INSTRUMENTACIÓN Y SUPERCOMPUTACIÓN (II)

Implementation of de-noising methods in the cWB pipeline for the analysis of LIGO/Virgo gravitational data

Pablo J. Barneo[1], Alejandro Torres-Forné[2], José Antonio Font[3], Marco Drago[4,5], Jordi Portell[1]

1 Institute de Ciencias del Cosmos, Universidad de Barcelona (ICCUB), 2 Max Planck Institute for Gravitational Physics (AEI), 3 Departamento de Astronomía y Astrofísica, Universitat de València, 4 Laboratori Nazionali del Gran Sasso (INFN), 5 Gran Sasso Science Institute (GSSI)

A total variation method is proposed to de-noise the gravitational wave data taken by the International Gravitational Wave Network. We use a regularized version of the Rudin-Osher-Fatemi method to de-noise and extract gravitational wave signals from the data. This method has previously proven to deliver satisfatory results when de-noising numerically generated gravitational waves injected in simulated noise. The method needs a parametrization which will determine the efficiency of the de-noising, ranging from a small reduction of the noise present in the data to the removal of a huge portion of the data, including the detected signal. Currently, its implementation in the cWB data analysis pipeline is under developement. We will shortly provide results of its effectiveness with real data taken by the LIGO/Virgo interferometers during O3.

Pablo J. Barneo — Institute of Cosmos Sciences, University of Barcelona

TEIDESAT.

Joshua Barrios Pérez (General Coordinator) and Elías Gabriel Ferrer Jorge (R&D Coordinator)

TEIDESAT is an initiative that was born in the University of La Laguna (Tenerife, Canary Islands), in December 2017, and that now involves up to 25 students, mainly from the University of La Laguna (ULL) and the University of Las Palmas de Gran Canaria (ULPGC), but that has extended widely, with students from universities in Madrid, Valencia, Barcelona and Milan. All members of the team share a common vision: to design, build, fly and operate the first nanosatellite, Teidesat-I, made from university-level students from the Canary Islands. Such a complex and engaging endeavour requires a multidisciplinary approach, including science, engineering, design, management and economics. Our team is conformed by students covering all these areas, and from all university levels, from undergraduate students all the way to MSc and PhD levels.

The main goal of the TEIDESAT team is to learn to develop, in a practical way, the skills and abilities necessary for the creation of a 1U CubeSat, and to form future professionals in the aerospace field. With that goal in mind, and after a thorough research, we decided the mission objective of Teidesat-I: to demonstrate the capability to establish optical communication through LED technology between a CubeSat on Low Earth Orbit (LEO) and Earth, using robotic telescopes located in the observatories of the Canary Islands (Observatorios de Canarias).

Making the most of Gaia Raw Data: Sub-pixellic CrossMatch of Gaia Observations.

Describing a dual space transformation as a preprocess to cluster observations with large error in one direction.

Marcel Bernet, Ferran Torra and the Gaia-ICCUB/IEEC Team

Transition Edge Sensors devices 'Made in Spain': from fabrication to photon energy measurements

M.T. Ceballos[1], A. Camón[2], L. Fábrega[3], C. Pobes[2], P. Strichovanec[2], J. Bolea[2], B. Cobo[1], N. Cardiel[4]
1 Instituto de Física de Cantabria (CSIC-UC) / 2 Instituto de Ciencia de Materiales de Aragón (CSIC-UZ)
3 Instituto de Ciencia de Materiales de Barcelona / 4 Universidad Complutense de Madrid

Under the coordinated national project RTI2018-096686-B-C2, the collaboration among research groups at ICMA(CSIC-UZ), ICMAB(CSIC) and IFCA(CSIC-UC)+UCM has developed for the first time in Spain an instrumental setup to fabricate Transition Edge Sensors (TES), measure the detected X-ray pulses in the lab and reconstruct those pulses to establish the photons energies.

TES are very sensitive detectors, with a high spectral resolution specially optimized for X-ray energies, like the ones that are the base for the X-IFU instrument that will be on board the ESA mission *Athena*. But they can be also designed to work at other wavelengths.

This achievement opens the path in Spain for the local development of this cutting-edge technology specially suited for the astronomical research.

eXTP: an European-Chinese X-ray mission to study the state of matter under extreme conditions

M. Hernanz
JL Gálvez, E. Mirabet, M. Lamensans, Ll. Gesa
Institute of Space Sciences (CSIC) & IEEC
on behalf of the eXTP/WFM consortium

- ❑ eXTP: enhanced X-ray Timing and Polarimetry Mission
- ❑ A flagship X-ray observatory mission from the Chinese Academy of Sciences (CAS), with a large European contribution (2 of 4 instruments)
- ❑ Now in Phase B. Launch planned in 2027. Nominal lifetime: 5 yrs; goal: 8 yrs
- ❑ Core programme plus guest observer programme. Observatory will be open to the worldwide scientific community

Uchuu Data Release 1

Tomoaki Ishiyama and Francisco Prada on behalf of the Uchuu Collaboration

We plan to releasing on July 28th various products of the large cosmological *N*-body simulation named Uchuu, a Japanese word meaning Universe. Uchuu consists of 2.1 trillion ($12,800^3$) dark matter particles in a box of 2.0 h^{-1}Gpc and a mass resolution of $3.27 \times 10^8\ h^{-1}M_\odot$. DR1 includes for all 50 epochs halos and subhalo catalogues and their merger trees, as well as a random sample of dark matter particles. More info on DR1 can be found at *Skies & Universes*.

宇宙 uchuu

Coming Soon!

The JWST/MIRI Medium Resolution Spectrometer

The Medium Resolution Spectrometer (MRS) for the JWST-MIRI instrument is designed to cover the wavelength range from 5 to 28.8 μm at a spectral resolving power of ~3000. This wavelength range is divided into four simultaneous spectral channels (each channel with its own IFU). A single MRS exposure provides a spectral sub-band, which covers one third of each channel. Two grating and dichroic wheels select these sub-bands. It covers a field of view of 4x4" up to 8x8"at a spectral resolution of 1500 to 4000. The expected on-orbit performance is presented, based on the latest commissioning plans and ground data.

