The IAA-CSIC 2020 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 all human beings, 2020 will be kept on the historical records as the year that reminded us how fragile we are. The lock-down sent most of us home, while humanity workers at hospitals put their lives at risk to save people, and providers of basic means gave support to our necessities. Three very important events for the scientific-technical life of the IAA had taken place at the end of February: the launch of Solar Orbiter, the first visit to the IAA of our External Advisory Board and the award of the Medalla de Andalucía. We could not have anticipated that, after such a busy start to 2020, we would be mainly homebound for the remaining six months.

The visit of the IAA External Scientific Advisory Board (ESAB) was a success in all respects and resulted in a very positive evaluation for the IAA. In fact, the committee states in its report:

“The ESAB members very much appreciate the work that went into preparing for our visit, the open and detailed discussions we had with different groups and people at the institute, and the care of the direction and the administrative support put into the organization of the visit. These efforts, the written report, and the high-quality presentations delivered during our visit provide a clear view of relevant aspects of the IAA science, its personnel situation, recent success and future plans. We had also a clear view of the pertinence of the Severo Ochoa program and its impact of the institute since its deployment starting in July 2018, and the pertinence of its continuation in the future after the present term. We thank all the IAA members and extensively the CSIC for a very informative and interesting visit.”

ESAB provided also very valuable recommendations that have been implemented to improve the scientific life of the institute. On November 2020, we passed the mid-term review of the Severo Ochoa – IAA program, evaluation charged to an International Advisory Committee nominated by the Spanish Research Agency, obtaining the highest degree.

A couple of days after the ESAB meeting, on February 28th, the IAA received the Medalla de Andalucía 2020 in the area of “Research, Science and Health”. This is the highest recognition granted by the Andalusian government and recognized the international impact of the science and technology performed at the IAA.
At the beginning of February 2020 the Solar Orbiter mission, where the IAA is co-PI of the instrument PHI, was launched and is still now on its way to the Sun. At the moment of writing this foreword, Solar Orbiter just passed 8,000 kilometers from Venus. This is the second of the eight passes that this spacecraft plans to make, to propel itself and modify its trajectory in order to study in detail an almost unknown part of our star: the solar poles. Curiously, the space mission Beppi Colombo, in which the IAA contributes to the BeLA instrument, was flying just 552 kilometers from the surface of Venus in the same days. Beppi Colombo will explore Mercury, the closest planet to the Sun and the least studied of the rocky planets in our Solar System. Several months later, on July 2020, Solar Orbiter provided the first magnetic map of the surface of the Sun without human intervention and from space. Being the Sun in a period of low activity, no structures were visible in the intensity image, but magnetic structures were observed on its surface in the circular polarization map.

During 2020, researchers from the IAA published the most extensive catalogue of stars in the Galactic Center to date. It is the result of the ERC Consolidator Grant Galactic Nucleus, led by researchers from the IAA. Thanks to its unprecedented resolution, it has been possible to unravel the history of star formation at the Galactic Center, showing that it has not been continuous and presents steep ups and downs in star formation. Many other scientific and technological results during 2020 could be mentioned: the discovery of more than three hundred planet-forming disks around young stars in the Orion Clouds, illustrating the diversity of physical conditions in which this process can occur; the first technical light of the JPcam panoramic camera at the Javalambre Astrophysical Observatory, the evidence of the existence of a second planet around Proxima Centauri, with a minimum mass of about six times that of the Earth and the discovery of two super-Earths around the brightest red dwarf star [GJ887] in our galactic environment; the study with the EHT of the innermost jet structure of 3C279, in the close neighborhood of the hot spots of the supermassive black hole and the accretion disk, the experimental proof that the seeds of the solid bodies of the Solar System looked like porous dust particles a few mm long, the detection with NOMAD@ExoMars of the green line of oxygen which provides information on the composition and dynamics of the Mars atmosphere; or the transformation of the Stingray nebula that has lost its brightness and changed shape in just two decades. All our results in 2020 have been published by in 270 publications in refereed journals, many of them showing our commitment in large surveys/projects/instruments such as GALANTE, CALIFA, ROSSETA, CARMENES, TESS, RED DOTS, EHT, J-PLUS, GALACTIC NUCLEUS, GAIA, MONOS, SMASHING, ALFALFA, OTEO, DESI, SOLAR ORBITER, Mars Express, ExoMars, ASIM, IPHAS, MEGARA, LaMMINGs, RadioAstron, SKA pathfinders and precursors, among others.

Concerning CAHA, on March 2020 the presentation of the proposals for legacy projects with present or newly proposed CAHA instrumentation, corresponding to the call released in December 2019, took place in an hybrid, all online meeting, just before the panemics shutdown. The Calar Alto Science Advisory Committee (SAC) was charged with the task of evaluating the proposals submitted. The evaluation considered the scientific strength of each proposal, the addition or maintenance of competitive instrument/technological capabilities where applicable, and the strategic value for the future of the observatory. The SAC recommended to proceed with feasibility studies for TARSIS and GAMAICA as a step to select one of the two projects in the future. Additionally, the SAC recommended the allocation of time to the legacy proposal corresponding to either TARSIS or GAMAICA, depending which one is selected after the feasibility study, once the instrument is operational. These feasibility studies were performed in 2020, and defended in spring 2021. On the other hand, three legacy proposals with existing instrumentation (CAVITY, KDBE and CARMENES-PLUS) were selected.

In this very special year, the IAA has also contributed to the research on COVID, in particular through the development of a prototype instrument to analyze surfaces contaminated by SARS-CoV-2 via polarimetric analysis, and the study of the influence of the State of Alarm in the light pollution levels. Despite the evident difficulties during 2020, there were many technological developments with important contributions from the IAA Instrument Development Unit (UDIT) for both space projects and ground-based instrumentation. The Solar Orbiter commissioning was performed via teleconference for the first time for a space mission due to the Covid-19 pandemic situation. UDIT has contributed to the instruments GALA & JANUS for the JUICE mission, to the Instrument Preliminary Requirements Review (IPRR) for Comet Interceptor, to the EMISSION concept design review, to PLATO, to LAGRANGE, and to the instruments TuMag and SKIP onboard Sunrise III. Referring to ground-based instrumentation, UDIT has contributed to the CAHA (CARMENES-PLUS, GAMA/C and TARSIS) and OSM (MIMA) instruments, besides new developments for the ESFRI infrastructures ELT and EST. We are very proud of the fact that our colleague Conchi Cárdenas obtained the 2020 MERAC Prize by the European Astronomical Society (EAS) for the best doctoral thesis in the field of new technologies (instrumentation). She received the award for her work PANIC, una cámara infrarroja de gran campo para Calar Alto (PANIC, an infrared wide-field camera for Calar Alto), based on her leadership qualities and her creative work in instrumentation related to the instrument PANIC.

IAA-CSIC is leading Spanish scientific and technological participation in the Square Kilometer Array (SKA), supporting academic groups and industry, as well as the Ministry, acting as a national and international point of contact, performing the functions of a SKA Office in Spain. SKA will be the world’s largest public data generator, with distributed processing centres interoperating around the globe (the so-called SKA Regional Centres, SRCs). Maximising the scientific return on Spain’s investment in the SKA requires a platform that provides specific support to users through the creation of a SRC in Spain, integrated into the international network of SRCs. The year 2020 has been instrumental for the development of a prototype of the SRC at the IAA, developing technical capabilities and expertise to host an SRC, strengthening scientific activities related to SKA and its precursors/ pathfinders, enhancing synergies for and beyond SKA, and fostering and enabling the application of Open Science principles. As you have probably noticed, the format of this report is changed with respect to previous years, with the aim of providing a quicker and more visual look. We are pleased to share with you the panorama of the activities developed at the IAA in 2020.
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 a number of 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
- Lowmass Stars
- Stellar Variability
- ARAE
- HETH

Radio Astronomy and Galactic Structure
- Stellar Systems
- PISM
- AGN jets

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 CSIC reference research center for the Calar Alto Observatory (CAHA).

Staff

213
Total member

Category and gender distribution

Permanent Staff (9 Female / 39 Male)

Postdoc Fellows (15 Female / 26 Male)

Predoctoral Researchess (10 Female / 23 Male)

Technicians/Engineers (11 Female / 56 Male)

Services (13 Female / 11 Male)

Age distribution

2020 results

267 SCI publications

34 press releases

8 meetings and schools

14 theses (PhD, Master, Degree)

15 courses

6 awards (including the Andalucía Medal 2020)

14.2 M€ total budget

International Staff

27 people in 15 foreign countries
The IAA Severo Ochoa Programme

Even in the hard circumstances we all faced in 2020, the IAA Severo Ochoa programme kept running, with full respect to the sanitary circumstances, and producing excellent results.

We confirmed a new electrical phenomenon in the Earth’s atmosphere, the production of blue flashes by cold electrical discharges. The molecular mechanism connecting oceanic iodine emissions and atmospheric particles, a process not yet included in chemical-climatic models, was revealed. We detected for the first time an elevated stratopause in Aurora, whose ultimate origin is not entirely clear. We captured the very first magnetic map of the surface of the Sun without human intervention from space with SQ/PHI, the instrument co-led by IAA onboard Solar Orbiter.

We showed, for the first time experimentally, that the seed of the solid bodies of the Solar System look like porous dust particles a few micrometers long.

With the instrument NOMAD on board ExoMars, we detected for the first time outside the Earth the green line of Oxygen in the atmosphere of Mars.

We put on evidence the existence of a second planet around Proxima Centauri, the closest star to the Sun. We participated in the discovery of a multiple planetary system around a massive star in the Solar environment called GJ887.

We participated in an ALMA and VLA joint work revealing a stellar nursery of hundreds of planet-forming disks in the Orion clouds. We captured with ALMA the evolution of a star in its way towards a planetary nebula, or the most probable binary nature of planetary nebulae with TESS. We provided the evidence of expansion at human time-scales in various nova explosions. We showed how the the Stingray planetary nebula, the youngest known, was fading through Hubble Space Telescope observations two decades apart.

We participated in the obtenition of a movie showing how a stellar black hole ejects matter and interacts with the medium. This black hole belongs to a binary system with a sun-like star as companion. We participated in the identification of a source producing very short duration radio bursts in the Milky Way, most probably produced by a magnetar (a neutron star with a very strong magnetic field).

We published the new (DR2) J-PLUS 12-band catalogue with almost 20 000 000 celestial objects, which will have a strong impact in the study of the evolution of galaxies. We led a study revealing the existence of two rotating gas disks in the vicinity of the super-massive black hole in NGC7449, and a third component indicative of turbulent motions, thanks to the unprecedented velocity resolution of the MEGARA instrument at GTC. We participated in the detection, for the first time, of differences between the galactic disks of active and non-active galaxies, based on the comparison of pairs of twin galaxies from the CALIFA survey.

We participated in the first study with MHONGOOSE, a legacy project with the SKA-MID precursor MeerKAT, showing the atomic Hydrogen distributions in some nearby galaxies with unprecedented quality.

We first unequivocally showed the connection between galaxy merging and jets, with the detection of a jet of material at very high speed emerging from the supermassive black hole of a galaxy in collision.

We observed transversal apparent super-luminal motion in the base of the jet of the quasar 3C279 with the EHT. A completely new window was opened towards the study of the time evolution of black holes with EHT, showing for the M87 black hole image that while the diameter of the ring remains constant with time, the ring is wobbling, revealing turbulent evolution of the hot plasma swirling around M87.

All our research produced 259 publications in refereed journals of the first quartile (Q1), more than one third led by IAA scientists. They provide a fair representation on the numerous projects we are involved in, among which we could highlight GALANTE, CALIFA, ROSSETA, CARMENES, TESS, Red Dots, EHT, EVN, J-PLUS, GALACTIC CENTER, GAIA, MONOS, SMASHing, ALFA, OTELO, DESI, SOLAR ORBITER, Mars Express, ExoMars, ASIM, IFHAS, MEGARA, OLeMINDs, RadioAstron, SKA pathfinders and precursors, etc.

Concerning our prototype of SKA Regional Center, the first stage of the platform was set up and started running. The Science Gateway started its implementation based on our participation on the H2020 ESCAPE project. We started the development of an archive prototype in collaboration with the technical group of the ASKAP precursor. User support was provided to four MeerKAT proposals involving eleven IAA members. An invited talk was given at the 75th United Nations General Assembly on the Open Science for sustainability and inclusiveness: the SKA role model.

Last but not least, contributing to the research on Covid-19 with our skills and tools, we have investigated the detection of coronavirus on surfaces with our Cosmic Dust Laboratory, and studied the impact of the strict confinement on the light pollution levels at the city of Granada.

