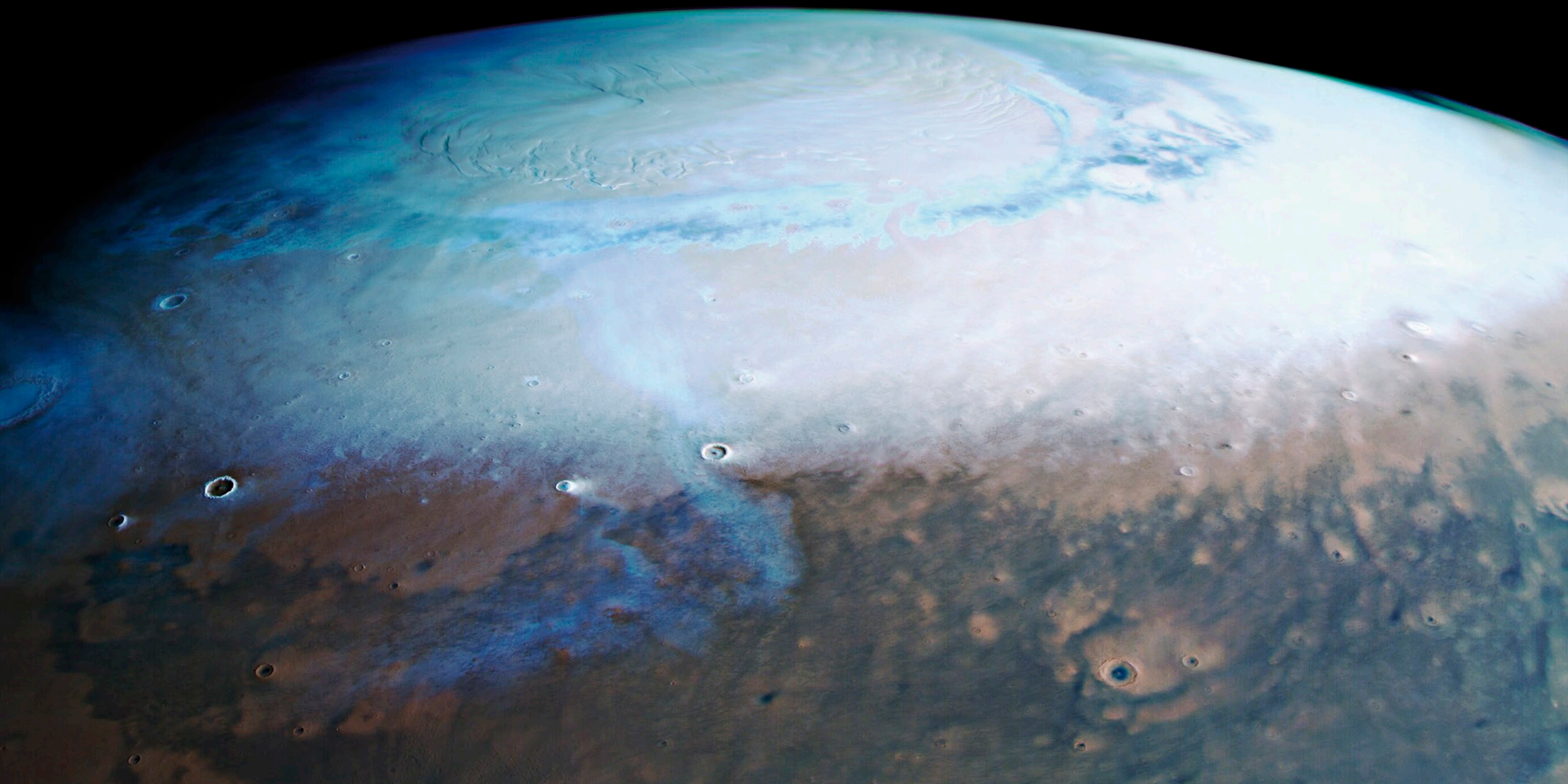
INSTITUTO DE ASTROFÍSICA DE ANDALUCÍA

EXCELENCIA SEVERO OCHOA

CSIC

2024
Annual report



The **IAA-CSIC 2024 Annual Report** is the result of a collective process of the people who make up the Instituto de Astrofísica de Andalucía. We would like to thank all of them for their dedication and willingness to capture the best possible picture of what we do and what we work for.

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For any communication related to this work, please contact:
Instituto de Astrofísica de Andalucía
Glorieta de la Astronomía s/n (18008) Granada.
Tel.: +34 958 12 13 11
severoochoa@iaa.es

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Foreword

Antxon Alberdi
Director IAA-CSIC

Isabel Márquez
Scientific Director SO-IAA Project

2024 was a good year in the life of the IAA. In addition to the second year of our second award as a "**Severo Ochoa Centre of Excellence",** with a large number of activities described in this report, we coordinated the "**Complementary Plan of Astrophysics and High Energy Physics"** in Andalucía, linked to the "Recovery and Resilience Funds" of the European Community. This proposal aims to increase our participation in the next generation of leading international projects in astrophysics and high energy physics, linked to the ESFRI initiatives and the ICTS, with particular emphasis on their more technological aspects. This work is carried out in collaboration with other Autonomous Communities (Aragón, Baleares, Cantabria, Cataluña and Comunidad Valenciana, in addition to Andalucía), promoting collaboration and synergies between different research centres. This is proving to be very positive in the various areas of research covered by the plan.

Thanks to the support of previous and other research projects, the new positions we get in the CSIC and the stabilisation process, **the Institute grew to 260 people**. To give rough figures, about 60% are scientific staff (staff scientists, postdocs, predocs), 30% are technical staff and 10% cover administration, outreach/dissemination and other tasks. More than 20% of them are foreigners, coming from more than 20 countries, which brings a scientific and cultural richness to the life of the Institute. New staff joined the IAA: 3 new positions of "Científico Titular", 2 positions of "Investigador Científico", 4 new positions of "Permanent Employment as Doctor", 2 "Ayudantes de Investigación" and 2 "Tecnólogos". The stabilization process the technical staff is still today underway, on the basis of the merits established during the period of work at the IAA. It will be completed in the spring of 2025. This process is very important for our Institute, as most of the stabilised staff belong to the UDIT (Instrumental and Technological Development Unit), thus ensuring our work in important instrumentation projects.

In 2024 we also had a **very intense institutional life**. In July, **our CSIC President, Eloísa del Pino**, and the "**Secretary General for Research"** of the Ministry of Science, Innovation and Universities (MICIU), **Eva Ortega Paíno**, visited the IAA-CSIC and had a meeting with the IAA staff. They had previously attended the opening of the **Scientific Meeting of the**

Visit of the "Secretary General for Research" of the Ministry of Science, Innovation and Universities (MICIU), Eva Ortega Paíno, and of our CSIC President, Eloísa del Pino.

Spanish Astronomical Society (SEA), organised by the IAA in collaboration with the SEA. More than 600 scientists from all Spanish institutions involved in astrophysical and space research attended the meeting. It was an excellent opportunity to get a global view of the science and technology being done in Spain, and a good opportunity for the IAA to showcase the science we are doing. In October, it was the turn of the new Director General of the **Spanish Space Agency (AEE)**, Juan Carlos Cortés. He came with part of his team, including the Scientific Director, Isabel Pérez Grande. We had a round table with all IAA researchers and technicians involved in space missions and a general meeting with all IAA staff. Previously, in April, we had a joint meeting with the Director and instrumentation team of the **IFMIF-DONES** (International Fusion Materials Irradiation Facility - DEMO Oriented Neutron Source) project to identify those techniques of common interest to both projects where we could collaborate. IFMIF-DONES is one of the major bets of the MICIU, with a large investment to host this facility in Spain.

In August 2024, in Cape Town, we presented to the Executive Committee of the International Astronomical Union (IAU) the candidacy of Granada to host the **IAU General Assembly (GA)** in 2030. The candidacy was prepared by the Presidency of the CSIC and the National Astronomy Commission (CNA), the Spanish Astrophysical Society (SEA) and the IAA-CSIC as host organisation. Granada's bid was shortlisted as one of four cities, with Santiago de Chile, Perth and Mumbai being the other three candidates. We sincerely believe that both the bid and the presentation were excellent. However, the fact that the 2027 IAU General Assembly will be held in Rome, and the unwritten rule that two consecutive General Assemblies cannot be held on the same continent, prevented Granada from being selected. This is our goal for 2033, with the full support of the Spanish astronomical community, as demonstrated during the SEA Scientific Meeting.

Let me recall some **highlights of IAA activities in 2024**: The IAA published 427 SCI papers, more than 90% of them in Q1 journals, with 15 publications in Nature Editorial; 10 Ph.D. theses were defended; 4 large workshops and a number of small meetings were organized; Lourdes Verdes-Montenegro received the CSIC Margarita Salas Medal for the best performance in the supervision of research staff; Julio Arrechea received the SEA Thesis Award 2024; our colleagues Yolanda Jiménez Teja, Pedro Amado, Jose Luis Ortiz, Emilio Alfaro, Enrique Pérez-Montero and Francisco Bailén: received the Granada City of Science and Innovation 2024 Awards in different categories; and the IAA itself received the Internationalization Award of the Social Council of the University of Granada.

In terms of our technological activities, the **Sunrise III** mission was launched on July 10. The IAA solar physics group is heavily involved, leading one of the three postfocus instruments (TuMag) and co-leading another (SCIP). First results already show that the mission has obtained unprecedented solar data with exceptional spatial and temporal resolution. On the other hand, the European Space Agency (ESA) approved the construction of **EnVision**, the next major mission to Venus, with the IAA's contribution focused on the VenSpec instrument, a suite of three spectrometers (U, H and M) for observing wavelengths from the visible to the near infrared. The mission will study Venus' core and atmosphere to understand its volcanic activity and climate. Concerning the Extremely Large Telescope (ELT), the European Southern Observatory (ESO) signed an agreement with an international consortium of institutions, including the IAA-CSIC, for the design and construction of **ANDES** (ArmazoNes high Dispersion Echelle Spectrograph). This instrument will be used to search for signs of life on exoplanets and to search for the first stars, among other scientific objectives. In CAHA, **TARSIS** passed its Preliminary Design Report (PDR). In the OSN, the **DIPOL-1** polarimeter installed on T90 proved to be a very productive instrument. In fact, 22 peer-reviewed publications in 2024 included data from the OSN.

There were many relevant scientific results in 2024 with the participation of IAA scientists: the detection of organic matter on Ceres; the release of the first data from J-PAS, with 550. 000 astronomical objects in the survey area; the demonstration that supermassive black holes alter the chemical evolution of galaxies; the fantastic images of the Earth and the Moon provided by the JANUS camera during the JUICE flyby of the Earth-Moon system; the high-resolution image of the Didymus binary asteroid system taken by the DART mission; the images of the farthest and oldest star clusters discovered with JWST; the discovery of a giant planet as light as cotton candy; the first polarized-light image of SgrA* obtained with the EHT, revealing the presence of intense and organized magnetic fields at the very edge of the black hole; the detection of rare-earth formation after the merger of two neutron stars; the first images of galaxies inhabiting cosmological voids in the local universe obtained with the project CAVITY/CAHA; and many others, we could also mention.

As a compromise between the IAA and the City of Granada, the Director of the IAA signed, on behalf of the CSIC, the declaration of adherence to the **"Granada European Capital of Culture 2031"** project. The six CSIC centers in Granada, and the IAA in particular, will contribute with their extraordinary experience in different fields of knowledge to the enrichment of a proposal that considers science as a fundamental part of the culture of our city.

At the IAA's year-end celebration, we honored our colleague **José Luis de la Rosa**, who retired after more than 48 years with the IAA. We wish him a well-deserved rest. He is undoubtedly the longest serving employee in the history of the IAA!

Finally, we would like to mention that the IAA will celebrate its **50th anniversary** in 2025. Research in astrophysics is a collaborative effort in which curiosity, intelligence, and enthusiasm are necessary ingredients, and we would like to take this opportunity to pay tribute to those who have been part of our institution. Their dedication and creativity have been the driving force behind our success. We would also like to thank our parent institution, the Consejo Superior de Investigaciones Científicas (CSIC), as well as the institutions that have collaborated with us over the years. Their contributions have enriched our research and broadened our impact on the global scientific community. We invite readers to join the IAA community in this celebration. Our legacy is built not only on the accomplishments of the past, but also on the vision and dedication for all that lies ahead.

IAA Organizational Chart

Director
Antxon Alberdi Odriozola

Deputy Science Director
Isabel Márquez Pérez

Deputy Tech. Director

Manager
Francisco Tapia Ruiz

DEPARTMENTS

Solar System
René Duffard

Stellar Physics
Pedro J. Amado González

Radio Astronomy & Galactic Structure
Iván Agudo Rodríguez

Extragalactic Astronomy
Rubén García Benito

SERVICE UNITS

General services
Francisco Tapia Ruiz

Outreach & Communication
Emilio J. García Gómez-Caro

Instrumental & Technological Development Unit
María Balaguer Jiménez (up to February)
Miguel Abril Martí (since February)

Computer Center
José Ruedas Sánchez

OBSERVATORIES

Calar Alto (CAHA)
Jesús Aceituno Castro

Sierra Nevada (OSN)
Pablo Santos-Sanz

ADVISORY COMMITTEES

External Advisory Board

Institute Board

Picture group at the "IAA Day 2024"

IAA
overview

The **Instituto de Astrofísica de Andalucía** (IAA) is the largest Astronomy institute of the **Consejo Superior de Investigaciones Científicas** (CSIC)

The IAA research is supported by twelve active CSIC research groups, covering most of the research topics in modern Astrophysics. This research is carried out within four different departments.

Research Groups

Solar System

- Solar Physics
- Planets and minor bodies
- Terrestrial Atmosphere

Stellar Physics

- Low-mass stars & exoplanets
- Stellar Variability
- ARAE

Radio Astronomy and Galactic Structure

- Stellar Systems
- Physics of the Interstellar Medium
- AGN jets
- VHEGA

Extragalactic Astronomy

- Galaxy evolution
- Theoretical gravitation
- Observational Cosmology
- Cosmology and Astroparticle Physics

The **Instrumental and Technological Development Unit** (UDIT) and the **Computer Center** (CC) provide technical support to the research lines.

The IAA owns the **Sierra Nevada Observatory** (OSN) and is also the reference research center for the **Calar Alto Observatory** (CAHA).

Staff

303
Total member

Category and gender distribution

62 Permanent Staff (**16** Female / **46** Male)

68 Postdoc Fellows (**19** Female / **49** Male)

53 Predoctoral Researchess (**15** Female / **38** Male)

73 Technicians/Engineers (**13** Female / **60** Male)

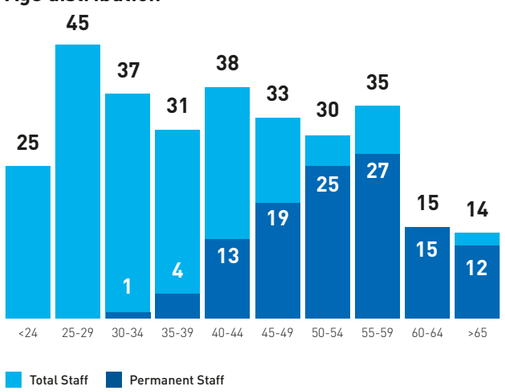
41 Services (**22** Female / **19** Male)

6 Entailed personnel (**1** Female / **5** Male)

Detailed Cientifical and Technical Staff /of which women

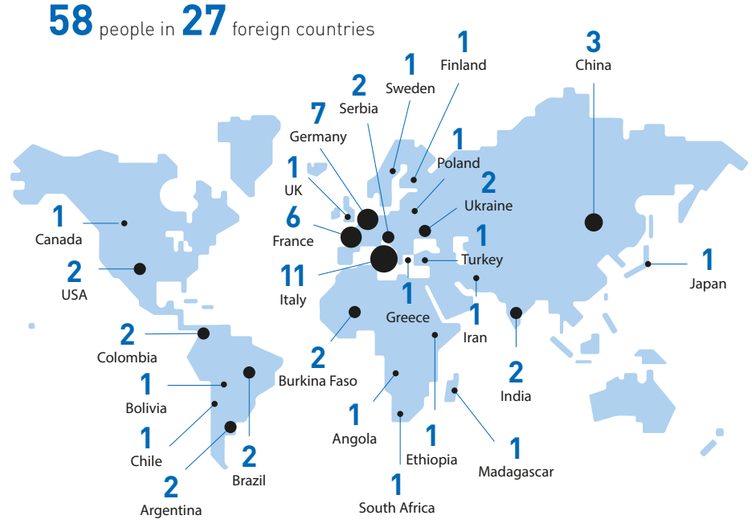
- **19** /5 Scientific researcher
- **27** /6 Senior scientist
- **9** /2 Research professor
- **7** /3 Permanent doctor contract
- **63** /19 Postdoc contract
- **3** /0 Ramón y Cajal
- **2** /0 Juan de la Cierva
- **33** /11 FPI/FPU
- **5** /2 PhD contract
- **15** /2 JAE-Intro
- **22** /3 Electronics
- **32** /7 Software
- **10** /0 OSN
- **5** /2 Mechanics
- **4** /1 Optics

Age distribution



International Staff

58 people in **27** foreign countries



2024
results

427
SCI publications

46
seminars at the IAA

28
press releases

14
meetings and schools

30
theses (PhD, Master, Degree)

13
courses

10
awards

15.6 M€
total budget

The IAA Severo Ochoa Programme

Isabel Márquez
Scientific Director SO-IAA Project

In 2024, during the second year of our second award as Severo Ochoa Center of Excellence, we pushed forward the different programs of our SO-IAA strategic plan. In terms of **human resources**, by mid-2024, all eleven Ph.D. researchers hired as part of the SO-IAA had started their projects. By the end of the year, ten postdocs/engineers were already working on different aspects of the SO plan, and two people had been integrated into the SO Technical Office. We also had ten Masters students, granted through the JAE-intro ICU call, funded by the SO-IAA, who took their first steps in research at our center. This JAE introductory programme has proven to be a successful way of identifying talented graduate students for our research projects. The program of **incoming and outgoing visits** continued its successful track record, increasing the number of researchers involved. **SO colloquia** were celebrated from January to November, with outstanding researchers coming from all over the world. In addition to a number of smaller actions of the **training program**, an Advanced School was celebrated in 2024: **The tenth edition of the European Radio Interferometry School, ERIS2024**, co-organized by the Instituto de Astrofísica de Andalucía (IAA-CSIC) and JIVE - Joint Institute for VLBI ERIC with more than 100 participants.

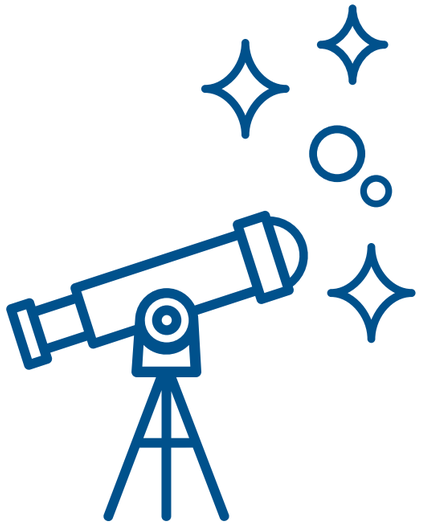
Among the **numerous and significant scientific results of 2024**, let's briefly mention those that, led by the IAA, gave rise to a press release. **Galaxies were caught in the throes of chemical "rejuvenation"** in a landmark study that reveals the crucial role of galactic mergers in the chemical evolution of ultra-luminous infrared galaxies. The **secrets of the AFGL 5180 region, a cradle of giant forming stars** and a prototypical region of massive star formation, were revealed in unprecedented detail. **A giant planet as light as cotton candy was discovered**, challenging our understanding of the formation of giant and ultra-light planets. Using a new method to measure carbon dioxide snow and frost variations, the thickness of **snow deposited on the surface of Mars was found to be up to two orders of magnitude greater** than previously estimated. Around red dwarf or M-type stars (smaller and cooler than our Sun), **several Neptune-like planets were discovered in a theoretically barren region**, within or very close to the "Neptunian desert". **On Ceres**, the second most water-rich body in the inner Solar System after Earth, **new evidence for organic material was identified in unprecedented detail.**

Among the activities of our **Gender programme**, we would like to highlight the organisation of a round table on "Vocations in STEM fields; the case of physics", and an invited contribution to the "Equity and Diversity" session of the Scientific Meeting of the Spanish Astronomical Society (SEA). In terms of **outreach**, a number of the SO strategic lines were presented at the Pint of Science and the European Researchers' Night, and at the outreach session of the Scientific Meeting of the Spanish Astrophysical Society (SEA).

As part of our activities as a member of the **SOMMa Alliance**, we participated in its 2024 annual meeting, "**100 x ciencia.8. Islands of Knowledge in a Complex World in Transition",** in Palma de Mallorca. We continued to serve on the SOMMa Executive Committee, now holding the position of 1st Vice President.

As anticipated last year, we participated in the official ceremony of the Severo Ochoa Award, organised in September by the Spanish Ministry of Science, Innovation and Universities, where we received the trophy with the two seals, one for each Severo Ochoa recognition.

Research groups



CSIC considers the research groups as specific fundamental units which contribute to achieving the scientific objectives of the institution.

During 2023, the IAA had 13 active research groups, which belong to the global area of "Materia". At the IAA we cover all major fields of astrophysics and space science. Our research is based on the three pillars of modern astrophysics: observation, instrumental development, and theoretical and numerical studies, all of which are firmly established and interconnected. The IAA groups study:

• **The Sun**, via spectropolarimetry, and its magnetic fields from an observational, theoretical and instrumental point of view: "Solar Physics Group".

• **The Earth's atmosphere** and planet atmospheres, including exo-atmospheric studies: "Group of Terrestrial Planet Atmospheres".

• **Planets** and the formation and evolution of minor bodies in the Solar System: "Planets and Minor Bodies Group".

• **The physics of planetary systems** and their low-mass stars: "Physics of low-mass stars, exoplanets and associated instrumentation Group".

• **The variability of stars** and asteroseismology, including theoretical stellar evolutionary models: "Stellar Variability Group".

• **Stellar clusters,** massive stars and the Galactic Center: "Stellar Systems Group".

• **The formation, evolution and death of stars** at different mass and spatial scales and the interstellar medium: "Physics of the Interstellar Medium Group".

• **The structure and evolution of galaxies,** from the inner stellar and diffuse components to their large-scale cosmic distribution and evolution: "Galaxy Evolution Group".

• **Supermassive Black Holes** and their immediate environments, including their associated relativistic jets: "Relativistic Jets and Blazars Group".

• **The most violent events in the universe** through multi-wavelength observations: "Very High Energy Group for Astrophysics".

• The combination between **General Relativity and Quantum Mechanics** in astrophysical scenarios: "Theoretical Gravitation and Cosmology Group".

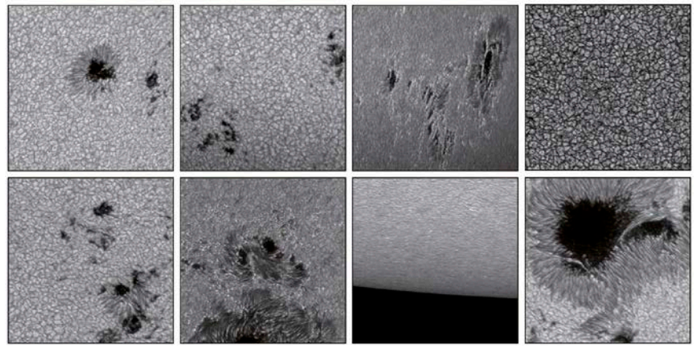
• The analysis of **large-scale galaxy clustering mechanisms** and the production of accurate cosmological simulations and galaxy mock catalogs: "Cosmology and Astroparticle Physics Group".

• Multirange observations of **high-energy phenomena** and stellar tidal streams: "High Energy Astrophysics and Robotic Astronomy Group (ARAE)".

The following pages present a summary of the results obtained in 2024 by the different research groups. The publications corresponding to the highlights of the research groups are identified in brackets, with the corresponding number in the publication list (from page 76 on).

SOLAR SYSTEM

Solar Physics



Overview

The IAA's Solar Physics Group (SPG) focuses on solar spectropolarimetry and magnetic fields from the theoretical, observational, and instrumental aspects:

- The Radiative transfer equation (RTE) for polarized light in the presence of magnetic fields and its use for diagnostics in interpretating spectropolarimetric measurements.
- Structure and physical nature of all kind of solar magnetic structures including quiet-sun and active region magnetism.
- Magnetic coupling of the solar atmosphere, space weather, and the solar cycle.
- Theoretical modeling of optical devices and phase-diversity based image reconstruction methods.
- Design, development, and construction of solar instrumentation.

Research lines:

- Quiet-Sun and active regions magnetism
- Magnetic coupling of the solar atmosphere
- Diagnostic techniques in spectropolarimetry
- Solar cycle
- Solar instrumentation

Image above
TuMAG continuum images showing an overview of some of the observed solar targets.

Highlights

Instrumentation

GENERAL

- New S3PC consortium webpage https://s3pc.es/.

SUNRISE III MISSION (TUMAG & SCIP INSTRUMENTS)

- Successful SUNRISE III flight in July 2024.
- Works on TuMAG and SCIP data reduction started.

ESA'S VIGIL MISSION (PMI INSTRUMENT)

- Fabrication of the Digital Processing Unit (DPU) and AMHD for the development model (DM).
- Passed the SRR (System Requirements Review) for the MPU's software and firmware.
- Passed the PDR (Preliminary Design Review) for the PMI instrument.
- E-Unit interconnection board (EDS) design finished.

SOLAR ORBITER PHI (SO/PHI) INSTRUMENT

- Support to scientific operations as instrument co-leads. Several campaigns led from IAA-CSIC.
- Year 2023 data released to the community.
- Solar Orbiter starts to go above the ecliptic: unprecedented observations of the solar poles starting in 2025.

TISES FOR EST

- Group leaders of the international consortium (Spain, Italy, Sweden, Germany) for the development of the Tunable Imaging Spectropolarimeters (TISes) for the European Solar Telescope (EST).

Science

- 7 papers in Q1; 1 papers in Q2; SOLAR ORBITER's regular operations in flight; Sunrise III flight
- Determination of the SO/PHI-HRT wavefront degradation using multiple defocused images [35]
- Comparison of magnetic data products from Solar Orbiter SO/PHI-FDT and SDO/HMI [280]
- Correcting Fabry-Pérot etalon effects in solar observations [358]
- Ph.D Thesis awards: Premio Extraordinario de Tesis Doctoral de la Universidad de Granada and Premio Granada Ciudad de la Ciencia y la Innovación (Ayto. de Granada) to F.J. Bailén Martínez: "Spectropolarimetric and Imaging Properties of Fabry-Pérot Etalons. Applications to Solar Instrumentation"
- "PMI kick-off meeting" took place at IAA-CSIC.
- Leadership of Spanish Space Solar Physics Consortium.

