Advances in Space AstroParticle Physics (ASAPP2025) - 2nd edition

Report of Contributions

https://indico.cern.ch/e/asapp2025

Contribution ID: **3** Type: **Oral**

Advanced Tracking Analysis in Space Experiments with Graph Neural Networks

Friday 16 May 2025 12:15 (25 minutes)

The integration of advanced artificial intelligence techniques into astroparticle experiments marks a transformative step in data analysis and experimental design. As space missions grow increasingly complex, the adoption of AI technologies becomes critical to optimizing performance and achieving robust scientific outcomes.
This study focuses on the development of innovative AI-driven algorithms for tracking purposes, leveraging the power of Graph Neural Networks (GNNs). GNNs, a subset of geometric deep learning, are well-suited for exploiting the inherent graph structure of tracking systems, where nodes correspond to energy deposits (hits) and edges represent their interconnections. These networks enable a range of tasks, including node classification, link prediction, and graph classification, tailored to the specific challenges of space-based experiments.
A key obstacle in tracking systems for space experiments is the high-noise environment, characterized by backscattering tracks from calorimeter, which complicate the accurate identification of the primary particle trajectory. To overcome this, we propose a novel GNN-based approach for node-level classification, designed to distinguish noise hits, which include backscattering hits and electronic noise, from signal hits and accurately reconstruct particle tracks
The algorithm recognizes the primary hits among the noises one and allows to easily retrieve the track parameters.
By addressing these challenges, our work aims to improve the accuracy and reliability of data interpretation in astroparticle physics, paving the way for more precise and insightful discoveries through the application of cutting-edge AI methodologies.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: CUNA, Federica (Universita e INFN, Bari (IT))

Co-authors: BOSSA, Maria; GARGANO, Fabio (Univ. + INFN); MAZZIOTTA, Nicola (Universita e INFN, Bari (IT))

Presenter: CUNA, Federica (Universita e INFN, Bari (IT))

Session Classification: R&D of novel approaches and instruments

Contribution ID: **4** Type: **Poster**

Advanced Particle Classification in Space Missions Using Transformers

Tuesday 13 May 2025 22:14 (2 minutes)

The application of advanced artificial intelligence (AI) techniques in astroparticle experiments represents a groundbreaking advancement in data analysis and experimental design. As space missions become increasingly complex, integrating AI technologies is essential for optimizing their performance and enhancing their scientific outcomes. In this study, we propose a fully custom-designed Transformer-based model tailored for calorimeters in space-based experiments. One of the goal for space calorimeter experiment is to distinguish between particle types, such as electrons and protons. By capturing the dependencies within these features, Transformers can achieve robust classifications, even when the data spans thousands of channels or dimensions. By addressing these challenges, we aim to enhance the accuracy and reliability of data interpretation in astroparticle physics through the application of advanced artificial intelligence techniques. Furthermore, this approach has the potential to extend the classification capability across a very broad energy range, spanning from 1 GeV to 100 TeV.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: BOSSA, Maria

Co-authors: CUNA, Federica; GARGANO, Fabio (Univ. + INFN)

Presenter: BOSSA, Maria

Session Classification: Posters

Contribution ID: **5** Type: **Oral**

First results of the second batch of Space LGADs for AstroParticle Physics (SLAPP-2)

Tuesday 13 May 2025 15:25 (25 minutes)