Alvaro Labiano on behalf of the MRS team

PLATO Follow-up coordination

Specification and Development proposal

Daniel Marín
In collaboration with E. Masana, F. Vilardell, J.C. Morales, J. Colomé, J. Portell, I. Ribas

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Institut de Ciències del Cosmos (ICCUB)
Universitat de Barcelona (UB), Barcelona, Spain

Abstract: The follow-up programme of the PLATO mission faces the problem of efficiently distributing and planning the observations among all observatories. Here we report our proposal of a PLATO follow-up target distribution architecture that will be able of coordinating the ground-based observations in an adaptable, reliable and efficient manner.

SEA Reunión científica XIV.0, 13-15 july 2020 — ieec.cat icc.ub.edu

The *Athena* Community Office

Silvia Martínez-Núñez (IFCA), Francisco J. Carrera (IFCA), María Teresa Ceballos (IFCA), Salvador Castillo (IFCA), Didier Barret (IRAP), Arne Rau (MPE) & Enrico Bozzo (ISDC)

The *Athena* Community Office (ACO) supports ESA's *Athena* Science Study Team (ASST) in its role as "focal point for the interests of the broad scientific community". The ACO is led by the Instituto de Física de Cantabria (CSIC-UC). Further ACO contributors are IRAP, MPE and the University of Geneva.

The responsibilities assigned to the ACO are divided into four main categories:

1. Optimisation of the community efforts assisting the ASST in several aspects, for instance supporting the production of ASST documents including the White Papers of the scientific synergies of *Athena* with other observational facilities in the early 2030s.
2. Organisational aspects such as helping to the promotion of *Athena* science capabilities in the research world, through conferences and workshops.
3. Keep the *Athena* community informed on the status of the project with the regular release of the newsletter, brief news, weekly news on the *Athena* web portal and in the social channels.
4. Develop communication and outreach activities, of particular interest are the *Athena* nuggets.

A Magnectic Subsystem Technology Demostrator based on Chip-scale Sensors for Magnetically Sensitive Space Missions

Ignacio Mateos
Universidad de Cádiz, Escuela Superior de Ingeniería

Abstract: A significant number of space missions require thorough measurements of the magnetic environment, either because one of the aims is to explore terrestrial or interplanetary magnetic fields, or because the performance of the instruments on-board is itself susceptible to magnetic effects. Missions belonging to the second category can be found in the area of high precision experiments of Fundamental Physics, such as high sensitivity atom interferometry or laser interferometer gravitational waves detectors.
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The special characteristic of the technology demonstrator is that the chip-scale magnetic sensors are magnetically shielded to low-frequency fluctuations by using a permalloy enclosure. This will allow the in-flight noise characterization of the sensors and the dedicated electronic noise reduction techniques under LEO environment.

A Gaia map of the natural sky brightness

Eduard Masana[1], Josep Manel Carrasco[1], Salva Bará[2] and Salvador J. Ribas[3]

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[3] Parc Astronòmic Montsec-Ferrocarrils de la Generalitat de Catalunya

Contact: emasana@fqa.ub.edu

Abstract: The natural brightness of the night sky in different photometric bands is a relevant parameter for light pollution research, since it allows establishing a baseline against which to evaluate the light pollution levels experienced in urban, periurban, rural and pristine dark sites. We present a model to map the natural brightness of the sky. In this model, the radiance out of the Earth due to the stars is obtained from the Gaia-DR2 catalogue.

Expanding Big Data mining for Astronomy

R. Mor and X. Luri on behalf of the Gaia UB team

University of Barcelona ICCUB-IEEC

Data Mining tools have been very important in the last years for the scientific exploitation of astronomical datasets (e.g. Mor et al. 2018; Castro-Ginard et al. 2018; Mor et al. 2019; Romero-Gomez et al. 2019). Data Mining and the Big data infrastructures have allowed us to reach very relevant scientific results. Furthermore, the amount of data that is being generated by space and on ground missions is becoming extremely large and astronomers need very large computational clusters to analyse it. This fact reduces the number of teams able to treat the data as a whole. We are working to widen the Big Data mining available tools to enable the capability of analysis of a larger number of groups. **We expect to make the difference by providing the infrastructure, tools and methods to analyse these large amounts of data data, influencing the future approaches to treat data in space science.**