SOLAR SYSTEM

Planets & minor bodies of the solar system

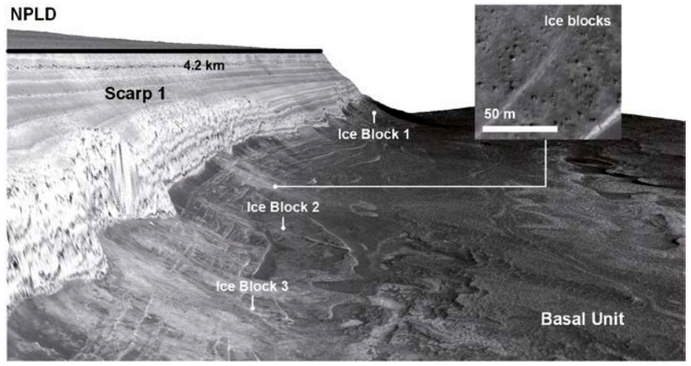


Illustration of the Martian North Polar Layered Deposits and ice blocks at the foot of the steep scarp (Scarp 1) by a 3D view with the High Resolution Imaging Science Experiment (HiRISE) camera on-board the NASA's Mars Reconnaissance Orbiter [411].

Overview

This group focuses on four main research lines: planets, minor bodies, exoplanetary atmospheres, and laboratory experiments with the Cosmic Dust Laboratory (CODULAB) on light scattering by particles, and the Gas-to-Particle Conversion Kinetics Laboratory (SPARKSLAB), aimed at understanding new particle formation processes of relevance to astrophysical environments, and the atmospheric chemistry of metals ablated from re-entering spacecraft. Broadly speaking, we aim to provide an integrated view of the Solar System and the atmospheres around exoplanets. Their work integrates observations from ground-based and space-borne instruments with theoretical modeling, simulations, and lab studies. They contribute to several space missions, including BepiColombo, ExoMars, JUICE, Comet Interceptor, EnVision, DART, and Hera.

Research lines

- Planets, minor bodies, exoplanetary atmospheres, and laboratory measurements: the Cosmic Dust Laboratory (CODULAb), and the Gas-to-Particle Conversion Kinetics Laboratory (SPARKSLAB).

Highlights

A hydrogenated amorphous carbon sample was synthesized as an analog of interstellar dust, suggesting that polarized light from AGB star envelopes can be explained by larger, porous aggregates of nanometer- sized grains rather than solely by 0.1-micron spherical dust grains [151]. Laboratory scattering matrices of three Martian dust simulants compared with sky-brightness data show that particle aggregation and multiple scattering significantly influence observed brightness in denser dust conditions [257].

A stellar occultation of TNO (143707) reveals an elliptical shape of 282x184 km, an absolute magnitude of 5.97, and a rotation period is 12.376 hours, providing valuable information about its physical properties [216]. In preparation of the occultation of Betelgeuse by asteroid (319) Leona, a preliminary occultation provided accurate measurements of Leona's dimensions and orbital parameters [300].

Discussion on the advantages of using large survey data to study the taxonomic distribution of asteroids by employing absolute magnitudes at several wavelengths [22]. Presentation of a catalog of absolute magnitudes in the SLOAN ugriz system. The so-called "phase reddening" effect is actually a "phase coloring" effect, and that it may depend on the range of phase angles observed [23].

Investigation of Bienor's physical properties revealed a triaxial ellipsoid shape, its rotation period and prograde rotation, and a higher-than-expected geometric albedo. Asymmetries in its lightcurve suggest albedo variations or a possible satellite [337]. Mapping of organics on Ceres reveals a granular distribution in Ernutet and a correlation with an ancient crater beneath it, supporting an endogenous origin for Ceres' organics [338].

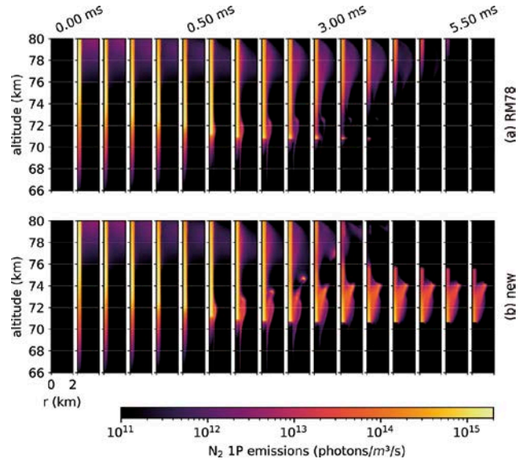
Models of ice sublimation and non-gravitational forces on comets reproduce 67P's water outgassing and chunk ejections but overestimate CO2 outgassing and surface erosion [32], and show that water- sublimation drive the non-gravitational forces, with thermal inertia and self-heating playing minor roles [31]

Study of seasonal CO2 deposition and sublimation on Mars North Polar region indicates a seasonal cover during winter, decreasing through spring, with snowfall potentially being more intense than previously thought, highlighting the dynamic nature of the Martian climate [411].

Dynamical modeling of long-term orbits of boulders ejected after DART impact, assessing their fate and the possibility of some remaining when Hera mission arrives [281].

SOLAR SYSTEM

Terrestrial and planetary atmospheres



Modeled temporal evolution of the molecular nitrogen emission for a sprite event. An updated coefficient for electron detachment (bottom row) allows the sprite glow to persist tens of milliseconds, in agreement with observations.

Overview

We investigate the thermal structure, composition, chemistry, dynamics, and electricity phenomena of the Earth and planetary atmospheres. About the Earth, we focus on the study of solar particles and radiation effects on atmospheric composition, trends in temperature and species abundances, and the occurrence and impacts of lightning, thunderstorm coronas and Transient Luminous Events phenomena on the composition. About Mars and Venus, we study their temperature structure, dynamics, ionosphere, and composition with GCMs and satellite data. We use a large variety of models and measurements from instruments on satellites, on the ground and in the laboratory. More recently we are studying the planetary formation, evolution and characterization of exoplanet atmospheres by modelling and analysing ground-based and space data.

Research lines

- Drivers of the Earth's middle atmosphere variability and its impact on climate
- Atmospheric Electricity in Planetary Atmospheres
- Thermal structure, composition and dynamics of Mars and Venus atmospheres. Remote sensing of other solar system planetary atmospheres in IR/UV
- Planetary formation, evolution and characterisation of exo-atmospheres.

Highlights

a) Slower associative electron detachment suggests sprite glows stem from electron depletion [249]. Simulations and measurements indicate that sprites impact mesospheric chemistry locally (sprites could be responsible for the observed NO_2 anomaly at 52 km altitude above storms) [318]. Four parameterizations (distinguishing land and ocean) have been developed to simulate global thundercloud streamer corona discharges producing greenhouse gases (N_2O, O_3). These parameterizations were implemented in global chemistry-climate models [376]. Modeling the electromagnetic emissions from thundercloud coronas shows measurable effects of the slantedness of the discharge direction, improving the correspondence between models and observations [226].

b) The CO_2 infrared radiative cooling plays a crucial role in the middle/upper atmospheric temperature. Also, it is nowadays widely accepted the large impact in that region of the CO_2 increase in the atmosphere. Hence, it is very important to model accurately the impact of projected increases in CO_2 emissions in the future. The calculation of this cooling requires, however, to include non-LTE processes which are computationally very expensive and cannot be afforded by Global Climate Models (GCMs). We have developed a fast, efficient and accurate parameterization of the CO_2 cooling, covering a large range of CO_2 abundances, for its implementation in GCMs [239].

c) The analysis of NOMAD observations accumulated over 3 Mars Years showed a strong vertical injection of water vapour into the upper mesosphere during the solstice season at high latitudes in the Southern hemisphere. We found a significant inter-annual variability in that injection which is probably due to changes in the atmospheric dust content. We also estimated the effect of the injection on the atmospheric escape of water, finding a non-negligible contribution to the accumulated escape rate [55].

d) Ground-based high-resolution spectra are powerful for characterizing exoplanet atmospheres, but they are greatly hindered by the dominant telluric and stellar contributions that must be removed. The removal techniques, however, deform the observed exoplanet spectrum whose effects need to be accounted for in forward models. We have developed a novel Bayesian-retrieval framework that formally considers this distortion, enabling precise constraints on exoplanet and exo-atmospheric properties, including atmospheric composition, temperature structure, surface gravity, cloud deck pressures, or transit timings [49].

VOLVER AL ÍNDICE →

STELLAR PHYSICS

Low-mass stars
& exoplanets

Overview

We study the physics of planetary systems and their low-mass stellar hosts. Red dwarfs are interesting objects in their own right, but also because of their potential as hosts to temperate rocky planets that could sustain liquid water. We work in several aspects of these systems: the general statistics and observational distribution of their exoplanets, theoretical studies of stellar structure and evolution, magnetic activity and asteroseismology, characterisation of the circumstellar environment and of the planet's atmosphere and interior, all this along with the technical development of new instrumentation for these studies.

Research lines

- Stellar structure and evolution of very low-mass stars
- Asteroseismology
- Exoplanets. Magnetic activity
- Astronomical instrumentation

Image above
Why is this planet so different from Jupiter? (Barkaoui, Francisco J. Pozuelos, Coel Hellier et al., 2024, NatAst, 8, 909–919: "An extended low-density atmosphere around the Jupiter-sized planet WASP-193 b"

Highlights

CARMENES is a unique, world-leading instrument internationally known for its survey to detect exoplanets around red dwarfs. Its near-infrared channel, designed and built at the IAA, has shown to be a ground-breaking instrument for studying the atmospheres of exoplanets. Co-led by the IAA, it is, to date, the largest exoplanet survey of red dwarfs. The consortium's productivity is exceptional, having published or submitted more than 127 papers, 13 this year, and discovered or confirmed 69 new planets, with another 11 additional firm candidates. These results have increased substantially the original small number of known planets orbiting red dwarfs.

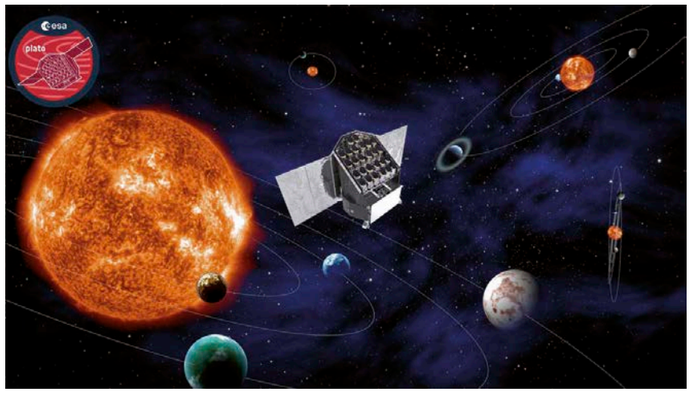
We have contributed to NASA's space mission TESS by confirming exoplanets with observations taken by several large ground-based telescopes, such as SPECULOOS. Within this collaboration, we co-led the work to study the "Cotton Candy" planet, WASP-193 b, a Jupiter-sized planet with an unusually low density, almost 20 times smaller than Jupiter and 100 times smaller than Earth [39]. The density we measured tells us that this is one of the least dense giant planets known, and ideal for the James Webb Space Telescope (JWST) to tell us more about its anomalous structure.

In June 2024 we signed the agreement to build the super-CARMENES instrument ANDES for the European Southern Observatory's Extremely Large Telescope (ELT). During this year, we also led the work for a new post-ELT era concept for a large-aperture telescope, MARCOT for the Calar Alto observatory in Almeria, based on the photonics technologies developed in our EMARCOT photonics lab. We also participate in several working groups for the next European Space Agency exoplanetary mission PLATO, to be launched in 2026 [86]. This year we also created the third IAA's Associated Unit, this time with the University of A Coruña's CITIC. Its name AIRExS stands for "Artificial Intelligence for Research on Exoplanets and Stars".

Eventually, the best asset of our group is its members, from the young master and JAE-Intro students to the predocs to the junior and senior postdocs and permanent staff. Thank you all for a very exciting year in exoplanet research.

STELLAR PHYSICS

Stellar variability



In the figure, an artist illustration depicts the future PLATO mission in space with its 26 telescopes pointing to planetary systems of Sun-like hosting stars.

Overview

Research at IAA's Stellar Variability Group (SVG) focuses mainly on the study of stellar structure and evolution and its impact on the characterization of planetary systems, stellar populations and galactic archaeology using asteroseismic techniques. Scientific members of the group are involved in the development of theoretical models as well as innovative time series analysis techniques that can be applied to extract information from ultra-precise data, especially observations from space satellites. The technical team of the group is focused in instrumental developments for space missions such as PLATO. Actually we are involved in the preparation of the PLATO (PLAnetary Transits and Oscillations of stars) 2.0 (ESA M3) space mission. We also participated in the design and exploitation of the precursor asteroseismic space mission CoRoT.

Research lines

- Stellar Structure
- Stellar Evolution
- Time Series Analysis
- Open Science

Highlights

PLATO main goal concerns the detection and characterization of Earth analogs and their hosting stars. The group has a key role in the PLATO Science Management (PSM) for the working packages "Light Curves Preparation for Asteroseismology" (WP 128.300), "Complementary Science" (WP 16), "Pulsating Stars" (WP 162.000), among others.

In [36], the emergence of a forest of low-amplitude peaks (grass) in the oscillation spectrum of some δ Sct pulsating stars is characterized and quantified in a rigorous study for the first time. The study rules out an instrumental origin for the grass, and its characterization presents a promising avenue for studying the physical properties and structure of this type of star. In particular, it sheds light on the interaction between rotation and pulsation, which is crucial for understanding stellar physics.

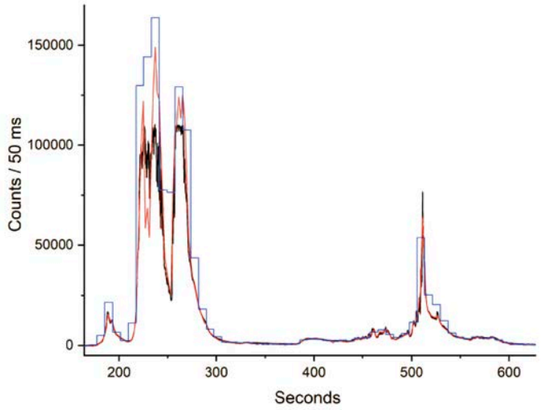
In [397] we introduced seven new high-amplitude δ Sct stars (HADS). We depict in our analysis that these are close to the red boundary of the instability strip in the Hertzsprung–Russell diagram. The fundamental mode of these targets follows the period–luminosity relation for δ Sct stars. Our HADS stars were categorized into single, double and triple modes. We determined the combination frequencies and non-radial oscillation frequencies. Moreover, we found a scaling relation between metallicity [Fe/H], mass, luminosity, effective temperature, and the fundamental period.

The group is leading the project of Citizen Science "Escuchando el Cante de las Estrellas", partially funded by Fundación Descubre and SEA Sociedad Española de Astronomía, in a joint collaboration with University of Granada UGR and the royal high school of music Victoria Eugenia. The project is centred on the study of δ Sct variable stars through sonification techniques, i.e. scientific data representations in the form of sounds. Our scientific goal is the detection of the parameter of large separation in frequency, a proxy of stellar mean density in δ Sct stars. By collecting and analyzing statistics of user responses, we aim to gain scientific insights into the properties of these variable stars. Our next goal is to extend this project to other citizen groups with special sensitivity to auditory perception, such as visually impaired individuals (ONCE).

VOLVER AL ÍNDICE →

STELLAR PHYSICS

ARAE
(Robotic and high-energy Astrophysics)



Light curve of the main episode of GRB 221009A prompt emission as observed from *INTEGRAL*/ACS (in count rate units). In black, we represent the original data (saturated), the red line shows the model calibrated against the *BepiColombo* detector, and in blue we plot the restored light curves using the INTEGRAL/IBIS-VETO detector [354]

Overview

The ARAE research group was founded in 2001, although some of its members had already started their activity in 1990. Scientists and engineers are working on a variety of projects, combining their strengths. Research lines are multi-range studies of high-energy phenomena and gravitational waves, and dwarf galaxy satellites and stellar tidal streams as dark matter probes in the local Universe. Significant technological developments are also carried out, regarding the robotization of small/medium size observatories and astronomical instrumentation development such as the BOOTES Global network of telescopes. We are also involved at space-borne missions such as ARRAKIHS and THESEUS. Teaching, public outreach and citizen science are also part of the ARAE activities.

Research lines

- Compact Objects in the Galaxy
- Cosmic Gamma-Ray Bursts (GRBs)
- Gravitational Waves (GW) electromagnetic counterparts
- Dwarf galaxy satellites and stellar tidal streams as dark matter probes in the local Universe
- Robotic Astronomy
- Astrophysical Transients

Highlights

Revealing the characteristics of the dark GRB 150309A: Dust extinguished or high-z? [71]

Dark gamma-ray bursts (GRBs) constitute a significant fraction of the GRB population. We present a multi-wavelength analysis for the intense GRB 150309A, regarding both the prompt emission during the internal shocks and the afterglow emission as result of the forward shock with the external interstellar medium. Despite the strong gamma-ray emission, no optical afterglow was detected for this particular event, which we observed very early with the Global BOOTES Network. However, we discovered a near-infrared afterglow in the K-band (2.2 microns), ~5.2 h post burst, with the CIRCE instrument mounted at the 10.4 m Gran Telescopio Canarias in La Palma. The GTC observations of the GRB 150309A afterglow revealed that it was very red, with H – K > 2.1 mag, resulting in a null detection in the H-band (1.6 microns). This fact could only be explained due to either a highly intrinsic absorption or a very high distance. In the later case, a high redshift origin was discarded based on multiple arguments, such as spectral analysis of the X-ray afterglow, which would constrain the redshift z < 4.15 and a moderate redshift value obtained using the spectral energy distribution (SED) modelling of the potential galaxy. Therefore the broadband (X-ray to the near-infrared) afterglow SED implied a very dusty host galaxy with a deeply embedded GRB, suggesting an optical extinction AV ≳ 35 magnitudes). This result establishes GRB 150309A as the most extinguished GRB known to date.

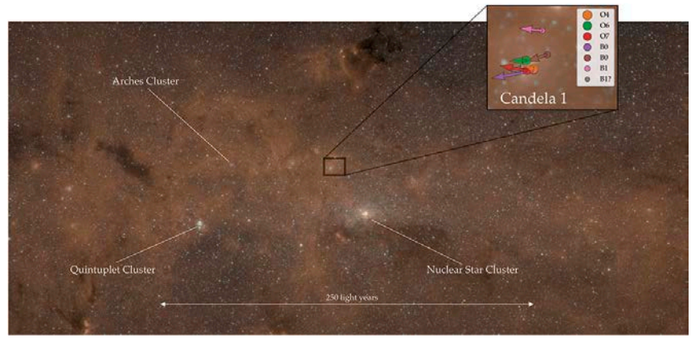
Early photometric and spectroscopic observations of the extraordinarily bright INTEGRAL-detected GRB 221009A. [354]

GRB 221009A is distinguished itself as the brightest ever recorded, presenting an unparalleled opportunity to probe the complexities of GRB physics. The unprecedented brightness, however, challenged observation efforts, as it led to the saturation of several high-energy instruments. We aimed to understand the fundamental physics illuminated by the detection of teraelectronvolt (TeV) photons emitted by GRB 221009A and conducted detailed analyses of early photometric and spectroscopic observations.

Our findings from analyzing INTEGRAL data confirm GRB 221009A as the most energetic event observed to date. Early optical observations during the prompt phase negate the presence of bright optical emissions with internal or external shock origins. Spectroscopic analyses enabled us to measure GRB 221009A's distance and line-of-sight properties. The afterglow's temporal and spectral analysis suggests prolonged activity of the central engine and a transition in the circumburst medium's density. Finally, we discuss the implications for fundamental physics of detecting photons as energetic as 18 TeV from GRB 221009A.

RADIO ASTRONOMY & GALACTIC STRUCTURE

Stellar systems



Overview

The Stellar Systems Group (SSG) studies star clusters, massive stars, star formation, and the morphology and dynamics of our and nearby galaxies via observations of stars in the Milky Way and galaxies in the Local Group. We are investigating the connection between star-forming processes and spatial and kinematic structures at different scales, and exploit the large Galactic surveys (including Gaia, GES, OTELO, GALANTE, J-PAS, J-PLUS, WEAVE and 4-MOST). As a significant part of the SSG, the Galactic Centre group specializes in understanding the astrophysics of the Galactic Centre, which is the only nucleus of a galaxy that we can observationally resolve into millions of individual stars. Please visit our website for more information: https://ssg.iaa.csic.es/.

Research lines

- Galactic Centre
- Formation, evolution and destruction of Stellar Systems
- Massive Stars

Image above
The young star cluster Candela 1 in the Galactic Centre. The arrows show the common velocities of the spectroscopically identified massive cluster members, with their stellar classifications listed in the legend. The background image is an infrared image from the Spitzer/IRAC Galactic Centre survey.

Highlights

The Galactic Centre is the most extreme environment of the Milky Way and also its most prolific star forming region, having formed about one million solar masses of new stars in the past 10 Myr. Surprisingly, there are currently only three massive, young clusters known in the Galactic Centre. This is because finding star clusters in this environment is an extremely challenging task due to the high density of stars and the extreme interstellar extinction towards this target. We developed a methodology to identify co-moving groups of stars – and thus potential cluster candidates – in the Galactic Centre via a combination of position, proper motion, and reddening measurements [260]. With the help of near-infrared spectroscopy, using the KMOS spectrometer at the European Southern Observatory's Very Large Telescope, we could confirm the presence of very young and massive stars in one of the candidates [261]. This is not only the first young cluster found in the Galactic Centre in more than 30 years, but the new method in combination with upcoming proper motions measurements will very likely lead to the discovery of more than a dozen or so similar clusters.

The Galactic Centre group also created a deep radio continuum study of the massive, young Arches cluster in the Galactic Centre, obtained with the Jansky Very Large Array. We could detect 25 radio stars, seven more than in any previous work. The variability of the radio emission from these stars suggests that – as one would expect - at least 60% of them are binary stars or multiples of higher order [67].

Lastly, the Stellar Systems Group has started to exploit the J-PLUS data using AI tools. This has allowed us to accurately classify the entire third data release of the J-PLUS survey (48 Million objects) into stars, galaxies, and quasi-stellar objects, enabling future studies about the chemistry and evolution of the Milky Way and its components [102]

RADIO ASTRONOMY
& GALACTIC STRUCTURE

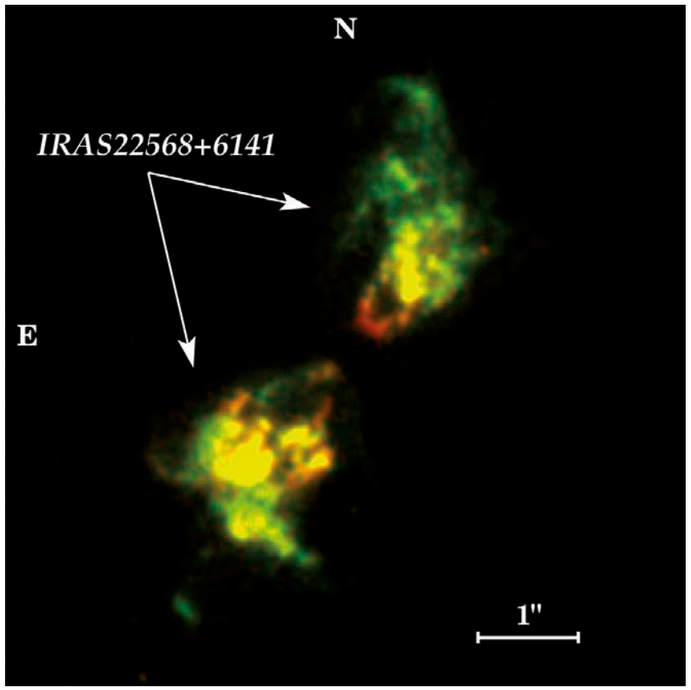
Physics of the Interstellar medium

Overview

The early stages of star and planet formation, with their jets and disks, are studied through radio/infrared observations and modelling.
The final stages of the life of stars are studied by the multi-wavelength characterization of evolved stars and the wind-blown bubbles around them, to understand the processes that shape planetary nebulae and the circumstellar medium around massive stars.
Exoplanetary systems are studied through the observation of the radio emission from star-planet interactions.
Radio interferometric monitoring of supernova (SN) explosions and their distribution in ultra luminous infrared Galaxies is also carried out to determine the SN and star formation rates.

Research lines

- Star and planet formation. Jets and disks. Modelling and observation.
- Radio emission from star-planet interaction in M-dwarf systems, and from sub-stellar objects.
- Planetary nebulae and their precursors.
- Massive stars and their surroundings. Supernova remnants and wind-blown bubbles.
- Luminous and Ultra Luminous Infrared Galaxies
- Prospective Science work for the Square Kilometre Array.

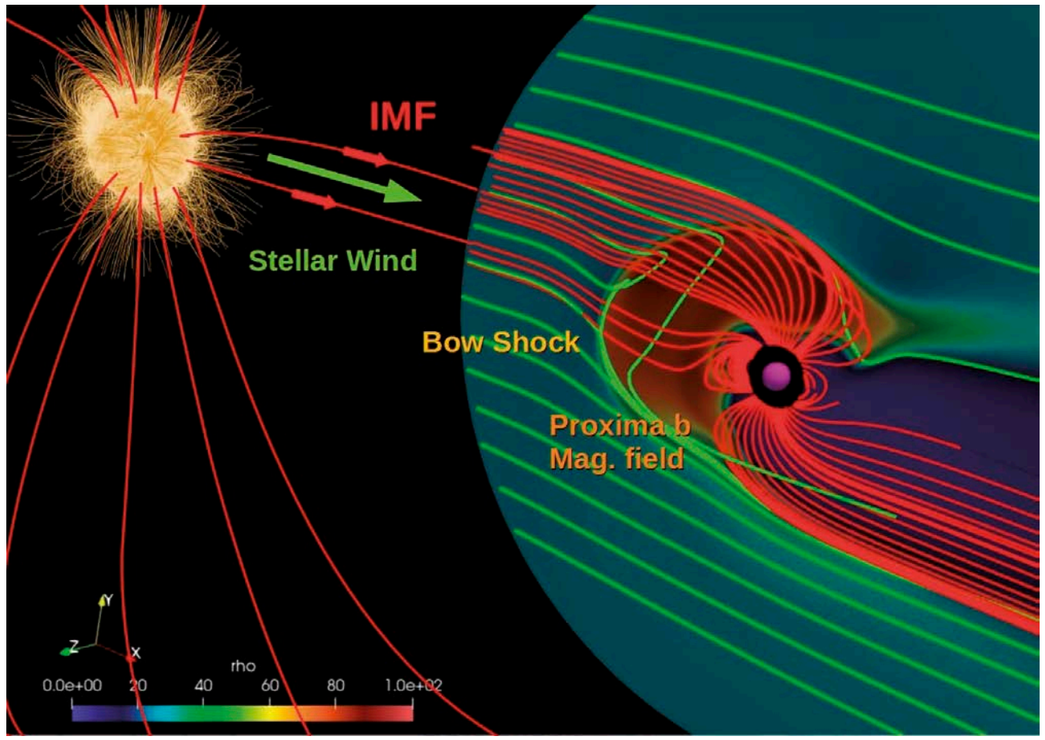


Color composite image of IRAS 22568+6141 constructed by using the individual broad band images taken in the f606 (green color) and f841 (red color) filters with the Hubble Space Telescope (HST). The bipolar lobes of the object are arrowed. The (so far unseen) central star is located between the lobes. The orientation (N-E) and spatial scale are indicated. Credit: HST.