Among our activities, either incoming or outgoing visits were obviously cancelled or postponed. We tried to give support to all those researchers that were at the IAA when the lockdown started, and helped them to get back to their home countries (Italy, Japan, South Africa, Germany...). Our SO-IAA Technical Office, together with the IAA General Services Unit, had an invaluable contribution to ease the whole process.

We transformed our Colloquia into a Web-Iloquia program, and hence kept open the access to high standard talks, which were attended by numerous researchers also from other institutions in Spain and abroad. Just to highlight two of the web-loquia, we had Andrea Ghez and Didier Queloz, Nobel Prices in Physics in 2020 and 2019, respectively. We also transformed our training activities into the online format, and had our introductory course to astronomy and astrophysics, a course on Gender analysis in research, and our first SO-IAA school on Machine Learning, Big Data and Deep Learning, co-organised with the Andalusian Institute of Data Science and Computational Intelligence (IDSci) of the University of Granada.

In addition to the SO-IAA report that was delivered and presented to the ESAB on February 2020, we also elaborated and presented the documentation required from the Spanish Research National Agency for the Mid-term evaluation of the Severo Ochoa project that took place on November. We were given the highest score by the International Evaluating Committee.
Research lines

The Sun, via spectropolarimetry, and their 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".

The 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: "Stellar Variability Group".

The supermassive Black Holes and their immediate environments, including their associated relativistic Jets: "Relativistic Jets and Blazars Group".

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".

The multiwavelength observations of high-energy phenomena and theoretical stellar evolutionary models: "High Energy Astrophysics and Robotic Astronomy Group (ARAE)".

The explosive transients and their host galaxy environments: "High Energy Transients and their Hosts (HETH) Group".

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

The supermassive Black Holes and their immediate environments, including their associated relativistic jets: "Relativistic Jets and Blazars Group".

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".

The multiwavelength observations of high-energy phenomena and theoretical stellar evolutionary models: "High Energy Astrophysics and Robotic Astronomy Group (ARAE)".

The explosive transients and their host galaxy environments: "High Energy Transients and their Hosts (HETH) Group".

The following pages present a summary of the results obtained in 2020 by the different research groups. The publications corresponding to the different highlights are identified in brackets, with the corresponding number in the publication list (from pag. 56 on).

Research lines:

- The physics of low-mass stars, exoplanets and associated instrumentation Group.
- The theoretical stellar evolutionary models: "High Energy Astrophysics and Robotic Astronomy Group (ARAE)".
- The explosive transients and their host galaxy environments: "High Energy Transients and their Hosts (HETH) Group".
- The galaxy structure and evolution, from the inner stellar and diffuse components to their large-scale cosmic distribution and evolution: "Galaxy Evolution Group".
- The supermassive Black Holes and their immediate environments, including their associated relativistic jets: "Relativistic Jets and Blazars Group".
- 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".
- The multiwavelength observations of high-energy phenomena and theoretical stellar evolutionary models: "High Energy Astrophysics and Robotic Astronomy Group (ARAE)".
- The explosive transients and their host galaxy environments: "High Energy Transients and their Hosts (HETH) Group".

Overview

The IAA’s Solar Physics Group (SPG) focuses on solar spectropolarimetry from all the three points of view: theoretical, observational, and instrumental. Investigations and developments are carried out on:

- The radiative transfer equation (RTE) for polarized light in the presence of magnetic fields,
- The inversion of the RTE for its use on the interpretation of spectropolarimetric measurements in terms of the thermodynamic, magnetic, and dynamic parameters of the Sun,
- The structure and physical nature of all kind of photospheric magnetic structures,
- The 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

Highlights in 2020

Temporal evolution of penumbral micro-jets (PMJ). The weak-field approximation reveals larger magnetic field changes in the upper photosphere than in the chromosphere during the PMJ maximum brightness stage. In the photosphere, the magnetic field inclination and strength undergo a transient increase for most PMJs, but in 25% of the cases the field strength decreases during the brightening. In the chromosphere, the magnetic field tends to be slightly stronger during the PMJs [232].

The scientific and instrumental description of the Polarimetric and Helioseismic Imager for Solar Orbiter were published with the co-leadership of the Solar Physics Group [233].

Trials were made to use artificial neural networks to accelerate the process of interpreting spectropolarimetric observations. The physical parameters inferred by the neural network show excellent agreement with the results from the inversion, and are obtained in a factor of $10^5$ less time. Additionally, substituting the results of the neural network back in the forward model, shows excellent agreement between inferred and original spectra [171].

Instrumentation

- Pre-development study of the DPU for the ESA’s Lagrange mission.
- Assembly and integration of the electronics unit of the SCIC instrument for Sunrise III.
- Further development of the TuMag and SCIP, in-house designed and manufactured, cameras.
- Launch of the ESA’s Solar Orbiter mission.
- Group members started leading the international consortium for the development of the tunable imaging spectropolarimeters for the European Solar Telescope.
Overview

The activities of this group are focused on four research lines: planets, minor bodies, exoplanetary atmospheres, and the Cosmic Dust Laboratory (CoDuLab). Broadly speaking, we aim at providing an integrated view of the Solar System and the atmospheres around exoplanets. Observational projects are being conducted from the ground as well as by using instrumentation on board space vehicles. The data interpretation is based on theoretical modeling, numerical simulations, and laboratory studies. We are involved in a number of space missions such as BepiColombo, ExoMars, JUICE, or Comet Interceptor.

Research lines
• Planets and minor bodies of the Solar System
• Dust in the Solar System
• Exoplanetary atmospheres

Highlights

Characterisation of the large trans-Neptunian object 2002 TC302. Stellar occultation, photometry, and astrometry data were used to provide dimensions, possible presence of a satellite, and lack of atmosphere or rings on this TNO [187].

Stellar occultations by TNOs: from predictions to observations. A chapter in the book "The Trans-Neptunian Solar System", describing how stellar occultations unveil the physical properties of those bodies, and the presence of satellites or rings around them. [Díaz et al., Elsevier, 2020].

Identification of large and possibly oriented particles in comet comae. Observations of 67P dust coma by Rosetta/OSIRIS gave a pronounced u-shaped phase function that might be interpreted by large and oriented absorbing particles. CoDuLab measurements of the scattering pattern of large and porous grains with absorbing inclusions confirm the theoretical interpretation, and agree with ground-based measurements of the degree of linear polarization [179].

Aerosol formation by iodine emissions. A gas-to-particle conversion mechanism helps to explain atmospheric aerosol formation through clustering of iodine oxides [85].

Understanding the atmospheric regions of HD 209458 b from where the escape originates. Atmospheric escape from this exoplanet was investigated by high-resolution measurements of the He I triplet absorption at 10830 Angstroms and 1D hydrodynamical modeling [137].

Detection of green line emission in the dayside atmosphere of Mars. Although predicted some 40 years ago, the observation of this line in Mars atmosphere had been elusive. This is the first time the 557.7 nm oxygen line dayglow emission is detected in a planetary atmosphere outside the Earth, thanks to measurements by NOMAD-UVIS on board ExoMars Trace Gas Orbiter [83].

Research lines
• Drivers of the Earth’s middle atmosphere variability and its impact on climate
• Atmospheric Electricity in Planetary Atmospheres
• Thermal structure and composition of the Terrestrial planetary atmospheres. Remote sensing of planetary atmospheres in IR/UV
• Characterisation of exo-atmospheres by modelling and analysis of ground-based and space measurements

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 on composition of lightning phenomena. About Mars, we study its temperature structure, dynamics, ionosphere and composition. We use a large variety of models and measurements from instruments on satellites, on ground and in the laboratory. More recently we started studying the giant exoplanets’ atmospheres by modelling and analysing ground-based CARMENES data.

Highlights

First Detection of a Brief Mesoscale Elevated Stratopause in Early Winter. The stratopause over the Northern pole jumped up 25 km in November 2009, the earliest in the season observed so far. It is very relevant, since it affects the downwards transport of NOx and H2O [with impact on stratospheric ozone] and on energy transfer through wave coupling [79].

ASIM confirms that blue optical detections are in-cloud large corona discharges, not lightning. ASIM measured (from the International Space Station) a succession of blue (337 nm) flashes in the UV without the presence of 777 nm optical signals (indicative for lightning). We developed a new method (combining with ground-based radio signals) that allows the identification of the source’s height inside thunderclouds. The results are important since corona discharges in thunderclouds can be a source of greenhouse gases like N2O and Q3. [234 – JGR Editor’s Highlight].

The atmospheric evaporation is a key mechanism in exoplanets’ evolution. The escape in these atmospheres had been studied so far through H Lyα, but with large uncertainties. The He triplet line offers a new window for studying the hydrodynamic escape. We analysed He triplet measurements of the hot Jupiter HD 209458 b taken by CARMENES with a developed hydrodynamic model and found unprecedented constraints on its temperature and mass loss rate. Also, its upper atmosphere resulted to be lighter (H/He~98/2) than previously thought [137].
Low-mass stars & exoplanets

Overview

Our group studies the physics of planetary systems and their low-mass host stars. M dwarfs are interesting by themselves and for their potential for the discovery of temperate rocky planets that could sustain liquid water. We work in several aspects of these systems, from the general statistics and observational distribution of their exoplanets to the astroseismic modelling and magnetic activity of their host stars. The group has expertise in theoretical studies of stellar structure and evolution, magnetic activity, astroseismology and technical development of new instrumentation. The group hosts the co-PI of the CARMENES consortium and one of the two PIs of the CARMENES Legacy-PLUS project.

Research lines

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

Highlights

CARMENES (Quirrenbach et al. 2020) is a worldwide unique instrument, co-led by the IAA. It is collecting high-precision radial velocities simultaneously in the optical and the near-infrared in what is the largest exoplanet survey of red dwarfs to date. Its NIR channel, designed and built at the IAA, has shown to be a groundbreaking instrument for the study of exoplanet atmospheres, opening new lines of research in this field. In 2020, the CARMENES Legacy-PLUS project was approved and started enlarging and deepening the original survey.

CARMENES has published, in-press, or submitted 76 papers and discovered 47 new planets. The CARMENES results have increased by 50% the number of planets in the parameter space probed by our instrument. In 2020, we continued our participation by leading the consortium and contributing to its work packages. We also continued our participation in the other large exoplanet survey in the southern hemisphere, keeping a line of research on stellar pulsations. In this line, we published keep a line of research on stellar pulsations. In this line, we published keep a line of research on stellar pulsations. In this line, we published keep a line of research on stellar pulsations. In this line, we published.

We are discovering unique systems that deepen our understanding of close-in terrestrial and super-Earth planets, as for GJ 1061 [67], the third nearest known compact terrestrial multi-planetary system, or benchmark examples for the performance of our instrument like GJ 1057 b [25], a super-Earth around a quiet mid-M dwarf. The publication (with worldwide Press Release notes) of the detection of a second planet around Proxima Centauri [77] and the nearest known compact terrestrial multi-planetary system, GJ 887 [115] also originate from this work.

To understand different aspects of planetary systems and their stars, we keep a line of research on stellar pulsations. In this line, we published the study of a selected sample of stars in NGC 6811, one of the four open clusters within the field of view of the original Kepler space mission [212]. All studied stars were found to be photometric variables, mainly as main-sequence Gamma Dor and Delta Scuti-type pulsators. Interestingly, and contrary to expectations, a high percentage of these stars showed variability modulated by their rotation, which indicates that stellar activity is common on the surfaces of these hot stars.

Stellar variability

Overview

The Stellar Variability Group focuses mainly on the study of stellar structure and evolution and its impact on the characterization of exoplanets, stellar populations and galactic archaeology using astroseismic techniques. The group is 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 spacecraft. Instrumental development is a fundamental part of the work of the group’s technical team. We have participated in the design and exploitation of the CoRoT space mission and, currently, we are strongly involved in the preparation of the PLATO (ESA) mission.

Research lines

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

Highlights

Asteroseismology allows the study of stellar interiors by analysing how oscillations (manifested at the surface of the star as bright variations or Doppler shifts) propagate at different depths depending on their frequency. The most informative and illustrative tool to analyse data from pulsating stars is the periodogram, since it shows peaks at the significant frequencies, thus allowing us to detect stellar pulsation periods. However, it is common to find peaks at other frequencies too, which are not solutions of the perturbed stellar structure equations though related to them. These are the so-called combination frequencies. This is the case in heat-driven pulsating stars such as RR Lyrae stars and Cepheids, white dwarfs, β Cepheids, δ Scvt stars and slowly pulsating B-type (SPB) stars, or even γ Dor stars, where the excitation mechanism is convective flux blocking.

When many pulsation periods are present in the data, these frequencies can compromise the mode identification in asteroseismic analyses. In [138] a method based on fitting the set of frequencies that best describes a general non-linear model was introduced. The method allows these frequencies to be removed from data, thereby improving the frequency analysis and enabling hidden frequencies to emerge from what was initially considered as noise.