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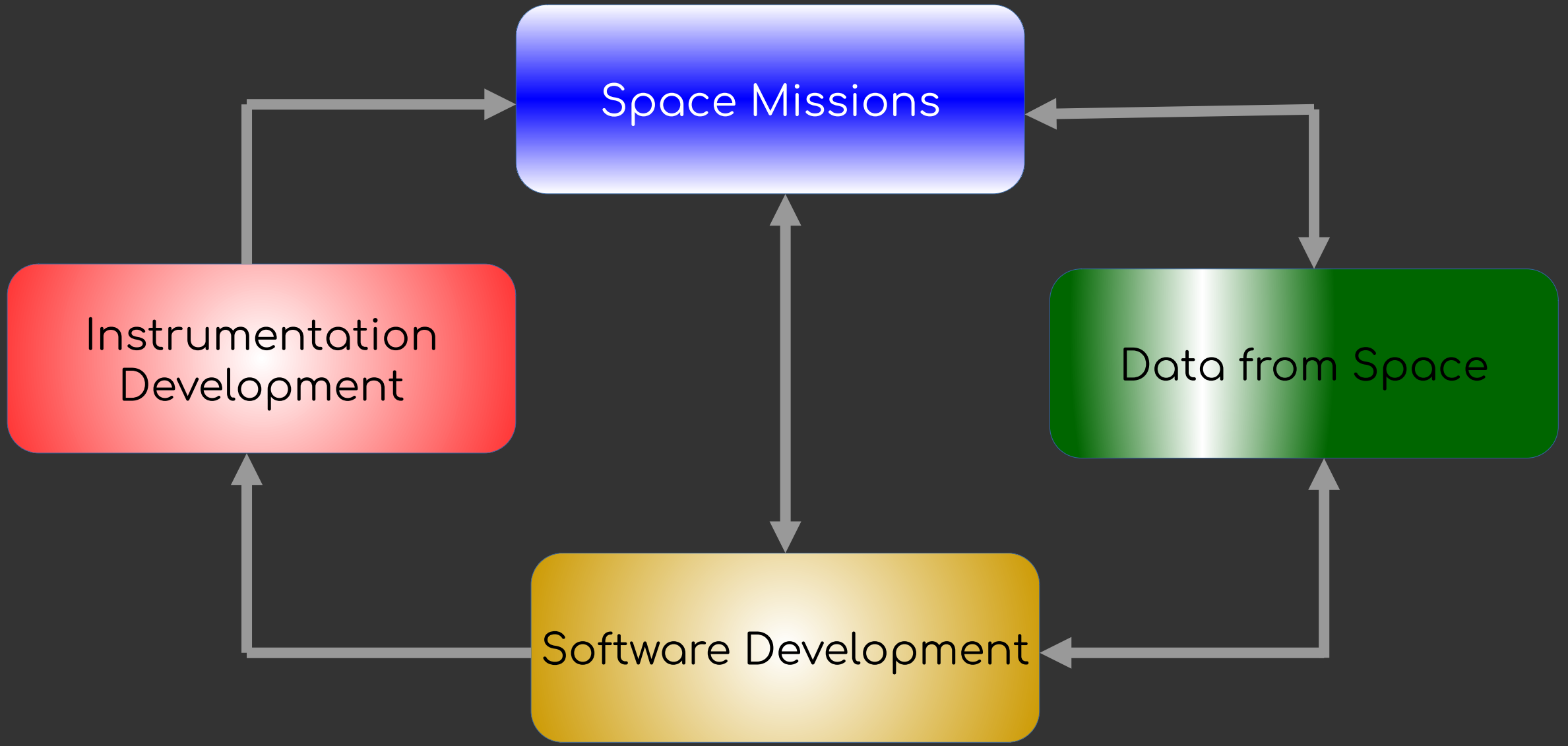
Space Missions
Instrumentation Development
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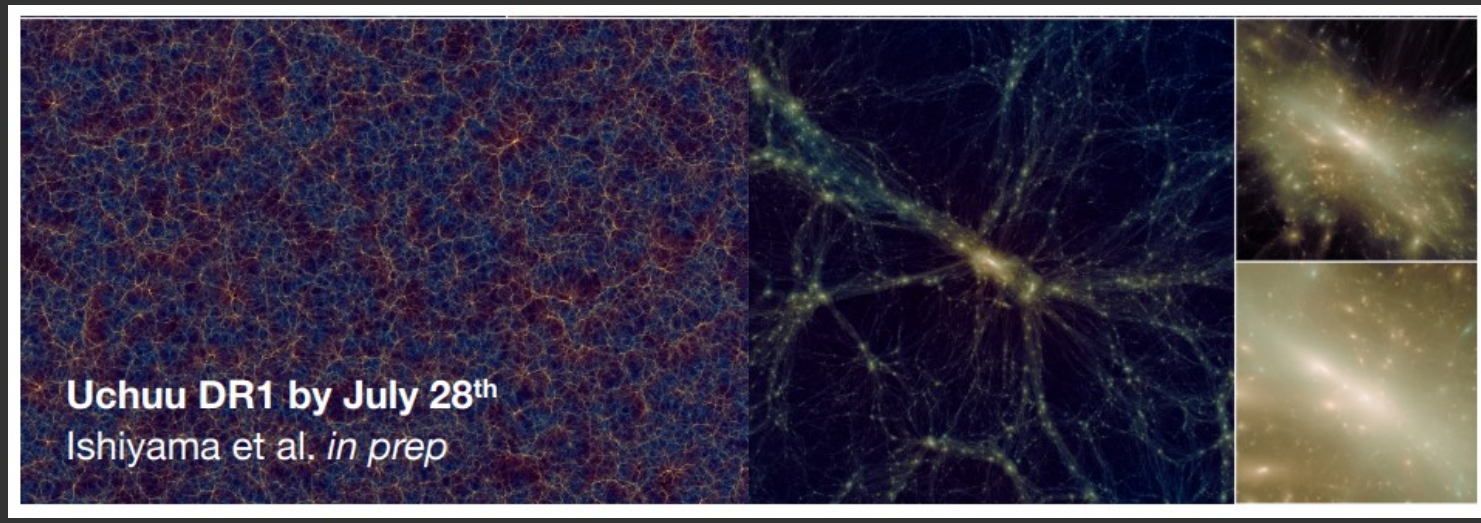
宇宙
uchuu
Coming Soon!



ICCUB Institut de Ciències del Cosmos

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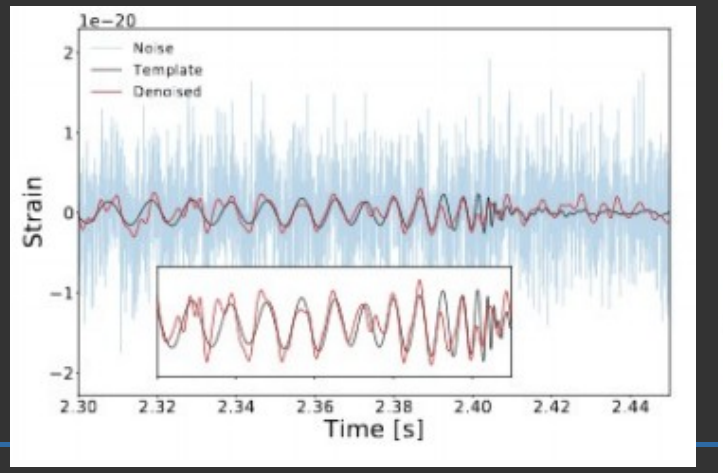
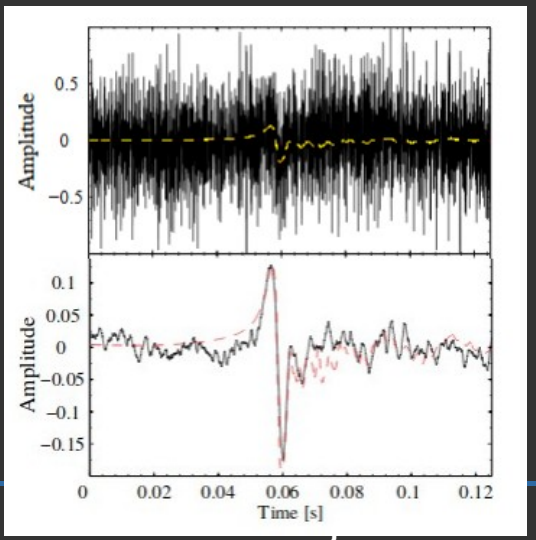
University of Barcelona