Highlight

Crowe, Fedriani, et al. A&A, 682, A2 (2024) [92]

Massive stars (stars with a mass over 8 times the mass of the Sun) play a crucial role in astrophysics, from galaxy evolution to the enrichment of the interstellar medium with heavy metals. Therefore, understanding how these massive stars are born is paramount. However, star-forming regions are heavily embedded in gas and dust making them practically invisible to optical observations. Thus, we need to observe these regions at longer wavelengths such as infrared (IR) and radio. The radio continuum emission can reveal protostellar candidates, whereas the infrared shows mainly accretion and ejection processes associated to these protostars. Combining IR+radio, we have observed the massive star forming region AFGL5180 where we have discovered two protoclusters with at least a dozen protostellar candidates which are driving at least 40 jet knots. In particular, we made use of the Atacama Large Millimeter/submillimeter Array (ALMA), Large Binocular Telescope (LBT), and the Hubble Space Telescope (HST). Our observations show that the star formation occurring at AFGL5180 proceeds in a relatively ordered manner with well-defined outflows.



Sketch of the magnetospheric interaction in the star-planet system Proxima - Proxima b. The stellar wind velocity and the interplanetary magnetic field (IMF) streamlines are drawn in green and red, respectively. The density distribution is shown as a color scale, normalized to the value of the stellar wind density.

Peña-Moñino et al. A&A, 638, A138 (2024) [310]

We carried out 3D magnetohydrodynamic simulations to analyze the space weather and habitability of the planet Proxima b under various conditions. We find that the planet's magnetosphere can shield its surface from the damage caused by particles and radiation carried by stellar wind towards the planet, even during extreme events like coronal mass ejections, if the planet has an Earth-like magnetic field, or stronger. We also find that calm weather conditions yield weaker radio emissions. However, extreme weather can amplify emissions by over two orders of magnitude, suggesting that radio signals from planets with strong magnetic fields in close orbits could be detected. These findings are useful to guide future radio observations of exoplanets.

Guerrero et al. A&A, 689, A62 (2024) [164]

We present the first use of eROSITA (extended ROentgen Survey with an Imaging Telescope Array) All Sky Survey (eRASS1-DE) data at the IAA to search for X-ray emission from asymptotic giant branch stars. Such X-ray emission, arising from accretion disks or enhanced coronal activity, provides compelling evidence for binary companions in these evolved stars.

Cala et al. A&A, 691, A321 (2024) [62]

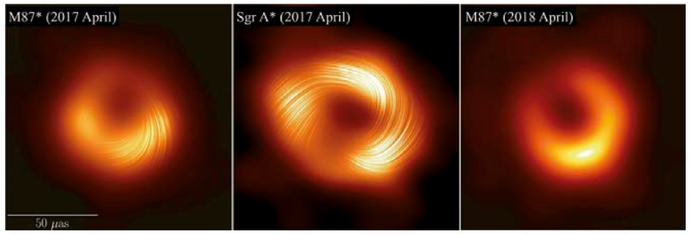
We have investigated the evolution of the possible nascent planetary nebula (PN) IRAS 22568+6141 (see Figure) over the past 70 years at optical, infrared, and radio wavelengths, revealing variability and emission characteristics that are unusual for PNe. The object underwent a sudden and energetic event that manifested itself as a dramatic nebular brightening around 1990, followed by a gradual fading that continues today. We identify this event with a 'late thermal pulse' in the central star of IRAS 2568+6141, a rare and poorly understood process in PNe. This thermal pulse has probably generated a shock wave with velocities of almost 500 km/s, which accounts for many of the observations. Monitoring IRAS 22568+6141 is crucial to understand late thermal pulses in PNe.

VOLVER AL ÍNDICE →

RADIO ASTRONOMY
& GALACTIC STRUCTURE

AGN Jets

Relativistic Jets & Blazars



The first images of black holes, obtained by the Event Horizon Telescope (EHT) through observations of M87* and the supermassive black hole in the galactic center, Sagittarius A*. They reveal a bright ring of emission produced by the strong bending of light near the black hole's event horizon. These long-sought images provide the strongest evidence to date for the existence of supermassive black holes and open a new window into the study of black holes, their astrophysical environments, and gravity.

Overview

The main research topic of our group is the study of supermassive black holes (SMBH) harbored in the nuclear region of active galaxies. Huge amounts of energy are released from their innermost environment in the form of ultra-relativistic jets, as a consequence of mass accretion onto the SMBH and energy extraction through powerful twisted magnetic fields anchored to it. We study these objects at the maximum achievable angular resolution by means of very long baseline interferometry observations at radio wavelengths with the Event Horizon Telescope (EHT) and other VLBI arrays. Thanks to these observations, we are able to directly image SMBHs and the jets forming close to them.

Research lines

- Imaging supermassive black holes with the Event Horizon Telescope
- Accretion onto supermassive black holes and the formation of relativistic jets
- Blazar jet multi-wavelength phenomenology from the horizon to parsec scales
- AGN, black hole growth and demographics, binary blackholes and gravitational waves

Highlights

Our recent EHT observations of M87* during the 2018 campaign have significantly advanced our understanding of the black hole's immediate environment [123]. An expanded array—including the Greenland Telescope and enhanced bandwidth—yielded higher data precision than previous epochs. The measured shadow diameter remains consistent with the 2017 results and the predictions for a Kerr black hole. Notably, the brightest segment of the ring shifted by approximately 30° between epochs. GRMHD simulations attribute this shift to turbulent variability in the accretion flow rather than a change in the black hole's orientation. Furthermore, the simulations confirm that M87*'s spin axis aligns with its large-scale jet, effectively ruling out tilted accretion disk models.

The first polarization observations of Sagittarius A* captured in 2017 reveal a bright, thick ring with a diameter of 51.8 ± 2.3 μas, consistent with the expected shadow of a ~4 × 10^6 M⊙ black hole [122, 18]. Analysis of resolved linear and circular polarimetric images uncovers a highly polarized emission ring. The linear polarization exhibits a spiral electric vector pattern with peak fractional polarization near 40% in the western region, while the circular polarization displays a modest dipole-like structure (5–10%). Extensive imaging and modeling—supported by synthetic data—demonstrate that the high linear polarization fraction (24–28%) constrains the physical parameter space, disfavoring models with excessive Faraday depolarization. Although a time-variable rotation measure (≈46° ± 12° at 228 GHz) introduces some uncertainty, one promising model, characterized by strong magnetic fields, a spin parameter of 0.94, and an inclination of 150°, satisfies both total intensity and polarimetric constraints. Together, these results from M87* and Sagittarius A* offer a unified view of the complex interplay between accretion dynamics and jet formation in supermassive black holes.

RADIO ASTRONOMY
& GALACTIC STRUCTURE

VHEGA

Very High Energy Group for Astrophysics

The four Large-Sized Telescopes (LSTs) -the largest types of Cherenkov telescopes to be integrated into the CTAO northern site- and now being commissioned (LST-1) or built (LST2, 3 and 4) in La Palma, the Canary Islands, Spain. Credit: Cristian Pozo

Overview

The group investigates the most extreme and violent events in the universe through multi-wavelength observations. It has a long track of astrophysical research on active galactic nuclei, galactic compact objects and their environments and other highly energetic and transient sources at all spectral ranges from radio up to gamma-ray energies. The group also specializes in software development, including AI techniques, for astronomical data analysis and archives. We are part of the CTAO Consortium, and of the LST Collaboration that is building the largest telescopes of CTAO in La Palma (Spain) and Paranal (Chile), as well as of the MAGIC Collaboration, also operating on the island of La Palma.

Research lines.

- Astrophysics of extreme and violent events studied through MWL (radio, optical, X-rays and high and very high-energy gamma-ray) observations, including polarimetry, wherever feasible. In particular the astrophysical scenarios currently studied are:
- Relativistic jets from supermassive black holes in active galactic nuclei.
- Galactic compact objects.
- Star formation galaxies.
- Star forming regions.
- Data analysis software development, including AI techniques

Highlights

LST-1 Detects the Highest-Energy Gamma Rays from the Crab Pulsar.

The Large-Sized Telescope 1 (LST-1), the first prototype of the Cherenkov Telescope Array Observatory (CTAO), has achieved a major milestone by detecting very high-energy gamma rays from the Crab pulsar. This result confirms the telescope's exceptional capabilities and provides new insights into the extreme processes at work in pulsars—rapidly spinning neutron stars left behind after supernova explosions.

Located at the center of the Crab Nebula, the Crab pulsar rotates 30 times per second, emitting beams of radiation that sweep across our line of sight, much like a cosmic lighthouse. While gamma rays from pulsars have been observed by space telescopes such as Fermi-LAT, detecting them from the ground at very high energies (above 100 GeV) is extremely challenging due to their faint signals.

Over 103 hours of observation, LST-1 successfully detected the pulsed emission from the Crab pulsar with high significance, capturing the two characteristic peaks in its light curve, known as P1 and P2. These pulses were observed at energies up to 450 GeV for P1 and 700 GeV for P2, making this one of the most precise ground-based measurements of a pulsar at these extreme energies. Additionally, the so-called bridge emission, a weaker signal between the two peaks, was also detected, further improving our understanding of how pulsars generate high-energy radiation.

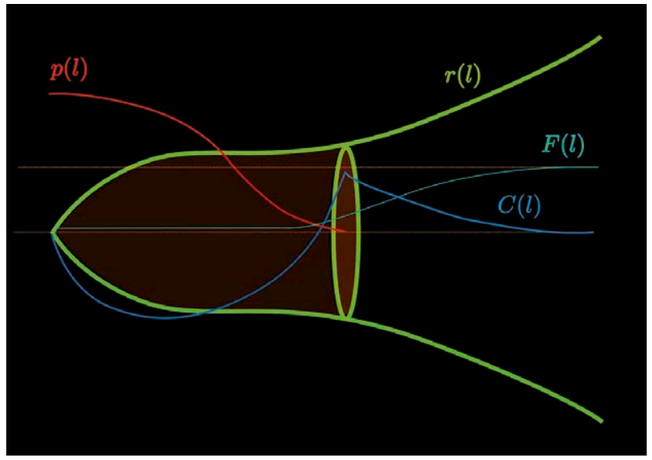
By combining LST-1's results with more than a decade of data from Fermi-LAT, researchers confirmed a smooth transition between the two energy ranges, reinforcing the reliability of LST-1's measurements. The study also showed that the pulsar's gamma-ray spectrum follows a power-law behavior at the highest energies, supporting models where the emission is produced by inverse Compton scattering in the pulsar's magnetosphere.

This first pulsar detection by LST-1 demonstrates the telescope's exceptional sensitivity and its potential to study other gamma-ray pulsars. As more LSTs are deployed in the coming years, CTAO will revolutionize our understanding of these extreme cosmic accelerators, opening new windows into the high-energy universe [5].

VOLVER AL ÍNDICE →

EXTRAGALACTIC
ASTRONOMY

Theoretical Gravitation & Cosmology



Overview

Our group is interested on theoretical gravity, both at the classical level and specially on those situations in which General Relativity (GR) –the best theory of gravity we have– is expected to start failing. The most promising situation in which to observe departures from GR is the physics of gravitational collapse and its end result –black holes in the standard theory. Thus, a large body of our research is centered in analyzing how different situations in standard GR would be modified when going beyond this theory. For instance, we analyze modifications based on semiclassical gravity and those suggested by emergent and analogue gravity scenarios. We study the viability of the new scenarios suggested by these frameworks.

Research lines

- Semiclassical gravity
- Analogue and emergent gravity
- Black holes and their alternatives

Image above
Schematic description of a semiclassical star. Using a radial parameter *l* we portrait the radial shape *r(l)*, the pressure *p(l)*, the compactness *2m(l)/r(l)* (with *m(l)* the mass contained inside the radius *r(l)*), and the redshift function *F(l)*.

Highlights

After collapse: On how a physical vacuum can change the black hole paradigm

In this book chapter we have reviewed our line of research on semiclassical gravity. We have discussed why it is interesting to look at the gravitational modifications that semiclassical effects entail. Then, we describe the main results of our inquiries in the past years. On the one hand, the more than plausible theoretical existence of stars amply surpassing the Buchdahl compactness limit.

On the other hand, that semiclassical effects on the inner horizon that any realistic gravitational collapse should develop, could make it explode outwards and meet the external horizon before it has had any time to evaporate.

Invited book chapter of "New frontiers in Gravitational Collapse and Spacetime Singularities"; Daniele Malafarina and Pankaj S. Joshi eds. Springer Series on Astrophysics and Cosmology (2024).

Nonexistence of a parent theory for general relativity and unimodular gravity

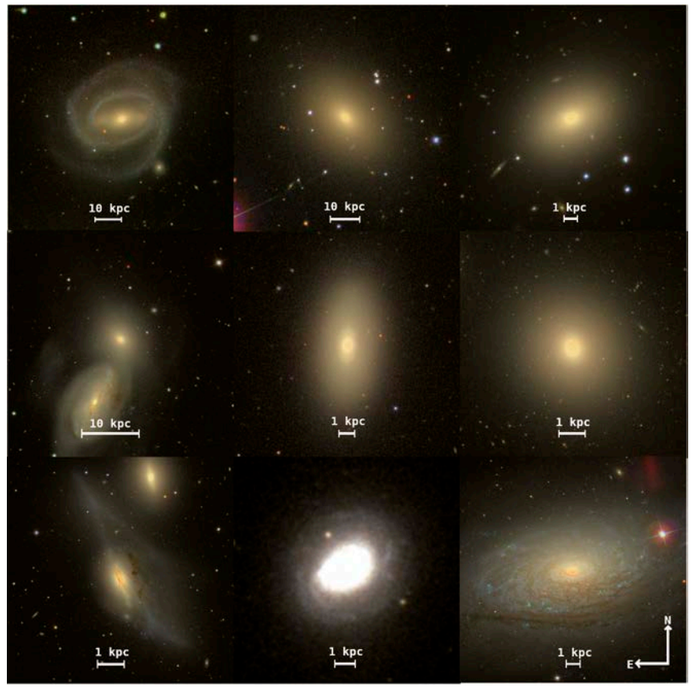
Among the set of alternative theories of gravity differing from general relativity there is one that stands alone because it is almost a twin theory but there are some remarkable differences at the structural level. This is the so-called unimodular gravity or Weyl-transverse gravity. Due to its similarities, one wonders whether there is a single parent theory from which general relativity and Weyl-transverse gravity appear just as different partial gauge-fixing of the parent theory. In this work it is shown that this cannot be the case [142].

Tachyons in "momentum-space" representation

Tachyons are particle-like entities that always travel at speeds faster than light. They are perfectly compatible with Lorentz invariance, the symmetry underneath special relativity. There is a renewed interest in tachyons because they could have some relevance in situations like inflation. The momentum representation associated with these particles is not well known. In this work we completely develop this representation. This has required a sound revision of the notion of associated Cauchy surface and scalar product [19].

EXTRAGALACTIC
ASTRONOMY

Galaxy Evolution



Optical images of the nine LINERs observed with MEGARA. The physical scale is indicated for all images; north is up and east to the left.

Overview

The group conducts observational and theoretical research on galaxy structure and evolution, spanning from the inner stellar and gaseous components of galaxies to their large-scale cosmic distribution. It also undertakes instrumental and technological development projects. Observational studies utilize diverse data sources, including 3D spectroscopy, multi-band photometric surveys, and HI data, to investigate star formation physics, stellar populations, nuclear activity and its interplay with stellar evolution, and the diffuse medium within galaxies. Additionally, the group explores environmental effects on galaxy structure and evolution, from isolated systems to galaxy clusters.

Beyond research, the group supervises PhD students, teaches at the master's and doctoral levels, and engages in public outreach. It also leads Spain's participation in the Square Kilometre Array Observatory (SKAO) and the development of a SKA Regional Centre at the IAA-CSIC, a hub for Open Science. Furthermore, it is involved in constructing the TARSIS Integral Field Spectrograph for the 3.5m telescope at Calar Alto Observatory.

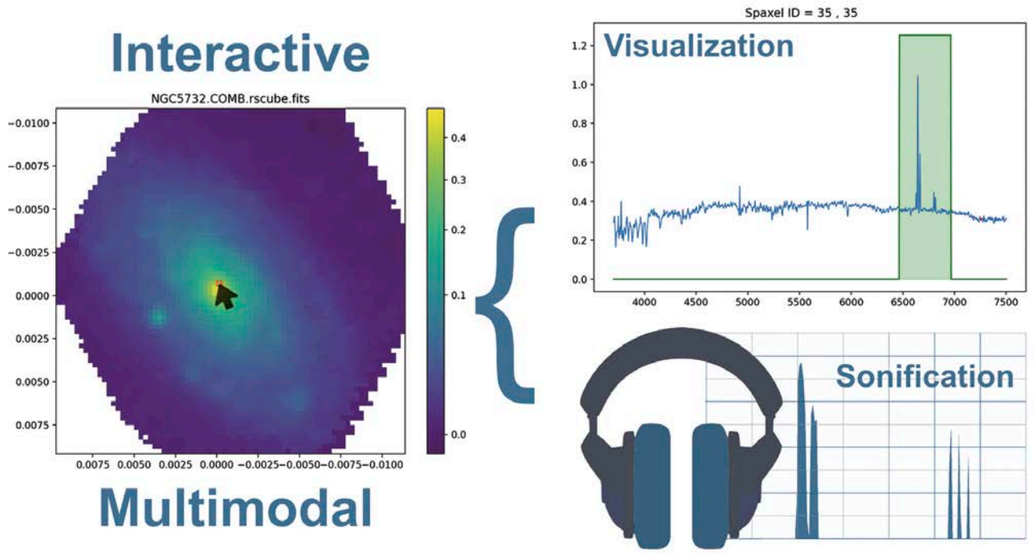
Highlights

Galaxy Evolution through Environmental Impact and Innovative Analysis Tools

This project studies galaxy evolution using five nearby Universe samples (z < 1) from J-PAS, CAVITY, and CALIFA surveys. It focuses on star formation histories, stellar populations, and ionized gas properties, emphasizing environmental effects in clusters, groups, and voids, with contributions to data releases and international collaborations.

The miniJPAS survey investigates galaxy luminosity and stellar mass functions up to redshift 0.7 using J-PAS data. It reveals the evolution of these functions, particularly for star-forming and quiescent galaxies, providing insights into the cosmic evolution of luminosity and stellar mass densities [106].

The CAVITY project studies galaxies in voids, releasing its first data set of datacubes observed from Calar Alto [141]. These results explore the spatially resolved properties of galaxies in low-density environments, showing that void galaxies are typically bluer, younger, and exhibit slower evolution, especially in their outer regions. Comparison with galaxies in denser regions highlights the influence of environmental factors, particularly for lower-mass galaxies [89].



ViewCube User Interface displaying the data cube of the spiral galaxy NGC 5732. The left panel shows a 2D image, while the right panel provides a multimodal view of a specific point in the galaxy, including a spectral window and its corresponding sonification.

Contrastive learning (CL), a technique within machine learning, is applied to the extended CALIFA data to classify galaxies based on physical properties like morphology and star formation. CL successfully separates galaxy populations, such as the blue cloud and red sequence, and shows potential for mapping galaxy distributions across large-scale structures like voids and clusters [264].

Finally, ViewCube, an interactive tool combining visualization and sonification, enhances accessibility by generating auditory representations of datacubes from the CALIFA survey. User feedback confirms its effectiveness in extracting information from auditory data, showcasing the role of sound in scientific analysis [139].

Understanding nuclear activity in galaxies: from low to high accretion rates

Feedback processes, such as those driven by outflows, are believed to play a major role in galaxy evolution. They are ubiquitous in all active galactic nuclei (AGNs). In Low-Ionisation Nuclear Emission line Regions (LINERs), they have been scarcely explored. However, in our work with integral field spectroscopy (IFU) we found clear signatures of outflows in six LINERs, with ionized gas mass outflow rates much larger than predicted for their luminosities (see Figure AGN-Fig-1) [176].

We also studied Mrk 1498, a giant low-frequency double radio source, whose radio emission suggests at least two radio activity episodes: an old one (~100 Myr) at megaparsec scales, and a young episode (>2000 yr ago) from the core. By means of using [O III] IFU data we propose a scenario of two different ionized gas features over the radio AGN lifecycle [72].

Research lines

- Active Galactic Nuclei
- Astronomical instrumentation
- Cosmic evolution of galaxies
- Open Science
- Physics of Quasars
- Star formation and violent star formation in galaxies
- Sonification
- Stellar populations in galaxies and their evolution
- The interplay between massive star formation and chemical evolution in galaxies
- The influence of the environment on the evolution of galaxies
- Virtual Reality

At the highest AGN luminosity, for a sample of high-redshift quasars, we analyzed the impact of the presence of relativistic jets on the kinematics of the gas surrounding the supermassive black hole (SMBH) and its effect on the outflows. We find that, although radio-loudness seems to modulate the outflow properties, as radio-loud quasars exhibit smaller outflows than radio-quiet ones, the fundamental factor driving the outflows is the accretion rate to the SMBH. Our findings suggest that [OIII] outflowings are driven by the AGN, but their influence is limited to the central kiloparsecs, while the dynamical parameters of CIV outflows (mass rate, kinetic power) are in the range required to produce AGN feedback effects in the host galaxy. [100]

Galaxies caught in the throes of chemical "rejuvenation"

Ultra-luminous Infrared Galaxies (ULIRGs) are massive galaxies characterized by the huge amounts of dust producing their large infrared emission and obscuring the extreme physical processes in their centers. We found a group of ultra-luminous infrared galaxies (aka 'deep-diving' ULIRGs) mimicking the properties of the less massive, much younger systems. This is explained as a consequence of the strong interactions with other galaxies driving large amounts of reservoir gas to the center of these systems. Our study, based on infrared spectroscopy which avoids effects of their large amounts of dust, allowed the analysis of the ionized gas showing that most normal ULIRGs show physical/chemical properties corresponding to galaxies of similar mass. This result gives clues on how galaxies evolve under extreme conditions [315].

Unveiled very high velocity flows in the record-breaking low metallicity galaxy IZw18

IZw18 is a nearby, small galaxy mostly made of the lightest chemical elements formed soon after the Big Bang. By observing it with the advanced MEGARA instrument on the Gran Telescopio Canarias, we uncovered surprising details about how gas flows in this cosmic "baby". We see a rotating pattern between its two star-forming regions but also an extremely high-velocity gas, likely driven by stellar explosions and winds. This powerful outflow extends far and wide, hinting at large-scale events stirring up the gas. Interestingly, the northeastern halo looks calmer, while the southwestern halo shows faster speeds and more tangled activity. Our results help us piece together how young galaxies form and evolve, proving that even the smallest galaxies can host dramatic, universe-shaping phenomena [30].

Angular Momentum of Isolated Galaxies

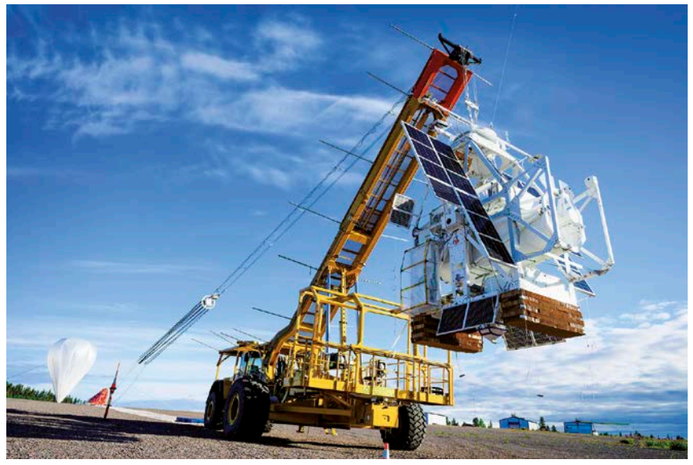
Galaxies evolve through complex interactions, including mergers and environmental influences that shape their structure and internal motion (kinematics). This study focuses on the Analysis of the interstellar Medium in Isolated GAlaxies (AMIGA) sample, the most carefully constructed sample of isolated galaxies, which exhibit extremely low values for parameters typically enhanced by interaction. The research explores how isolation influences the angular momentum of galaxies, a fundamental property that governs their rotation and structure.

By analyzing 36 isolated disc galaxies with neutral hydrogen (HI) kinematics and infrared photometry from NASA's Wide-field Infrared Survey Explorer (WISE), the study reveals that the specific angular momenta of AMIGA galaxies are, on average, higher than those of non-isolated counterparts. These findings provide important insights into the role of isolation in galaxy evolution, showing that galaxies free of major interactions retain more of their original angular momentum. This is clear evidence of the role of the local environment in removing angular momentum from galaxies, supporting theories stipulating that environmental processes involving galaxy–galaxy interactions alter the internal dynamics of galaxies over time. However, no relation was found between the angular momentum and the degree of isolation, suggesting that there may exist a threshold density of galaxies beyond which the effects of the environment become important [378].

Future studies using advanced telescopes, as the SKA precursor MeerKAT, will help further refine our understanding of how the environment shapes the fundamental properties of galaxies.

UDIT

Instrumental & Technological Development Unit



SUNRISE III mission launch. In the foreground, the platform carrying the payload, mounted on the launch structure. In the background, the stratospheric balloon. The IAA has a key role in two of the on-board instruments: TuMAG and SCIP

Overview

The Instrumental and Technological Development Unit (UDIT) was founded in 1975 and since its foundation it has been focused on the development of state-of-the-art instruments for ground-based telescopes and space-borne astrophysical payload instrumentation. During more than 40 years, the instruments developed at the UDIT have placed the IAA as a reference center for technological research projects.

The technical production at the UDIT can be split into two major lines:

- Analysis, design, integration, and verification of astronomical instruments for ground-based telescopes in Calar Alto Observatory (CAHA), Sierra Nevada Observatory (OSN), ELT (Extremely Large Telescope)...
- Analysis, design, integration, and verification of astronomical instruments for interplanetary scientific space missions and stratospheric balloon observatories

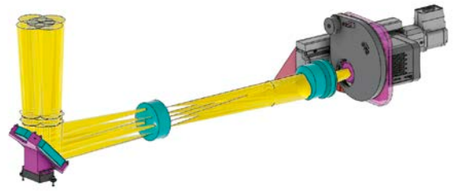
Space projects

Comet Interceptor: ESA's Comet Interceptor will be the first mission to visit a comet coming directly from the outer reaches of the Solar System. During 2024 several models (EM, EFM and EQM) of power supplies of instruments CoCa, MaNiaC and EnVisS have been developed. The UDIT team has also given support for the environmental, electrical and functional tests of various hardware and software modules within the system.