Low Gain Avalanche Diodes (LGADs) are silicon detectors with an intrinsic gain, developed for timing measurements in High Energy Physics Experiments. The sate-of-the-art LGADs foreseen for ATLAS and CMS experiments feature a channel size of about 2 mm^2 on 50 μm thick silicon providing a timing resolution of about 30 ps for Minimum Ionizing Particles (MIPs). These detectors are radiation hard up to a fluence of few 10^{15} n_{eq}/cm^2.
Thanks to these properties, LGADs are a promising technology to build a Time-of-Flight system for future space missions to improve the tracking capabilities of the instruments.
In fact, due to the compact design of the payloads, secondary particles created in the calorimeter may enter the tracker, degrading the performance of the latter in reconstructing the trajectory of the observed primary particle. Adding a time tag to each event in the tracker would reduce this effect.
In the past few years, LGAD technology has been developed by Fondazione Bruno Kessler with the channel size of 1 cm^2, which is the typical one of the silicon micro-strip sensors for trackers in numerous space experiments.
Wafers with thicknesses 50 , 100, and 150 μm, and different gain layers were produced to study the effect of capacitance and gain on the timing performance of the sensor. Each wafer contains pad sensors with three different active areas and different metallization.
The timing performance of these devices is evaluated using Transient Current Technique and a ^{90}Sr radioactive source. Jitter of about 80 ps is measured for the 1 cm^2 LGADs with a gain of about 40. However, a non uniform gain was also observed in the sensors, worsening the timing resolution even with the laser.
A timing resolution of about 150 ps is measured with the beta particles. The performance of these sensors is limited by the gain as increasing the bias further would put them into breakdown. A new batch of sensors were produced to improve the gain and timing resolution of the detectors.
In addition to that, uniformity and propagation of the signal will be investigated by comprehensively studying the layout variations present in the batch.
The simulations performed to design the batch, the electrical characterization along with the gain measurements, and the first results of timing resolution for the new batch of large area LGADs will be presented in this work.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Authors: BISHT, Ashish (Fondazione Bruno Kessler (FBK)); BOSCARDIN, Maurizio (FBK Trento); CAVAZZINI, Leo (Universita degli Studi di Trento and INFN (IT)); CENTIS VIGNALI, Matteo (FBK); FERNANDEZ GARCIA, Marcos (Universidad de Cantabria and CSIC (ES)); Mr FICORELLA, Francesco (Fondazione Bruno Kessler); HAMMAD ALI, Omar; MOLL, Michael (CERN); PATERNOSTER, Giovanni

(Fondazione Bruno KEssler); WIEHE, Moritz (CERN)

Presenter: CAVAZZINI, Leo (Universita degli Studi di Trento and INFN (IT))

Session Classification: R&D of novel approaches and instruments

Contribution ID: **6** Type: **Poster**

Advanced readout logic for the XGIS instrument: discriminating X-ray and gamma-ray photons from background and particles

Tuesday 13 May 2025 22:16 (2 minutes)

The X and Gamma Imager and Spectrometer (XGIS) on board THESEUS is a finely pixelized and modular instrument designed for broadband high-energy transient detection. XGIS consists of two cameras, each composed of 10 supermodules, with each supermodule further divided into 10 modules, and each module made with 64 independently readout pixels based on Silicon Drift Detectors coupled with 5x5x30 mm3 CsI scintillator bars.
An algorithm to fastly read out the signal from the 64 pixels and send them in chronological order through the Module and Super-Module logic up to the Camera logic is under development.
Furthermore, a challenge for space-based high-energy instruments is distinguishing X-/gamma-ray photons while effectively rejecting background photons and particles, including electrons, protons, and heavier cosmic rays. Unlike traditional systems that rely on anticoincidence systems, XGIS aims to achieve background rejection through an innovative readout logic that analyzes the spatial and temporal properties of energy deposits in the detector. By leveraging the finely pixelized structure, the readout system can differentiate single-photon events from charged-particle tracks based on energy deposition patterns and event topology.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: CALABRETTO, Paolo (INAF-OAS Bologna)

Co-authors: MATTIOLI, Giulia (INAF-OAS Bologna); SRIVASTAVA, Smiriti (INAF-OAS Bologna); LABANTI, Claudio (INAF-OAS Bologna); Dr AMATI, Lorenzo (INAF - OAS Bologna); VIRGILLI, Enrico (Istituto Nazionale di Astrofisica - INAF OAS Bologna); CAMPANA, Riccardo (INAF/OAS); MARCHESINI, Ezequiel Joaquin (INAF-OAS Bologna); BORCIANI, Edoardo (INAF-OAS Bologna); SHARMA, Ajay (INAF-OAS Bologna); LA ROSA, Giovanni (INAF Palermo); SOTTILE, Giuseppe (INAF Palermo); NOGARA, Paolo (INAF Palermo); PISAPIA, Alfonso (Università degli Studi di Bologna)