Technological highlights of PLATO, where IAA is responsible for the MEU (Main Electronic Unit).

- Delivery of MEU EM to PLATO Consortium at the DLR.
- Successful integration of the MEU EM (Engineering Model) unit at DLR with the rest of the electronic units: N-FEE, SIS PSUs, ICU EM, SIS TM/TC.
- Assembly of the structural/thermal units MEU MTDs at IAA and tests.
STELLAR PHYSICS

ARAE
(Astrofísica robótica y de altas energías)

Overview
The ARAE research group was founded in 2001 (under the auspices of the PAI), 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 areas are multi-range observations of high-energy phenomena, theoretical stellar evolutionary models and models of stellar population synthesis. Significant technological developments are also carried out, regarding the robotization of small/medium size observatories and astronomical instrumentation development such as the BOOTES network of telescopes. We are involved in space-borne developments such as the BOOTES and astronomical instrumentation, and engineers are working on a new type of observatory. Scientists have also been some failed or partially erroneous projects. According to their activity in 1990. Scientists and engineers are working on a variety of projects, combining their strengths. Research areas are multi-range observations of high-energy phenomena, theoretical stellar evolutionary models and models of stellar population synthesis. Significant technological developments are also carried out, regarding the robotization of small/medium size observatories and astronomical instrumentation development such as the BOOTES network of telescopes. We are involved in space-borne developments such as the BOOTES and astronomical instrumentation, and engineers are working on a new type of observatory. Scientists have also been some failed or partially erroneous projects. According to their activity in 1990.

Research lines:
- Stellar Physics Theory
- Compact Objects in the Galaxy
- Cosmic Gamma-Ray Bursts (GRBs)
- Gravitational Waves (GW)
- Electromagnetic counterparts
- Robotic Astronomy
- Astrophysical Transients

Highlights
Gravity and limb-darkening coefficients for compact stars: DA, DB, and DBA eclipsing white dwarfs [54]
The distribution of the specific intensity over the stellar disk is an essential tool for modeling the light curves in eclipsing binaries, planetary transits, and stellar diameters through interferometric techniques, line profiles in rotating stars, gravitational microlensing, etc. However, the available theoretical calculations were mostly restricted to stars on the main sequence or the giant branch, and very few calculations are available for compact stars. In order to extend these investigations, we computed gravity and limb-darkening coefficients for different white dwarfs atmosphere models. The computations for different photometric systems were presented for a range of chemical compositions and gravity values and are now available via the Strasbourg astronomical Data Center (CDS) for the astronomical community.

A typological study of astronomical observatories [47]
The development of Astronomy as a science, construction systems and technology has led to an unplanned evolution of astronomical observatories as buildings. These changes have been consolidated through a process of trial and error in which certain innovations were discarded, while some new features were consolidated and other modifications replaced pre-existing solutions. As one would expect, during this process there have also been some failed or partially erroneous projects. According to the constant evolution of the parameters that determine the needs and technical possibilities of the observatories, this paper classifies these astronomical centers, proposing 10 types in the development of astronomical observatories throughout history, and study the features that define them to establish a basic knowledge that will serve the designers of future projects.

STELLAR PHYSICS

HETH
(High energy transients and their hosts)

Overview
The “High-Energy Transients and their Hosts” (HETH) group studies stellar explosions and their galactic environments. HETH focuses on gamma-ray bursts [GRBs] and their hosts from an observational perspective, but also studies different types of supernovae (SNe), magnetars, compact objects and other peculiar transients. The group also develops new tools, techniques and instrumentation for astronomy. HETH members have been part of the teams developing GROND at the 2.2m telescope in La Silla or X-shooter (VLT) and won with OCTOCAM the bid for the Gem4W3 call for the 8.1m Gemini South telescope. This concept is the base for the GATOS instrument that was proposed for the 10.4m GTC.

Research lines:
- Explosive transients: Gamma-ray bursts, supernovae, fast radio bursts, unusual objects
- Electromagnetic counterparts of gravitational waves
- Host galaxies of astronomical transients: Spatially resolved with IFU and unresolved
- Starburst galaxies from low to high redshift
- Late evolution stages of massive stars
- New instrumentation: OCTOCAM at Gemini, GATOS at GTC

Highlights
GRB 19014C in the nuclear region of an interacting galaxy [61]
GRB 19014C was the first GRB for which the MAGIC Cerenkov telescope reported the detection of very high energy emission (VHE) [ MAGIC collaboration, 2019, Nat. 575, 459, several HETH members are co-authors]. The emission likely originates from inverse Compton scattering in the GRB jet. HETH started a multi-wavelength follow-up campaign using ALMA, the VLT and HST (see Figure). These observations have resulted in several papers. In the one featured here we study the host galaxy of the event, that, contrary to many other long GRBs, occurred close to the center of the possible in a dense star cluster. The host has a close companion with which it is likely interacting. Both galaxies show strong CO emission, pointing to a dusty environment, unusual for a long GRB. We conclude that this dense environment might be crucial for the production of the observed high energy emission, which has only been observed in three other GRBs since.

NGC 2770: High supernova rate due to interaction [170]
Some galaxies have been observed to host a much larger amount of supernovae than the average. NGC 2770 is one of these supernova factories and previous works had not been able to explain its high SN rate [four in the last two decades]. This work studied the hydrogen content of the host his paper using HI and Hα observations. We concluded that NGC 2770 has an enhanced stellar production due to its interaction with several nearby companion galaxies some of which had not been identified previously.

GRANDMA observations of advanced LIGO’s and advanced Virgo’s third observational campaign [14]
GRANDMA is a collaboration to follow-up electromagnetic counterparts of gravitational wave sources. Several HETH members are part of the core team. GRANDMA is composed of 25 telescopes located literally around the globe. This paper describes the observing strategies and reports the follow-up campaign corresponding to the 3rd observing run, in which the collaboration observed 90% of the triggers produced by the gravitational wave observatories.
Stellar systems

Overview
The Stellar Systems Group (SSG) was created in 1988. The group's development is based on the two basic concepts of internationalisation and specialisation. Our research lines are stellar clusters, massive stars, and the Galactic Centre. Currently, the group is studying the connection between star-forming processes and spatial and kinematic structures at different scales (http://ssg.iaa.csic.es). It has finished an unprecedented study of the Galactic Centre region (https://ssg.iaa.csic.es/research/galacticnucleus-project) and is creating the most complete catalogue of Galactic massive stars to this date.

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

Highlights
The Galactic Centre is the only nucleus of a galaxy that can be observed on milli-parsec scales. It is a unique target for understanding galactic nuclei and star formation in conditions that approach those in high-redshift star-forming galaxies. The Galactic Centre group aims at understanding its structure and formation history and studies present-day star formation in this region. Among the results obtained by the GCG in 2020, we provided:

- Demographics, binary black holes, and horizons at parsec scales
- Phenomenology from the relativistic jet emanating from the SMBHs environment with an unprecedented angular resolution of 24 micro-arcsecond
- Polarimetric images obtained revealed complex structures and a remarkable curved morphology in the inner 100 micro-arcseconds, along with signatures of a helical magnetic field threaded to the jet plasma flow.

AGN Jets
Relativistic Jets & Blazars

Overview
The main research topic of our group is the study of supermassive black holes (SMBHs) 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 the space antenna RadioAstron. Thanks to these instruments, 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 black holes and gravitational waves

Highlights
The prototypical quasar 3C 279 is one of the best-monitored sources in the sky, as it has provided the first signs of apparent superluminal motions. The EHT observed the source at 1.3 mm on 2017 April 5, 6, 10, and 11. Out of these observations, we reconstructed the sharpest image ever of 3C 279 (see main figure) at an angular resolution of 20 micro-arcseconds (1700 Schwarzschild radii). The combination of the observed data revealed an elongated nuclear structure, in spatial scales close to the jet apex. Additionally, day-to-day structural variability was detected, matching the model of traveling shocks or instabilities in a bent, maybe rotating jet. Lastly, the low intrinsic brightness temperature indicates that either the local plasma is optically thin at the given frequency or the energy budget at those spatial scales is magnetically dominated.

Jointly with 11 radio-telescopes across the Earth, the orbiting antenna RadioAstron observed the BL Lac object 0716+714 in January 2015. We were able to detect the source at a maximum ground-space distance of 5.6 Earth diameters, which allowed us to resolve the innermost region of the relativistic jet emanating from the SMBHs environment with an unprecedented angular resolution of 24 micro-arcsecond. The polarimetric images obtained revealed complex structures and a remarkable curved morphology in the inner 100 micro-arcseconds, along with signatures of a helical magnetic field threaded to the jet plasma flow.

PG1055+113 is the first blazar showing a ~2 yr quasi-periodic pattern in its gamma-ray light curve. This behavior might be related to the precessing nature of the jet and the peculiarities in the central black hole(s) system, or to accretion rate modulations. We investigated the source pc-scale radio emission properties with a multi-frequency and multi-epoch very long baseline array monitoring. We find a limb-brightened jet, with a time variable position angle, and no clear periodic patterns in the radio light curve. This indicates that, besides geometrical effects, additional mechanisms are required to explain the high-energy emission variability pattern. Moreover, the intrinsic brightness temperature indicates that the energy in the core region is dominated by the magnetic field.
Overview:
We study the formation, evolution and death of stars at different mass and spatial scales across different environments. The early stages of star and planet formation are studied through radio interferometric observations and modelling of the observed emission. The final stages of a star’s life 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.
Exo-planetary systems are studied through the observation of the radio emission from star-planet interactions. Radio interferometric monitoring of supernova explosions and their distribution in Ultra Luminous Infrared Galaxies is also carried out to determine the SN and star formation rates.

Highlights
Nova explosions are non-destructive thermonuclear runaways taking place on the surface of white dwarfs accreting material from a companion. An investigation of the angular expansion of a sample of five nova shells has allowed us to conclude that the nova ejecta has free expansion until it disperses into the interstellar medium, i.e., the material ejected in these events is not slowed down by the circumstellar medium [22]. This result has significant implications for the determination of the time-span of nova shells and so for their rate and recurrent time-lapses.

It has been well established that planet formation takes place in so-called protoplanetary disks. These are frequently found around young, low-mass stars, but their presence around high-mass stars is less well studied. We have carried out the first detailed modeling of a disk around a massive protostar, the one driving the HH80-81 system [12] that has been imaged by ALMA with a degree of detail similar to that of protoplanetary disks in low-mass stars. Our modeling reveals that the disk is hotter than similar low-mass disks, with temperatures above 200 K everywhere in the disk, thus precluding the formation of Jupiter-like gaseous planets in this environment, and allowing only that of rocky planets.

Research lines
- Massive stars and their surroundings. Supernova remnants and wind-blown bubbles
- Star and planet formation. Modeling and observation
- Planetary nebulae and their precursors
- Star-planet interaction of exoplanetary systems
- Luminous and Ultra Luminous Infrared Galaxies
- Prospective Science work for the Square Kilometre Array

Overview
Our group is interested in theoretical gravity, both at the classical level and specially on those situations in which General Relativity (GR) 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 part 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
- Gravitational collapse and semiclassical gravity
- Black holes and ultracompact objects
- Analogue and emergent gravity
- Group theoretical quantization
- Origin of masses of elementary particles

Highlights
Schwarzschild geometry counterpart in semiclassical gravity [16]
Semiclassical gravity is the most conservative way to incorporating into GR the first modifications caused by the quantum nature of matter and the vacuum. The quantum vacuum is understood as a non-empty entity which can become a source of the Einstein equations even in the absence of matter. The contribution of the quantum vacuum to the stress-energy tensor can be renormalized to zero when the spacetime is flat but not any more when the spacetime acquires curvature. We solved self-consistently the equations of semiclassical vacuum GR in spherical symmetry. It is well known that the solutions of the classical equations are Schwarzschild black-hole spacetimes with different masses. Instead, we found that the solutions to the semiclassical equations are asymmetric wormholes with different neck sizes. These wormholes does not have any horizon and develop a null singularity in an internal asymptotic region. To understand these solutions is necessary intermediate step in understanding stellar semiclassical configurations.

Asymptotic horizon formation, spacetime stretching and causality [22]
In our group it was proved that semiclassical effects can become significant in geometries in the verge of developing horizons or when some stretching is present. We took an entire family of geometries of this sort and analyze them from the causal point of view. The family splits into two subfamilies. In one we show that almost in all the situations there appear a Cauchy horizon beyond which the geometry can be extended. On the other subfamily the geometry is non-extensible but has two null infinities on either side of the horizon. We also analyze whether to attain these geometries it is necessary or not to violate the energy conditions of GR.
Galaxy Evolution

Overview

The group conducts observational and theoretical studies on galaxy structure and evolution and cosmology. These range from the inner stellar and gaseous components of galaxies to their large scale cosmic distribution and evolution. We also participate in instrumental and technological projects. The main topics include star formation, the diffuse medium in stellar clusters and in galaxies, and galaxy groups and clusters, the nuclear activity in galaxies and their interplay with stellar evolution, or the environmental dependence of the structure and evolution of galaxies. These activities include supervising PhD, teaching at master and doctoral levels, public outreach conferences, and eScience.