VIRGO





Software Development ← Data from Space

gaia

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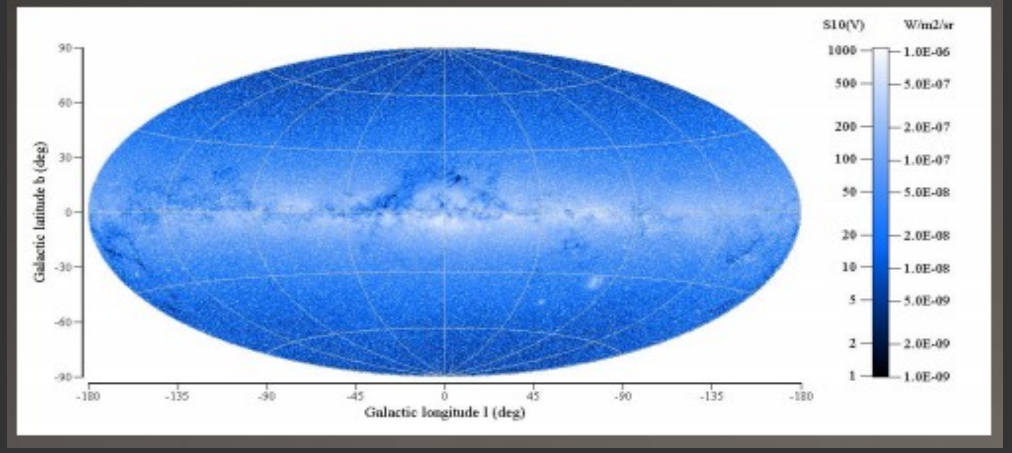

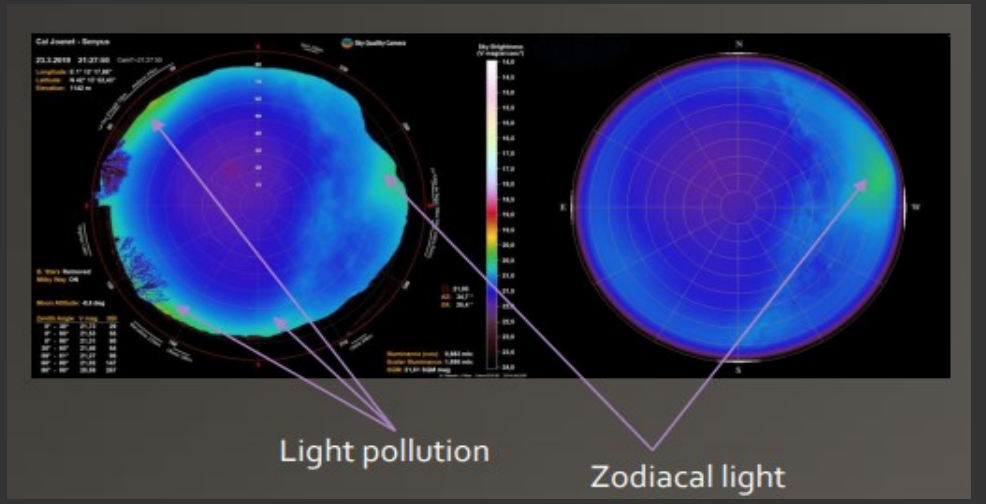

Space Missions → Data from Space ← Software Development

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Space Missions → Data from Space ← Software Development

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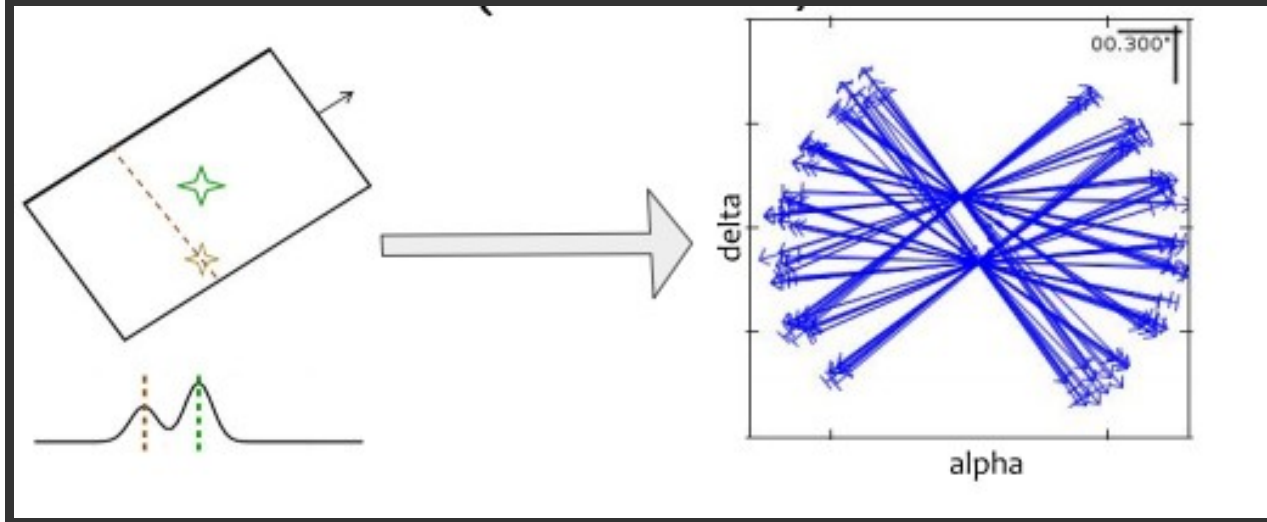

Space Missions → Data from Space ← Software Development

Roadmap to the open science platform

- To develop a Prototype: Our Big data environment, Gaia Data Analytics Framework (GDAF) ✓ 

- Ambition: To provide a self-deployable template to deploy GDAF in main the commercial cloud services. 