Presenter: CALABRETTO, Paolo (INAF-OAS Bologna)

Session Classification: Posters

Contribution ID: **7** Type: **Oral**

The X and Gamma-ray Imager and Spectrometer on board THESEUS: status and technological progresses

Wednesday 14 May 2025 09:00 (25 minutes)

THESEUS (Transient High-Energy Sky and Early Universe Surveyor) is one of the three M7 mission candidates currently in Phase A for assessment and launch opportunity in 2037. The mission is designed to provide unprecedented capabilities for detecting and characterizing X-ray and gamma-ray transients, supporting time-domain and multi-messenger astrophysics. A key instrument on board THESEUS is the X and Gamma Imaging Spectrometer (XGIS), which will detect and localize transient sources over a broad energy range (2 keV–10 MeV) with timing resolution down to milliseconds.
XGIS consists of two identical coded-mask cameras covering 2 steradians, equipped with an innovative detection technology based on Silicon Drift Detectors (SDDs) with CsI(Tl) crystal scintillator bars. This configuration, combined with a low-noise distributed front-end electronics system (ORION-ASICs), enables spectroscopy and precise timing over an unprecedentedly wide energy range within a single, modular, and compact device. Utilizing the coded mask technique, the instrument provides imaging capabilities up to 150 keV while serving as a half-sky monitor in the 150 keV–10 MeV energy range.
Since its initial design phase, significant technological advancements have been made in the XGIS system. In this talk we present an updated overview of the XGIS instrument, highlighting its current status, technological developments, and its expected impact on high-energy astrophysics.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: MATTIOLI, Giulia (INAF-OAS Bologna)

Co-authors: Mr CALABRETTO, Paolo (INAF-OAS Bologna); Ms SRIVASTAVA, Smiriti (INAF-OAS Bologna); Mr LABANTI, Claudio (INAF-OAS Bologna); Dr AMATI, Lorenzo (INAF - OAS Bologna); VIRGILLI, Enrico (Istituto Nazionale di Astrofisica - INAF OAS Bologna); CAMPANA, Riccardo (INAF/OAS); Mr MARCHESINI, Ezequiel (INAF-OAS Bologna); Mr BORCIANI, Edoardo (INAF-OAS Bologna); Mr SHARMA, Ajay (INAF-OAS Bologna); Mr LA ROSA, Giovanni (INAF-Palermo); Mr SOTTILE, Giuseppe (INAF-Palermo); Mr NOGARA, Paolo (INAF-Palermo); Mr PISAPIA, Alfonso (Università degli studi di Bologna)

Presenter: MATTIOLI, Giulia (INAF-OAS Bologna)

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **8** Type: **Oral**

MAPS: from vertex detectors to space applications

Tuesday 13 May 2025 15:00 (25 minutes)

Over the past decade, Monolithic Active Pixel Sensors (MAPS) have well established their position in high-energy physics experiment vertex detectors. By integrating both the readout circuitry and the sensitive volume on a single chip manufactured via commercial processes, MAPS enable the development of ultra-thin, large-scale tracking detectors. The ALICE Inner Tracking System 2 (ITS2), currently the largest MAPS-based vertex detector, employs the state-of-the-art ALPIDE chip across seven cylindrical layers, covering a total area of approximately 10 m² around the interaction point. Fabricated using TowerJazz's 180 nm CMOS imaging sensor process, the ALPIDE chip has demonstrated an excellent detection efficiency (≫ 99%) and spatial resolution (< 5 μm) performance at low power dissipation (< 40 mW/cm^2) and extremely low fake-hit rate (< 10^{-7} hits/pixel/event).