Research lines

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

Highlights

The circumnuclear region of the active galaxy NGC7449 was studied [49] at the highest spectral resolution [R-20 000] provided by the integral field spectrograph MEGARA attached to the Gran Telescopio Canarias. The unprecedented resolution allowed the detection of three emission line kinematic components in the ionized gas. Two of these components correspond to disks that co-rotate in the sample plane, one thinner than the other; star formation seems to be the dominant mechanism of ionization in the thinner disk, whereas shocks ionize the second disk. The third kinematic component does not show any rotation and is ascribed to non-rotational, turbulent motions most possibly associated to the presence of winds or outflows. In the very nuclear region of NGC7449 (at distances to the nucleus smaller than 1.85 arcseconds), a very broad (FWHM=2590 km s⁻¹) Hα component contributes to the emission in the spectral region of Hα-[NII], tracing the broad line region of the Seyfert nucleus.

Mapping the ionized gas of the metal-poor H II galaxy PHL 293B with MEGARA [120]. PHL 293B is a local, extremely metal-poor, high ionization galaxy. This makes PHL 293B an excellent analogue for galaxies in the early Universe. Bidimensional spectroscopic observations with MEGARA@GTC report low intensity broad emission components and blueshifted absorptions in the Balmer lines (Hα, Hβ) which are located in the brightest zone of the galaxy ISM. A chemically homogeneity, across hundreds of parsecs, is observed in O/H, taking the oxygen abundance 12+log (O/H) = 7.64 ± 0.06 derived from the PHL 293B integrated spectrum as the representative metallicity for the galaxy. These IFU data reveal for the first time that the nebular He II λ4686 emission from PHL 293B is spatially extended and coincident with the ionizing stellar cluster, and allow to compute its absolute He II ionizing photon flux. Wolf-Rayet bumps are not detected excluding therefore Wolf-Rayet stars as the main He II excitation source. The origin of the nebular He II λ4686 is discussed.

The AMIGA team continued its deep involvement in the preparation of SKA. In science, we highlight the study of the ALFALFA (Arecibo Legacy Fast ALFA survey) sample to obtain the HI mass function (HIMF) of galaxies in groups [116]. We obtain that for dwarf galaxies the distribution is significantly flatter than for the full sample, consistent with studies of individual groups. This is part of a line of research focused on the study of groups. Together with previous works, this led AMIGA to be awarded with telescope time in the first MeerKAT Call open to the international community to study Hickson Compact Groups.

Technological activities included the contribution to the development of the Science Analysis Platform for the European Open Science Cloud (ESCape -H2020). The SKA Regional Centre (SRC) prototype platform was deployed and used in the SOMACHINE 2020 school, with support from the IAA Severo Ochoa programme. AMIGA also contributes to the design of the international SRC network. The team is becoming a reference in promoting SKAO as a role model for Open Science and inclusiveness, a topic in which AMIGA PI was invited to give a talk in the SKA session held at the 75th anniversary of the UN General Assembly. SKA coordinating activities continued, including contribution to the negotiation of contracts for Spanish industry.
Overview
Since its foundation in 1975, the Instrumental and Technological Development Unit (UDIT) has focused on the development of state-of-the-art instruments for ground-based telescopes and space-borne astrophysical payloads. The UDIT covers the analysis, design, development at the UDIT have placed instrumentation. The instruments developed at the UDIT have been used in two main areas:
- Ground-based telescopes and stratospheric balloon observatories
- Interplanetary scientific space missions and stratospheric balloon observatories.

Ground-based instruments:
- MOSAIC (Multi-object spectrograph for ELT): The IAA contributes with the hardware and control software for the cryogenic mechanisms of the IR spectrograph. The activities in 2020 were focused on the design, assembly and testing of the first hardware prototype: two CPUs, two motors and I/D boards and a motor control board. The second version of the ESO high level software was also tested.
- MIMA (Multi-Spectral Imager Mopassave Airglow): Based upon a well-proven concept of the instrument SATI (OSN), MIMA is a portable ground based image (2D) VIS-NIR spectrometer with 5 channels for long-term monitoring of mesopause changes. In 2020, most of the mechanical parts of the instrument were manufactured and the MIMA Control Software (MCS) which is in charge of managing the system (filter wheel, CCD, temperature control...), was released, tested and ready for the AIU campaign.
- GALIUS (GaAnada Lightning Ultrafast Spectrograph) is a portable, high spectral resolution imaging spectrograph that achieves unprecedented high speeds. In 2020 it allowed the detection of CO in rays using spectroscopy, which was confirmed with complementary chemical techniques. Additionally, an estimation of the temperature and pressure radial profiles with high velocity spectroscopy was carried out, as well as estimations of temperature maps from images taken with a beam splitter (700 kfps). A cryostat was manufactured to perform discharges and arcs at different pressures (100-1000 mbar) to analyze optical spectrum and electrical characteristics.
- CARMENES-PLUS is aimed at upgrading the CAHA instrument CARMENES. In 2020 the instrument current radial velocity long-term stability was improved from 8 m/s to 1 m/s. Also the final designs of the automatic vacuum system for cooling lines and that of the warm-up system for the exhaust gas at the exit were carried out.

Activities in 2020
Concerning other CAHA instrumentation, the UDIT continued to work in PANIC (Panoramic Near Infrared Camera for Calar Alto) through the adaptation of the instrument software to the new detector. The UDIT also participated in the feasibility studies of the two potential instruments for next generation instrumentation, GAMAICA and TARSIS. GAMAICA is a multiple spectrograph, with 4 channels (extended to 8) by IFUs. The IAA participated in the assessments for the pre-optics, front-end optics and optical fibers, and also carried out the project management and systems engineering tasks. TARSIS is a new wide-Field, blue-optimized, intermediate-resolution Integral Field Spectrograph (IFS). The IAA participated in the definition of the instrument control package concept.

Space projects
Concerning other CAHA instrumentation, the UDIT continued to work in PHIL (Panoramic High-Definition Imaging for Solar Orbiter, SQ). The IAA is the PI co-PI institution and its Solar Physics Group (SPG) coordinates the Spanish team. The PI is also responsible for the electronics unit and the harness work packages and scientific core of the instrument, the RTE inversion algorithm implemented in an FPGA. The SQ mission was successfully launched in February and in 2020 the main technological activities were focused on the PHIL instrument commissioning.
- GALA (GAnymede Laser Altimeter) and JANUS (Jo- vis, Amorum ac Natorum Undique Scrutator) for the ESA mission Solar Orbiter. SQ. The IAA is the PI co-PI institution and its Solar Physics Group (SPG) coordinates the Spanish team. The IAA is also responsible for the electronics unit and the harness work packages and scientific core of the instrument, the RTE inversion algorithm implemented in an FPGA. The SQ mission was successfully launched in February and in 2020 the main technological activities were focused on the PHIL instrument commissioning.

Concerning other CAHA instrumentation, the UDIT continued to work in PLATO (PLanetary Transits and Oscillation of stars). The IAA is responsible for its 2 Main Electronic Units (MEUs). Each MEU is equipped with 6 Digital Processing Units (DPUs) and 2 SpaceWire routers also under IAA responsibility. In 2020 several Engineering Models for different purposes were tested and delivered. One was successfully integrated with the ICU Engineering Model. The IAA also worked in the MEU Mass Thermal Dummy.

SUNRISE III is the third mission of the Sunrise solar 1m telescope. The IAA manages the TuMag instrument consortium and is responsible for the electronics, harness, control software and the electronics and mechanics of the scientific cameras of TuMag and SCIP. In 2020 the SCIP Flight Model cameras and E-Unit were manufactured, tested and delivered to NAGI team. The TuMag CDR was held and the flight model cameras were manufactured.

ENVISION is an ESA orbital mission proposal to Venus to perform high-resolution radar mapping and atmospheric studies. In 2020, the IAA worked in several pre-developments for the Polarimetric Magnetic Field Image instrument. The major effort was devoted to the definition of the PMI DPU concept, an optimized, novel approach based on PHIL PDU.

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EnVision is an ESA orbital mission proposal to Venus to perform high-resolution radar mapping and atmospheric studies. In 2020, the IAA worked in the preparation of the CoDR documentation package for the power supply of the instruments Venspec (Venus Spectroscopy) and VEM (Venus Emission mapper).

Comet Interceptor is an ESA mission that comprises three spacecrafts, to study a pristine comet. IAA worked during 2020 in the Instrument Preliminary Requirements Review (IPRR) and participated in an ESA contract for the development of prototypes for the DPU of the instruments EnVisS and OPIC, and the power supplies for other instruments.
Calar Alto Observatory (CAHA)

Overview

CAHA is a Spanish Unique Scientific and Technical Infrastructure (ICTS), and is the most important observatory with optical telescopes in continental Europe. Its main telescopes have apertures of 1.23, 2.2 and 3.5 metres. It also has a fireball detection system that covers the whole sky visible from the observatory. The telescopes provide a wide variety of astronomical instrumentation in the optical and near-infrared range, as well as direct image sensor cameras and low-, high- or very-high-resolution spectrographs.

Highlights

A group of astronomers from the University of Guanajuato (Mexico) and from the CALIFA survey collaboration studied the effects of gravitational perturbations on the star formation rate in a subsample of CALIFA galaxies in the Local Universe. They found that regions hosting recent star formation in perturbed galaxies follow a different star formation rate vs. stellar mass relation, compared to non-perturbed ones. The difference found in star forming regions of perturbed galaxies compared to those of non-perturbed galaxies could be indicative that encounters with nearby galaxies generate radial gas flows toward the centers of galaxies. In turn, these flows enhance the star formation rate of the internal regions of perturbed galaxies. Star formation in gravitationally perturbed galaxies. Morales-Vargas, A. et al., MNRAS 499, 4370 (2020)

Habitable moons around cool nearby stars: from science fiction to reality [255].

Observations with the CARMENES spectrograph have revealed relevant information on the M-dwarf planetary system CJ 1148. This system, known to host two gas giants exoplanets, one of them CJ 1148b orbiting in the habitable zone. Using refined dynamical analysis of CARMENES data, and self-consistent dynamical models suggest that although there is a narrow stability region around this planet where exomoons could exist, they would exhibit quick orbital decay due to tidal interaction with the planet. Thus, any sufficiently large exomoon that could sustain an ocean or an atmosphere would become a victim of the system’s unique dynamics.

Promising scientific and technological new developments for Calar Alto

On March 12th-13th 2020, a workshop on new instrumentation and legacy projects for Calar Alto was held at IAA-CSIC headquarters. From the several projects presented in this workshop, the CAHA Scientific Advisory Committee selected three observational legacy projects:
• CAVITY (Calar Alto Void Integral-field Treasury surve): observations with PPAK/PMAS of galaxies inhabiting the loneliest regions of the local Universe.
• KOBE (K-dwarfs Orbited By habitable Exoplanets): observations with CARMENES of K-dwarfs orbited by potentially habitable exo-planets.
• CARMENES Legacy-plus: extension of the CARMENES survey, detection and characterizations of planets around M-dwarfs, the occurrence rate of long-period giant planets – GJ3512-like planets – and the characterization of exoplanet atmospheres.

In addition, the conceptual designs of two new generation instruments, both co-led by researchers of the IAA-CSIC were also preselected for the feasibility study phase, after which one of them will be selected for construction:
• TARSIS (Tetra-ARm Super-Ifu Spectrograph), co-led by Complutense University of Madrid and IAA-CSIC, presents a design optimized for the UV range to study cosmological evolution through the observation of distant galaxies.
• GAMAICA (Galaxy Mapper Instrument at Calar Alto), co-led by the Astrophysics institutes in Postdam and IAA-CSIC, mainly targets the local Universe, namely the Andromeda galaxy and galaxies in Virgo, the closest cluster of galaxies.
• Last but not least, an upgrade of the CARMENES instrument – called CARMENES-PLUS – is foreseen to improve the already remarkable stability of its infrared channel. This update will allow to extend its successful search for rocky planets around a new and large sample of M-type red dwarf stars, in addition to fine tune its ability to detect and characterize atmospheres possibly similar to the one of the Earth.

A more sustainable observatory: Calar Alto will be converted into an “energy island”
The Calar Alto Observatory, the largest optical observatory in mainland Europe, will partially replace its energy sources in the next months to reduce its ecological footprint, thanks to a European Regional Development Fund (ERDF/FEDER).