EnVision: The main goal of EnVision is understanding why Venus, our closest neighbor, is so different from Earth. During 2024 the UDIT team has designed, analyzed and developed several models of the three on-board power supplies of the Venspec suite (CCU-PSU, H-PSU and U-PSU). EnVision is planned to be launched in 2031.

PLATO: PLATO is a space observatory that will search Earth-sized planets in the habitable zone of over 200000 stars. IAA participates in the design and development of the Main Electronics Unit (MEU). In 2024 the EQM model was delivered, and the final models (PFM and FM) were under testing, in order to be delivered in the first months of 2025. PLATO is planned to be launched in 2026.

DUSTER: Project DUSTER is dedicated to the design and development of a system for measuring and analyzing dust and charged particles, conceived as an instrument suitable for a wide range of space exploration missions. During 2024 the IAA team has developed the prototypes of the DPU (Data Processing Unit), LVPSU (Low Voltage Power Supply Unit), harness and electronics box, as well as the software for instrument control and EGSE (Electronics Ground Support Equipment). The activities of the IAA team also included the coordination of the AIT (Assembly, Integration & Testing) and supervision of the EMC tests.



TARSIS instrument acquisition and guiding system design

SUNRISE III. After two extremely successful campaigns held in years 2008 and 2013 and a failed attempt in 2022, SUNRISE was launched again in July 2024. IAA has a strong participation, leading one of the three postfocus instruments (TuMag) and co-leading another (SCIP). The mission was once again successful and provided a new dataset to be analyzed by the scientific team.

Vigil: the Vigil mission will perform space weather forecast for advance warning of oncoming solar storms. IAA participates with instrument PMI (Photospheric Magnetic field Imager). During 2024, several prototypes and models have been manufactured after technical test campaigns, and three progress meetings have been held (MPU software and firmware SRR, PMI E-Unit PDR and PMI instrument PDR). The Vigil mission is expected to be launched in 2031.

Other projects: An instrument development team's work does not conclude with the mission's launch, as ongoing monitoring is required. In some cases, support must be provided for tasks such as gravity assists or remote software updates. In 2024, UDIT's development teams carried out various support activities for operational missions like JUICE, NOMAD and Solar Orbiter.

Ground based instruments

MOSAIC: MOSAIC will be a multi-object NIR & VIS spectrograph that will use the widest possible FoV provided by the ELT. Several meetings and reviews were held during 2024, in order to define the system architecture. The UDIT team has performed cryogenic tests of the cryo-motors and resolvers and has developed and implemented motor PLC libraries derived from ESO standards.

TARSIS: TARSIS, a wide-FoV, blue-optimized, intermediate-resolution Integral Field Spectrograph, will be the new generation instrument for CAHA's 3.5 m telescope. Throughout 2024, progress has been made in the design of the optomechanics for the acquisition and guiding systems, calibration unit and rotator, and the hardware structure of the instrument's control system has been defined.

ANDES: ANDES (formerly HIRES) will be a high-resolution spectrograph that will allow to perform extremely high sensitive observations. The UDIT team has developed several designs for two different types of optomechanic mountings: precharged and bonded optics. ANDES is a second generation instrument for the ELT and is expected to start its operations in the 2030's.

PANIC (PAnoramic Near Infrared camera for Calar Alto): Throughout 2024, PANIC commissioning activities have continued, focused on detector characterization and non-linearity correction, and improvement and debugging of the software. The instrument is expected to be delivered to the CAHA observatory in the first half of 2025.

Other projects: after its deployment in 2023, MIMA has been giving its first data in 2024, confirming the quality of the observations, that will help understanding the dynamics and long-term changes in Earth's mesopause.

The mechanical improvements developed during 2023 in CARMENES-PLUS have led to an increasing in the radial velocity precision of the NIR channel, now below 1 m/s, allowing for more ambitious scientific objectives in detecting and characterizing exoplanets around M-type stars.

Additionally, in 2024, participation began in new ground-based instrumentation projects: MARCOT, a modular telescope for exoplanet searches from the Calar Alto Observatory, and the future European Solar Telescope (EST), where tasks related to optical design, software, and systems engineering will be carried out.

VOLVER AL ÍNDICE →

Calar Alto Observatory (CAHA)

Panorama of the CAHA installations. Credit: Javier Flores (CAHA)

Overview

The Calar Alto observatory (CAHA) is a key institution for the international astronomical community, for its highly competitive astronomical facilities (telescopes and instrumentation). From 2019 on, the current administration of CAHA includes the Junta de Andalucía as a new partner – replacing the Max Planck Gesellschaft (MPG) -, and together with the Spanish National Research Council (CSIC) these two institutions manage the operation of the observatory with the same percentage. In this new scenario, the Instituto de Astrofísica de Andalucía (IAA-CSIC), recently awarded with Severo Ochoa consideration, will continue playing the role of benchmark institute of the observatory.

Activities and highlights

Publications and main scientific results

Observations at Calar Alto have produced in 2024 more than 152 publications in international peer reviewed journals. This includes not only scientific projects awarded with open time, but also the long-term legacy projects that started in 2021. In addition to the scientific activity, Calar Alto has continued its activities involving the development of new instrumentation as well as basic infrastructures. We describe below the most relevant of these results:

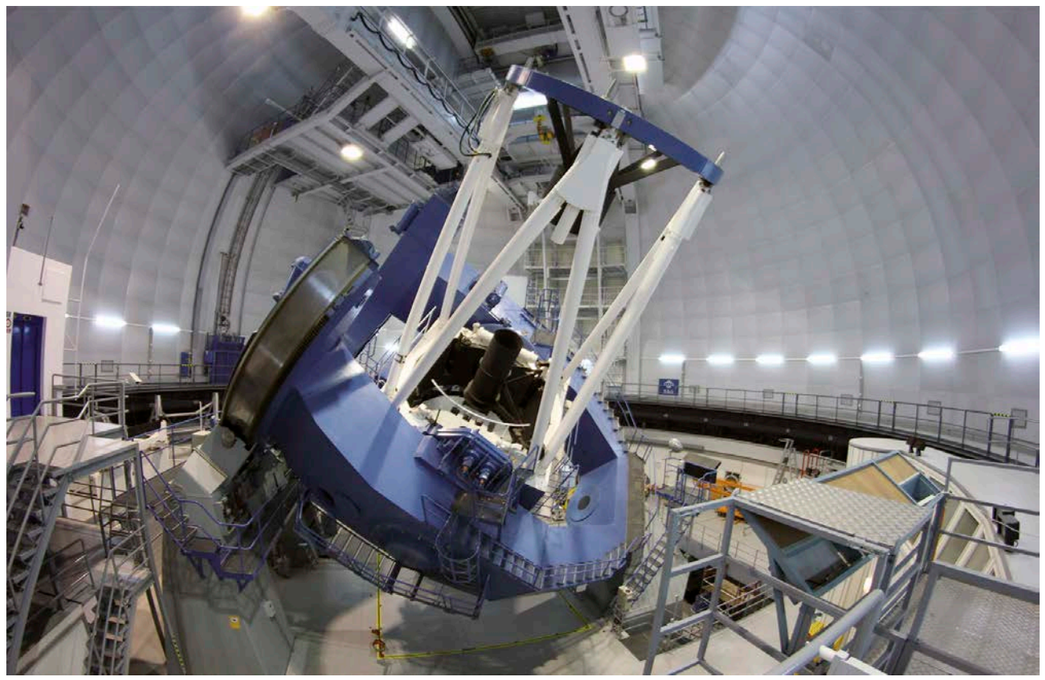
"K2-399 is not a planet: the Saturn that wandered through the Neptune desert is actually a hierarchical eclipsing binary", J. Lillo-Box et al., 2024, Astronomy & Astrophysics, 689, L8

A new research led from the Centro de Astrobiología in Madrid (CAB, INTA-CSIC) has revised a previous study from NASA that had claimed the discovery, by the transit method alone, of an exoplanet orbiting the star K2-399.

Using more complete observations, including those taken in Calar Alto with CARMENES, the new research concludes that the detected transits, those mini-eclipses, are not due to a planet but to a pair of red dwarf stars orbiting K2-399, while eclipsing each other, which perfectly mimics a typical exoplanetary transit. This case reminds us that revision based on new data, and where appropriate, correction of previous results is the basis of the scientific method.

"CAVITY: Calar Alto Void Integral-field Treasury survey. I. First public data release" [140]

The CAVITY international project, led from the University of Granada and based on three-dimensional (3D) images taken at Calar Alto publishes a sample of 100 galaxies located in the so-called "voids", the most uninhabited areas of the Universe. These galaxies represent a pristine population, a reference sample for multiple cosmological studies.



The two-dimensional (2D) spectra obtained with the PMAS instrument on the 3.5 m telescope for CAVITY are made freely available to the public today at cavity.caha.es. CAVITY is one of the three major ongoing legacy programs at Calar Alto.

"Gliese 12b: a temperature Earth-sized planet at 12 pc ideal for atmospheric transmission spectroscopy", M. Kuzuhara et al. 2024, ApJ, 967, L21

Using space and ground-based telescopes, including the 3.5m at Calar Alto, an international team has discovered a rocky planet named Gliese 12b. It is very similar in size to Venus, and orbits in the habitable zone around the red dwarf star Gliese 12, less than 40 light-years from the Sun.

Thanks to its proximity and its equilibrium temperature of about 42 ºC, Gliese 12b is an ideal candidate for studying its possible atmosphere with the James Webb Space Telescope when mini-eclipses (or transits) of Gliese 12 take place.

International collaborations

During 2024, Calar Alto has continued its participation in the ORP european network, which started in 2021 as a merging of the OPTICON and RadioNet networks, and it is currently the largest collaborative network of ground astronomy in Europe, that intends to coordinate methods and observation tools, and to provide access to a wider set of astronomical facilities. Calar Alto participates in ORP, together with the Instituto de Astrofísica de Andalucía (IAA-CSIC), Cambridge University (United Kingdom), CNRS (France), and Max-Planck Institute of Radioastronomy (Germany). The ongoing international long-term observational projects have continued during 2024:

- **SEAMBH** (Super-Eddington Accreting Massive Black Hole), in collaboration with Beijing University, is dedicated to the study of supermassive black holes in active galactic nuclei applying the reverberation method, using the CAFOS instrument at the 2.2m telescope.
- **CAVITY** (Calar Alto Void Integral field Treasury surveY), is devoted to the study of the properties of galaxies in cosmic voids, the most isolated objects in the Universe. This project makes use of the integral field spectrograph PMAS at the 3.5m telescope.
- **KOBE** survey is searching for potentially habitable exoplanets orbiting K-dwarfs, and is using the CARMENES spectrograph at the 3.5m telescope.
- **CARMENES Legacy-Plus**, is an extension of the CARMENES survey, and is intended to the detection and characterization of planets around M-dwarfs, the occurrence of long-period giant planets, and the characterization of exoplanet atmospheres.

New technological developments

During 2024, CAHA has been involved in the development of TARSIS (the Tetra-ARmed Super-Ifu Spectrograph), that will be the future instrument for the Calar Alto 3.5m telescope. TARSIS, that is co-lead by IAA-CSIC and UCM, has unique characteristics like its capacity to detect near ultraviolet (down to 320 nm) light, and its unprecedent field of view (~8 sq. arcmin). TARSIS, and CATARSIS, the ambitious observational survey of galaxy cluster that will occupy most of the first years of operation of the instrument, will maintain the largest optical telescope in the European mainland at the forefront of Astronomy.

The Multi-Array of Combined Telescopes (MARCOT) is a modular astronomical infrastructure for high resolution spectroscopy and large field of view, high dynamic range imaging at subarcsecond spatial resolution. The main goal of this project is to carry out the conceptual design and establish a plan for the construction of a new European telescope concept with a large effective aperture and low cost. The idea consists of the combination of multiple identical elements resulting in a new infrastructure facility with a large effective aperture. The photons are collected by individual optical fibers attached to each optical assembly, which are finally combined by a novel multimode photonic lantern into a single fiber, which feeds a high-resolution spectrograph. Each optical assembly is equipped with a low readout noise detector, and the images from the detector can be combined later. This generates a single frame with a signal to noise ratio identical to that of a single large aperture telescope, but with improved resolution, dynamic range and larger field of view.

OSN
Sierra Nevada Observatory

Overview

The OSN is a high mountain observatory at 2896m in the Sierra Nevada National Park. It is owned by the CSIC and operated by the IAA. The observatory has two optical telescopes: a 1.5m aperture (T150) and a 90cm aperture (T90). To compensate for the limited access to observing time at larger observatories, the OSN offers excellent flexibility to serve programs that require rapid response or intense temporal coverage, either in terms of sampling or extension. The OSN focuses on long-term follow-up and target of opportunity programs to support IAA research lines. Its location is ideal for mid-upper atmosphere sounding and as a test bed for external instrumentation.

Highlights

The T150 telescope is equipped with a 4Mp camera and the ALBIREO spectrograph. The T90 telescope is also equipped with a 4Mp camera and the DIPOL-1 polarimeter since September 2023. **Twenty-three peer-reviewed papers based on OSN data were published in 2024.** The OSN also hosted the MIMA spectrometer, which is dedicated to studying the mesopause region, as well as instruments from the IAA Sky Quality Office and external equipment. Among the activities, we highlight:

Observation programs

The **Exoplanet** program is key to seeking and characterizing exoplanets and their parent stars detected by important surveys like SPECULOOS, CARMENES, etc. Three papers were published in this program in 2024, most notably the detection of an Earth-sized exoplanet orbiting the nearby ultracool dwarf star SPECULOOS-3, which is one of the best Earth-like candidate for JWST spectroscopy[148] (Figure1).

The follow-up of **gamma-ray bursts (GRBs)** to study their temporal evolution resulted in the publication of two papers and four circulars in 2024. We highlight the result on **an underlying magnetar in GRB 240529A** [383]. The prompt emission of this GRB (at z=2.695) shows two comparable energetic episodes separated by a quiescence time of roughly 400 seconds; it is the most energetic event observed to date.

The **trans-Neptunian objects (TNOs)** programs are devoted to physically characterizing distant solar system icy bodies (TNOs and centaurs) through stellar occultations and photometry. Three papers were published in 2024 using OSN data, one of which studies the intriguing centaur Bienor in detail using multiple stellar occultations and rotational light curves [337] (Figure 2).

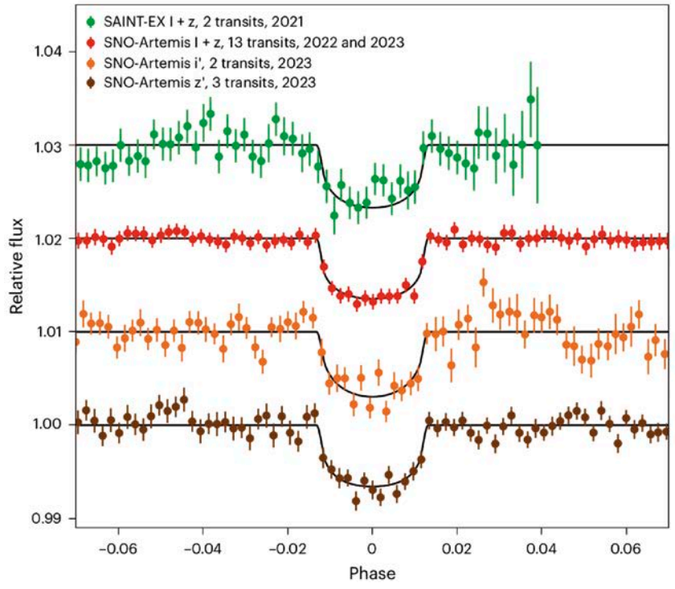


Fig. 1. Discovery transit photometry of SPECULOOS-3 b, an **Earth-sized exoplanet** orbiting the nearby ultracool dwarf star SPECULOOS-3. Data obtained by SAINT-EX and SNO-Artemis between 2021 and 2023 at different filters. For clarity, the light curves are shifted along the y-axis. Figure from [148].

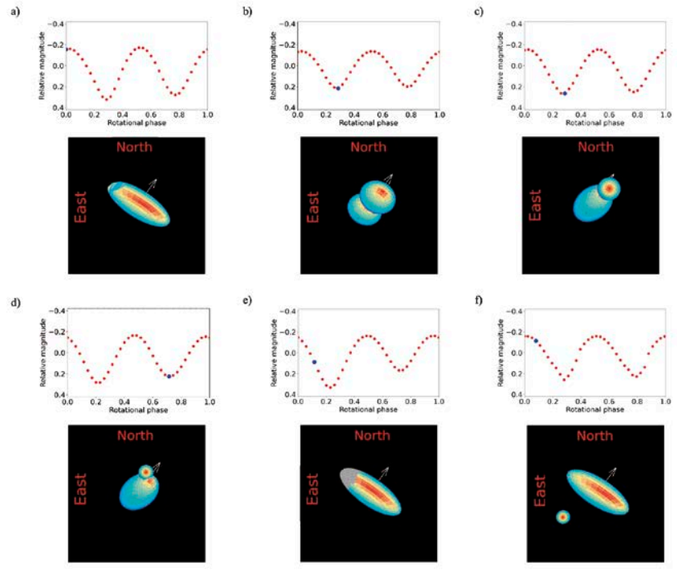


Fig. 2. Several potential **3D shape models for the centaur Bienor** are presented. These models include options such as an elongated body, a binary object, an object with a small satellite, and an object featuring surfaces exhibiting significant reflectivity variations. All models are displayed against a black background and are compatible with the observed rotational light curves (modeled here) and the results from stellar occultation. Figure from [337].

The **Transits** program, focused on observing massive planets (hot Jupiters) on tight orbits to study tidal interactions outside the Solar System, published two papers in 2024. In particular, the planet-star interactions with precise transit timing were studied by means of new ground-based transit light curves obtained for the hot Jupiter TrES-3 b [243].

Other ongoing programs at OSN include the **Blazars** programs, the **CARMENES follow-up** project, a program dedicated to obtaining an **empirical main sequence for very low-mass, solar metallicity stars**, and **photometric observations of the recurrent nova T Crb**. Twelve papers were published based on observations from these programs.

Main Technical Activities

The T150 telescope was out of service for one month due to the re-aluminization of the tertiary mirror. The dome of T150 was thermally isolated, and a forced ventilation system to enhance seeing was installed.

External collaborations

SMART Project (U. Huelva) uses five robotic cameras to analyze interplanetary matter impacting Earth.

Topo-Iberia station (U. Barcelona) is a GPS station used for integrated topography and 4-D evolution studies.

Since September 2023, OSN and UGR have agreed to exchange meteorological data.

Master's in Astronomy and Astrophysics from VIU and UNIR, including observational practices conducted under an agreement.

The ESFRI initiatives

CTAO-North Rendering. Artistic rendering of the Alpha Configuration of the CTAO's northern hemisphere site or CTAO-North. The site already hosts a prototype of the Large-Sized Telescope, the LST-1 (top left) in commissioning phase and the remaining three LSTs in construction phase, plus nine Medium-Sized Telescopes (MSTs), to start construction soon, to cover CTAO's low and medium energy range. The array is located on the existing site of the Observatorio del Roque de los Muchachos on the island of La Palma in the Canary Islands (Spain). Credit: CTAO

Cherenkov Telescope Array Observatory (CTAO)

Over the next few years, CTAO will become the largest and most sensitive very-high-energy gamma-ray observatory in the world, with a much higher angular resolution, energy coverage, and field of view than ever before. CTAO-North is already being built in Spain, on the island of La Palma, here the four Large-Scale Telescopes (LSTs) are in an advanced construction stage, and even one of them (LST-1) is already in operation and producing early science.

The CTAO is a landmark of ESFRI. In fact, the formal application to the European Commission to establish the CTAO ERIC is at an advanced stage, and the official establishment is expected to take place in early 2025. In 2024 the Managing Director of the CTAO officially announced the new growth phase of the Observatory, supported by the 30 million € endorsement of the CTAO governing bodies. In addition, the CTAO LST Collaboration, which focuses on the construction of the Observatory's large telescopes, reached a major milestone with the successful approval and completion of the telescope's Critical Design Review (CDR), paving the way for the final acceptance and handover of the LSTs to the CTAO. The CTAO's Science Data Management Center (SDMC) in Zeuthen, Germany, was also inaugurated in late 2024.

The IAA-CSIC has played a leading role in the commissioning of the LSTs, in the design and development of the software needed to analyze the data from the LSTs (and later the entire CTAO), and in the early scientific exploitation of the LST-1. In fact, IAA researchers are co-leaders of most of the early scientific publications from LST-1. The IAA is also a member of the governing and decision-making bodies of both the LST Collaboration and the CTAO Consortium.

Artistic rendering of the ELT

Extremely Large Telescope (ELT)

On June 5, 2024, the European Southern Observatory (ESO) signed an agreement with the international ANDES consortium for the design and construction of the ANDES (ArmazoNes high Dispersion Echelle Spectrograph) high-resolution spectrograph. This instrument, which will be installed on the ELT, will make it possible to search exoplanetary atmospheres for signs of life, detect the first stars in the universe and measure the acceleration of cosmic expansion. The signing of the ANDES construction contract, led by the Italian National Institute for Astrophysics (INAF), represented a major milestone in the instrumentation of the ELT. With unprecedented precision in the visible and near-infrared, ANDES will enable groundbreaking scientific discoveries in many areas of astrophysics. When the ELT becomes operational later this decade, it will be the largest ground-based telescope ever built, and with ANDES on board, it will mark a "before and after" in the exploration of the cosmos.

The IAA-CSIC is an active part of this project, both in its scientific objectives and in its technological development. In particular, the IAA-CSIC is contributing to the opto-mechanical design of the optical mounts for the UBV and RIZ spectrographs, optimizing their integration with the optical bench of the instrument. This experience stems from the success of the CARMENES spectrograph, in whose construction and scientific exploitation the IAA-CSIC played a key role. Thanks to this, the IAA-CSIC remains at the forefront of the search and study of exoplanets.

Regarding MOSAIC, the multi-object, multi-IFU spectrograph with visible and infrared coverage, the instrument is currently in the preliminary design phase (phase B1), which will be finalized with the revision of the system architecture (SAR) in early 2025 and the subsequent agreement between CNRS and ESO for the construction of the instrument.

The IAA-CSIC is making a major contribution to the development of the control system for the various cryogenic mechanisms of the infrared spectrograph. In 2024, a thorough review and update of the system requirements (SRR) and its main interfaces was carried out, with successful approval by the external review panel. During this period, prototyping activities continued and a successful second cryogenic test campaign was performed with the IAA cryostat prototype.

EST Optics and Adaptive Optics Preliminary Design Review Meeting held in La Laguna (Spain) on October 10-11, 2024.

European Solar Telescope (EST)

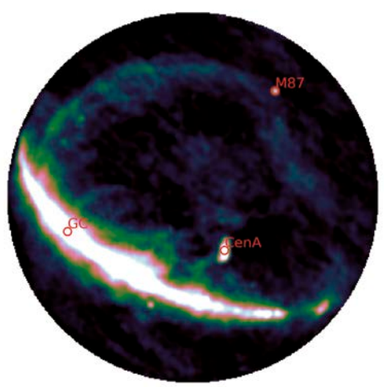
The EST is an ESFRI landmark. The EST project reached several milestones in 2024. The governing body of the project, the Fundación Canaria "European Solar Telescope", became operational in January and has since steered the technical and strategic work towards the construction of the EST and the establishment of the EST ERIC. In September 2024, the project successfully passed the EST Optics and Adaptive Optics Preliminary Design Review (PDR), paving the way for the global PDR that will take place in September 2025. This partial PDR demonstrated that the telescope's optical design is mature and sound, and identified several areas that require further attention to achieve the telescope's ambitious performance goals.

During 2024, the IAA-CSIC participated in the EST Foundation Board of Trustees meetings and maintained the EST communications office in Granada. Significant progress was also made on the conceptual design of the three Tunable Imaging Spectropolarimeters/Fixed-Band Imagers (TIS/FBI) that will be part of the EST suite of first-light instruments. IAA-CSIC leads the international consortium responsible for the development of the TIS/FBIs, consisting of institutions from 5 European countries. Work has been carried out in the areas of systems engineering, optical design and optomechanics. In particular, the specifications for the TIS/FBI large format interference filters and liquid crystal variable retarders were defined and contracts were signed with vendors for the procurement of test units to be thoroughly measured in the laboratory.

SKA-MPI, the Max Planck Society funded prototype dish, being assembled at the SKA-Mid site in South Africa. Credit: Nasief Manie/SARAO

Square Kilometer Array Observatory (SKAO)

2024 was the year when the SKAO telescopes began to take shape, with the deployment of the first antennas at the SKA-Low site in Western Australia and the assembly of the first SKA-Mid dish in South Africa, which was also tested for synchronization with the MeerKAT telescope. In addition, the SKA-Mid prototype antenna received its first light, and the SKA-Low antennas installed at the first of the 512 planned stations already produced their first images and interference fringes with another station. Regarding the international SKA collaboration, three more countries -Canada, India and Germany- joined the observatory.



First SKA-Low single station image. This image emphasises the large-scale structure from our Milky Way. Famous structures known from other radio surveys such as the North Polar Spur can be seen. Several notable locations are marked: the Galactic Centre (GC), the nearby radio galaxy Centaurus A (CenA), and M87. Credit: SKAO

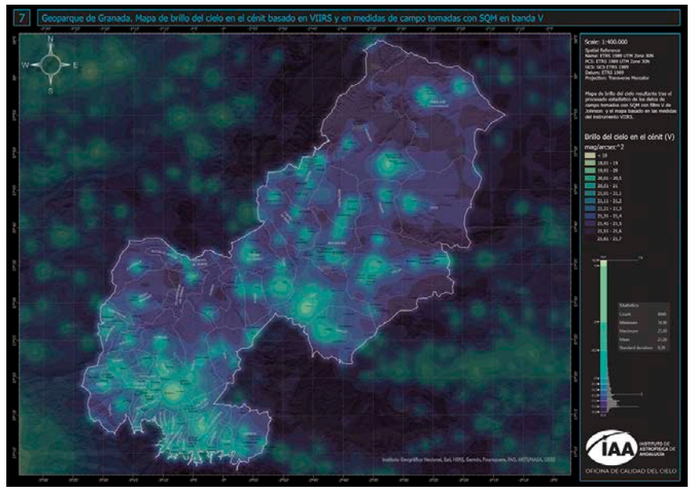
Spain has been a member of the SKAO since 2023 and formally completed the accession process in August 2024. This milestone represents a significant achievement for the IAA-CSIC's coordination of the SKA Spain, reinforcing the country's commitment to the SKAO and its scientific and technological contributions. In 2024, a new construction contract was awarded to Spanish industry (SKA-Mid subreflectors, 8.7 M€).

