básica – ESE-Porto – IPP); Supervisor – Ilídio André P. M. Costa, April – June 2024
84. Inês de Sousa Pimenta, Exploring the impact of PoET's pointing error, FCUP PEEC; Supervisor – João N. T. Gomes da Silva, 02 February – 28 May 2024
85. Telmo Monteiro, The stellar activity in stars with exoplanets, FCUP PEEC, Co-supervisor – João N. T. Gomes da Silva, 02 February – 28 May 2024
86. Alexis Cogneau, at IA – University of Lisbon. Project: “Quasar Quest: Exploring Machine Learning to Estimate Quasar Properties”: Machine Learning applied to multifrequency data to predict quasar properties. This project was developed in collaboration with "Closer", a Data Science company with headquarters in Lisbon; Supervisor – Bruno Arsioli, June – September 2024
87. Cláudio Coelho, for the course 'Lab. of Astrophysics’, at University of Lisbon. Project: “Machine Learning applied to multifrequency data to predict quasar properties”; Supervisor – Bruno Arsioli, March – July 2024
88. Urvish Vaghasiya, at Vellore Institute of Technology Chennai, India. Side-Project: Photo-MBH; Machine Learning for Estimating Quasar Black Hole Masses; Description: Prediction of Quasar properties with Machine Learning Applied to Multifrequency Photometric Data; Supervisor – Bruno Arsioli, Prof. Suprabh Prakash
89. Beatriz Alves Ferreira, "Clarões no Cosmos" – projeto de design para série de vídeo do Grupo de Estrelas do IA, estágio académico do 4º ano da licenciatura em Design de Comunicação da Faculdade de Belas Artes da Universidade do Porto; Supervisor – Paulo J. T. Pereira, Emília Dias da Costa, February – June 2024
90. Helena Rodrigues Pereira, "Planetas do Sistema Solar a Unir Gerações" – projeto Reescreve as Estrelas e PLOAD, estágio académico do 4º ano da licenciatura em Design de Comunicação da Faculdade de Belas Artes da Universidade do Porto; Supervisor – Paulo J. T. Pereira, Emília Dias da Costa), February – June 2024
91. Leonor Marques Tomé, "As Estações do Ano", projeto de um filme animado explicando as estações do ano para o Planetário do Porto – CCV, estágio académico do 4º ano da licenciatura em Design de Comunicação da Faculdade de Belas Artes da Universidade do Porto; Supervisor – Paulo J. T. Pereira, Emília Dias da Costa, February – June 2024
92. Ana Margarida Alves Martins Pinheiro, "Em Nome do Centro das margens e dos que Nelas Habitam” – filme artístico e poético fulldome para o Planetário do Porto – CCV, Projecto-Multimédia da Licenciatura em Artes Plásticas da Faculdade de Belas Artes da Universidade do Porto; Supervisor – Paulo J. T. Pereira, Miguel Leal (FBAUP), Virginia de Diego (FBAUP), February – June 2024
93. Hugo Daniel Leite Aston, "Em Nome do Centro das margens e dos que Nelas Habitam” – filme artístico e poético fulldome para o Planetário do Porto – CCV, Projecto-Multimédia da Licenciatura em Artes Plásticas da Faculdade de Belas Artes da Universidade do Porto; Supervisor – Paulo J. T. Pereira, Miguel Leal (FBAUP), Virginia de Diego (FBAUP), February – June 2024

COVER PICTURE Installation of the PoET solar telescope at the Paranal Observatory (ESO - Chile). © IA / ESO

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