By implementing the Calar Alto energy island, we intend to be a world reference for other professional observatories as a management model that helps the environment, with an estimated reduction of a hundred and sixty tons of carbon dioxide per year and the resulting optimization of the associated costs.

The project includes the installation of a biomass boiler to substitute diesel fuel for heating and hot water, a solar power production system, and changing the observatory vehicle fleet for electric cars.

On one hand, this project aims at optimizing the way we consume and produce energy at the observatory. On the other hand, we want to demonstrate that it is possible to guarantee the power supply in extreme climatic conditions for a high-tech facility, in altitude, while generating savings and reducing enormously our impact on the environment.

This project is funded by the ERDF/FEDER program ICTS2017-07-CAHA-4 and by the ICTS support program CAHA-16-CE-3978.

Solar Orbiter spotted with the Schmidt two days after launch. February 12th 2020

Using the Calar Alto Schmidt telescope remotely from Italy, a team from the Planetary Defence Office of the European Spatial Agency (ESA) managed to observe the Solar Orbiter satellite and booster two days after launch from Cape Canaveral. The observations were obtained in coordination with ESA’s Near-Earth Object Coordination Centre (NEOCC).

After the ESOC’s Mission Analysis team computed an accurate post-launch trajectory, the Schmidt telescope pointed to the expected position, and Solar Orbiter was indeed recovered in the field.

Solar Orbiter is now on its way towards Venus, before heading finally to the Sun. By 2022 and for a nominal duration of seven years, it will give us for the first time a close-in view of the poles of our star, so important for the understanding of the solar wind and the magnetic field, which have strong consequences on our life (and telecommunication system) on Earth. Solar Orbiter includes the SO/PHI instrument co-led by a team from IAA-CSIC in Granada.
Several ToO programs were running, for the follow-up of Gamma Ray burts by the HETH and the ARAE groups, as well as for Stellar occultations by dwarf planets, transneptunian objects (TNOs), and centaurs.

The OSN also performed observations related to educational activities, such as observing practices of the Master in Astronomy and Astrophysics organized by the Valencia International University.

Although guided visits for the general public are traditionally organized in the summer months at OSN with great success, they had to be suspended in 2020 due to security reasons relating to the pandemic situation.

The IAA Sky Quality Office, who works to preserve the sky quality in Andalucía, used its several instruments located at the OSN to continuously monitor the sky brightness in different filters providing the acquired data to the Red Española de Estudios sobre Contaminación Luminica (REECL).
Public Outreach

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

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 2020: 60, 61, 62.

Lucas Lara popular talks
These conferences began in 1995. We celebrate nine talks every year. VIEW>

El Radioscopio, a weekly popular science radio program in collaboration with Canal Sur Radio and broadcasted by Radio Andalucía Información. VIEW>

Alicia Pelegrina, Head of Severo Ochoa Office-IAA Support Office, was awarded second prize at the "Famelab 2020" scientific monologue festival. VIEW>

The European Researchers’ Night takes place every year all over Europe the last Friday of September. The IAA-CSIC took part in the event in Granada on Friday 25. Due to COVID-19 restrictions, the activities were mostly online: 10 talks for the general public, two talks for students, participation in live online programming and participation in the Canal Sur television programme. VIEW>

"El enigma Agustina", science documentary. Presentation, shows and selection in festivals. VIEW>

PRE-EST project (European Solar Telescope). Communication support and recording of the documentary "Reaching for the Sun" (in production). VIEW>

11 February, International Day of Woman and Girls in Science and 8 March, International Day of Woman: Different informal meetings with Women Researchers, engineers and technicians at the IAA were held for the educational centres in Granada with the aim of highlighting the role of women in the different branches of science and Cineforum El enigma Agustina, with Carmen Magallón Puertolés and Cristina Prieto Sánchez (UMA) VIEW>

Calar Alto Observatory Communication. The IAA-CSIC Communication, Education and Public Outreach Unit is in charge of the communication of the Observatory.

Astronomía Accesible. This project aims at emphasizing the popularization of astronomy among blind and low-sight people. VIEW>

Jupiter-Saturn planetary conjunction. Outreach activities related to the alignment of Jupiter and Saturn. Remote observation broadcast live on our youtube channel. It currently has about 35,000 views. VIEW>

Pilares e incertidumbres. IAA-CSIC audiovisual project in which we talk about what we do not know about the universe. VIEW>

Dissemination of different outreach resources on television channels such as La 2, Canal 22 (Mexico) or platforms such as #cienciamelladecasa (Fundación Descubre).

Weekly collaboration in the Radio 3 programme Hoy Empieza Todo (Daniel Guirado).

Weekly collaboration in the Radio 3 programme Hoy Empieza Todo (Daniel Guirado).

El camino de los planetas. A project whose objective is to promote research and planetary exploration among the citizens of Granada. It has included activities, the development of tactile models of celestial bodies and two publicity campaigns in the streets. VIEW>

Mil millones de ojos para mil millones de estrellas. Exhibition on the Gaia mission. Collaboration. VIEW>

Calar Alto Observatory Communication. The IAA-CSIC Communication, Education and Public Outreach Unit is in charge of the communication of the Observatory.

Participation in Granada: ciudad de la Ciencia y la Innovación, a FECYT funded project of the largest institutions in Granada to bring science and knowledge closer to citizens.

Marte. La conquista de un sueño. Exhibition on Mars. Collaboration with Ciutat de les Arts i Ciències, Fundació Telefónica and Generalitat Valenciana. VIEW>

Astronomía Accesible. This project aims at emphasizing the popularization of astronomy among blind and low-sight people. VIEW>

Publications

The research activity carried out at the IAA-CSIC during 2020 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 2020, this activity resulted in 267 papers published in journals of the SCI.

The complete list of the IAA-CSIC publications in 2020 is given in the Annex at the end of this report. The evolution of the number of SCI publications since 2014 is shown below. Along the years, the number of publications fluctuates around an average value of 270 papers per year.

The publications of the IAA-CSIC are mostly distributed in high impact journals. About 91% of our publications appeared in journals of the first quartile (top 25% journals, or Q1). Among these publications, 14% appeared in the first decile (top 10% journals, or D1). 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. About 16% of the IAA SCI 2020 publications are led by IAA scientists, i.e. their first author belongs to the IAA. This is consistent with the leadership of the IAA in the last 5 years.

Workshops & meetings

Meetings

Public Surveys and new instrumentation for Calar Alto Observatory

INTERNATIONAL WORKSHOP
Granada, March 12th-13th, 2020 (In person & virtual)
IAA MEMBERS OF THE SOC:
J. Iglesias, I. Márquez, J. Aceituno
IAA MEMBERS OF THE LOC:
J. Iglesias, C. Kohring, C. Rodríguez, A. Arroyo

Astronomical Data Analysis Software and Systems

INTERNATIONAL MEETING
Granada, Nov 8th-12th, 2020 (Virtual Format)
IAA MEMBERS OF THE SOC:
J. Ruiz del Mazo
IAA MEMBERS OF THE LOC:
J. Ruiz del Mazo

Scientific writing and presentation in Astronomy

Granada, Sep. 16th-17th, 2020 (Virtual Format)
https://forms.gle/EcLmmMHW93LiPMyN9

El cielo oscuro como recurso científico, cultural, medioambiental y turístico

Sevilla, Oct. 6th-9th, 2020 (Virtual Format)
https://www.iaa.csic.es/meetings/el-cielo-oscuro-como-recurso-cientifico-cultural-medioambiental-y-turistico

SOMACHINE Machine Learning, Big Data, and Deep Learning in Astronomy

IAA-CSIC, Nov. 23th-27th, 2020
IAA MEMBERS OF THE ORGANIZING COMMITTEE:
R. Schoedel
IAA MEMBERS OF THE LOCAL ORGANIZING COMMITTEE:
A. Pelegrina López, M. González García
https://www.granadacongresos.com/somachine2020

Schools

Open Science Droplets
Granada, Feb. 25th-29th, 2020
https://droplets-spirc.readthedocs.io

Course on gender analysis in research
Granada, June 25th–July 24th, 2020
(Virtual Format)
https://www.iaa.csic.es/meetings/course-gender-analysis-research

Panoptic spectroscopy of our universe with OSIRIS+MAAT at GTC

INTERNATIONAL MEETING
Granada May 5th, 2020 (Virtual Format)
Overview

The IAA has been characterized by its support of inclusive initiatives in Gender Equality. This trajectory has crystallized in 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. Here we present the gender diagnostic and main activities for the year 2020.

During the year 2020, the Equality Commission continued its work of advising on the necessary or appropriate measures to actively integrate the principle of gender equality between women and men in the daily life of the centre, as well as organizing events to raise awareness of the role of women in science. In October 2020, some of its members were renewed.

Highlights

In addition to ensuring the gender equality measure, the Gender Equality Commission 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, and the following actions have been contemplated:

1) Hypatia of Alexandria Visiting Grant: 3 visits of the visiting researchers programme, out of the 9 offered, were given by female researchers.
2) Vera Rubin Colloquium: A minimum of 9 colloquia, out of the 17 offered, were given by female researchers.

Gender Activities in 2020 in the center

- Production of the annual statistics segregated by gender.
- Organization of activities for the International Day of Women and Girls in Science (11 February). Different informal meetings with Women Researchers, engineers and technicians at the IAA were held for the educational centers in Granada with the aim of highlighting the role of women in the different branches of science and included open discussion, reflection and questions about gender roles and the existing stereotype around science, technology and engineering.
- From the IAA we count with the participation of the researchers: Rocío Ortega Calvo, Cristina Rodríguez Lópe, Mayra Osorio, Ascensión del Olmo, Carmen Pastor, Olga Muñoz and Laura Hermosa as well as students from 3rd course of ESO of IES Jiménez de Quesada and 20 pupils of CEIP Abencerrajes (11-12 years old).
- Organization of activities for the International Women’s Day (March 8). Two open activities were organised: Feminism in STEM areas, with the participation of María José Cáceres (UGR) Evangelina Santos Álvez (UGR) and Carmen Magallón Puertolés (Fundación Seminario de Investigación para la Paz) and the Cineforum El enigma Agustina, with Carmen Magallón Puertolés and Cristina Prieto Sánchez (UMA).
- Outreach activities: Lecture for students about Women and Astronomy by Sara Cazzoli (IAA) at the GRAVITE festival. Five online lectures by women researchers from the IAA at the European Researchers’ Night 2020. Alicia Pelegrina, Head of Severo Ochoa Office-IAA Support Office, was awarded with the second prize at the Fameslab 2020 scientific monologue festival.
- The librarian of the IAA-CSIC disseminate in open access the activities on gender developed in the IAA equality plans, articles, IAA magazine, material of spreading, and any other activity carried out in the IAA. All the materials are located in the Institutional Repository CSIC, guaranteeing in this way their preservation in the long term.
- We continued to collaborate with scientific outreach magazines and the newspapers El País, Granada Hoy and Ideal. In the IAA magazine Información y Actualidad Astronómica, several articles were published with the aim of making visible female scientists who have contributed significantly to the development of astronomy.
- Gender equality course: In June and July 2020 the online course Inclusion of Gender Analysis in Research and Innovation took place. This course was led by Capitolina Díaz, Professor of Sociology at the University of Valencia. This course was aimed at improving the competences of research staff and doctoral students in the inclusion of the gender perspective both in projects and doctoral thesis work as well as in research projects and scientific articles. About 20 people attended (60% women, 40% men). The response to the course by the students was highly satisfactory.
- Gender Equality and COVID-19 Questionnaire: An online evaluation survey was launched on 22 October among IAA-CSIC members to collect data on the impact of the COVID-19 health crisis actions taken at work. The results were published in March 2021.
- CSIC Gender Equality Commissions Meeting: In November, we participated in the first meeting of the CSIC Gender–Equality Commissions. The conference, developed in the framework of the European project LeTSGEPs, was organised by the ICM-CSIC in coordination with the CSIC Gender Equality Commission. The IAA-CSIC Gender Equality Commission presented its activities and then several of its members participated in group discussions.
- IAA-CSIC Activities Gender Impact Report: During the last months of 2020, the IAA Gender Equality Commission worked on the elaboration of a short gender impact report that all activities (courses, congresses, meetings, dissemination activities, etc) with the participation of the IAA-CSIC, either as organiser or co-organiser, must fill out to assess the level of compliance with the IAA-CSIC Gender Equality Plan.


Olivia Pelegrina, 2nd prize at Fameslab 2020.

Online course Inclusion of Gender Analysis in Research and Innovation.
In 2020, the IAA-CSIC was awarded the Medalla de Andalucía, an honorary distinction granted by the Junta de Andalucía in recognition of extraordinary actions, services and merits, in the category of Research, Science and Health.