The Spanish prototype of the SKA Regional Centre (espSRC) served 62 projects in 2024, divided into scientific research, training and development projects, e.g. the espSRC provided resources for the SKA Data Challenge 3a (ionization epoch), hosting two teams, and contributed to the organization of the European School of Radio Interferometry. The espSRC team also contributes to the development of the global SRC network (SRCNet), which will have its first functional version in the first quarter of 2025.

VOLVER AL ÍNDICE →

Sky Quality Office

(OCC-IAA)



Overview

The OCC was created in 2016 as a tool to protect astronomical quality at the Sierra Nevada and Calar Alto observatories against the threat of light pollution. Due to an increase of night sky brightness in recent years, the aim of the office is to serve as a scientific reference for public and private institutions in the protection and improvement of the dark sky, in addition to advising and promoting the best practices for correct outdoor lighting. Illuminate properly and sustainably is crucial to preserve the nocturnal ecosystem and minimize harmful effects on human health. To monitor sky brightness, the OCC has installed different sensors at the Sierra Nevada Observatory and IAA buildings.

Image above
Map of night sky brightness at zenith in the V-band. It is the result of combining the diffuse brightness map from the VIIRS satellite instrument with ground-based measurements with Johnson's V-filter.
Credit: Máximo Bustamante Calabria

Image on the right
SDGSAT-1 satellite image of Granada and its metropolitan area (2021-2023).
Authors: A. Sánchez de Miguel (IAA-CSIC, UCM) and S. Morell (U. Exeter). Data source: CBAS

Highlights and Activities

One of the most significant achievements in 2024 has been the publication of the article [60] on the quality of the night sky in the Granada Geopark. This study describes the tools used to analyse the lighting, including images from remote sensors such as VIIRS and photographs captured from the International Space Station (ISS). A significant milestone for our office is that the CSIC has included the problem of light pollution in its Science4Police report collection [A. Pelegrina, J.M. Vílchez, F. Ramírez, A. Rodríguez. *Contaminación lumínica: Los peligros de un mundo cada vez más iluminado*. Colección CSIC Science4Policy (2024)], highlighting it as both a scientific and a societal challenge.

The office has also participated actively in international conferences such as the LPTMM Conference 2024 and CIMAS II in Sierra Nevada, where talks were given on light pollution in this area of high ecological and astronomical value. At the LPTMM Conference, the main results to date of the sky brightness measurements obtained from the detectors installed at the Observatorio de Sierra Nevada were presented. Additionally, a new technical report has been produced on the quality of the sky in the municipality of Pampaneira, which will contribute to the evaluation and improvement of lighting in sensitive environments.

Among the most significant events of this year was the presentation to the media of the report "Geoparque de Granada: Estudio de calidad de su cielo nocturno" carried out in 2022, which was carried out in collaboration with the Granada Provincial Council. The Office also participated in the Senate discussion on the inclusion of the "Sky Quality and Access to Starlight" as a Sustainable Development Goal (SDG18), which would be an important milestone in the environmental and global development agenda.

Finally, the office has continued its educational and outreach work, participating in talks and events, including astronomical meetings, activities in universities and schools, science fairs, astrotourism days and commemorative events such as the "Day of women and girls in Science".

Public Outreach

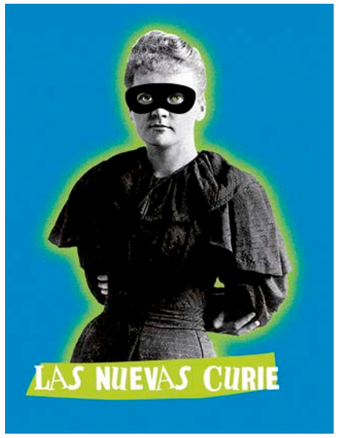
The activities of the IAA-CSIC Communication, Education and Public Outreach Unit cover almost all existing formats to communicate science.

Events

XVI Reunión Científica de la SEA. Coorganization and participation in the "16th Scientific Meeting of the SEA" (15-19 July), which brought together more than 600 astronomy professionals to Granada.

Astronomía "Made in Spain". As part of the 16th Scientific Meeting of the SEA (15-19 July), on July 17th, this open session, where a review was given of recent astrophysical milestones in which Spanish centres have participated on topics as varied as exoplanets, asteroids, or extragalactic astrophysics, took place.

Coorganization of the event **"I Encuentro IAA + IFMIF-DONES"**, with the IFMIF-DONES consortium. On 8 April, in the auditorium of the IAA-CSIC.



"Entre Sillas: Las nuevas Curie". An interview format event in which six women from different fields talked about three aspects of Marie Curie's life and work. It took place in the theatre of the Federico García Lorca Centre on 22 March.

Book presentation **"El universo a vista de pájaro"** by Mariano Moles Villamate. Presented by Mariano Moles (IAA-CSIC/CEFCA and accompanied by Emilio J. Alfaro, Ascensión del Olmo and Isabel Márquez (IAA-CSIC)

Festivals

Granada Book Fair 2024. Organization of the "Área de la Ciencia", a stand for science outreach activities at the Granada Book Fair 2024, with EEZ-CSIC and Parque de las Ciencias.

Social Networks.
X, facebook, youtube, Instagram and bluesky profiles managing.

https://x.com/iaa_csic
https://www.facebook.com/iaa.comunicacion
https://www.youtube.com/user/iaaudc
https://www.instagram.com/iaa_csic
https://bsky.app/profile/iaacsic.bsky.social

The European Researchers' Night. It takes place every year all over Europe the last Friday of September. The IAA-CSIC took part in the event in Granada on Friday 27th September.

Collaboration and participation in **Pint of Science**, a 3-day event that invites cutting-edge researchers to share their knowledge in a relaxed and informal atmosphere: a bar.

Participation in **TAI Granada.** Talk by Emilio García (IAA-CSIC) and Óscar Huertas (DaSCI-UGR) about the understanding the universe with Artificial Intelligence.

Special projects

Espacio 3: Science and Performing Arts Laboratory. A monthly event in the Palacio del Almirante (Albaicín) that mixes science talks, theater and impro. Project led by Sara Cazzoli.

Citizen Science: Leadership of two Citizen Science projects: 'El cante de las Estrellas', which translates data from the Delta Scuti stars into sounds, and 'Ciudades sostenibles - ciudades respirables', which produces a map of atmospheric pollution in the city of Granada.

Education

PIIISA Project. A multidisciplinary project designed to allow high school students work with scientists. The IAA-CSIC is the founder of the project.

Participation in **CESAR (Cooperation through Education in Science and Astronomy Research)**, an educational initiative for teacher training developed by ESA, INTA and ISDEFE. Training classes by Carlos Barceló, Enrique Pérez and Luis Bellot. Coordination by Pedro Gutiérrez

Gender & Diversity

11 February, International Day of Woman and Girls in Science. Conferences, workshops with students and video.

8 March, International Day of Woman. Round Tables 'Vocations in STEM areas: The case of Physics' and II Meeting of Women Scientists and Businesswomen in Granada.

23 June, International Women in Engineering Day. Conference 'Women in Engineering: Advances and Challenges', by Laura M. Roa, Professor of Systems Engineering and Automatics at the Universidad de Sevilla.

28 June, Pride Day. Round table 'LGTBIQ+ ROUND TABLE: towards a more diverse and inclusive research'.

Exhibitions

Planetarium Go! 360º street cinema. Projection of the IAA productions "El Enigma Agustina" and "Camino a Congreso"

Exhibitions **"Escape Road".** Developed by 10 CSIC centres from Madrid, this exposition came to Granada coordinated by three of Granada's CSIC centres (EEZ, IPBLN and IAA) from 12 to 29 November 2024. In the Cultural Gallery (Parque de las Ciencias). The exhibition shows the contributions of Nobel Prize female winners in scientific disciplines. In addition, as there is no Nobel Prize in Mathematics, it includes the female winners of its equivalents: the Abel Prize and the Fields Medal.

Audiovisuals

Press releases. Video-summary of the press releases published by the Instituto de Astrofísica de Andalucía (IAA-CSIC).

Interviews with researchers. Interviews with researchers who participate in the press releases published by the Instituto de Astrofísica de Andalucía (IAA-CSIC)

¡Movimiento, teatro, SgrA* ... y telón!: This project, conceived and directed by the researcher Sara Cazzoli, and under the scientific direction of Rainer Schödel, shows the great informative potential of the performing arts as a metaphor for scientific concepts. The Palace of Charles V was converted into the galactic centre in the heart of the Alhambra.

Territorio Gravedad. Completion of the Spanish docu-series about the cosmos, with the release of its second season on Filmin and Vimeo On Demand.

Talks

Lucas Lara popular talks. These conferences are held since in 1995. We celebrated seven talks this year.

III Ciclo de Conferencias 'El Universo desde Sevilla'. Coordinated by Emilio J. Alfaro. Talks by Jose Carlos del Toro Iniesta (IAA-CSIC), Olga Muñoz (IAA-CSIC) and José Oñorbe Bernis (US), in the Museo Casa de la Ciencia (Sevilla)

TEDxAlcoi. Chispas Cósmicas: Descubre Cómo los Supervientos Transforman Galaxias by Sara Cazzoli

Naukas Bilbao 2024. "El Universo: un teatro" by Sara Cazzoli and "Esculpir en el tiempo" by Emilio García

Inclusion

Astronomía Accesible. This project aims to enhance the popularization of astronomy among blind and low-vision people.

Bajo un mismo cielo. On 17 May and 7 June, AA-CSIC researchers from different nationalities and cultures carried out different activities with young people in foster care. The activities were carried out in collaboration with three NGOs: Acción en red; Granada acoge and Provivienda.

Magazines, Journals, Blogs

Popular Science Journal IAA: Información y Actualidad Astronómica. Issued once every four months, it is devoted to high school and university students, as well as general public interested in astronomy. Issues in 2024: 72, 73,74. www.revista.iaa.es

Revista Astronomía. The IAA maintains a monthly collaboration with the magazine, the only one with a commercial circulation specialised in astronomy.

Participation in the blog **'La cuadratura del círculo'** (eldiario.es)

Awards

IAA-CSIC was recognised with the Prize for Internationalisation 2024 of the Social Council of the University of Granada.

Julio Arrechea received the 2024 award for the *best PhD thesis* in "Astronomy and Astrophysics" from the Spanish Society of Astronomy (SEA).

Francisco J. Bailén was recognised with the *Extraordinary Doctorate Award* in the area of Science of the University of Granada.

Yolanda Jiménez Teja, Pedro Amado, José Luis Ortiz, Emilio Alfaro, Enrique Pérez Montero and **Francisco J. Bailén** received the *"Granada City of Science and Innovation" 2024 awards* in the categories "Women and Science", "Impact on knowledge", "Research Trajectory", "Outreach", "Social Innovation" and "Young Researcher", respectively.

Lourdes Verdes-Montenegro was awarded with the CSIC *Margarita Salas Medal* for the best track record in staff supervision researcher. The medal invites individuals who have been mentored at different stages of their professional life to nominate a mentor who has made a significant contribution to their career development.

The conference "Chemical Abundances in Gaseous Nebulae: Multi-Scale Metals Throughout the Universe" was held in honor of **José Manuel Vílchez**. It took place at Universidade do Vale do Paraiba in Sao Jose dos Campos (Brazil), from 6 to 10 May.

Workshops & meetings

International Meetings

3rd edition of the HONEST Workshops: The high energy end of pulsar spectra
International Workshop
Online, Nov 26 - 28, 2024
IAA MEMBERS OF THE SCIENTIFIC ORGANIZING COMMITEE:
R. López Coto
IAA MEMBERS OF THE LOCAL ORGANIZING COMMITEE:
Paula Kornecki, Stefano Menchiari, Javier Méndez-Gallego, Denise Sammartino
https://indico.iaa.csic.es/e/HighEnergyPulsars

ESA's Vigil PMI instrument kick-off consortium meeting
International Workshop
Granada, Mar 12 - 15, 2024
IAA MEMBERS OF THE SCIENTIFIC ORGANIZING COMMITEE:
J. del Toro Iniesta
IAA MEMBERS OF THE LOCAL ORGANIZING COMMITEE:
D. Orozco Suárez, H. Strecker
https://form.jotform.com/240521968228359

COSMIC DUST WORKSHOP
International Workshop
Granada, Jan 24 - 24, 2024
IAA MEMBERS OF THE SCIENTIFIC ORGANIZING COMMITEE:
O. Muñoz Gómez
IAA MEMBERS OF THE LOCAL ORGANIZING COMMITEE:
O. Muñoz Gómez

Europlanet Science Congress 2024
Hybrid format (online + onsite Berlin-Germany), Sept 8-13, 2024
IAA MEMBERS OF THE SCIENTIFIC ORGANIZING COMMITEE:
Francisco Pozuelos
https://www.epsc2024.eu/home.html

National Meetings

XVI Reunión Científica de la SEA
National Meeting
Granada July 15 – 19, 2024
IAA MEMBERS OF THE SCIENTIFIC ORGANIZING COMMITEE:
Francisco González Galindo
IAA MEMBERS OF THE LOCAL ORGANIZING COMMITEE:
C. Rodríguez López (Chair), Emilio Alfaro (co-chair, IAA-CSIC), Sara Cazzoli, Emilio García, Gabriella Gilli, Manuel González, Rubén López Coto, Alicia Pelegrina, José Ramón Rodón Ortiz, Azaymi Siu Tapia, Roberto Varas

Schools

ERIS 2024 Tenth European Radio Interferometry School
Granada, Sep 30 - Oct 04, 2024
IAA MEMBERS OF THE SCIENTIFIC ORGANIZING COMMITEE:
J. Moldón (Chair), L. Verdes-Montenegro Atalaya, A. Alberdi Odriozola
IAA MEMBERS OF THE LOCAL ORGANIZING COMMITEE:
L. Darriba Pol, M. Cano González, A. Fuentes Fernández, M. Puig Subira, M. Villaverde
https://www.granadacongresos.com/eris2024

PySnack 10: PROSE
Granada, Dec 12, 2024
IAA MEMBERS OF THE ORGANIZING COMMITEE:
F. Pozuelos Romero, L. Darriba Pol, F. Moldón Vara
https://indico.iaa.csic.es/event/19/

PySnack 9: GASTLI
Granada, Dec 02, 2024
IAA MEMBERS OF THE ORGANIZING COMMITEE:
F. Pozuelos Romero, L. Darriba Pol, F. Moldón Vara
https://indico.iaa.csic.es/event/18/

Introduction to Github
Granada, Nov 25, 2024
IAA MEMBERS OF THE ORGANIZING COMMITEE:
L. Darriba Pol, F. Moldón Vara
https://indico.iaa.csic.es/e/github2024

Writing and Communicating your Science: an IAA-CSIC Severo Ochoa Workshop
Granada, Nov 04 - 08, 2024
https://indico.iaa.csic.es/event/16/

PySnacks 8: PyBDSF
Granada, Oct 31, 2024
IAA MEMBERS OF THE ORGANIZING COMMITEE:
M. Cano González
https://indico.iaa.csic.es/event/17/

SO Training on Scientific Presentation in Astronomy
Granada, Apr 23 - Jun 18, 2024
IAA MEMBERS OF THE LOCAL ORGANIZING COMMITEE:
F. Moldón Vara, L. Darriba Pol
https://indico.iaa.csic.es/event/15/

PySnacks 7: sedcreator: the python package to build and fit spectral energy distributions
Granada, Mar 11, 2024
IAA MEMBERS OF THE LOCAL ORGANIZING COMMITEE:
L. Darriba Pol
https://indico.iaa.csic.es/event/10/

PySnacks 6: pyFIT3D/pyPipe3D: Resolved Properties of Stellar Populations and Ionized Gas with Galaxy IFS Data
Granada, Mar 05 - 06, 2024
IAA MEMBERS OF THE LOCAL ORGANIZING COMMITEE:
R. García Benito, L. Darriba Pol
https://indico.iaa.csic.es/event/14/

English for Academic Purposes
Granada, Feb 19 - 23, 2024
https://indico.iaa.csic.es/event/11/

Gender actions

Overview

The IAA has been always characterized by its support to inclusive initiatives in Gender Equality. This trajectory tookform with the creation of the Institute's Gender Equality Commission and the elaboration and approval of the First Gender Equality Plan of the IAA-CSIC (GEP), in 2017. In May 2024 the commission changed to include diversity and currently its name is Committee of Equality, Diversity and Inclusion (CIDI). Here we present the main activities of the year 2024. The CIDI continued its work of counseling on the necessary or appropriate measures to actively integrate the principle of gender equality between women and men, diversity and disability in the daily life of the center, as well as organizing events to raise awareness on equality.

Highlights

In addition to ensuring the equality measure, the CIDI of the IAA-CSIC acts as the Gender Working Group of the gender equality plan drawn up by the Severo Ochoa project. All their governance bodies verify the gender equality, annual statistics are prepared segregated by gender, and the following actions were contemplated:

Activities for the International day of Women and Girls in Science (11 February).

Conferences: A series of informal meetings with female researchers, engineers and technicians from the IAA were held with alumni of training centres in Granada, with the aim of highlighting the role of women in the different branches of science. These included open discussions, reflections and questions about gender roles and existing stereotypes around science, technology and engineering.

Round Table: Primary school children from the CEIP F. García Lorca school met some female astronomers from the IAA-CSIC to ask them questions about astronomy, their careers and their aspirations. This year the researchers Teresa Toscano Domingo, Rocio Calvo Ortega, Julia Ferrer Ereza and Gabriella Gilli took part in the event.

Astronomical Tables: Secondary school students are confronted with astronomers who rotate every 10 minutes, allowing them to have a fruitful exchange of information from the different areas of knowledge at the Institute. The event was attended by researchers Angeles Mendoza Pérez, María Passas Varo, Teresa Gallego Calvente, Elisa Frattin, Rosario Sanz Mesa, Mayra Osorio Gutierrez, Susana Martín Ruíz and around 30 bachelor students from Soto de Rojas Secondary School.

"Is that question for me?" : Primary school children asked questions about astronomy and astronomers Sara Muñoz Torres, Marie Lou Gendron Marsolais and Beatriz Agis González answered them in a very accessible and fun format. The recording of this event is available at the IAA-CSIC YouTube channel https://www.youtube.com/watch?v=E2d-6WLFTZ44&list=PLDOpkwOM33-b6WppRToGWxZ0ByW2mWBSi&index=9

Exhibition "AstrónomAs" : The exhibition "Astrónomas" (http://astrónomas.org), prepared with the participation of women astronomers from the Instituto de Astrofísica, was installed throughout the year in the educational centres of Atarfe and Huetor Vega in Granada, Málaga, Seville and the Permanent Mission of Spain to the Office of the United Nations in Vienna (Austria).

Activities for the International Day of Women (8 March):

Evento "Vocaciones en áreas STEM. El caso de la Física": Round table with the participation of Mari Carmen Carrión (Decana de la Facultad de Físicas de la Universidad de Granada), Maria José Cano Úbeda (Docente de Física del IES Soto de Rojas de Granada) and Ascensión del Olmo Orozco (Vocal por el área de Materia en la Comisión Mujeres y Ciencia del CSIC), coordinated by the CIDI. In this event the current situation of vocations in STEM was analysed.

Evento "Entre Sillas": In this edition of the activity Entre Sillas, Ana Tamayo (Comunicadora Científica y responsable de Comunicación EU-JAMRAI 2) inteviewed Elenaiser (Sound Engineer) about women working in very masculinized environments; Carolina González (Expert in communication from a feminist perspective) discussed with Blanca Torres (Sexlogist and antropologist) about women´s desire; and Alba Fernández-Barral (Communication Officer de CTAO) interviewed Pilar Aranda (Full Professor of Physiology at Universidad de Granada, first female Rector of the UGR) about the highlights to become the first women in a very top level position. The event was organized together with the Granada City Council in the theatre Garcia Lorca.

Activities for the International Day of Female Engineers (23 June):

The CIDI organized the conference **"Women in Engineering: progress and challenging"** given by Prof. Laura Roa Romero, emeritus professor of the school of system engineering and automation of the Universidad de Sevilla.

Activities for the International Day of LGTBI´s Proud (28 June):

Round table **"Towards a more diverse and inclusive research"** with the participation of Eleonora Fiorellino (INAF, University of Naple), Jara Juana Bermejo Vega (University of Granada), Rocio Sola Jiménez (University of Granada) and Oscar Huertas Rosales (DaSCI -UGR). Coordinated by Manuel González (Parque de las Ciencias).

Activities for the International Day of Violence against Women (25 November):

We gathered at the door of our institute to read the CSIC manifesto on the occasion of this day and above all to observe a minute's silence for all women victims of gender violence.

Other activities:

The Commission also participated in various activities aimed at improving the inclusion of people with disabilities and people belonging to groups at risk of social exclusion. Some of these activities are related to the actions of the CSIC Inclusion Group, of which Enrique Pérez Montero is a member, as well as to the Astroaccessible inclusive outreach project. Among the activities carried out are:

Attendance and participation as a guest of the Ministry of Science in the **reform of Article 49 of the Spanish Constitution** at the Congreso de los Diputados in January.

Invited **lectures on inclusion in science** for the Spanish Astronomical Society in Granada in July and the National Astronomy Congress in Aranjuez in November.

Teacher training courses on inclusion in science: University of Córdoba (May), European Space Agency (May), and Spanish State Research Agency (October).

Collaboration with the European Southern Observatory to improve the accessibility of scientific archive access methods, including a visit to ESO headquarters in Garching in March.

As a result of all these activities, among others, Enrique Pérez Montero received the "Granada, ciudad de la ciencia y la innovación" **award in the Social Innovation category** this year.

We continued **collaborating with scientific outreach magazines** and the newspapers El Pais, Granada Hoy, and Ideal. In the IAA magazine Información y Actualidad Astronómica, several articles were published with the aim of enhancing the visibility of female scientists who have contributed significantly to the development of astronomy.

The IAA´s Gender Equality Committee, together with the Committees of the other institutes of the CSIC in Granada, has created **a network with the main objective of sharing experiences and resources**. We had a meeting every 3 months rotating in the different institutions.

CSIC Gender Equality Commission Meetings: We participated in the meeting of equality committees of the CSIC ICUs, held in the Instituto de las Grasas-CSIC in Sevilla in October 2024.

Different awards were obtained: Yolanda Jimenez Teja obtained the award "Women in Science" on the fifth edition of the prices "Granada, Ciudad de la Ciencia y la Innovación" and Lourdes Verdes Montenegro got the "Margarita Salas Medal" to the best supervision of young researchers.

Funding

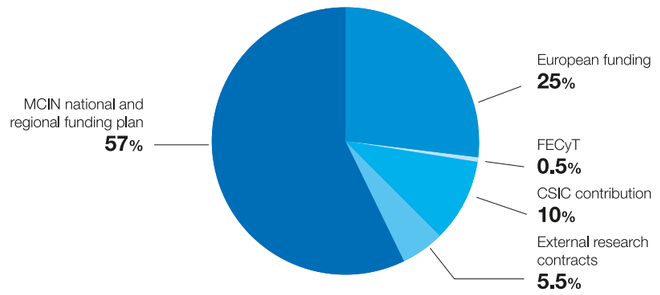
IAA obtains most of its funding through competitive European and Spanish grants (**5.6 million €**).

During 2024, IAA has a total budget of **15.6 million €**, from which **6.6 million €** (42%) come from competitive projects and CSIC investments; the other **9 million €** (58%) corresponds to the permanent staff total cost and common expenses.

The yearly evolution of the IAA budget in the last 5 years is shown below, including the different concepts.

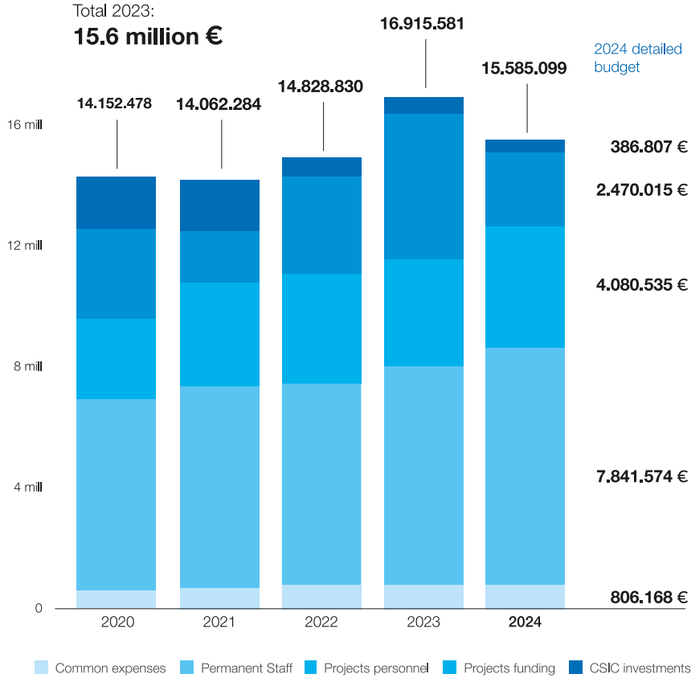
IAA 2024 competitive fundings

Total:
5.6 million €

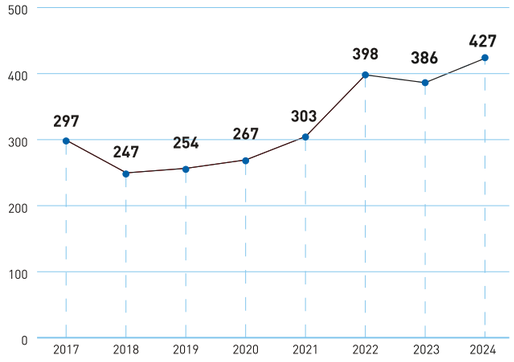


IAA budget yearly evolution

Total 2023:
15.6 million €



Publications



IAA publications in SCI journals

The research activity carried out at the IAA-CSIC during 2024 can be measured by the number of publications in scientific journals included in the Science Citation Index (SCI), i.e., international journals recognized by their quality and impact. In 2024, this activity resulted in **427 papers published** in journals of the SCI.

The complete list of the IAA-CSIC publications in 2024 is given in the Annex at the end of this report. The evolution of the number of SCI publications since 2017 is shown below. Along the years, the number of publications had fluctuated around an average value of 300 papers per year, but it has significantly increased in the last three years.

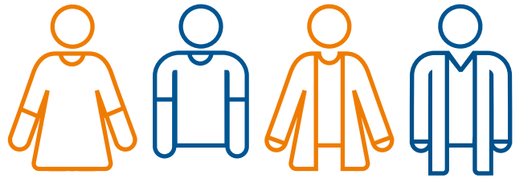
The publications of the IAA-CSIC are mostly distributed in high impact journals. About 88% of our publications appeared in journals of the first quartile (top 25% journals, or Q1). Among these publications, 6% appeared in the first decile (top 10% journals, or D1); 15 papers were published in journals from the Nature/Science editorial groups. Most of the IAA-CSIC scientific results are published in *Astronomy & Astrophysics* and *Monthly Notices of the Royal Astronomical Society*, the main European astronomical journals. A significant fraction of our results is published in *Astrophysical Journal*, the most important American astronomical journal.