- Challenge:To provide a self-deployable environment to deploy GDAF in both the commercial cloud services and local physical environments 

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Space Missions → Data from Space ← Software Development

Coordination between observatories

Coordination protocols

How will the target distribution be coordinated?

Default coordination
- Handled by AI (**scheduler**)
- Targets are distributed in:

Human-readable format
For telescope operators
(can modify/improve plan!)

Machine-readable format
For robotic telescopes

Proposal-based coordination
- Handled by PLATO scientists
- Only for telescopes that grant observing time following a proposal system
- PLATO scientists will use the output of the scheduler

The scheduler algorithm will be built upon the IEEC's expertise on similar projects:

- CTA
- CARMENES (Calar Alto telescope)
- ARIEL
- Others: Joan Oró, Colibrì, ...

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XIV.0 Reunión Científica

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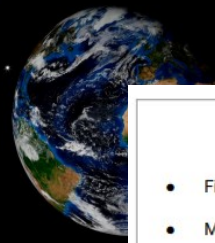

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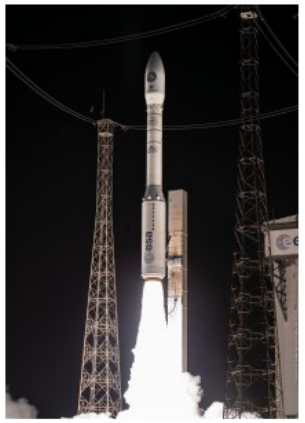
XIV.0 Reunión Científica

TEIDESAT-I (Satellite)

- Finish the critical design
- Manufacture and test
- Launch and operate



Source: ESA, Vega

Radio Ground Station (VHF/UHF)

- Automate radio ground station (VHF / UHF)
- Complete the tests for uploading and downloading data to satellites currently in orbit

Source: HamStudio UT8UU
http://ut8uu.blogspot.com/2018/09/satnogs-antenna-rotator-part-1-overview.html

Optical Ground Station

- Design and integration of the robotic telescope capable of TEIDESAT-I nanosatellite downlink optical communications.
- Track calibration with bright satellites
- Calibration of the light pulse receiving instrument

Source: Journal of Astronomical Telescopes, Instruments and Systems.Rapid telescope pointing calibration: A quaternion-based solution using low-cost hardware (Kathleen M. Riesing, Hyosang Yoon, Kerri L. Cahoy)

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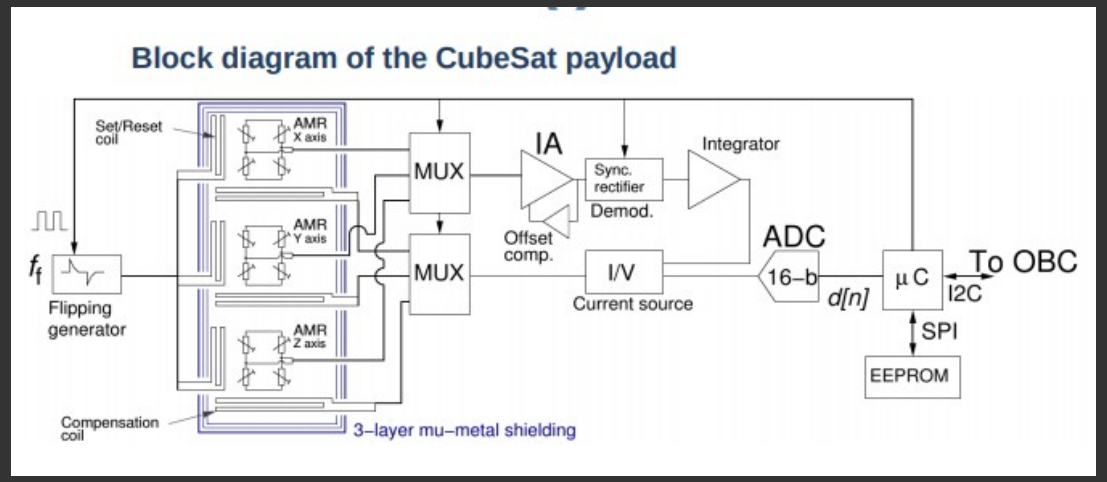