On the fortieth anniversary of the constitution of Andalusia as an autonomous community, the forty-five years of work of the Instituto de Astrofísica de Andalucía are recognised, which have culminated in a privileged position in the international environment, both in astrophysics research and in technological development for space, and in the distinction as a Severo Ochoa Centre of Excellence. This Medal is an honour for all of us, which gives us a new dose of enthusiasm and determination to continue developing top-level science and technology, said Antxon Alberdi, director of the IAA-CSIC.

In addition, the researchers José Luis Gómez and Antxon Alberdi were awarded with the Bandera de Andalucía de Granada 2020 for their participation in obtaining the first image of a black hole with the Event Horizon Telescope (EHT). The award, which recognises exceptional work at the provincial level, has gone to the group of engineers and scientists participating in the EHT consortium from the IAA and the IRAM observatory at Pico Veleta (Sierra Nevada).

IAA
Medalla de Andalucía 2020 (+ Bandera de Andalucía de Granada 2020)

Concepción Cárdenas
MERAC Award 2020, Best PHD in New Technologies

Silvia López de Lacalle
Premio Primas 2020 Mejor “Texto inédito” por su libro Expedición al volcán de sal

EHT Collaboration
José Luis Gómez - GuangYao Zhang-Rocca Lice - Antxon Alberdi 2020 Einstein Medal and 2020 Bruno Rossi Prize

A. Alberdi / J.L. Gómez
Premio RSEF 2020 Mejor Artículo de Divulgación en las publicaciones de la RSEF

Alicia Pelegrina
2nd Prize Famelab Spain 2020

Funding
IAA obtains most of its funding through competitive European and Spanish grants.

During 2020, IAA had a total budget of 14,2 million €, from which 7,3 million € (52%) come from competitive projects and CSIC investments; the other 6,8 million € (48%) 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.
Annexes

Staff

STAFF RESEARCHERS

Research Professors
Alberdi Odriozola, Antonio María [10]
Castro Tirado, Alberto Javier [10]
Garrido Haba, Rafael [10]
González Delgado, Rosa María [10]
López Moreno, José Juan [10]
Pérez Puertas, Manuel [10]
Pérez Jiménez, Enrique [11]
Prada Martínez, Francisco [14]
Vilchez Medina, José Manuel [11]

Scientific Researchers
Aldaya Valverde, Víctor [12]
Alfaro Navarro, Emilio Javier [10]
Anglada i Pons, Guillem Josep [9]
del Toro Iniesta, José Carlos [1]
Gómez Fernández, José Luis [10]
Guerrero Rencel, Martín [10]
Lara López, Luisa María [10]
Márquez Pérez, Isabel [11]
Masegosa Gallego, Joseta [12]
Morero Danvila, Fernando [10]
Ortiz Moreno, José Luis [10]
Pérez Montero, Enrique [11]
Rodríguez Martínez, Eloy [10]
Verdes-Montenegro Atalaya, Leurdes [10]

Senior Scientists
Agudo Rodríguez, Juan Iván [10]
Amado González, Pedro José [10]
Barceló Serín, Carlos [10]
Bellot Rubio, Luis Ramón [10]
Claret dos Santos, Antonio [10]
del Olmo Orosco, Ascensión [10]
Duffard, René Damián [10]
Fernández Hernández, Matiá [10]
Funke, Bernd Rainer [10]
Gómez Rivero, José Francisco [10]
Gordillo Vázquez, Francisco José [10]
Gutiérrez Buenestado, Pedro José [10]
Iglesias Páramo, Jorge [10]
López González, María José [10]
López Jiménez, Antonio Carlos [10]
López Valverde, Miguel Ángel [10]
Luque Estepa, Alejandro [12]
Miranda Palacios, Luis Felipe [10]
Muñoz Gómez, Olga [10]
Olivos Martín, José Ignacio [10]
Perea Duarte, Jaime David [10]
Pérez Torres, Miguel Ángel [10]
Rodríguez Gómez, Julio Federico [10]
Ruedas Sánchez, José [10]
Schoedel, Rainer [10]

Assigned research group
(1) Solar Physics
(2) Planets and minor bodies
(3) Terrestrial atmosphere
(4) Low-mass stars
(5) Stellar variability
(6) ARAE
(7) HETH
(8) Stellar systems
(9) Physics of the interstellar medium
(10) AGN jets
(11) Galaxy evolution
(12) Theoretical gravitation and cosmology
(13) Observational cosmology
(14) Cosmology and particle physics
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Juan de la Cierva Postdocs
Jiménez Teja, Yolanda (11)

Marie Curie Postdocs
Thöne, Christina C. (7)
Gómez Martín, Juan Carlos (2)
de Ugarte Postigo, Antonio (7)

Ramón y Cajal Postdocs
Sánchez de Miguel, Alejandro (2)
Povic, Mirjana (11)
Madiedo Gil, José María (2)

Associated Doctors
Aceituno Castro, Jesús (11)
Alvarez Candal, Álvaro Augusto (11)
Fuller, Gary Anthony (11)
García Hernández, Antonio (11)
Maseda Gil, José María (11)
Pego, Mirjana (11)
Sánchez de Miguel, Alejandro (11)
Sedaghati, Elayar (11)

Juan de la Cierva Postdocs
Jones, Michael Gordon (11)

Marie Curie Postdocs
Jiménez Teja, Yolanda (11)

Postdocs
Ayala Gómez, Adrián (11)
Bauer, Florian Franziskus (11)
Bonoli, Giacomo (11)
Castro Tirado, Miguel Ángel (11)
Cazzoli, Sara (11)
García Benito, Rubén (11)
García Lomas, Maia Leira (11)
Damas Segovia, Ancor Enren (11)
Danielski, Camilla (11)
Durnba Pol, Laura (11)
Díaz García, Luis Alberto (11)
Duarte Puertas, Salvador (11)
Garrido Sánchez, Julian (11)

PhD contracts
Deconto Machado, Alice (11)
Díaz Rodríguez, Ana Karla (11)
Lares Martíz, Mariel (11)
Malagón Romero, Alejandro Francisco (11)
Schmalzried, Anthony (11)
Soler López, Sergio (11)

Marie Curie PhD
Kieu, Thi Ny (11)

FPI PhD
Agui Fernández, José Feliciano (11)
Alvarez Miranda, Julián (11)
Arrechea Rodríguez, Julio (11)
Arroyo Polonio, Antonio (11)
Blázquez Calero, Guillermo (11)
Brines Montoro, Adrián (11)
Dorantes Montaagudo, Antonio Jesús (11)
Escudero Pedrosa, Juan (11)
Ferrer Erez, Julia (11)
Fuentes Fernández, Antonio (11)
Gallego Caimate, Aurelia Teresa (11)
Herrera Muñoz, Laura (11)
Hill, Brittany Nicole (11)
Lampín González-Albo, Manuel (11)
Martínez Arranz, Álvaro (11)
Martínez Solache, Ginés (11)
Mentor Molina, Borja (11)
Moreno Vasas, Alejandro Miguel (11)
Pérez Díaz, Borja (11)
Román Ballesta, Alejandro (11)
Santamarina Guerreros, Pablo (11)
Vera Lubiano, Mónica (11)

Optics
Atienzar García, Julia
Bailén Martínez, Francisco Javier (11)
Paladino Medialdo, David

Electronics
Abníl Martí, Miguel
Alvarez García, Daniel (11)
Aparicio del Moral, Beatriz (11)
Balague Jiménez, María (11)
Castro Martín, José Marla (11)
Cobos Carrascosa, Juan Pedro (11)
Cortillo Iciarta, Luis Pedro
Girela Rejón, Fernando Javier (11)
Herranz de la Revilla, Miguel (11)
Jeronimo Zafra, José María (11)
Jiménez Ortega, Jaime (11)
Labrousse, Pierre (11)
Magen Madina, Héctor
Martínez Navajas, Ignacio (11)
Morales Palomino, Nicolás Francisco (11)
Moreno Mantas, Antonio Jesús (11)
Ramos Más, José Luis (11)

Mechanics
Álvarez Moreno, Fernando
Becerril Jaque, Santiago
Bustamante Díaz, María Isabel
Calvo Ortega, Rocío
Sánchez Carrasco, Miguel Andrés (11)

Software
Alburaí, Alaa R.A. (11)
Bailén Martínez, Eduardo
Blazek, Martin (11)
Cabrer Morales, Manuel (11)
Fernández García, Emilio Jesús (11)
García Segura, Antonio Jesús
Gómez López, Juan Manuel (11)
Husillos Rodríguez, César
Ibáñez Mengué, José Miguel
Luna Valero, Sebastián (11)
Morales Fernández, José Miguel (11)
Morales Muñoz, Rafael
Passas Varo, María (11)
Pastor Morales, Mª del Carmen (11)
Rodríguez Venzal, Sergio (11)
Román García, Javier (11)
Ruiz del Mazo, José Enriqu (11)
Sánchez Expósito, Susan (11)

OSN maintenance/support
Aceituno Castro, Francisco José Carmona Rodríguez, Enrique
Casanova Escuin, Víctor Manuel de la Rosa Alvarez, José Luis
Mirosal Juncos, José Alberto
Pérez Silvente, Tomás
Ruiz Bueno, José Antonio
Sánchez Funes, Fernando
Sota Ballano, Alfredo

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Engineers & Technicians

Administration & project support
Bustamante Calabria, Máximo
Castillo Sánchez, María Teresa (11)
Cortés de la Roza, Rosa Irene de
Correa Guerra, María Ángeles
Cosano Mañas, José Ruño
Gallardo Jiménez, Julio Miguel (11)
Gómez Frenett, Susana Alicia
González Esteva, Alonso M
González García, Manuel Jesús
Heredia Malondaño, María José
Herrera Jiménez, Eva María
Jiménez Zafra, María Isabel
López Fernández, Víctor Aníbal (11)
Madrid Gómez, Carmen Elisa
Martínez Fortes, Natalia
Molina Guerra, Josefina
Pastor Cañedo, Adelina (11)
Pérez López, Alicia
Sánchez Castro, Lorena
Tapia Ruiz, Francisco José
Torredosaved Rodrigo, Cristina
Villaverde Aparicio, Marcos (11)

Computer centre
Bayo Muñoz, Francisco Manuel
Guirao Jiménez, José Parra Garofano, Rafael

General services
Díaz Molina, José
Medina Delgado, José Francisco
Molina Rodríguez, Antonio
Rendón Martos, Francisco

Library
Arco Sarmiento, María Ángeles

Outreach and communication
García Gómez-Caro, Emilio José
López de la Cabeza Ramón, Sibila
Title: Apoyo a Centros de Excelencia Severo Ochoa  
Ref: SEV-2017-0709  
PI: Isabel Márquez Pérez  
Dur: Jun 01, 2018 - Jun 30, 2022

Title: Modelo de repuesto y de vuelo de subsystems de JANUS y GALA. Formacion y evolucion de sistemas planetarios: desde cuerpos menores a exoplanetas  
Ref: PGC2018-094925-B-100  
PI: Luisa María Lara López  
Dur: Jan 01, 2019 - Sep 30, 2022

Title: Participacion 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, 2024

Title: Física solar espacial  
Ref: RTI2018-096886-B-C51  
PI: José Carlos del Toro Iniesta, David Orozco Suárez  
Dur: Jan 01, 2019 - Dec 31, 2021

Title: Agujeros negros supermasivos y jets relativistas  
Ref: PID2019-108995GB-C21  
PI: José Luis Gómez Fernández  
Dur: Jun 01, 2020 - May 31, 2023

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 - May 31, 2023

Title: Atmosfera y clima de la tierra y exo-planetas  
Ref: PID2019-110697RB-I00  
PI: Bernd Rainer Funke, Manuel López Puertas  
Dur: Jun 01, 2020 - May 31, 2023

Title: Contribucion del IAA a la explotacion cientifica de ASIM: Experimentos, observaciones desde suelo, analisis de datos y modelizacion  
Ref: PID2019-109269RB-C63  
PI: Francisco José Gordillo Vázquez  
Dur: Jun 01, 2020 - May 31, 2023

Title: Comprension de la actividad nuclear en galaxias: de las bajas a las altas tasas de acrecion  
Ref: PID2019-106027GB-C61  
PI: Isabel Márquez Pérez, Ascensión del Olmo Ónizco  
Dur: Jun 01, 2020 - May 31, 2023

Title: Galaxias en 3D y sus propiedades integradas: sinergia entre J-PAS/J-PLUS e IFS  
Ref: PID2019-109670GB-I00  
PI: Rosa María González Delgado  
Dur: Jun 01, 2020 - May 31, 2023