Another aspect of the scientific research of the IAA and its quantitative results is the leadership of these publications. **In about 18% of the IAA SCI 2024 publications their first author belongs to our institute.** This is consistent with the leadership of the IAA in the last 5 years.

Number of publications by journal

159 Astronomy and Astrophysics
68 Monthly Notices of the Royal Astronomical Society
38 Astrophysical Journal
24 Astrophysical Journal
18 Astronomical Journal Letters
10 Planetary Science Journal
9 Icarus
Nature Astronomy
8 Journal of Cosmology and Astroparticle Physics
7 Geophysical Research Letters
5 Physical Review D
Space Science Reviews
4 Astrophysical Journal Supplement Series
Journal of Geophysical Research, Planets
Nature
3 Journal of Geophysical Research, Atmospheres
Monthly Notices of the Royal Astr. Society: Letters
RAS Techniques and Instruments
2 Astronomy and Astrophysics Review
Atmospheric Chemistry & Physics
Atmospheric Measurement Techniques
Earth and Space Science
Geoscientific Model Development
Physics
Planetary and Space Science
Publications of the Astronomical Society of Australia
Revista Mexicana de Astronomía y Astrofísica
28 Other

Staff



Assigned research group

[1] Solar Physics
[2] Planets and minor bodies
[3] Terrestrial atmosphere
[4] Exoplanets group
[5] Stellar variability
[6] ARAE
[7] Stellar systems
[8] Physics of the interstellar medium
[9] AGN jets
[10] VHEGA: Very High Energy Group for Astrophysics
[11] Galaxy evolution
[12] Theoretical gravitation and cosmology
[13] Cosmology and particle physics

STAFF RESEARCHERS

Research Professors

Alberdi Odriozola, Antonio María [8]
Castro Tirado, Alberto Javier [6]
del Toro Iniesta, Jose Carlos [1]
González Delgado, Rosa María [11]
Lara López, Luisa María [2]
López Puertas, Manuel [3]
Pérez Jiménez, Enrique [11]
Prada Martínez, Francisco [13]
Vílchez Medina, José Manuel [11]

Scientific Researchers

Aceituno Castro, Jesús [11]
Amorín Barbieri, Ricardo Óscar [11]
Anglada i Pons, Guillem Josep [8]
Bellot Rubio, Luis Ramón [1]
Caballero García, María Dolores [6]
Funke, Bernd Rainer [3]
Gómez Fernández, José Luis [9]
Guerrero Roncel, Martín [8]
Márquez Pérez, Isabel [11]
Masegosa Gallego, Josefa [11]
Moldón Vara, Javier [11]
Moreno Danvila, Fernando [2]
Muñoz Gómez, Olga [2]
Ortiz Moreno, José Luis [2]
Pérez Montero, Enrique [11]
Pérez Torres, Miguel Angel [8]
Rodríguez Martínez, Eloy [4]
Schoedel, Rainer [7]
Verdes-Montenegro Atalaya, Lourdes [11]

Senior Scientists

Agudo Rodríguez, Juan Iván [10]
Amado González, Pedro José [4]
Barceló Serón, Carlos [12]
Claret dos Santos, Antonio [6]
del Olmo Orozco, Ascensión [11]
Duffard, René Damián [2]
Fernández Hernández, Matilde [4]
García Benito, Rubén [11]
García Comas, Maia Leire [3]
Gómez Martín, Juan Carlos [2]
Gómez Rivero, José Francisco [8]
González Galindo, Francisco [3]
Gordillo Vázquez, Francisco José [3]
Gutiérrez Buenestado, Pedro José [2]
Iglesias Páramo, Jorge [11]
Kehrig Martin dos Santos, Carolina [11]
López Coto, Rubén [10]
López González, María José [3]
López Valverde, Miguel Angel [3]
Luque Estepa, Alejandro [3]
Miranda Palacios, Luis Felipe [8]
Olivares Martín, José Ignacio [5]
Orozco Suárez, David [1]
Osorio Gutiérrez, Mayra Carolina [8]
Perea Duarte, Jaime David [11]
Rodríguez Gómez, Julio Federico [5]
Ruedas Sánchez, José [13]

Permanent doctor contract

Cazzoli, Sara [11]
Guirado Rodríguez, Daniel [2]
Pascual Granado, Javier [5]
Povic Mosorinac, Mirjana [11]
Pozuelos, Francisco [4]
Rodríguez López, Cristina Teresa [4]
Santos Sanz, Pablo [2]

Ad honorem

Aldaya Valverde, Víctor [12]
Alfaro Navarro, Emilio Javier [7]
Garrido Haba, Rafael [5]
López Moreno, José Juan [2]

Research Advisor

Rodríguez Espinosa, José Miguel [11]
(up to August)

Associated Doctors

Cardesín, Alejandro [3]
Korsaga, Marie [11]
Lico, Rocco [9]
Luque Ramírez, Rafael [4]
Madiedo Gil, José María [2]
Masqué Saumell, Josep María [8]

Ramón y Cajal Postdocs

del Pino Molina, Andrés [7]
Morello, Giuseppe [4]
Pérez Invernón, Francisco Javier [3]

Juan de la Cierva Postdocs

Fedriani López, Rubén [8]
Rizos García, Juan Luis [2]

Postdocs

Agís González, Beatriz [11]
Alvarez Candal, Alvaro Augusto [2]
Attree, Nicholas Oliver [2]
Barceló Forteza, Sebastiá [5]
Bender, Stephan [3]
Bonnassieux, Etienne Henri Joseph [8]
Brines Montoro, Adrián [3]
Candini, Gian Paolo [5]
Darriba Pol, Laura [11]
de Franciscis, Sebastiano [5]
Díaz García, Luis Alberto [11]
Emery, Gabriel Stephane Marcel Guy [10]
Evangelista Santana, Marçal [2]
Fratin, Elisa [2]
Fuentes Fernández, Antonio [9]
Gallego Calvente, Aurelia Teresa [1]
Gallego Cano, Eulalia [8]
García Garaluz, Esther [3]
Gardini, Angela [7]
Garrido Sánchez, Julian [11]
Gendron Marsolais, Marie Lou [11]
Gilli, Gabriella [3]
Goswami, Sabyasachi [11]
Guziy, Seriy [6]
Guzmán Sánchez, Pablo [10]
Hu, Youdong [6]
Ianjamasimanana, Roger [11]
Jiménez Teja, Yolanda [11]
Kilic, Yücel [2]
Kornecki, Paola [10]
Kozakis, Thea [2]
Leiva Espinoza, Rodrigo [8]
Martikainen, Julia Anneli [2]
Martín Ruiz, Susana [5]
Martinez, Antoine [2]
Martínez Arranz, Álvaro [7]
Martinez Delgado, David [6]
Martínez Solaeche, Ginés [11]
Menchiari, Stefano [10]
Mirouh, Giovanni Marcello [4]
Morcuende Parrilla, Daniel [10]
Moriyama, Kotaro [9]
Novakovic, Bojan [2]
Nyffenegger Péré, Yaniss Inouk [3]
Ocaña Fernández, Antonio Jesús [2]
Otero Santos, Jorge [10]
Parra Royón, Manuel Jesús [11]
Rodón Ortiz, José Ramón [5]
Rodríguez Martín, Julio Esteban [11]
Roeder, Jan [9]
Sánchez López, Alejandro [3]
Sánchez Ramírez, Rubén [6]
Schoefer, Patrick [4]
Shulyak, Denis [2]
Siu Tapia, Azaymi Litzi [1]
Sorgho, Amidou [11]
Stolzenbach, Aurélien [3]
Strecker, Hanna Maria [1]
Traianou, Efthalia [9]
Van Vliet Wiegert, Theresa Beatrice Veronica [11]
Wielgus, Maciej Slawomir [9]
Xiao, Haifeng [2]
Ziaali, Elham [5]

FPI & FPU PhD

Arroyo Caballero, David [1]
Bravo Ferres, Lucía [7]
Cala Barón, Roldán Alonso [8]
Cano González, Miguel [7]
Centenera Merino, Marina [4]
Conrado Pérez, Ana María [11]
Escudero Pedrosa, Juan [10]
Fernández García, Elena [13]
Ferrer Ereza, Julia [13]
Gamonal García-Galán, Miguel Ángel [3]
García Izquierdo, Francisco José [2]
García Moreno, Gerardo [12]
Giménez Alcázar, Antonio [11]
Gómez-Limón Gallardo, José María [2]
Joao Edgar Ribeiro Simao Chivia [11]
Labadie García, Ixaka [11]
Mariblanca Escalona, Irene [2]
Martínez Mondejar, Belén [3]
Méndez Gallego, Javier [10]
Mendi Martos, Alberto [2]
Montoro Molina, Borja [8]
Peláez Torres, Alberto [3]
Peña Moñino, Luis [8]
Pérez Díaz, Borja [11]
Placinta Mitrea, Alexandru Florin [8]
Puig Subirá, Marta [11]
Revilla Martínez de Albéniz, Daniel [4]
Sánchez Sánchez, David [3]
Toscano Domingo, Teresa [9]
Vargas Peláez, Gonzalo [2]
Vera Moreno, Manuel [1]
Woldeyes, Betelehem Bilata [11]
Zeng, Ailing [9]

PhD contracts

Arroyo Polonio, Antonio [11]
Dahale, Rohan [9]
Deconto Machado, Alice [11]
Foschi, Marianna [9]
Pozo González, Cristian [10]

JAE-Intro

Álvarez Santiago, María [11]
Barrios Tascón, Ignacio [4]
Camacho Cortés, Adrián [8]
Chaudhry Bahmni, Fateh Abdulfateh [1]
García García, Jorge [10]
García Morillo, José María [10]
Grana Ramos, Daniel [4]
Jaimes Illanes, Gabriel Andrés [11]
Lara Bogatell, Huascar Caissara [8]
Moyano Rejano, Inmaculada [4]
Ortega Hunter, Carlos Axel [10]
Peralta Fuentes, Manuel [4]
Rodríguez Gallardo, Álvaro [11]
Ruiz López, Pablo [8]
Vico Medina, Cayetano [4]

ENGINEERS & TECHNICIANS

Mechanics

Alvarez Moreno, Fernando
Bustamante Díaz, María Isabel
Calvo Ortega, Rocio
Sánchez Carrasco, Miguel Andrés [5]
Varas González, Roberto

Electronics

Abril Martí, Miguel
Alvarez García, Daniel [1]
Aparicio del Moral, Beatriz [5]
Balaguer Jiménez, María [1]
Castro Marín, José María [2]
Cerezuela Mora, Javier [2]
Girela Rejón, Fernando Javier [1]
Jiménez Ortega, Jaime [2]
Magan Madinabeitia, Héctor
Martín Pretel, José Antonio [2]
Martínez Navajas, Ignacio [2]
Mazuecos Nogales, Álvaro [2]
Morales Palomino, Nicolás Francisco [2]
Moreno Mantas, Antonio Jesús [1]
Ramos Más, José Luis [1]
Robles Muñoz, Nicolás Francisco [5]
Rodrigo Campos, Julio
Rodríguez Venzal, Sergio [11]
Sánchez Castañeda, Jesús [11]
Sánchez Gómez, Antonio [1]
Sanz Mesa, María del Rosario [5]
Tobaruela Abarca, Angel Fernando

Optics

Bailén Martínez, Francisco Javier [1]
Pérez Medialdea, David
Ruiz López, María Isabel [1]
Sánchez Barranquero, Javier [1]

Software

Armenteros Escabias, David
Bailón Martínez, Eduardo
Baraibar Larraza, Oier [8]
Blazquez Calero, Guillermo [8]
Bustamante Calabria, Máximo [2]
Cabanillas de la Casa, Clara [11]
Camino Faillace, Pablo Antonio [3]
Fernández García, Emilio Jesús [6]
Gallardo Jiménez, Julio Miguel [11]
García Illescas, Ángel [11]
García Segura, Antonio Jesús
Gómez López, Juan Manuel [5]
González Díaz, Raúl [11]
Ibáñez Mengual, José Miguel
Jurado Fortuna, Sergio [3]
Kretlow, Mike [2]
Lobón Villanueva, Francisco de Asís [5]
Malagón Romero, Alejandro Francisco [3]
Mendoza Pérez, María Ángeles [11]
Morales Fernández, José Miguel [1]
Morales Muñoz, Rafael
Moreno Vacas, Alejandro Miguel [1]
Muñoz Torres, Sara [4]
Namumba, Brenda [11]
Passas Varo, María [3]
Pastor Morales, María del Carmen [5]
Quintana Martín de Vidales, Ignacio
Requena Carrión, Víctor [1]
Ruiz del Mazo, José Enrique
Sánchez Expósito, Susana [11]
Santamarina Guerrero, Pablo [1]
Santo-Tomás Ros, Pablo [8]

OSN maintenance/support

Aceituno Castro, Francisco José
Casanova Escurín, Víctor Manuel
de la Rosa Alvarez, José Luis
Hernández Sánchez, Francisco Antonio
Palomares Martínez, Pedro
Pérez García, Ignacio
Pérez Silvente, Tomás
Ruiz Bueno, José Antonio
Sánchez Funes, Fernando
Sota Ballano, Alfredo

SERVICES & ADMINISTRATION

Administration and project support

Ayllón Ramírez, José Ignacio
Blanca Gámez, Ana Belén
Cosano Mañas, José Rufino
Fernández Torres, María Lourdes
Gómez Finnett, Susana Alicia
González Esteva, Alonso M
González García, Manuel Jesús
Heredia Maldonado, María José
Herrera Jiménez, Eva María
Jiménez del Rio, Yrene [12]
Jiménez Zafrilla, María Isabel
Madrid Gómez, Carmen Elisa
Martínez López, Rosario
Medina Ortiz, César
Molina Guerrero, Josefina
Navajas Rueda, Isabel María
Pelegrina López, Alicia
Peregrín Álvarez, Rosario María
Pérez Requena, Sonia
Pineda López, Manuel
Sánchez Jáuregui, Jaione
Smith, Lauren Callista
Soriano Carrascosa, Trinidad
Tapia Ruiz, Francisco José
Torrededia Rodrigo, Cristina
Villaverde Aparicio, Marcos [11]

Computer center

Bayo Muñoz, Francisco Manuel
Guijarro Jiménez, Juan José
Parra Garófano, Rafael

General services

Caro Fernández, José Fernando
Jiménez Suárez, Juan Carlos
Molero Delgado, José Francisco
Molina Rodrigo, Antonio
Morales Briones, José Miguel
Rendón Martos, Francisco

Library

Arco Sarmiento, María Ángeles
Pérez Presa, Enrique

Outreach and communication

García Gómez-Caro, Emilio José
López de la Calle Ramos, Silbia
López Moreno, Amanda
Navas Martín, Celia

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DFE: Stellar Physics Dpt.
DRAyEG: Radio Astron. & Galactic structure Dpt.
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L.M. Lara
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Universidad de Berna, Physikalisches Institut, Suiza.

Ongoing projects

AGENCIA ESTATAL DE INVESTIGACIÓN

Title: **Centros de Excelencia Severo Ochoa**
Ref.: CEX2021-001131-S
PI: Isabel Márquez Pérez
Dur.: Jan 01, 2023 - Dec 31, 2026

Title: **El tejido cuántico del universo gravitational: gravedad emergente y semiclásica**
Ref.: PID2023-149018NB-C43
PI: Carlos Barceló Serón, Gil Jannes
Dur.: Sep 01, 2024 - Aug 31, 2028

Title: **Contribucion to PLATO 2.0 Space Mission IAA**
Ref.: PCI2024-155041-2
PI: Julio Federico Rodríguez Gómez
Dur.: Dec 10, 2024 - Dec 10, 2027

Title: **Formación y evolución de estrellas y planetas: acreción, eyección y variabilidad**
Ref.: PID2023-146295NB-I00
PI: Guillem Josep Anglada i Pons, Mayra Carolina Osorio Gutiérrez
Dur.: Sep 01, 2024 - Aug 31, 2027

Title: **Contribucion española a la mision THESEUS de esa (M7)**
Ref.: PID2023-149817OB-C31
PI: María Dolores Caballero García
Dur.: Sep 01, 2024 - Aug 31, 2027

Title: **Detectando y clasificando automáticamente fuentes transitorias**
Ref.: PID2023-151905OB-I00
PI: Alberto Javier Castro Tirado
Dur.: Sep 01, 2024 - Aug 31, 2027

Title: **De los exoplanetas a los agujeros negros supermasivos: las fronteras cósmicas a la máxima resolución y sensibilidad con el EHT y los precursores del SKA**
Ref.: PID2023-147883NB-C21
PI: Antonio María Alberdi Odriozola, Miguel Angel Pérez Torres
Dur.: Sep 01, 2024 - Aug 31, 2027

Title: **Astrosismología con PLATO y preparación para HAYDN en el IAA. Operación en NOMAD-ExoMars**
Ref.: PID2023-149439NB-C42
PI: Javier Pascual Granado, Julio Esteban Rodríguez Martín
Dur.: Sep 01, 2024 - Aug 31, 2027

Title: **Estudiando pequeños cuerpos en múltiple longitudes de onda**
Ref.: PID2023-153123NB-I00
PI: Álvaro Augusto Álvarez Candal
Dur.: Sep 01, 2024 - Aug 31, 2026

Title: **Desafios de formacion estelar e instrumentacion avanzada para telescopios de primer nivel: TARSIS y MOSAIC**
Ref.: PID2022-136598NB-C32
PI: Jorge Iglesias Páramo, José Manuel Vílchez Medina
Dur.: Sep 01, 2023 - Aug 31, 2027

Title: **Contribución española a la misión CAIRT (Fase A), Interacción Sol-Tierra y Exo-atmósferas**
Ref.: PID2022-141216NB-100
PI: Bernd Rainer Funke, Maia Leire García Comas
Dur.: Sep 01, 2023 - Aug 31, 2026

Title: **Astronomia de rayos gamma con CTA-NORTE y MAGIC, PROYECTO 2 - Contribucion del IAA-CSIC**
Ref.: PID2022-139117NB-C44
PI: Juan Iván Agudo Rodríguez, Rubén López Coto
Dur.: Sep 01, 2023 - Aug 31, 2026

Title: **Contribucion del IAA a ASIM: Experimentos, observaciones desde suelo, analisis de datos y modelizacion**
Ref.: PID2022-136348NB-C31
PI: Francisco José Gordillo Vázquez
Dur.: Sep 01, 2023 - Aug 31, 2026

Title: **Entendiendo las enanas frias y sus sistemas planetarios**
Ref.: PID2022-137241NB-C43-ENTENDIENDO LAS ENANAS FRIAS Y SUS SISTEMAS PLANETARIOS
PI: Pedro José Amado González, Cristina Teresa Rodríguez López
Dur.: Sep 01, 2023 - Aug 31, 2026

Title: **La estructura y la historia de formacion del centro galactico y del disco galactico local**
Ref.: PID2022-136640NB-C21
PI: Rainer Schoedel, Emilio Javier Alfaro Navarro
Dur.: Sep 01, 2023 - Aug 31, 2026

Title: **Stellar tidal streams as dark matter probe with the space mission ARRAKIHS**
Ref.: PID2022-138896NB-C53
PI: David Martinez Delgado
Dur.: Sep 01, 2023 - Aug 31, 2026

Title: **Desvelando las poblaciones más primordiales del sistema solar en la era del telescopio espacial JAMES WEBB**
Ref.: PID2022-139555NB-I00
PI: Pablo Santos Sanz
Dur.: Sep 01, 2023 - Aug 31, 2026

Title: **Galaxias en 3D con J-PAS e IFS: Trazando el papel de la formacion estelar y el entorno en la evolucion de las galaxias**
Ref.: PID2022-141755NB-I00
PI: Rubén García Benito, Rosa María González Delgado
Dur.: Sep 01, 2023 - Aug 31, 2026

Title: **Comprension de los AGN en las galaxias: desde las bajas a las altas tasas de acrecion**
Ref.: PID2022-140871NB-C21
PI: Isabel Márquez Pérez, Ascensión del Olmo Orozco
Dur.: Sep 01, 2023 - Aug 31, 2026

Title: **Investigacion de la atmosfera de Marte y de su evolución con los instrumentos NOMAD y ACS del EXOMARS TRACE GAS ORBITER y con el modelo fisico MARS-PCM**
Ref.: PID2022-137579NB-I00
PI: Miguel Angel López Valverde, Francisco González Galindo
Dur.: Sep 01, 2023 - Aug 31, 2026

Title: **Agujeros negros supermasivos y Jets relativistas**
Ref.: PID2022-140888NB-C21
PI: José Luis Gómez Fernández
Dur.: Sep 01, 2023 - Aug 31, 2026

Title: **Key histories of the ejection of material processed by stars to the interstellar medium**
Ref.: PID2022-142925NB-I00
PI: Martín Guerrero Roncel
Dur.: Sep 01, 2023 - Aug 31, 2026

Title: **Aprendizaje profundo en el universo de rayos gamma de muy alta energia**
Ref.: CNS2023-144504
PI: Rubén López Coto
Dur.: Apr 01, 2024 - Jun 30, 2026

Title: **Ciencia con SOLAR ORBITER**
Ref.: CNS2023-144723
PI: David Orozco Suárez
Dur.: Apr 01, 2024 - Mar 31, 2026

Title: **Astronomía cuántica con detectores basados en SPAD-Arrays**
Ref.: PDC2023-145909-I00
PI: Francisco Prada Martínez
Dur.: Jan 01, 2024 - Dec 31, 2025

Title: **Un nuevo instrumento de campo integral para el espectografo OSIRIS en el GRAN TELESCOPIO CANARIAS**
Ref.: EQC2021-007105-P
PI: Francisco Prada Martínez
Dur.: Jun 01, 2021 - Dec 31, 2025

Title: **Coordinación científico-técnica de la participación española en SKA: oficina española del SKA**
Ref.: 202450E066 (Nominativa 2024)
PI: Lourdes Verdes-Montenegro Atalaya, Julián Garrido Sánchez
Dur.: Jan 01, 2024 - Dec 31, 2024

Title: **Space science and technology for the exploration of comets and rocky planets ENVISION MISSION PCU**
Ref.: PCI2022-135027-2
PI: Luisa María Lara López
Dur.: Dec 12, 2022 - Dec 11, 2025

Title: **Space solar physics and space weather PMI instrument**
Ref.: PCI2022-135009-2
PI: Jose Carlos del Toro Iniesta
Dur.: Sep 01, 2022 - Aug 31, 2025

Title: **Monitorización de la calidad ambiental atmosférica y otros parametros atmosféricos usando procedimientos astronomicos**
Ref.: PDC2022-133985-I00
PI: Pablo Santos Sanz
Dur.: Dec 01, 2022 - Sep 30, 2025

Title: **Cometary and Asteroidal dusT Science**
Ref.: PID2021-123370OB-I00
PI: Olga Muñoz Gómez, Juan Carlos Gómez Martín
Dur.: Sep 01, 2022 - Aug 31, 2025

Title: **AMIGA8: Estudio con precursores de SKA de la evolución de galaxias en entornos extremos regulada a grandes escalas. Nuevas tecnologías para SKA y su Red de Centros Regionales**
Ref.: PID2021-123930OB-C21
PI: Lourdes Verdes-Montenegro Atalaya, Julián Garrido Sánchez
Dur.: Sep 01, 2022 - Aug 31, 2025

Title: **Física solar espacial y tiempo espacial**
Ref.: PID2021-125325OB-C51
PI: Jose Carlos del Toro Iniesta, David Orozco Suárez
Dur.: Sep 01, 2022 - Aug 31, 2025

Title: **Ciencia y tecnología espaciales para la exploración de cometas y planetas rocosos**
Ref.: PID2021-126365NB-C21
PI: Pedro José Gutiérrez Buenestado, Luisa María Lara López
Dur.: Sep 01, 2022 - Aug 31, 2025

Title: **Tests de modelos cosmológicos con las medidas de BAO y H0 realizadas con DESI y MAAT**
Ref.: PID2021-126086NB-I00
PI: Francisco Prada Martínez
Dur.: Sep 01, 2022 - Apr 19, 2024

Title: **Física de los objetos transneptunianos y poblaciones relacionadas**
Ref.: PID2020-112789GB-I00
PI: José Luis Ortiz Moreno
Dur.: Sep 01, 2021 - Aug 31, 2025

Title: **Sistemas planetarios a lo largo de la evolucion estelar**
Ref.: PID2020-114461GB-I00
PI: Guillem Josep Anglada i Pons, José Francisco Gómez Rivero
Dur.: Sep 01, 2021 - Dec 31, 2024

Title: **De los exoplanetas a los agujeros negros supermasivos: la exploracion de las fronteras**
Ref.: PID2020-117404GB-C21
PI: Miguel Angel Pérez Torres
Dur.: Sep 01, 2021 - Aug 31, 2024

Title: **Detección de fenomenos transitorios haciendo uso de instrumentacion robotica con alta resolución temporal**

Ref.: PID2020-118491GB-I00
PI: Alberto Javier Castro Tirado
Dur.: Sep 01, 2021 - Aug 31, 2024

Title: **El universo cuantico gravitatacional: espaciotiempos efectivos y sus fluctuaciones cuanticas**

Ref.: PID2020-118159GB-C43
PI: Carlos Barceló Serón
Dur.: Sep 01, 2021 - Dec 31, 2024

Title: **Un enfoque sostenible para los centros de datos de la infraestructura de Big Data del SKA: el prototipo español de Centro Regional del SKA**

Ref.: TED2021-130231B-I00
PI: Julian Garrido Sánchez, Lourdes Verdes-Montenegro Atalaya
Dur.: Sep 01, 2022 - Aug 31, 2025

Title: **Estudios de laboratorio de cinetica de conversion gas-particula**

Ref.: CNS2022-135828
PI: Juan Carlos Gómez Martín
Dur.: Jul 01, 2023 - Jun 30, 2025

Title: **Corrientes estelares de marea como trazadores de materia oscura con la mision espacial ARRAKIHS**

Ref.: CNS2022-136017
PI: David Martinez Delgado
Dur.: Jul 01, 2023 - Jun 30, 2025

Title: **Promoviendo sinergias entre las ICTS astronomicas españolas**

Ref.: RED2022-134688-I
PI: Martín Guerrero Roncel
Dur.: Jun 01, 2023 - May 31, 2025

Title: **Red temática para la participacion científica y tecnológica española en el SKA**

Ref.: RED2022-134464-T
PI: Lourdes Verdes-Montenegro Atalaya
Dur.: Jun 01, 2023 - May 31, 2025

Title: **Unpuzzling the milky way s nucleus - kinematics as key to structure, history, and star formation**