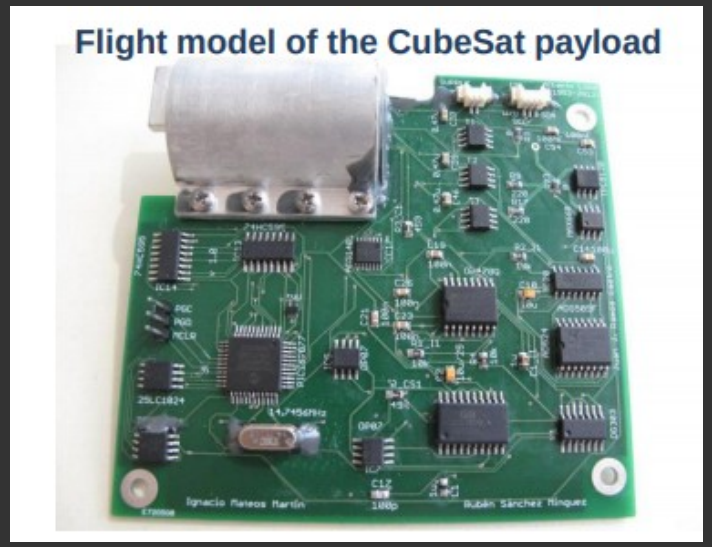

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A Magnetic Measurement Subsystem has been designed and developed for a CubeSat platform with the purpose of guiding the technological progress towards space missions with strict constraints on long-term stability and magnetic cleanliness at sub-millihertz frequencies.
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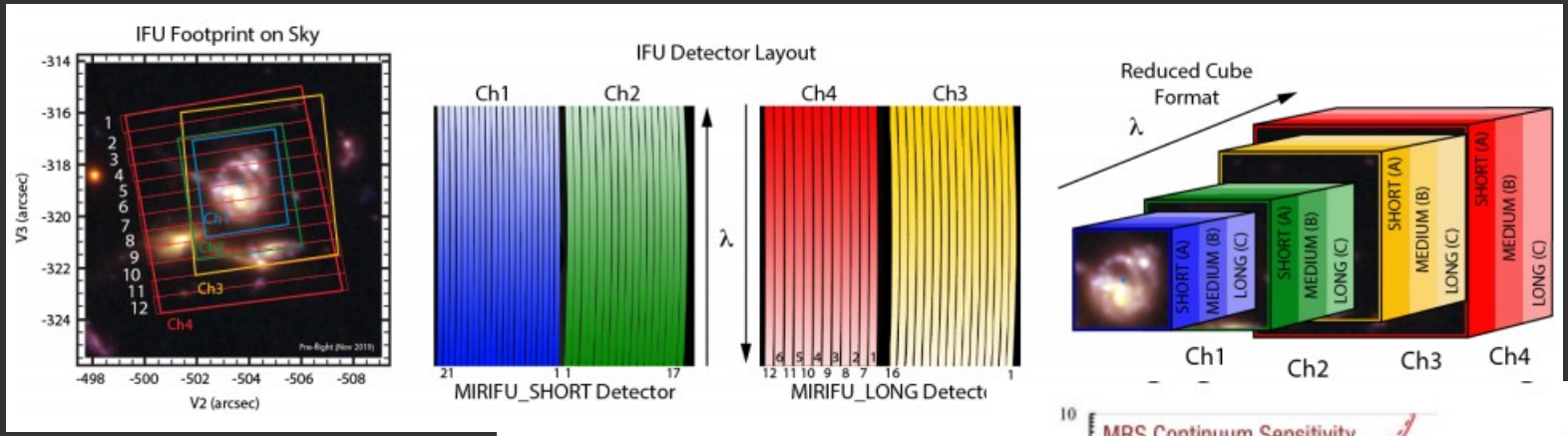
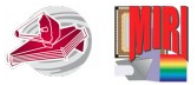
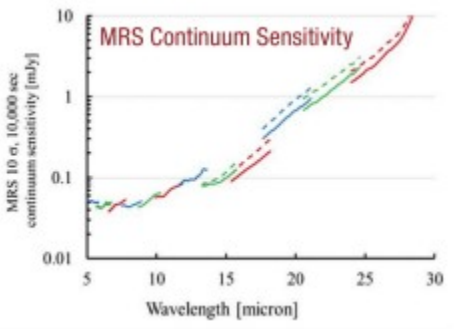
SEA XIV.0 Reunión Científica 13-15 julio 2020

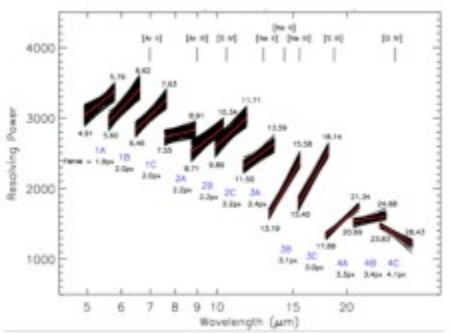
Space Missions → Instrumentation Development ← Software Development

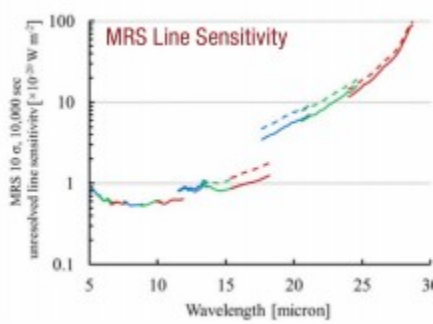




The JWST/MIRI M







The Medium Resolution Spectrometer (MRS) for the JWST-MIRI instrument is designed to cover the wavelength range from 5 to 28.8 μm at a spectral resolving power of ~3000. This wavelength range is divided into four simultaneous spectral channels (each channel with its own IFU). A single MRS exposure provides a spectral sub-band, which covers one third of each channel. Two grating and dichroic wheels select these sub-bands. It covers a field of view of 4x4" up to 8x8"at a spectral resolution of 1500 to 4000. The expected on-orbit performance is presented, based on the latest commissioning plans and ground data.

Alvaro Labiano on behalf of the MRS team

R~300 @5um, 1500@28um

Space Missions → Instrumentation Development ← Software Development

The *Athena* Community Office

Silvia Martínez-Núñez (IFCA), Francisco J. Carrera (IFCA), María Teresa Ceballos (IFCA), Salvador Castillo (IFCA), Didier Barret (IRAP), Arne Rau (MPE) & Enrico Bozzo (ISDC)

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3. Keep the *Athena* community informed on the status of the project with the regular release of the newsletter, brief news, weekly news on the *Athena* web portal and in
4. Develop communication and outreach activities, of p

Transition Edge Sensors devices 'Made in Spain': from fabrication to photon energy measurements

M.T. Ceballos[1], A. Camón[2], L. Fábrega[3], C. Pobes[2], P. Strichovanec[2], J. Bolea[2], B. Cobo[1], N. Cardiel[4]
1 Instituto de Física de Cantabria (CSIC-UC) / 2 Instituto de Ciencia de Materiales de Aragón (CSIC-UZ)
3 Instituto de Ciencia de Materiales de Barcelona / 4 Universidad Complutense de Madrid

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TES are very sensitive detectors, with a high spectral resolution specially optimized for X-ray energies, like the ones that are the base for the X-IFU instrument that will be on board the ESA mission *Athena*. But they can be also designed to work at other wavelengths.