Title: Estallidos de formacion estelar a lo largo de la evolucion del universo  
Ref: PID2019-107408GB-C44  
PI: José Manuel Vílchez Medina,  
Dur: Jun 01, 2020 - May 31, 2023

Title: Astronomia de rayos gamma con MAGIC y CTA-NORTE - contribucion del IAA-CSIC  
Ref: PID2019-107847RB-C44  
PI: Federico Rodríguez Gómez  
Dur: Jun 01, 2020 - May 31, 2023

Title: Caracterizacion de la atmosfera de marte con los instrumentos NOMAD y ACS a bordo de TGO/EXOMARS  
Ref: PGC2018-101931-B-I00  
PI: Miguel Ángel López Valverde  
Dur: Jan 01, 2019 - Sep 30, 2022

Title: AMIGA7: Gas y campos magneticos en entornos extremos de galaxias con los precursores de SKA - desde el diseño del flujo de datos hacia su construccion  
Ref: RTI2018-096228-B-C31  
PI: Lourdes Verdes-Montenegro Atalaya  
Dur: Jan 01, 2019 - Dec 31, 2022

Title: Los galacticos de la galaxia: Estrellas masivas, cumulos estelares y el centro galactico  
Ref: PGC2018-095047-B-C21  
PI: Rainer Schoedel, Emilio Javier Alfaro Navarro  
Dur: Jan 01, 2019 - Dec 31, 2022

Title: GRBphot - Base de datos fotometricos de explosiones de rayos gamma  
Ref: RTI2018-098104-J-I00  
PI: David Alexander Kann  
Dur: Sep 01, 2019 - Aug 31, 2021

Title: Legado del proyecto  
Ref: RTI2018-098657-J-I00  
PI: Pablo Santos Sanz  
Dur: Jan 01, 2019 - Aug 31, 2021

Title: Cieles y universos para los grandes cartografiados de galaxias: Explotacion cientifica  
Ref: PGC2018-101931-B-I00  
PI: Francisco Prada Martínez  
Dur: Jan 01, 2019 - Dec 31, 2021

Title: Experimentos de laboratorio, observaciones y modelos de polvo cometario. Una nueva estrategia  
Ref: RTI2018-095330-B-I00  
PI: Olga Muñoz Gómez, Juan Carlos Gómez Martín  
Dur: Jan 01, 2019 - Dec 31, 2021

Title: Física oculta en la evolucion en tiempo real de las nebulosas gasosas en torno a estrellas evolucionadas de masa baja e intermedia  
Ref: PGC2018-102184-B-I00  
PI: Martín Guerrero Roncel  
Dur: Jan 01, 2019 - Dec 31, 2022

Title: Red tematica para la participacion cientifica y tecnologica espanola en el SKA  
Ref: RED2018-102567-T  
PI: Lourdes Verdes-Montenegro Atalaya  
Dur: Jan 01, 2020 - Dec 31, 2021

Title: SISTEMA DE OBSERVACIÓN DE LA MITAD DE LA BÓVEDA CELESTE EN LA NUEVA ERA DE ASTROFÍSICA DE MULTIMENSAJEROS  
Ref: EQC2018-004735-P  
PI: Alberto Javier Castro Tirado  
Dur: Jan 01, 2018 - Mar 31, 2021
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**Title:** Contribución del IAA-CSC a la misión espacial PLATET2.0: fases B2/C/D. operación de NOMED-EXOMARS

**In:** ESP-2017-8767A-C5-5-R

**PI:** Rafael Garrido Haba, Julio Federico Rodríguez Gómez

**Dur.:** Jan 01, 2018 - Dec 31, 2020

**Title:** Estructura, procesos y clima de las atmosferas de la tierra y exoplanetas

**In:** ESP-2017-87143-R

**PI:** Bernd Rainer Funke, Manuel López Puertas

**Dur.:** Jan 01, 2018 - Dec 31, 2020

**Title:** Jets estelares, discos y campos magnéticos. ciencia para el SKA y contribución al diseño de PHASED ARRAY FEEDS

**In:** AYA2017-84390-C2-1-R

**PI:** Guillén Josep Anglada i Pons, José Francisco Gómez Rivero

**Dur.:** Jan 01, 2018 - Sep 30, 2021

**Title:** Caracterización polariométrica bidimensional del frente de onda en cristales ópticos

**In:** EDC2019-00649-P

**PI:** David Orozco Suárez

**Dur.:** Jan 10, 2018 - Dec 31, 2020

**Title:** Entendiendo la estructura interna, la evolución y la variabilidad de estrellas de baja masa con planetas

**In:** AYA2016-79425-C3-3-P

**PI:** Matilde Fernández Hernández

**Dur.:** Dec 30, 2016 - Dec 29, 2020

**Title:** Galaxias en 3D a través del universo: Sinergia entre espectroscopia de campo integral y cartografíaes multidimensional de galaxias

**In:** AYA2016-79425-C3-3-P

**PI:** Manuel Fernández Hernández

**Dur.:** Dec 30, 2016 - Dec 29, 2020

**Title:** Jets relativistas en galaxias activas

**In:** AYA2016-8089-P

**PI:** José Luis Gómez Fernández, Juan Ignacio Rodríguez

**Dur.:** Dec 30, 2016 - Dec 29, 2020

**Title:** Photometric REDSHIFTS for J-PAS

**In:** AYA2016-81865-C2-1-P

**PI:** Narciso Benítez Lozano

**Dur.:** Dec 30, 2016 - Dec 29, 2020

**Title:** MICINN/MINECO

**Title:** AMIGA6: Gas in the interior and in the entorno of the galaxies. prepairación científica para SKA and contribución al diseño del digital data

**In:** AYA2015-45973-C3-1-R

**PI:** Lourdes Verdes-Montenegro Atalaya

**Dur.:** Jan 01, 2016 - Jun 30, 2020

**Title:** Coordinación de la participación científica y tecnológica de España en el Square Kilometre Array. Oficina española del SKA.

**In:** 2015S0125

**PI:** Lourdes Verdes-Montenegro Atalaya

**Dur.:** Dec 01, 2019 - Nov 30, 2022

**Title:** EUROPEAN PROGRAM FUNDS

**Title:** e-LIGHTING: Lightning propagation and high-energy emissions within coupled multi-model simulations

**In:** 681257 (ERC-2016-ERC)

**PI:** Alejandro Luque Estapa

**Dur.:** Jun 01, 2016 - May 31, 2021

**Title:** Preparatory Phase for the European Solar Telescope (PRE-EST)

**In:** 739500 (H2020-INFRA/0289)

**PI:** Luis Ramón Bellot Rubio

**Dur.:** Apr 01, 2017 - Dec 31, 2021

**Title:** Science and Innovation with thunderstorms

**In:** H2020-MSCA-ITN-2016

**PI:** Antonio María Alberdi Odriozola

**Dur.:** Mar 01, 2017 - Feb 28, 2022

**Title:** Rôle and impact of Dust and clouds in the Martian Atmosphere: from lab to space (ROADMAP)

**In:** 0104052 (H2020-LEST-SPACE/5753

**PI:** Olga Muñoz Gómez

**Dur.:** Nov 01, 2020 - Oct 31, 2023

**Title:** CICLE - Revealing the formation and evolution of galaxy clusters through the intracluster light and multidisciplinary techniques of image processing and big data analysis

**In:** H2028-MSCA-IF-2019 -- 898633

**PI:** Yolanda Jiménez Teja

**Dur.:** Apr 01, 2020 - Mar 31, 2022

**Title:** SOLARNET - B24135 - Integrating High Resolution Solar Physics - H2020

**In:** 824135

**PI:** Luis Ramón Bellot Rubio

**Dur.:** Jan 01, 2019 - Dec 31, 2022

**Title:** ESCAPE-European Science Cluster of Astronomy & Particle physics

**In:** 824064 - H2020-INFRA/0489

**PI:** Lourdes Verdes-Montenegro Atalaya

**Dur.:** Feb 01, 2019 - Jul 31, 2022

**Title:** Optical Infrared Coordination Network for Astronomy (OPTICON)

**In:** 730890 - H2020-INFRA/0243

**PI:** José Manuel Vílchez Medrina

**Dur.:** Jan 01, 2017 - Dec 31, 2020

**Title:** REGIONAL GOVERNMENT JUNTA DE ANDALUCÍA

**Title:** Acciones para el fortalecimiento del IAA-CSC para la adquisición del sello “Severo Ochoa”

**In:** GOMM17/528/IAA

**PI:** Antonio María Alberdi Odriozola

**Dur.:** Jan 01, 2019 - Feb 28, 2022

**Title:** Stellar Tidal Streams in the Local Universe as Cosmological Diagnostic

**In:** TASE-138

**PI:** David Martínez Delgado

**Dur.:** Oct 01, 2020 - Sep 30, 2023

**Title:** LUCA: Revelando la estructura final de las

**In:** P18-FRJ-2595

**PI:** Rosa María González Delgado, Enrique Pérez Jiménez, Ginés Martínez Solaech

**Dur.:** Dec 01, 2020 - Nov 30, 2023
### PhD, Master and Degree theses

**Title:** Physical and chemical properties of galaxies with star formation in different environment  
**Level:** PhD  
**Author:** Salvador Duarte Puertas  
**Sup.:** Jose Manuel Vilchez and J. Iglesias Páramo  
**Univ.:** Universidad de Granada  
**Date:** 20 January 2020

**Title:** Estudio de las abundancias químicas en galaxias con núcleos activos del cartografiado CALIFA  
**Level:** Master  
**Author:** Jesús Javier González Padilla  
**Sup.:** Enrique Pérez Montero & Rubén García Benito  
**Univ.:** Universidad Internacional de Valencia (VIU)  
**Date:** 07 April 2020

**Title:** Normalized Cumulative Rank distributions of supernova environments from J-PLUS  
**Level:** Máster  
**Author:** Raúl González Díaz  
**Sup.:** Lluís Galbany (UGR) & Rubén García Benito (IAA)  
**Univ.:** Universidad de Granada  
**Date:** July 2020

**Title:** Caracterización de atmósferas de exoplanetas con espectroscopía de alta resolución  
**Level:** Master  
**Author:** Francisco José García Izquierdo  
**Sup.:** Manuel López Puertas  
**Univ.:** Universidad de Granada  
**Date:** July 2020

**Title:** A Combined Mid-to-Near Infrared Study of the Stellar Population in the Galactic Centre  
**Level:** Master  
**Author:** Miguel Cano González  
**Sup.:** Rainer Schoedel (IAA) and Francisco Nogueras Lara (MPIA, Germany)  
**Univ.:** Universidad de Granada  
**Date:** 17 September 2020

**Title:** Variability of Nearby Quasars  
**Level:** Master  
**Author:** Jerusalem Tamirat  
**Sup.:** Mirjana Povic  
**Univ.:** Ethiopian Space Science and Technology Institute, in collaboration with Addis Ababa Univ., Ethiopia  
**Date:** October 2020

**Title:** Global data transfer survey for SKA Interferometer data processing nodes  
**Level:** Master  
**Author:** Álvaro Mesa Suárez  
**Sup.:** Julián Garrido, Javier Moldón  
**Univ.:** Universidad de Granada  
**Date:** September 2020

**Title:** Chemical abundances in nearby galaxies from the Palomar Survey  
**Level:** Master  
**Author:** Borja Pérez Díaz  
**Sup.:** Josefa Masegosa Gallego, Isabel Márquez Pérez  
**Univ.:** Universidad de Granada  
**Date:** 15 July 2020
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**Other Programs**

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Triple planetary conjunction: an ideal opportunity to enjoy the night sky

11/12/2020

In December 2020, due to the alignment of the Earth, Jupiter and Saturn, we were able to see the giant planets of the Solar System very close in the sky. Many activities were organized to enjoy the event.

RoadMap: studying the ubiquitous yet poorly known Martian dust

10/12/2020

As part of the European Horizon 2020 program, the RoadMap project (Role and impact of dust and clouds in the Martian atmosphere) started in December.

The Stingray nebula, the youngest known, is fading

03/12/2020

Observations with the Hubble Space Telescope showed how this young nebula lost its brightness and changed shape in just two decades.

MHONGOOSE begins to study the weak atomic gas that surrounds galaxies, key in their evolution

30/11/2020

MHONGOOSE, a legacy project of the MeerKAT radio-interferometer, South African precursor of the Square Kilometer Array, produced its first results. They were obtained in its preparatory phase, thus anticipating the window that will open to the understanding of the formation and evolution of galaxies.

Ariel mission moves from blueprint to reality

23/11/2020

The mission, developed by the European Space Agency (ESA) and scheduled for launch in 2029, moved from the study phase to the implementation phase, which involves selecting an industrial contractor to build the spacecraft. The IAA-CSIC participates in Ariel through two of its scientific working groups.