Ref.: EUR2022-134031 UNPUZZLING THE MILKY WAY S NUCLEUS -
PI: Rainer Schoedel
Dur.: Dec 01, 2022 - Nov 30, 2024

Title: **Participación del IAA-CSIC en la mision espacial PLATO2.0. Fases C/D-1. operacion NOMAD-EXOMARS**

Ref.: PID2019-107061GB-C63
PI: Rafael Garrido Haba, Julio Federico Rodríguez Gómez
Dur.: Jun 01, 2020 - May 31, 2025

Title: **Galaxias en 3D y sus propiedades integradas: sinergia entre J-PAS/J-PLUS e IFS**

Ref.: PID2019-109067GB-I00
PI: Rosa María González Delgado
Dur.: Jun 01, 2020 - Nov 30, 2024

Title: **Astronomía de rayos gamma con MAGIC y CTA-NORTE - contribucion del IAA-CSIC**

Ref.: PID2019-107847RB-C44
PI: Juan Iván Agudo Rodríguez
Dur.: Jun 01, 2020 - May 07, 2024

Title: **Comprensión de la actividad nuclear en galaxias: de las bajas a las altas tasas de acrecion**

Ref.: PID2019-106027GB-C41
PI: Isabel Márquez Pérez, Ascensión del Olmo Orozco
Dur.: Jun 01, 2020 - Feb 29, 2024

Title: **Detección y caracterización de los sistemas planetarios en estrellas enanas M: Entendiendo su estrella y sus planetas**

Ref.: PID2019-109522GB-C52
PI: Pedro José Amado González
Dur.: Jun 01, 2020 - Feb 29, 2024

Title: **Agujeros negros supermasivos y Jets relativistas**

Ref.: PID2019-108995GB-C21
PI: José Luis Gómez Fernández
Dur.: Jun 01, 2020 - Feb 29, 2024

Title: **Modalidad A programa Salvador Madariaga movilidad**

Ref.: PRX22/00316
PI: Carlos Barceló Serón
Dur.: Nov 01, 2023 – Febr 29, 2024

Title: **Modalidad A programa Salvador Madariaga movilidad**

Ref.: PRX22/00222
PI: Francisco José Gordillo Vázquez
Dur.: June 01 – Aug 31, 2024

Title: **Ayudas Juan de la Cierva-formación 2021**

Ref.: FJC2021-047036-I
PI: Juan Luis Rizos García
Dur.: Jan 01, 2023 – Dec 31, 2024

Title: **Ayudas Juan de la Cierva-formación 2021**

Ref.: FJC2021-046802-I
PI: Rubén Fedriani López
Dur.: Jan 01, 2023 – Dec 31, 2024

Title: **Ayudas Ramón y Cajal 2022**

Ref.: RYC2022-037854-I
PI: Giuseppe Morello
Dur.: April 1, 2024 – March 31, 2029

Title: **Ayudas Ramón y Cajal 2022**

Ref.: RYC2022-038448-I
PI: Andrés del Pino Molina
Dur.: Sep 1, 2024, Aug 31, 2029

Title: **Ayudas Ramón y Cajal 2022**

Ref.: RYC2022-035821-I
PI: Francsico Javier Pérez Invernón
Dur.: Sep 1, 2024, Aug 31, 2029

CDTI

Title: **Convenio CSIC-CDTI para la ejecución del Proyecto «Modelos de Vuelo para la MEU (Unidad de la Electrónica Principal) de PLATO»**

Ref.: ICTP-20210005
PI: Julio Federico Rodríguez Gómez
Dur.: Dec 06, 2021 - Dec 05, 2026

CSIC

Title: **Programa de apoyo a servicios científico-técnicos**

Ref.: FAS2024_082
PI: Antonio Alberdi Odriozola
Dur.: July 25 – Dec 31, 2024

Title: **Contribución del CSIC al proyecto ESFRI Telescopio Solar Europeo**

Ref.: INFRA20014
PI: Luis Ramón Bellot Rubio
Dur.: Jun 01, 2022 - May 31, 2024

Title: **MOTHER: iMage classification in the extreme universe**

Ref.: MMT24-IAA-01
PI: Rubén López Coto
Dur.: Dec 30, 2024 - Dec 29, 2028

Title: **Pro-ERC AGAIN2024**

Ref.: AGAIN24009
PI: José Luis Ortiz
Dur: Jan 01, 2024 – Dec 31 2026

Title: **Ayudas CSIC-CAIXA**

Ref.: OTR08931
PI: Francisco Pérez Invernón
Dur.: Sep 01 2022 – Aug 31, 2025

Title: **Ayuda CSIC, Fundación La Caixa INPhINIT Incoming**

Ref.: OTR08985
PI: Rohan Arun Dahale
Dur.: Sep 01, 2021 – Sep 01, 2025

Title: **Ayuda CSIC, Fundación La Caixa INPhINIT Incoming**

Ref.: OTR08984
PI: Marianna Foschi
Dur.: Sep 01, 2022 – Sep 01, 2025

Title: **Funds ADV-01 2024 Acción PRO-ERC-Ayuda CSIC**

Ref.: FUNDS24054
PI: Alberto Javier Castro Tirado
Dur.: Jan 01, 2024 - Dec 31, 2026

Title: **Programa CSIC en Grandes Infraestructuras de Investigación Europeas - Convocatoria 2024**

Ref.: LVA-441-INFRA24023-GRANDES INFRAESTRUCTURAS CONV-2024-CSIC
PI: Lourdes Verdes-Montenegro Atalaya
Dur.: Jun 11, 2024 - May 31, 2026

Title: **SRC-Link: Sustainability approach for prototyping the SKA Regional Centre network**

Ref.: ILINK23051
PI: Susana Sánchez Expósito
Dur.: Jan 01, 2024, Dec 31 2025

Title: **Multi-wavelength data analysis of cosmic gamma-ray bursts and gravitational waves electromagnetic counterparts**

Ref.: UCRAN20083
PI: Alberto Castro Tirado
Dur.: Jan 1, 2023 – Dec 31, 202450E066

Title: **El cúmulo de la Hidra una historia de evolución galáctica y formación en estructuras a gran escala**

Ref.: IMOVE24294
PI: Lourdes Verdes-Montenegro
Dur.: Jan 01, 2024 – Dec 31, 2026

Title: **Ayudas atracción talento Ramón y Cajal**

Ref.: 20225AT016
PI: Rubén López Coto
Dur.: July 01, 2022 – June 30, 2025

Title: **Ayudas extraordinarias de excelencia RYC-MaX 2023**

Ref.: 20245MAX008 - RYC
PI: Andrés del Pino Molina
Dur.: Oct 01, 2024 – Oct 01, 2027

Title: **Ayudas de incorporación cientificos titulares OEP 2020-2021**

Ref.: 2024ICT051
PI: Juan Carlos Gómez Martín
Dur.: Jul 01, 2024 - May 30, 2025

Title: **Ayudas de incorporación cientificos titulares OEP 2020-2021**

Ref.: 2024ICT045
PI: Carolina Kehrig Martin dos Santos
Dur.: Jul 01, 2024 - May 30, 2025

Title: **Ayudas de incorporación cientificos titulares OEP 2020-2021**

Ref.: 2024ICT067
PI: David Orozco Suárez
Dur.: Jul 01, 2024 - May 30, 2025

Title: **CVCSIC-AEPP-Ayudas extraordinarias preparacion proyectos 2024**

Ref.: 2024AEP076
PI: Miguel Angel Pérez Torres
Dur.: Sept 01 – Nov 30, 2024

Title: **CVCSIC-AEPP-Ayudas extraordinarias preparacion proyectos 2024**

Ref.: 2024AEP097
PI: Álvaro Álvarez Candal
Dur.: Sept 01 – Nov 30, 2024

Title: **CVCSIC-AEPP-Ayudas extraordinarias preparacion proyectos 2024**

Ref.: 2024AEP127
PI: Guillem Anglada i Pons
Dur.: Sept 01 – Nov 30, 2024

Title: **CVCSIC-AEPP-Ayudas extraordinarias preparacion proyectos 2024**

Ref.: 2024AEP162
PI: Alberto Castro Tirado
Dur.: Sept 01 – Nov 30, 2024

Title: **Ayuda CSIC MARIE-CURIE Yolanda Jiménez Teja**

Ref.: EXT_898633
PI: José Manuel Vílchez Medina
Dur.: July 22, 2022 – Jan 21, 2024

Title: **Combatir la contaminacion luminica**

Ref.: SCIENCE 4 POLICY
PI: José Manuel Vílchez Medina
Dur.: Jan 17, 2024 - Dec 31, 2024

Title: **Medalla MARGARITA SALAS 2023**

Ref.: OTR13154
PI: Lourdes Verdes-Montenegro
Dur.: Sept 18, 2024 – Dec 31, 2026

EUROPEAN PROGRAM FUNDS

Title: **EXPECT: Towards an Integrated Capability to Explain and Predict Regional Climate Changes**

Ref.: 101137656
PI: Bernd Rainer Funke
Dur.: Apr 01, 2023 - March 31, 2028

Title: **RADIOBLOCKS: New science in Radio Astronomy: applying cutting-edge technology to enhance the entire data chain, from receiver to final output.**

Ref.: 101093934
PI: José Luis Gómez Fernández
Dur.: Mar 01, 2023 - Feb 28, 2027

Title: **DUSTER: Dust Study, Transport, and Electrostatic Removal for Exploration Missions**

Ref.: 101082466
PI: Julio Federico Rodríguez Gómez
Dur.: Jan 01, 2023 - Dec 31, 2024

Title: **ALLIES: Artificial inteLLigence In sustainable dEvelopment goalS**

Ref.: 101126626
PI: Javier Pascual Granado
Dur.: Jan 01, 2024 – Dec 31, 2028

Title: **OPTICON RADIONET PILOT**

Ref.: 101004719
PI: Antonio Albedi Odriozola
Dur.: March 01, 2021 – Febr 28, 2025

REGIONAL GOVERNMENT JUNTA DE ANDALUCíA

Title: **EMC21_00249 Incentivo Junta Andalucia EMERGIA 2021, contrato Gabriella Gilli**

Ref.: EMC21_00249
PI: Gabriella Gilli
Dur.: Mar 01, 2023 - Feb 28, 2027

Title: **Ayudas Planes Complementarios CCAA-PRTR-Astrofísica y física de altas energías. Financiados por la Unión Europea NextGeneration, el Gobierno de España Plan de Recuperación, Transformación y Resiliencia y la Junta de Andalucía**

Ref.: Ayudas Planes Complementarios CCAA-PRTR-Astrofísica y física de altas energías. Financiados por la Unión Europea NextGeneration, el Gobierno de España Plan de Recuperación, Transformación y Resiliencia y la Junta de Andalucía
PI: Antonio Alberdi
Co-Pis: Luis Ramón Bellot Rubio, Pedro José Amado González, Jorge Iglesias Páramo, Luisa María Lara López, Francisco González Galindo, Isabel Márquez Pérez, Juan Iván Agudo Rodríguez, José Luis Gómez Fernández, Francisco Prada Martínez, Lourdes Verdes-Montenegro Atalaya, José Manuel Vílchez Medina

FECYT

Title: **Soninautas: Realidad Virtual y Sonificación**

Ref.: FCT-23-19041
PI: Rubén García Benito
Dur.: Nov 01, 2024 - Oct 30, 2025

Title: **Horizontes de luz Reboot**

Ref.: FCT-22-18281
PI: Emilio José García Gómez-Caro
Dur.: Jul 01, 2023 - Jun 30, 2025

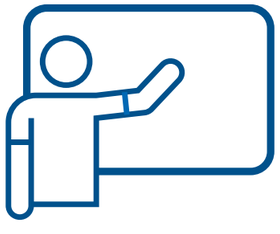
Title: **Bazar Gravedad**

Ref.: FCT-22-18188
PI: Carlos Barceló Serón
Dur.: Jul 01, 2023 - Dec 31, 2024

Title: **ESPACIO3: laboratorio de ciencia y artes escénicas**

Ref.: FCT-22-18345
PI: Sara Cazzoli
Dur.: Jul 01, 2023 - Jun 30, 2024

Education & teaching



PhD Theses

Title: **The environment as a driver of galaxy evolution with the miniJPAS survey**

Author: Julio Esteban Rodríguez Martín
Sup.: Rosa María González Delgado, Luis Alberto Díaz García
Univ.: Universidad de Granada
Date: 24/06/2024

Title: **Characterising the hottest Exoplanets at high Spectral Resolution**

Author: Tomas de Azevedo Silva
Sup.: Olivier Demangeon, Nuno C. Santos, Gabriella Gilli
Univ.: Universidade do Porto(Portugal)
Date: 04/07/2024

Title: **The Quasar Main Sequence at early Cosmic Epochs**

Author: Alice Deconto-Machado
Sup.: Ascensión del Olmo, Paola Marziani
Univ.: Universidad de Granada
Date: 30/10/2024

Title: **Dichotomy of Radio-Loud and Radio-Quiet Quasars in the Four Dimensional Eigenvector One Parameter Space**

Author: Shimeles Terefe Mengistue
Sup.: Ascensión del Olmo, Paola Marziani, Mirjana Povic
Univ.: Addis Ababa University (Ethiopia)
Date: 22/11/2024

Title: **The role of Starbursts in Galaxy Evolution**

Author: Antonio Arroyo Polonio
Sup.: Jorge Iglesias-Paramo, Carolina Kehrig
Univ.: Universidad de Granada
Date: 25/09/2024

Title: **Jets, acrecimiento y campos magnéticos en el entorno de agujeros negros supermasivos en los centros de galaxias**

Author: Juan Escudero Pedrosa
Sup.: Iván Agudo
Univ.: Universidad de Granada
Date: 20/09/2024

Title: **Understanding Born-Again Planetary Nebulae and Their Progenitors**

Author: Borja Montoro Molina
Sup.: Martín Antonio Guerrero Roncel, Jesús Alberto Toalá Sanz
Univ.: Universidad de Granada
Date: 13/09/2024

Title: **Proper motion studies in the nuclear stellar disk**

Author: Álvaro Martínez Arranz
Sup.: Rainer Schoedel
Univ.: Universidad de Granada
Date: 23/07/2024

Title: **Water vapor distribution in the Martian atmosphere from solar occultation measurements by the spectrometer NOMAD/Trace Gas Orbiter**

Author: Adrián Brines Montoro
Sup.: Miguel Ángel López Valverde
Univ.: Universidad de Granada
Date: 18/09/2024

Title: **Disentangling the formation path of lenticular galaxies**

Author: José Luis Tous Mayol
Sup.: Jaime David Perea Duarte, Josep María Solanes Majua
Univ.: Universidad de Barcelona
Date: 12/04/2024

MASTER Theses

Title: **Proyecto de accesibilidad basado en la sonificación de imágenes astronómicas**

Author: Mario Hernánn Muñoz Riffo
Sup.: Rubén García-Benito, Enrique Pérez-Montero
Univ.: Universidad Internacional de Valencia
Date: 12/11/2024

Title: **Optimization of an off-axis guidance system for 1-meter aperture telescopes // Optimización de un sistema de guiado fuera de eje para telescopios de 1 metro de apertura**

Author: Juan Pablo Yunda Díaz
Sup.: David Pérez Medialdea
Univ.: Universidad Internacional de Valencia
Date: 21/05/2024

Title: **Precision of wind measurements on Mars**

Author: Sergio Jurado Fortuna
Sup.: Francisco González Galindo, Denis Shulyak
Univ.: Universidad de Granada
Date: 23/07/2024

Title: **Densidad y temperatura en la termosfera de Marte mediante la técnica de ocultación solar con el espectrómetro NOMAD de la misión ExoMars Trace Gas Orbiter**

Author: Christopher Riera Soto
Sup.s: Miguel Ángel López Valverde, Francisco González Galindo
Univ.: Universidad de Granada
Date: 15/07/2024

Title: **Water maser emission as a signpost of cometary collisions on exoplanets**

Author: María Jesús Sanchez Cepas
Sup.: José Francisco Gómez Rivero
Univ.: Universidad de Granada
Date: 14/07/2024

Title: **Maser emission in evolved stars of "water fountain" type**

Author: María Herranz Molinero
Sup.: José Francisco Gómez Rivero
Univ.: Universidad Internacional de Valencia
Date: 06/11/2024

Title: **Active galactic nuclei connected to AGN power and environment. LINERs and fossil groups**

Author: María Álvarez Santiago
Sup.: Isabel Márquez
Univ.: Universidad de Granada
Date: 18/09/2024

Title: **Impact of prescribed H2SO4-H2O clouds on the circulation and predicted observables of potential Venus-analogues using a 3D Model**

Author: Arlen Parmentier
Sup.: Gabriella Gilli, Aurelien Stolzenbach
Univ.: Ecole Normale Supérieure de Paris (France)
Date: 03/09/2024

Title: **Uso de herramientas de machine learning para la detección de rayos gamma en telescopios de Cherenkov**

Author: Olmo Arquero Peinazo
Sup.: Rubén López-Coto, Alberto Guillén
Univ.: Universidad de Granada
Date: 12/09/2024

Title: **Emission line properties of type-2 AGN in the Lockman-SpReSO survey**

Author: Bereket Assefa Moltote
Sup.: Mirjana Povic
Univ.: Addis Ababa University (Ethiopia)
Date: October 2024

Title: **Spectral Energy Distribution (SED) Properties of Active and Non-active Galaxies in the Green Valley**

Author: Delphine Nishimwe
Sup.: Mirjana Povic, Cosmos Dumba, Antoine Mahoro
Univ.: Mbarara University of Science and Technology (Uganda)
Date: October 2024

Title: **Characterizing the very-high-energy gamma-ray and broadband emission of blazar BL Lacertae**

Author: Carlos Ortega Hunter
Sup.: Jorge Otero-Santos, Iván Agudo
Univ.: Universidad de Granada
Date: 19/09/2024

Title: **Análisis de la Emisión de Rayos Gamma observada por el LST-1 en Núcleos Activos de Galaxias Candidatos a Emisores de Neutrinos**

Author: José Manuel Gavilán Sánchez
Sup.: Daniel Morcuende, Sergio Navas
Univ.: Universidad de Granada
Date: 19/09/2024

Title: **Near-Infrared Observations of Massive Protostellar Outflows**

Author: Pablo Ruiz López
Sup.: Rubén Fedriani López
Univ.: Universidad de Granada
Date: 18/09/2024

Title: **Modelos de estructura estelar de estrellas enanas M**

Author: María Inmaculada Moyano Rejano
Sup.: Cristina Rodríguez López, Giovanni Mirouh
Univ.: Universidad de Granada
Date: 17/09/2024

Title: **Identificación y caracterización de estructuras fluviales y glaciales en el polo Sur de Marte**

Author: Alberto Del Castillo Hernández
Sup.: René Duffard
Univ.: Universidad de Granada
Date: 14/03/2024

Title: **Estudio y comparación de las características de los rilles lunares**

Author: Iñigo López Ayala
Sup.: René Duffard
Univ.: Universidad de Granada
Date: 14/03/2024

Title: **Debris disks in M-type Gyr old stars**

Author: Oier Baraibar
Sup.: Mayra Osorio
Univ.: Universidad de Granada
Date: 18/09/2024

DEGREE Theses

Title: **Procesado de imágenes del prototipo del Large-Sized-Telescope del Cherenkov Telescope Array Observatory mediante algoritmo de hormigas**

Author: Germán Cano Amaro
Sup.: Rubén López-Coto, Alberto Guillén
Univ.: Universidad de Granada
Date: 08/07/2024

Title: **Envolturas en estrellas tipo AGB**

Author: Eduardo Rodríguez González
Sup.: Mayra Osorio
Univ.: Universidad Veracruzana (México)
Date: 29/10/2024

Courses

Title: **Stellar Structure and Star Formation**

Teach.: Mayra Osorio
Prog.: Astrophysics, Particle Physics and Cosmology
Univ.: Department of Quantum Physics and Astrophysics of the Barcelona University
Hours: 3
Date: 14/05/2024 to 17/05/2024

Title: **Métodos matemáticos y computacionales en cosmología, astrofísica y física**

Teach.: Miguel Pérez Torres
Prog.: Master in the Physics of the Universe
Univ.: Universidad de Zaragoza
Hours: 10
Date: 01/04/2024 to 30/05/2024

Title: **Radioastronomy**

Teach.: Angela Gardini, Daniel Espada
Prog.: Master in Physics and Mathematics
Univ.: Universidad de Granada
Hours: 60
Date: September 2024 to January 2025

Title: **Cosmología y Galaxias**

Teach.: Emilio J. Alfaro Navarro, Mar Basteiro
Prog.: Master en Física: Radiaciones, Nanotecnología, Partículas y Astrofísica
Univ.: Universidad de Granada
Hours: 10
Date: 15/01/2024 to 18/01/2024

Title: **Sonificación de datos: Explorando la intersección entre ciencia y arte**

Teach.: Rubén García-Benito, José López-Montes
Prog.: Bailar la casa / Viernes eléctricos (Cátedra Miguel Ríos)
Univ.: Universidad de Granada
Hours: 3
Date: 12/04/2024

Title: **Modern Observational Techniques in Astronomy**

Teach.: Mirjana Povic
Prog.: PhD in Astronomy and Astrophysics
Univ.: Space Science and Geospatial Institute (Ethiopia)
Hours: 46
Date: 01/12/2023 to 01/03/2024

Title: **Observational Techniques in Astronomy**

Teach.: Mirjana Povic
Prog.: Master in Astronomy and Astrophysics
Univ.: Space Science and Geospatial Institute (Ethiopia)
Hours: 40
Date: 01/04/2024 to 01/07/2024

Title: **Galactic and Extragalactic Astronomy**

Teach.: Mirjana Povic
Prog.: PhD in Astronomy and Astrophysics
Univ.: Space Science and Geospatial Institute (Ethiopia)
Hours: 46
Date: 01/04/2024 to 01/07/2024

Title: **Virtual Observatory and Databases in Astronomy**

Teach.: Mirjana Povic
Prog.: International School for Young Astronomers
Univ.: IAU & CRAAG (Algeria)
Hours: 12
Date: 15/09/2024 to 03/10/2024

Title: **Mathematics II**

Teach.: Gerardo García Moreno
Prog.: Bachelor Degree in Optics and Optometry
Univ.: Universidad de Granada
Hours: 60
Date: February 2024 to July 2024

Title: **Protoestrellas y discos protoplanetarios**

Teach.: Mayra Osorio
Prog.: Master en Física y Matemáticas
Univ.: Universidad de Granada
Hours: 1.5
Date: 17/01/2024

Title: **Discos protoplanetarios**

Teach.: Mayra Osorio
Prog.: Master en Física y Matemáticas
Univ.: Universidad de Granada
Hours: 3
Date: 30/10/2024 to 31/10/2024

Title: **El arte de descubrir exoplanetas**

Teach.: Francisco Pozuelos
Prog.: X Curso de Astrofísica: el estudio del Universo variable.
Univ.: CEFCA y Universidad de Zaragoza
Hours: 2
Date: 03/07/2024 - 05/07/2024

Press releases

Access to all news at:

https://www.iaa.csic.es/en/news

Galaxies caught in the throes of chemical 'rejuvenation'

08/01/2024

An IAA-CSIC team leads a pioneering study that reveals the crucial role of galactic mergers in the chemical evolution of Ultraluminous Infrared Galaxies.

Project DUSTER: a study of lunar dust in preparation for future exploration missions

15/01/2024

As space agencies prepare to return to the Moon, scientific and engineering teams face the challenge of mitigating a major environmental risk: dust. The Instituto de Astrofísica de Andalucía (IAA-CSIC) participates in the DUSTER project, which will study charged dust particles, which pose a serious risk to the health of human explorers and space instruments

M87* One Year Later: Proof of a persistent black hole shadow

18/01/2024

The Instituto de Astrofísica de Andalucía (IAA-CSIC) participates in the international collaboration that confirms the existence of a bright ring corresponding to the shadow of the black hole in the Messier 87 galaxy. The stability of the diameter of the ring with respect to the data obtained in 2017 supports the conclusion that the black hole M87 is correctly described by the theory of general relativity.

The AFGL 5180 region, cradle of giant forming stars, reveals its secrets in the infrared

29/01/2024

The Instituto de Astrofísica de Andalucía (IAA-CSIC) leads a study that reveals, in unprecedented detail, a region of massive star formation

The European Space Agency approves construction of EnVision, the next major mission to Venus

06/02/2024

The Instituto de Astrofísica de Andalucía (IAA-CSIC) participates in both its technological development and its scientific return. The mission will study Venus' core and atmosphere to understand its volcanic activity and climate and find out how this twin of Earth became so inhospitable.

First observation of the formation of 'rare earths' following the merger of two neutron stars

21/02/2024

A study involving the Instituto de Astrofísica de Andalucía (IAA-CSIC) shows a kilonova as a source of heavy elements, including the precious 'rare earths'. The work, published in Nature, highlights this type of explosive and extremely energetic phenomena as the ideal environment for the formation of metals heavier than iron and silver.

Astronomers Unveil Strong Magnetic Fields Spiraling at the Edge of Milky Way's Central Black Hole

27/03/2024

A new image from the Event Horizon Telescope (EHT) collaboration has uncovered strong and organized magnetic fields spiraling from the edge of the supermassive black hole Sagittarius A* (Sgr A*).

Newly collapsed red supergiant star spotted

27/03/2024

Explosion of a supergiant star detected just one hour after its collapse. Amateur observatories have been key in detecting the supernova in its initial phases. The IAA-CSIC participates in this study published in Nature through its global network of robotic telescopes BOOTES.

Giant planet as light as cotton candy discovered

14/05/2024

The Instituto de Astrofísica de Andalucía (IAA-CSIC) is co-leading the study of the second lightest planet discovered to date.

Earth-type planet found in an ultra-cool dwarf star

15/05/2024

IAA-CSIC researchers participate in the discovery of one of the few known planetary systems in this type of stars. The results, published today in *Nature Astronomy*, have been contributed by the Sierra Nevada and Calar Alto observatories

It snows more on Mars than expected

28/05/2024

Researchers from IAA-CSIC lead a new method to measure carbon dioxide snow and frost variations on Mars surface. The initial results indicate that the deposited snow thickness is up to two orders of magnitude greater than estimated.

ANDES instrument for the European Giant Telescope ELT is agreed upon

05/06/2024

The Instituto de Astrofísica de Andalucía (IAA-CSIC) participates in both its technological development and its scientific objectives.

The IAA strengthens CSIC's international role in the SKA Observatory

21/06/2024

The IAA has been endowed by the CSIC with nearly one hundred thousand euros to strengthen the capacities of the scientific community that will use SKAO through the Spanish SKA Regional Centre. "CSIC4SKA", led by the IAA-CSIC, was one of five projects funded under the CSIC Programme for Large European Research Infrastructures.

The most distant and oldest star clusters discovered

24/06/2024

The James Webb Space Telescope observes star clusters in a galaxy just 460 million years after the Big Bang. The Instituto de Astrofísica de Andalucía (IAA-CSIC) and the Instituto de Física de Cantabria (IFCA-CSIC-UC) are participating in this discovery.