This achievement opens the path in Spain for the local development of this cutting-edge technology

eXTP: an European-Chinese X-ray mission to study the state of matter under extreme conditions

M. Hernanz
JL Gálvez, E. Mirabet, M. Lamensans, Ll. Gesa
Institute of Space Sciences (CSIC) & IEEC
on behalf of the eXTP/WFM consortium

ICE CSIC IEEC

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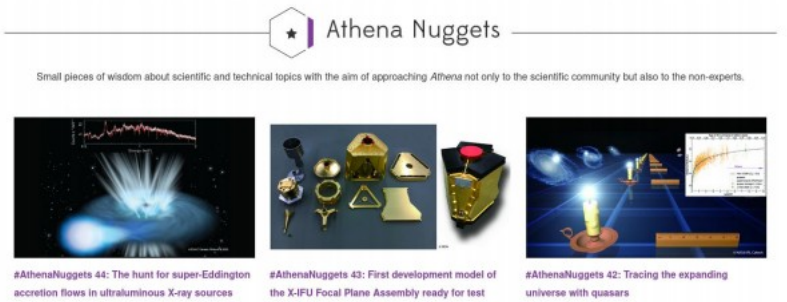
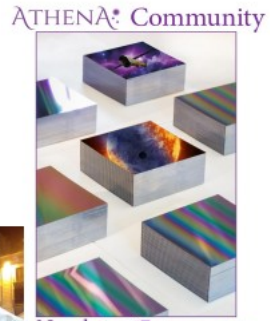
Keep the community informed and communication-outreach activities





SEA XIV.0 Reunión Científica

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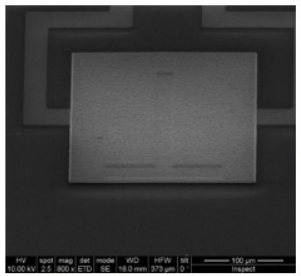
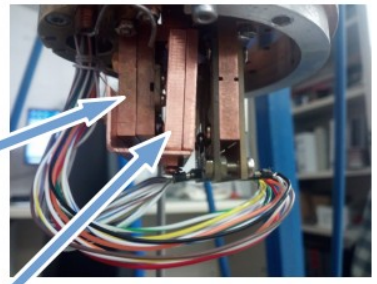
13-15 julio 2020

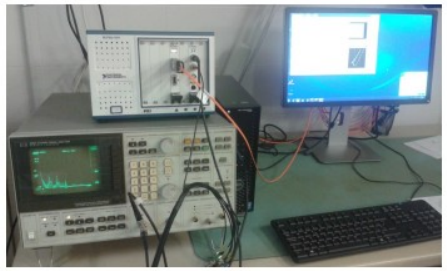
(Externally provided)
Radioactive X rays source ^{55}Fe



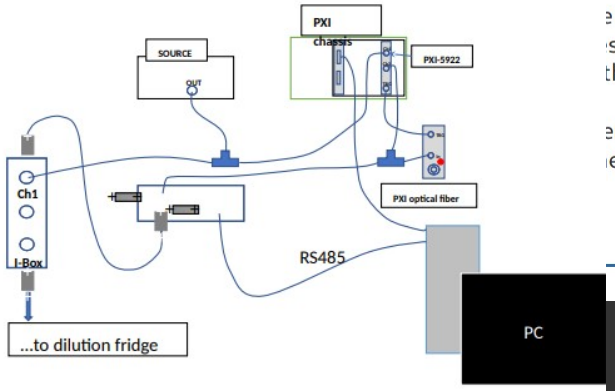
TES detector fabricated by icma ICMAB



Source + TES
in dilution fridge



Acquisition electronics

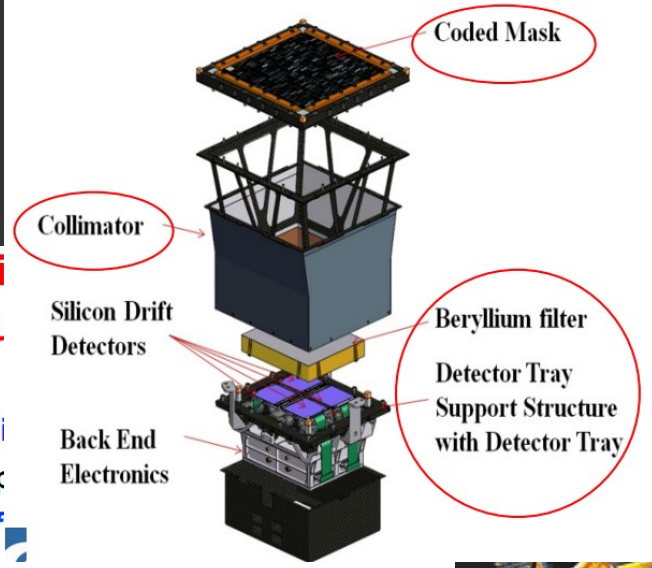


Lab setup scheme @ icma Instituto de Ciencia de Materiales de Aragón

Space Missions → Instrumentation Development ← Software Development

eXTP: Wide Field Monitor

Exploded view of the WFM camera design



ICE- CSIC & IEEC contribution to the eXTP-WFM instrument

- IP (MH) of the WFM instrument. Project Office
- Mechanical design, manufacturing and test of the coded mask, collimator, Beryllium filter, detector tray and its support structure
- Thermal control, analysis and design of the WFM instrument
- AIV of the camera

eXTP: an European-Chi… state of matter u…

JL Gálvez, E. Mi…
Institute of Sp…
on behalf of …
ICE CSIC IEEC

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Open meeting
@ 16:15

INSTRUMENTACIÓN Y SUPERCOMPUTACIÓN (II)

Implementation of de-noising methods in the cWB pipeline for the analysis of LIGO/Virgo gravitational data

Pablo J. Barneo[1], Alejandro Torres-Forné[2], José Antonio Font[3], Marco Drago[4,5], Jordi Portell[1]

1 Institute de Ciencias del Cosmos, Universidad de Barcelona (ICCUB), 2 Max Planck Institute for Gravitational Physics (AEI), 3 Departamento de Astronomía y Astrofísica, Universitat de València, 4 Laboratori Nazionali del Gran Sasso (INFN), 5 Gran Sasso Science Institute (GSSI)

A total variation method is proposed to de-noise the gravitational wave data taken by the International Gravitational Wave Network. We use a regularized version of the Rudin-Osher-Fatemi method to de-noise and extract gravitational wave signals from the data. This method has previously proven to deliver satisfatory results when de-noising numerically generated gravitational waves injected in simulated noise. The method needs a parametrization which will determine the efficiency of the de-noising, ranging from a small reduction of the noise present in the data to the removal of a huge portion of the data, including the detected signal. Currently, its implementation in the cWB data analysis pipeline is under developement. We will shortly provide results of its effectiveness with real data taken by the LIGO/Virgo interferometers during O3.