Published the new J-PLUS catalog, with almost twenty million celestial objects

05/11/2020

The IAA-CSIC participates in the project, coordinated by the Center for the Study of Physics of the Cosmos of Aragon (CEFCA).

Rapid radio bursts detected in our Galaxy

04/11/2020

The identification of a source producing very short duration radio bursts in our own galaxy, the Milky Way, was presented in three articles in the journal Nature. Studies suggest that a magnetar, a neutron star with a very intense magnetic field, would be behind this phenomenon.

Confirmed the existence of a new electrical phenomenon in the atmosphere: blue flashes produced by cold electrical discharges

23/10/2020

The study, led by researchers from the IAA-CSIC, was possible thanks to data provided by the ASIM space mission of the European Space Agency (ESA).

The Galactic Center: a unique laboratory for the study of black holes

23/10/2020

Andrea Ghez, Nobel Prize in Physics 2020, gave an online conference on the center of the Milky Way on October 29.

Wobbling Shadow of the M87* Black Hole

23/09/2020

Analysis of the Event Horizon Telescope observations from 2009-2017 revealed turbulent evolution of the M87* black hole image.

The SO/PHI instrument, on board the Solar Orbiter mission, obtains the first autonomous magnetic map of the Sun

16/07/2020

The SO/PHI instrument, on board the Solar Orbiter mission, launched on February, obtained the first autonomous magnetic map of the Sun.
IAA researchers participate in GRANDMA, an international network for the study of gravitational wave sources view>
16/07/2020

IAA researchers showed their participation in GRANDMA, an international network for the study of gravitational wave sources.

First technical light of the JPCam panoramic camera at the Javalambre Astrophysical Observatory view>
16/07/2020

JPCam, the second largest camera worldwide, specially designed for the J-PAS survey, got its first images on June 29th.

Two super-Earths found around the brightest red dwarf star in our solar neighborhood view>
25/04/2020

The Institute of IAA-CSIC participated in the discovery of a multiple planetary system around GJ887, a star located 10.7 light years away.

Detection of the green line of oxygen in the atmosphere of Mars view>
15/04/2020

The first detection in autumn of an elevated stratopause, a winter atmospheric phenomenon view>
04/04/2020

Researchers from the IAA-CSIC detected, in data files from 2009, an elevated stratopause in November, a phenomenon never seen outside the winter period.

Astromoners discover that novae, a type of explosions in double star systems, expand non-stop view>
10/06/2020

The Institute of IAA-CSIC participates in the study of the expansion of the shell of material ejected by various nova explosions. They found that, contrary to what was assumed, novae expand unrestrained until their end, when they end up dissipating in the inter-stellar medium.

The IAA studies the influence of state of alarm on light pollution levels view>
05/05/2020

The project, developed by the IAA-CSIC Sky Quality Office and with the support of the Granada City Council, would analyze how the environmental conditions during the lock-down affected light pollution levels.

The IAA cosmic dust laboratory reinvents itself to study the detection of coronavirus on surfaces view>
22/05/2020

The IAA-CSIC is involved in a project financed by the Carlos III Health Institute for the development of a prototype to analyze surfaces contaminated by SARS-CoV-2. The IAA would contribute with polarimetry studies to the project, which combined image acquisition in the entire optical and sub-millimeter range and its analysis with artificial intelligence.

The Event Horizon Telescope reveals unexpected structures in quasar 3C279 view>
07/04/2020

In April 2019 the Event Horizon Telescope (EHT) collaboration released the first image of a black hole. In 2020 they looked in detail at the high-speed jet of material emerging from a supermassive black hole.

A thesis developed at the IAA is awarded the 2020 MERAC 2020 in new technologies (Instrumental) view>
09/03/2020

The optical engineer Concepción Cárdenas Vázquez was awarded with the MERAC Prize for the Best Doctoral Thesis in New Technologies (Instrumental) by the European Astronomical Society (EAS).

The merger of two galaxies generates the juvenile version of a blazar, one of the most energetic objects known view>
07/04/2020

The first unequivocal detection of a jet of material at very high speed emerging from a galaxy in collision with another was obtained. The jet emerges from the galaxy’s central supermassive black hole and is seen head-on, a precursor structure to the formation of a blazar.

A more sustainable observatory: Calar Alto will be converted into an “energy island” view>
06/03/2020

Calar Alto Observatory, scientifically co-managed by the IAA-CSIC, started its energy transition programme thanks to a ERDF (European Regional Development Fund)-supported project. Using biomass and solar energy will considerably reduce the ecological footprint of the observatory, as well as the costs associated to its energy needs.

MEGARA instrument enters the heart of the active galaxy NGC 7469 view>
04/03/2020

A study led by the IAA-CSIC revealed the existence of two rotating gas discs in the vicinity of the galaxy’s supermassive black hole, as well as a third component that points to turbulent movements.
Astronomers get the whole film of how a black hole ejects matter and interacts with the medium

02/03/2020

The black hole, which forms a binary system with a sun-like star, experienced an ejection of matter that transported gas over huge distances.

A study reveals what the seeds of the solid bodies of the Solar System looked like: porous dust particles a few millimetres long

25/02/2020

The IAA-CSIC led an investigation that shows, for the first time experimentally, the features of the particles of a comet’s nucleus.

More than three hundred planet-forming disks around young stars found in the Orion Clouds

18/02/2020

ALMA and VLA radiotelescopes enter the Orion Clouds, a stellar nursery that reveals how newborn stars evolve and develop protoplanetary discs. Researchers from the IAA-CSIC participated in the work, which constitutes the largest survey of this type performed to date.

Indications of the existence of a second planet around Proxima Centauri, the closest star to the Sun

15/01/2020

With a minimum mass of about six times that of the Earth, the planet would revolve around the star at 1.5 times the distance between the Earth and the Sun. This study adds to a previous work that points to the existence of a complex planetary system around Proxima Centauri.

The Institute of Astrophysics of Andalusia, Medal of Andalusia 2020

24/02/2020

Awarded by the Junta de Andalucía, the IAA-CSIC obtained the Medal of Research, Science and Health.

The Institute of Astrophysics of Andalusia receives the visit of its External Scientific Advisory Board

24/02/2020

Appointed by the presidency of the Higher Council for Scientific Research (CSIC), the Board is made up of ten internationally renowned experts.

International Day of Women and Girls in Science

10/02/2020

The IAA-CSIC joined the celebration of the International Day of Women and Girls in Science, which seeks to make visible the scientific work of women and promote vocations in girls.

Solar Orbiter mission takes off towards its orbit around the Sun

06/02/2020

The mission, which will observe the Sun from an unprecedented perspective, will study both solar physics and the influence of the Sun on the interplanetary environment. The IAA-CSIC co-leads SO/PHI, the largest of the ten instruments on board the mission.
List of publications


89 Guo, Hong; József Rózsa, F.; Alaya V.; "SU(2)-particle sigma model: Momentum-space quantization of a particle on the sphere S3"; Journal of Physics A: Mathematical and Theoretical, Vol. 53, Number 145015, p. 145015 [2020].

90 Guo, Hong; József Rózsa, F.; Alaya V. "SU(2)-particle sigma model: Momentum-space quantization of a particle on the sphere S3"; Journal of Physics A: Mathematical and Theoretical, Vol. 53, Number 145015, p. 145015 [2020].

91 Guo, Hong; József Rózsa, F.; Alaya V. "SU(2)-particle sigma model: Momentum-space quantization of a particle on the sphere S3"; Journal of Physics A: Mathematical and Theoretical, Vol. 53, Number 145015, p. 145015 [2020].

92 Guo, Hong; Rózsa, József; Alaya V.; "SU(2)-particle sigma model: Momentum-space quantization of a particle on the sphere S3"; Journal of Physics A: Mathematical and Theoretical, Vol. 53, Number 145015, p. 145015 [2020].

93 Guo, Hong; Rózsa, József; Alaya V.; "SU(2)-particle sigma model: Momentum-space quantization of a particle on the sphere S3"; Journal of Physics A: Mathematical and Theoretical, Vol. 53, Number 145015, p. 145015 [2020].

94 Guo, Hong; Rózsa, József; Alaya V.; "SU(2)-particle sigma model: Momentum-space quantization of a particle on the sphere S3"; Journal of Physics A: Mathematical and Theoretical, Vol. 53, Number 145015, p. 145015 [2020].

95 Guo, Hong; Rózsa, József; Alaya V.; "SU(2)-particle sigma model: Momentum-space quantization of a particle on the sphere S3"; Journal of Physics A: Mathematical and Theoretical, Vol. 53, Number 145015, p. 145015 [2020].

96 Guo, Hong; Rózsa, József; Alaya V.; "SU(2)-particle sigma model: Momentum-space quantization of a particle on the sphere S3"; Journal of Physics A: Mathematical and Theoretical, Vol. 53, Number 145015, p. 145015 [2020].


107 Hu, Chao; Li et al. (includes Chen, Z.-Y.); et al. (includes Zhang, X.-Y.; et al.) "Optical spectroscopy of type 2 LINERs"; Astrophysical Journal, Vol. 891, p. 132 [2020].


INVITED

Clemens Thum
Instituto de Radioastronomía Milimétrica (IRAM)
01/01/2020 - 31/12/2020

Elyar Sedaghati
European Southern Observatory
01/10/2020 - 30/11/2020

Iván Muñoz Rodríguez
Universidad de Granada
26/03/2020 - 31/10/2020

Denis Shulyak
Max Planck Institute for Solar System Research
03/03/2020 - 01/05/2020

Gary Anthony Fuller
University of Manchester
01/03/2020 - 30/04/2020

Brenda Namumba
South African Astronomical Observatory
22/02/2020 - 19/04/2020

SHORT VISITS

Mohammand Akhlaghi
Instituto de Astrofísica de Canarias (IAC)
29/01/2020 - 31/01/2020

Alvaro Augusto Alvarez Candal
Observatorio Nacional de Rio de Janeiro
21/01/2020 - 31/01/2020

Valentín Boyanov Savov
Universidad Complutense de Madrid
16/09/2020 - 09/10/2020
16/07/2020 - 31/08/2020
03/02/2020 - 31/03/2020

Joyce Byun
Université de Genève
10/02/2020 - 14/02/2020

Miguel Cano González
Universidad de Oviedo
02/03/2020 - 26/11/2020

Roberto Cid Fernandes
Universidade Federal de Santa Catarina
10/01/2020 - 10/02/2020

Luis Alberto Díaz García
Academia Sinica, Institute of Astronomy & Astrophysics
03/02/2020 - 07/02/2020

Ana Karla Díaz Rodríguez
Universidad de Granada
21/10/2019 - 31/08/2021

Chi An Dong Paez
Durham University
01/07/2020 - 31/08/2020

Juan Antonio Fernández Ontiveros
Instituto de Astrofísica de Canarias (IAC)
03/02/2020 - 07/02/2020

Rocco Lico
Max Planck Institute for Radioastronomy
10/02/2020 - 14/02/2020

Asunción Fuente
Observatorio Astronómico Nacional
12/02/2020 - 14/02/2020

Gary Anthony Fuller
University of Manchester
01/06/2020 - 01/06/2020
06/02/2020 - 29/02/2020

Luis J Garay Elizondo
Universidad Complutense de Madrid
25/10/2020 - 24/01/2020

Angela Gardini
Universidad de Granada
21/10/2019 - 31/08/2021

Jannes Gill
Universidad Complutense de Madrid
19/02/2020 - 20/02/2020

Youdong Hu
Universidad de Granada
14/10/2019 - 03/10/2020

Hiroshi Imai
Kagoshima University
16/02/2020 - 15/03/2020

Tomoe Kishiyama
Chiba University
24/02/2020 - 28/02/2020

David Jones
Instituto de Astrofísica de Canarias (IAC)
03/02/2020 - 07/02/2020

Bathany Jones
University of Manchester
12/02/2020 - 27/02/2020

Patricia López Martínez
Universidad de Sevilla
02/09/2019 - 01/09/2020

David Eduardo Millán Calero
Universidad de Granada
01/01/2020 - 31/12/2020

Brenda Namumba
South African Radio Astronomy Observatory
01/01/2020 - 21/02/2020

Francisco Nogueiras Lara
Max Planck Institute for Astronomy
01/04/2020 - 24/04/2020

Catarina Pasta Aydar
Universidade de São Paulo
27/02/2019 - 06/01/2020

Borja Pérez Díaz
Universidad de Granada
01/07/2020 - 19/03/2020

Venkatesh Ramakrishnan
Universidad de Concepción
01/02/2020 - 21/02/2020

Jesús Ruiz López
Universidad Politécnica de Valencia
11/03/2020 - 11/03/2020

Jesús Alberto Toalá Sanz
Universidad Nacional Autónoma de México
12/12/2019 - 07/01/2020