Sunrise III successfully launched

10/07/2024

This mission has a strong participation of the Solar Physics Group of the IAA.

The IAA-CSIC participates in a project that offers the scientific community three-dimensional images of 100 galaxies

15/07/2024

CAVITY is the name of this international initiative whose objective is to monitor up to 400 galaxies in the future to learn about their formation and evolution. The material is now available through the website www.cavity.caha.es

NASA's DART mission captures high-resolution image of the binary asteroid system Didymos

30/07/2024

The study, which analyzes the geology and origin of this binary asteroid system close to Earth, concludes that the surface of Didymos is between 40 and 130 times older than its satellite Dimorphos. The work has been published in five articles in Nature Communications and the IAA-CSIC participates in one of them

Origin of persistent emission in enigmatic Fast Radio Bursts revealed

07/08/2024

A new international study involving the IAA-CSIC identifies a plasma bubble as the origin of the persistent emission observed in some fast radio bursts (FRBs). The data also allow researchers to determine the nature of the "engine" that powers these mysterious sources The results are published today in Nature

JANUS, the optical camera on ESA's JUICE probe, captures stunning images during its first lunar and terrestrial flyby

23/08/2024

JANUS, the optical camera on ESA's JUICE probe, captures stunning images during its first lunar and terrestrial flyby

IAA-CSIC researcher Rafael Luque receives a 'Starting Grant' from the European Research Council

05/09/2024

The grant, 1.5 million euros over the next five years, will help to understand the properties of subneptune-type planets.

Supermassive black holes alter the chemical evolution of galaxies

15/10/2024

The IAA-CSIC participates in this study that shows how the activity of a supermassive black hole hidden in the heart of a quasar has transformed the chemical composition of the gas in the galaxy.

Several Neptune-like planets discovered in a theoretically barren region

31/10/2024

The study, focusing on the planetary nature of thirteen objects of interest from the TESS mission, confirms the existence of five new planets around red dwarf or M-type stars, which are smaller and cooler than our Sun. The planets lie within or very near the "Neptunian desert," a region noted for the scarcity of planets with characteristics similar to those of Neptune.

Signal of a Binary Super Massive Black Hole System interacting with a gas cloud detected for the first time

13/11/2024

The Instituto de Astrofísica de Andalucía (IAA-CSIC) contributed to this study by providing key data obtained with its ALFOSC spectrograph, installed on the Nordic Optical Telescope (NOT) at the Roque de los Muchachos Observatory in La Palma. This information complements data from NASA's Neil Gehrels Swift Observatory and the ZTF project.

The J-PAS Astronomical Project releases the first data from its mapping of the Universe

20/11/2024

The project, co-led by the Instituto de Astrofísica de Andalucía (IAA-CSIC), has made available to the scientific community the first twelve square degrees of the three-dimensional map of the Universe being developed from the Javalambre Astrophysical Observatory (OAJ). The studied area contains 550,000 astronomical objects and represents just a small sample of the survey's data, which aims to cover thousands of square degrees over the next...

'Territorio gravedad', the Spanish docu-series about the cosmos, returns with its second season

27/11/2024

The four new episodes of the series, produced by the Instituto de Astrofísica de Andalucía (IAA-CSIC), will be available from 29 November on Filmin and Vimeo On Demand

New evidence of organic material identified on Ceres, the inner Solar System's most water-rich object after Earth

02/12/2024

Thanks to an innovative approach combining high spatial and spectral resolution, the Instituto de Astrofísica de Andalucía (IAA-CSIC) has analyzed the distribution of organic compounds on Ceres with unprecedented detail. This study paves the way for a potential future return to Ceres to clarify the nature of the detected material and examine its astrobiological implications

The LPI project to explore new frontiers in quantum astronomy from La Palma

05/12/2024

The Instituto de Astrofísica de Andalucía (IAA-CSIC) is leading the LPI (La Palma Interferometer) project, aimed at conducting astronomical observations with spatial resolution a thousand times greater than that of the Hubble and James Webb space telescopes. LPI brings together the collaboration of various research centers and institutions from Spain, Italy, the Nordic countries, and Mexico, working together to establish a cutting-edge scientific facility with international relevance.

The Sunrise III Mission captures unprecedented Solar data with exceptional spatial and temporal resolution

17/12/2024

An international scientific team, with significant Spanish participation through a consortium led by the Instituto de Astrofísica de Andalucía (IAA-CSIC), has, for the first time, obtained simultaneous data from the Sun in ultraviolet, visible, and infrared light bands. This information was gathered during the successful scientific flight of the Sunrise III mission in July 2024.

Seminars

Lauren Callista Smith
(Instituto de Astrofísica de Andalucía - CSIC)
Title: "Informative Session for Foreign New Hires"
Date: Dec 12, 2024

Manuel González
(Parque de las Ciencias)
Title: "ESERO, from space to the classroom"
Date: Dec 10, 2024

Guillermo Muñoz Caro
(Centro de Astrobiología - CSIC)
Title: "Experimental ice simulations for the interpretation of ice and organics observations in the Solar System"
Date: Dec 03, 2024

Ángeles Díaz
(Universidad Autónoma de Madrid)
Title: "SO Colloquium: Cosmic chemical evolution: here, there, and everywhere Primary tabs"
Date: Nov 28, 2024

Mireia Nievas Rosillo
(Instituto de Astrofísica de Canarias (IAC))
Title: "Towards the Standardization of the Modeling of Multi-Frequency Observations"
Date: Nov 21, 2024

Thea Kozakis
(Instituto de Astrofísica de Andalucía - CSIC)
Title: "Ozone and the Search for Life in the Universe"
Date: Nov 14, 2024

Henri Boffin
(European Southern Observatory)
Title: "SO Colloquium: The tidal arms of open star clusters are much longer than thought, but more difficult to find"
Date: Nov 07, 2024

Antonio García Hernández
(Universidad de Granada)
Title: "New UGR proceedings for PhDs"
Date: Nov 06, 2024

Hugh Osborn
(ETH Zurich)
Title: "Using CHEOPS to confirm small transiting exoplanets orbiting bright stars"
Date: Oct 31, 2024

Kalaga Madhav
(Leibniz Institute for Plasma Science and Technology (INP))
Title: "SO colloquium: Role of Astrophotonics in Astronomy: The MARCOT Pathfinder"
Date: Oct 24, 2024

Pietro Zucca
(ASTRON)
Title: "SO Colloquium: Radio eyes for the Sun, Heliosphere and Ionosphere: Status and plans for the SKAO era"
Date: Oct 17, 2024

Chi Yan (Paul) Law
(Osservatorio Astrofisico di Arcetri)
Title: "Uncovering the magnetized path of massive star formation"
Date: Oct 10, 2024

Jack Radcliffe
(University of Pretoria)
Title: "SO Colloquium: The next generation of milliarcsecond surveys with SKA-VLBI"
Date: Oct 03, 2024

Giorgos Michailidis
(Aristotle University of Thessaloniki)
Title: "High-Resolution Study of Blazar TXS 2013+370 and BEAM: A Space Technology and Research Student Team"
Date: Sep 30, 2024

Eric Linder
(Lawrence Berkeley National Laboratory)
Title: "Who Is Afraid of the Dark (Energy)?"
Date: Sep 27, 2024

Jorge Sánchez Almeida
(Instituto de Astrofísica de Canarias (IAC))
Title: "The stellar distribution in ultra-faint dwarf galaxies suggests deviations from the collisionless cold dark matter paradigm"
Date: Sep 26, 2024

Juan Diego Carrillo Sánchez
(NASA Goddard Space Flight Cente)
Title: "Constraining the Meteoroid Flux in the inner solar system"
Date: Sep 24, 2024

José Alberto Rubiño Martín
(Instituto de Astrofísica de Canarias (IAC))
Title: "The QUIJOTE experiment: status, latest results and future plans"
Date: Jul 23, 2024

Carlos Carrasco González
(Universidad Nacional Autónoma de México)
Title: "Dust in protoplanetary disks, (still) that great unknown"
Date: Jul 11, 2024

Alejandro López-Vázquez
(Academia Sinica, Institute of Astronomy & Astrophysics)
Title: "Multiple components in the protostellar system HH 212: Infalling envelope, nested shell, MHD disk winds, and free wind gas"
Date: Jun 27, 2024

Eleonora Fiorellino
(Osservatorio Astronomico di Capodimonte)
Title: "Intersexionality, a key work for diversity?"
Date: Jun 25, 2024

Laura Roa
(Universidad de Sevilla)
Title: "Mujer en la Ingeniería: Avances y Retos"
Date: Jun 20, 2024

Shane O'Sullivan
(Universidad Complutense de Madrid)
Title: "SO Colloquium: The magnetised intergalactic medium revealed by SKA Pathfinders"
Date: Jun 13, 2024

Elham Ziaali
(Instituto de Astrofísica de Andalucía - CSIC)
Title: "A complex network perspective on Delta Scuti stars"
Date: Jun 06, 2024

Filiz Kahraman Aliçavuş
(Çanakkale Onsekiz Mart University)
Title: "SO Colloquium: Spectroscopy's Role in Stellar Astrophysics"
Date: May 21, 2024

Yaniss Inouk Nyffenegger Péré
(Instituto de Astrofísica de Andalucía - CSIC)
Title: "New possibilities for atmospheric analysis with Monte Carlo"
Date: May 14, 2024

Francisco Nogueras Lara
(European Southern Observatory)
Title: "Journey into the Galactic Heart: Illuminating the Enigma of the Nuclear Star Cluster and the Nuclear Stellar Disc"
Date: May 07, 2024

Jose Carlos del Toro Iniesta
(Instituto de Astrofísica de Andalucía - CSIC)
Title: "The art of astrophysical measurements: An elementary lecture on photon counting and S/N"
Date: Apr 30, 2024

Ginés Martínez Solaeche
(Instituto de Astrofísica de Andalucía - CSIC)
Title: "Artificial Intelligence in Service of Galaxy Evolution Research: A Personal Journey"
Date: Apr 25, 2024

Agustín Sánchez Losa
(Instituto de Física Corspuscular - CSIC)
Title: "Astronomy with Neutrino Telescopes"
Date: Apr 15, 2024

Leonardos Gkouvelis

(University of Munich)

Title: "LP791-18d as a case study for outgassing rocky exoplanets"

Date: Apr 11, 2024

Antonio Jesús Ocaña Fernández

(Instituto de Astrofísica de Andalucía - CSIC)

Title: "Laboratory Research on the Atmospheric Impact of Spacecraft Re-entry Debris: Perspectives and Future Challenges"

Date: Apr 09, 2024

Maria Gritsevich

(University of Helsinki)

Title: "The Earthbound Fate of Meteor Phenomena"

Date: Apr 04, 2024

Francisco Prada Martínez

(Instituto de Astrofísica de Andalucía - CSIC)

Title: "Single-photon gig in Betelgeuse's occultation"

Date: Apr 02, 2024

Sebastián Sánchez

(Universidad Nacional Autónoma de México)

Title: "The Local Volume Mapper, state of the art"

Date: Mar 21, 2024

María Kazachenko

(University of Colorado Boulder)

Title: "Recent Progress in Understanding Solar Flare Magnetism using Data-Driven Simulations and Statistical Analysis of Vector Magnetic Fields"

Date: Mar 19, 2024

Sebastián Sánchez

(Universidad Nacional Autónoma de México)

Title: "SO Colloquium: Spatially resolved spectroscopy properties of low-redshift galaxies"

Date: Mar 14, 2024

Antonino Francesco Lanza

(INAF)

Title: "SO Colloquium: Stars and their close-by planets: clues of magnetic interactions"

Date: Mar 07, 2024

Cherry Ng

(CNRS (Centre National de la Recherche Scientifique))

Title: "SO Colloquium: A new digitized age of SETI – interferometric commensal observations and machine learning"

Date: Mar 05, 2024

Avery Broderick

(University of Waterloo)

Title: "SO Colloquium: Eyes on the Invisible: Charting New Horizons with the Event Horizon Telescope"

Date: Feb 29, 2024

Mireia Nievas Rosillo

(Instituto de Astrofísica de Canarias (IAC))

Title: "Unraveling the Gamma-ray emission in radiogalaxies and their jets"

Date: Feb 27, 2024

Lorenzo Amati

(INAF)

Title: "The Transient High-Energy Sky and Early Universe Surveyor (THESEUS)"

Date: Feb 08, 2024

Luis Alberto Díaz García

(Instituto de Astrofísica de Andalucía - CSIC)

Title: "Stellar population studies in the J-PAS survey"

Date: Jan 25, 2024

IAA-CSIC EHT group

(Instituto de Astrofísica de Andalucía - CSIC)

Title: "A Year Beyond the Horizon: Advancing Our Understanding of M87* with New EHT Observations"

Date: Jan 18, 2024

Teresa Toscano Domingo

(Instituto de Astrofísica de Andalucía - CSIC)

Title: "UGR bureocrazy for dummies: PhDs fight back"

Date: Jan 16, 2024

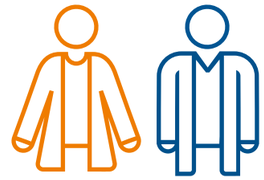
Ruben Sanchez-Janssen

(UK Astronomy Technology Centre)

Title: "SO Colloquium: MOSAIC: the high multiplex and multi-IFU spectrograph for the ELT"

Date: Jan 11, 2024

Visiting scientists



INVITED

Mireia Nievas Rosillo

Instituto de Astrofísica de Canarias (IAC)

16/10/2024 - 22/11/2024

Edgar Ivan Santamaria Domínguez

Universidad Nacional Autónoma de México

28/05/2024 - 27/07/2024

Bárbara Rojas Ayala

Universidad de Tarapacá, Chile

08/01/2024 - 08/04/2024

Estela del Mar Fernández Valenzuela

University of Florida, USA

20/11/2023 - 19/01/2024

LONG VISITS

Alba Fernández Barral

Cherenkov Telescope Array Observatory

18/04/2024 - 18/04/2025

21/03/2023 - 31/03/2024

Denise Sammartino

Università di Bologna, Italy

01/10/2024 - 05/10/2025

Siyu Wu

Moscow State University, Moscow, Russia

05/09/2024 - 04/09/2025

05/09/2023 - 04/09/2024

Marta Moreno Hernández

Universidad de Granada

02/12/2024 - 31/07/2025

Luan Machado Catani

Universidade Federal de Rio de Janeiro, Brazil

11/11/2024 - 24/05/2025

Carmen Naletto

Università di Padova, Italy

01/10/2024 - 31/03/2025

João Victor Zamperlini dos Santos

Universidade Federal de Santa Catarina, Brazil

01/09/2024 - 27/02/2025

Mathis Veschambre
CESI- École d'Ingénieurs, France
04/11/2024 - 14/02/2025

Máximo Bustamante Calabria
Universidad de Granada
01/11/2024 - 31/01/2025

Aurelia Teresa Gallego Calvente
Universitat de València
30/09/2024 - 30/12/2024
28/05/2024 - 28/08/2024

Oier Baraibar Larraza
Universidad del País Vasco
01/07/2024 - 31/10/2024
03/11/2023 - 31/01/2024

Gareb Enoch Fernández Rodríguez
Universidad de Granada
05/08/2024 - 20/09/2024

Jesús Alberto Toalá Sanz
Universidad Nacional Autónoma de México
28/05/2024 - 27/07/2024

María Álvarez Santiago
Universidad de Granada
30/07/2024 - 30/09/2024

Sergio Jurado Fortuna
Universidad de Granada
15/01/2024 - 01/09/2024

Júlia Thainá da Silva Cunha Batista
Universidade Federal de Santa Catarina, Brazil
01/11/2023 - 31/08/2024

Verónica Ibeas Fernández
University College Dublin, Ireland
03/06/2024 - 30/08/2024

Arlen Parmentier
Université de recherche Paris Sciences et Lettres, France
26/02/2024 - 31/07/2024

Sandino Estrada Dorado
Instituto de Radioastronomía y Astrofísica, UNAM, México
28/05/2024 - 19/07/2024

Janis Berenice Rodríguez González
Instituto de Radioastronomía y Astrofísica, UNAM, México
28/05/2024 - 09/07/2024

Daniel Fernandes Gama
Universidad de Extremadura
01/07/2024 - 17/07/2024

Diego Alejandro Vasquez Torres
Instituto de Radioastronomía y Astrofísica, UNAM, México
28/05/2024 - 27/07/2024

Andrea Sofía Garmendia González
Universidad de Granada
01/04/2024 - 28/06/2024

Teresa Martínez Pérez
Universidad de Granada
01/04/2024 - 28/06/2024

Alberto Sgariboldi
Università degli studi di Pavia, Italy
15/02/2024 - 15/06/2024

Konstantinos Kourmpetis
Aristotle University of Thessaloniki, Greece
01/03/2024 - 30/04/2024

Beray Fitoz
Freie Universität Berlin, Germany
24/02/2024 - 26/04/2024

Archana Giri Nair
Università di Roma Tor Vergata, Italy
29/01/2024 - 28/03/2024

Alejandro Ramón Ballesta
Universidad de Granada
04/10/2023 - 29/02/2024

Ailing Zeng
Shanghai Astronomical Observatory, China
01/10/2023 - 29/02/2024

Lucía Bravo Ferres
Universidad de Granada
15/09/2023 - 29/02/2024

Julio Esteban Rodríguez Martín
Universidad de Granada
01/09/2023 - 08/02/2024

Guillermo Blázquez Calero
Universidad de Granada
01/09/2023 - 02/02/2024

José Feliciano Agüí Fernández
Universidad de Granada
01/08/2023 - 31/01/2024

SHORT VISITS

Ricardo Jorge Maranhas Gafeira
Universidade de Coimbra, Portugal
10/12/2024 - 20/12/2024

Francisco Nogueras Lara
European Southern Observatory, Germany
18/12/2024 - 20/12/2024
23/09/2024 - 27/09/2024
22/07/2024 - 25/07/2024
04/03/2024 - 05/03/2024

Lorena Acuña
Max Planck Institute for Astronomy, Germany
18/11/2024 - 20/12/2024

Clemens Thum
Instituto de Radioastronomía Milimétrica (IRAM)
05/12/2024 - 19/12/2024
28/11/2024 - 28/11/2024

Ángeles Díaz Beltrán
Universidad Autónoma de Madrid
25/11/2024 - 04/12/2024

Gökhan Yücel
Istanbul University, Turkey
19/11/2024 - 01/12/2024

Christoffel Waelkens
Katholieke Universiteit Leuven, Belgium
13/11/2024 - 15/11/2024

Daniele Bjorn Malesani
University of Copenhagen, Denmark
13/11/2024 - 15/11/2024

Pierre Maggi
Max Planck Institute for Radioastronomy, Germany
13/11/2024 - 15/11/2024

Johan Knapen
Instituto de Astrofísica de Canarias (IAC)
04/11/2024 - 11/11/2024

Vladimir Zakharov
Observatoire de Paris, France
04/11/2024 - 10/11/2024

Gary Anthony Fuller
University of Manchester, UK
04/11/2024 - 07/11/2024
14/07/2024 - 23/07/2024

Enrique Macías Quevedo
European Southern Observatory, Chile
04/11/2024 - 04/11/2024

Paola Marziani
Osservatorio Astronomico di Padova, Italy
20/10/2024 - 01/11/2024

Alice Deconto Machado
INAF, Italy
24/10/2024 - 01/11/2024

Hugh Osborn
ETH Zurich, Switzerland
31/10/2024 - 31/10/2024

Etienne Henri Joseph Bonnassieux
U. Paris Cité, U. Paris-Saclay, CEA, CNRS, France
18/10/2024 - 31/10/2024

Takayoshi Oba
Max Planck Institute for Solar System Research, Germany
14/10/2024 - 19/10/2024

Ivana Batkovic
Istituto Nazionale di Fisica Nucleare, Italy
17/10/2024 - 18/10/2024
20/06/2024 - 25/06/2024

Juan Escudero Pedrosa
Harvard-Smithsonian Center for Astrophysics (CfA), USA
17/10/2024 - 18/10/2024

David Laroze
Universidad de Tarapacá, Chile
14/10/2024 - 16/10/2024

Bárbara Rojas Ayala
Universidad de Tarapacá, Chile
14/10/2024 - 16/10/2024

Geferson Lucatelli
University of Manchester, UK
23/09/2024 - 11/10/2024

Julio Arrechea Rodríguez
Scuola Internazionale Superiore di Studi Avanzati, Italy
11/10/2024 - 11/10/2024
10/06/2024 - 14/06/2024

Chi-Yan Law
INAF, Italy
09/10/2024 - 10/10/2024

José Luis Jaramillo Martín
Université de Bourgogne, France
07/10/2024 - 10/10/2024

Dongshuai Li
Danish Space Research Institute, Denmark
30/09/2024 - 01/10/2024

Maciej Slawomir Wielgus
Max Planck Institute for Radioastronomy, Germany
09/09/2024 - 20/09/2024

Ignacio Reyes Raffo
University of Amsterdam, The Netherlands
20/09/2024 - 20/09/2024

Gloria Sala Cladellas
Universidad Politécnica de Cataluña
13/09/2024 - 13/09/2024

Tomoaki Ishiyama
Chiba University, Japan
17/07/2024 - 09/08/2024

David Morate
Centro de Estudios de Física del Cosmos de Aragón (CEFCA)
22/07/2024 - 26/07/2024

José Alberto Rubiño Martin
Instituto de Astrofísica de Canarias (IAC)
22/07/2024 - 23/07/2024

Alice Pasetto
Universidad Nacional Autónoma de México
01/07/2024 - 21/07/2024

Carlos Eugenio Carrasco González
Universidad Nacional Autónoma de México
01/07/2024 - 21/07/2024

Marta González García
Valencian International University
08/07/2024 - 12/07/2024

Jorge Hernández Bernal
Laboratoire de Météorologie Dynamique, France
01/07/2024 - 12/07/2024

Beatriz Sánchez Cano
University of Leicester, UK
11/07/2024 - 12/07/2024

Gerardo Ramos Larios
Universidad de Guadalajara, México
29/06/2024 - 11/07/2024

Luis J Garay Elizondo
Universidad Complutense de Madrid
03/07/2024 - 05/07/2024

Yücel Kilic
Tubitak Observatory, Turkey
19/06/2024 - 30/06/2024

Alejandro López Vázquez
Academia Sinica, Institute of Astronomy & Astrophysics, China
23/06/2024 - 29/06/2024

Valentin Boyanov Savov
Universidad Complutense de Madrid
04/06/2024 - 07/06/2024
06/05/2024 - 09/05/2024

Begoña García Lorenzo
Instituto de Astrofísica de Canarias (IAC)
23/04/2024 - 26/04/2024

Achrène Dyrek
U. Paris Cité, U. Paris-Saclay, CEA, CNRS, AIM, France
10/04/2024 - 16/04/2024

Leonardos Gkouvelis
NASA Ames Research Center
11/03/2024 - 12/04/2024

Chiara Castagnoli
Università di Bologna, Italy
04/03/2024 - 24/03/2024

Sebastián Francisco Sánchez Sánchez
Universidad Nacional Autónoma de México
25/02/2024 - 23/03/2024

Dejan Vitlacil
Chalmers University of Technology, Sweden
04/03/2024 - 08/03/2024

Pablo Llopis SanMillán
École Polytechnique Fédérale de Lausanne, Switzerland
04/03/2024 - 08/03/2024

Hendrik Müller
National Radio Astronomy Observatory, USA
26/02/2024 - 08/03/2024

Antonino Francesco Lanza
INAF, Italy
05/03/2024 - 08/03/2024

Kelley Michelle Hess
Chalmers University of Technology, Sweden
04/03/2024 - 08/03/2024
20/01/2024 - 03/02/2024

Carolina Lindqvist
École Polytechnique Fédérale de Lausanne, Switzerland
04/03/2024 - 08/03/2024

Cherry Ng
CNRS (Centre National de la Recherche Scientifique), France
04/03/2024 - 05/03/2024

Iwata Yuhei
National Astronomical Observatory of Japan
26/02/2024 - 05/03/2024

Ioannis Myserlis
Instituto de Radioastronomía Milimétrica (IRAM)
29/02/2024 - 01/03/2024

Mireia Nievas Rosillo
Instituto de Astrofísica de Canarias (IAC)
01/03/2024 - 01/03/2024
26/02/2024 - 29/02/2024

Carolina Casadio
Foundation for Research and Technology Hellas (FORTH), Greece
26/02/2024 - 26/02/2024

Diego Álvarez Ortega
Foundation for Research and Technology Hellas (FORTH), Greece
26/02/2024 - 26/02/2024

Florence Durret
Institut d'Astrophysique de Paris, France
18/02/2024 - 23/02/2024

Karri Muinonen
University of Helsinki, Finland
09/01/2024 - 09/02/2024

María del Carmen Sánchez Gil
Universidad de Cádiz
29/01/2024 - 03/02/2024
15/01/2024 - 20/01/2024

Ignacio del Moral Castro
Pontificia Universidad Católica de Chile
08/01/2024 - 30/01/2024

Gorden Videen
Space Telescope Science Institute, USA
22/01/2024 - 29/01/2024

Antti Penttila
University of Helsinki, Finland
20/01/2024 - 27/01/2024

Sandra Zamora Alcázar
Universidad Autónoma de Madrid
08/01/2024 - 26/01/2024

María Arias de Saavedra Benítez
Leiden University, The Netherlands
08/01/2024 - 26/01/2024

Denise Sammartino
Università di Bologna, Italy
01/10/2024 - 05/10/2025

Marta Moreno Hernández
Universidad de Granada
02/12/2024 - 31/07/2025

José Manuel Gavilán Sánchez
Universidad de Granada
14/12/2023 - 31/12/2024

Santiago Gil Toriello
Pontificia Universidad Católica de Chile
30/09/2024 - 18/10/2024

Mikhail Villiers
University of Cape Town, South-Africa
14/09/2024 - 29/09/2024

Jorge García García
Instituto de Astrofísica de Canarias (IAC)
13/09/2024 - 13/09/2024

Brandon Zhao
Caltech, USA
26/08/2024 - 07/09/2024

Raquel Mejia Espinoza
Universidad de Guanajuato, México
05/09/2024 - 05/09/2024

Francisco José Gómez
IES Tháder, Orihuela, Alicante
08/07/2024 - 17/07/2024

Andres Toribio
IES Tháder, Orihuela, Alicante
08/07/2024 - 17/07/2024

Daniel Fernandes Gama
Universidad de Extremadura
01/07/2024 - 17/07/2024

Pau Crosas Gimeno
Universitat de Barcelona
02/07/2024 - 15/07/2024

Ana Blasco
Universidad Complutense de Madrid
10/06/2024 - 14/06/2024

Noemi La Bella
Radboud University, The Netherlands
26/02/2024 - 08/03/2024

Rohitha Neelam
University of Twente,The Netherlands
29/01/2024 - 02/02/2024

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