Pablo J. Barneo — Institute of Cosmos Sciences, University of Barcelona

TEIDESAT.

Joshua Barrios Pérez (General Coordinator) and Elías Gabriel Ferrer Jorge (R&D Coordinator)

TEIDESAT is an initiative that was born in the University of La Laguna (Tenerife, Canary Islands), in December 2017, and that now involves up to 25 students, mainly from the University of La Laguna (ULL) and the University of Las Palmas de Gran Canaria (ULPGC), but that has extended widely, with students from universities in Madrid, Valencia, Barcelona and Milan. All members of the team share a common vision: to design, build, fly and operate the first nanosatellite, Teidesat-I, made from university-level students from the Canary Islands. Such a complex and engaging endeavour requires a multidisciplinary approach, including science, engineering, design, management and economics. Our team is conformed by students covering all these areas, and from all university levels, from undergraduate students all the way to MSc and PhD levels.

The main goal of the TEIDESAT team is to learn to develop, in a practical way, the skills and abilities necessary for the creation of a 1U CubeSat, and to form future professionals in the aerospace field. With that goal in mind, and after a thorough research, we decided the mission objective of Teidesat-I: to demonstrate the capability to establish optical communication through LED technology between a CubeSat on Low Earth Orbit (LEO) and Earth, using robotic telescopes located in the observatories of the Canary Islands (Observatorios de Canarias).

Making the most of Gaia Raw Data: Sub-pixellic CrossMatch of Gaia Observations.

Describing a dual space transformation as a preprocess to cluster observations with large error in one direction.

Marcel Bernet, Ferran Torra and the Gaia-ICCUB/IEEC Team

Transition Edge Sensors devices 'Made in Spain': from fabrication to photon energy measurements

M.T. Ceballos[1], A. Camón[2], L. Fábrega[3], C. Pobes[2], P. Strichovanec[2], J. Bolea[2], B. Cobo[1], N. Cardiel[4]
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Uchuu Data Release 1

Tomoaki Ishiyama and Francisco Prada on behalf of the Uchuu Collaboration

We plan to releasing on July 28th various products of the large cosmological *N*-body simulation named Uchuu, a Japanese word meaning Universe. Uchuu consists of 2.1 trillion ($12,800^3$) dark matter particles in a box of 2.0 h^{-1}Gpc and a mass resolution of $3.27 \times 10^8\ h^{-1}M_\odot$. DR1 includes for all 50 epochs halos and subhalo catalogues and their merger trees, as well as a random sample of dark matter particles. More info on DR1 can be found at *Skies & Universes*.

宇宙 uchuu

Coming Soon!

The JWST/MIRI Medium Resolution Spectrometer

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Alvaro Labiano on behalf of the MRS team

PLATO Follow-up coordination

Specification and Development proposal

Daniel Marín
In collaboration with E. Masana, F. Vilardell, J.C. Morales, J. Colomé, J. Portell, I. Ribas

Institute of Space Studies of Catalonia (IEEC)
Institut de Ciències del Cosmos (ICCUB)
Universitat de Barcelona (UB), Barcelona, Spain

Abstract: The follow-up programme of the PLATO mission faces the problem of efficiently distributing and planning the observations among all observatories. Here we report our proposal of a PLATO follow-up target distribution architecture that will be able of coordinating the ground-based observations in an adaptable, reliable and efficient manner.

SEA Reunión científica XIV.0, 13-15 july 2020 — ieec.cat icc.ub.edu

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A Magnectic Subsystem Technology Demostrator based on Chip-scale Sensors for Magnetically Sensitive Space Missions

Ignacio Mateos
Universidad de Cádiz, Escuela Superior de Ingeniería

Abstract: A significant number of space missions require thorough measurements of the magnetic environment, either because one of the aims is to explore terrestrial or interplanetary magnetic fields, or because the performance of the instruments on-board is itself susceptible to magnetic effects. Missions belonging to the second category can be found in the area of high precision experiments of Fundamental Physics, such as high sensitivity atom interferometry or laser interferometer gravitational waves detectors.
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A Gaia map of the natural sky brightness

Eduard Masana[1], Josep Manel Carrasco[1], Salva Bará[2] and Salvador J. Ribas[3]

[1] Institut de Ciències del Cosmos – Universitat de Barcelona (ICCUB-IEEC)
[2] Departmento Física Aplicada, Universidade de Santiago de Compostela
[3] Parc Astronòmic Montsec-Ferrocarrils de la Generalitat de Catalunya

Contact: emasana@fqa.ub.edu

Abstract: The natural brightness of the night sky in different photometric bands is a relevant parameter for light pollution research, since it allows establishing a baseline against which to evaluate the light pollution levels experienced in urban, periurban, rural and pristine dark sites. We present a model to map the natural brightness of the sky. In this model, the radiance out of the Earth due to the stars is obtained from the Gaia-DR2 catalogue.

Expanding Big Data mining for Astronomy

R. Mor and X. Luri on behalf of the Gaia UB team

University of Barcelona ICCUB-IEEC

Data Mining tools have been very important in the last years for the scientific exploitation of astronomical datasets (e.g. Mor et al. 2018; Castro-Ginard et al. 2018; Mor et al. 2019; Romero-Gomez et al. 2019). Data Mining and the Big data infrastructures have allowed us to reach very relevant scientific results. Furthermore, the amount of data that is being generated by space and on ground missions is becoming extremely large and astronomers need very large computational clusters to analyse it. This fact reduces the number of teams able to treat the data as a whole. We are working to widen the Big Data mining available tools to enable the capability of analysis of a larger number of groups. **We expect to make the difference by providing the infrastructure, tools and methods to analyse these large amounts of data data, influencing the future approaches to treat data in space science.**

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@RogerMor_C