To enable operation even closer to the interaction point, the ALICE Collaboration is planning an upgrade in 2028 (ITS3), which necessitates the development of wafer-scale sensors with dimensions on the order of 10 × 30 cm². This upgrade requires the adoption of stitching techniques in sensor fabrication. The first prototype based on this approach, the Monolithic Stitched Sensor (MOSS), implemented in a TPSCo 65 nm CMOS imaging sensor process, has been extensively characterized and meets the stringent performance criteria. Furthermore, this new technology underpins plans for the subsequent ALICE upgrade in the 2030s (ALICE3), which will impose unprecedented demands on sensor radiation hardness (up to 10^{16} 1 MeV n_{eq}/cm² non-ionizing and 300 Mrad ionizing tolerance) while covering even larger surfaces (approximately 60 m²).

Similar challenges arise in the development of next-generation particle detectors for space applications. Although the radiation tolerance requirements are comparatively relaxed, the power consumption constraints become significantly more stringent. For example, the ALADInO experiment proposal envisions a 68 m² silicon tracker achieving a spatial resolution below 5 μm with a power consumption of less than 2 mW/cm².

This contribution will review the current state-of-the-art in MAPS technology developed within the ALICE and CERN EP R&D frameworks and will discuss the opportunities and challenges associated with implementing these sensors in space-based trackers, including their capabilities for energy and time measurements.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Author: SULJIC, Miljenko (CERN)

Presenter: SULJIC, Miljenko (CERN)

Session Classification: R&D of novel approaches and instruments

Contribution ID: **9** Type: **Oral**

X-POT: X-ray Polarimetry with Optical Time projection chamber

Friday 16 May 2025 09:50 (25 minutes)

We present a novel large-volume, extended field-of-view Time Projection Chamber (TPC) tailored for hard X-ray polarimetry. Originally developed for directional Dark Matter searches, the system has been adapted to measure the polarization of X-rays, providing a new tool to probe the high-energy universe. The detector employs a triple-GEM configuration coupled with an optical readout, using a scientific CMOS (sCMOS) camera to image the secondary scintillation light produced during gas amplification. Featuring a cylindrical active volume (3.7 cm radius and 5 cm height), the prototype achieves full reconstruction of photoelectron tracks in the 10–50 keV range, with angular resolutions reaching 15° and energy resolutions between 10–15% over the 5–45 keV range. Calibration tests using a collimated ^{90}Sr source and a fully polarized 17 keV X-ray beam have yielded promising results, including modulation factors above 0.4 at 17 keV. This work not only extends the energy sensitivity of X-ray polarimetry but also offers the potential to observe transient phenomena such as Gamma Ray Bursts and solar flares also the detector's extended field of view and rapid response capabilities make it ideal for capturing transient high-energy phenomena, including Gamma Ray Bursts and solar flares, where polarization measurements can illuminate the processes driving particle acceleration and energy dissipation.
Future developments will focus on optimizing gas mixtures and scaling the detector to a wide-field configuration, paving the way for innovative X-ray polarimetry missions.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Authors: Prof. BARACCHINI, Elisabetta (Gran Sasso Science Institute); COSTA, Enrico; DHO, Giorgio (INFN e Laboratori Nazionali di Frascati (IT)); FABIANI, Sergio (INAF/IAPS); FIORINA, Davide (GSSI & INFN LNGS); MULERI, Fabio (INAF); SOFFITTA, Paolo

Presenter: FIORINA, Davide (GSSI & INFN LNGS)

Session Classification: R&D of novel approaches and instruments

Contribution ID: **10** Type: **Oral**

Highlights from the last XSCRC2024 workshop

Monday 12 May 2025 15:35 (35 minutes)

The last generation of Galactic cosmic-ray experiments (AMS-02, CALET, DAMPE, ISS-CREAM) is providing a wealth of high-precision new data. The interpretation of these data is stimulating a very rich and active debate in the community, with strong discovery and constraining potentials on many topics (dark matter, acceleration and transport of cosmic rays, Galactic sources etc.). However, the consensus in the community is that these interpretations are strongly limited by nuclear cross-section uncertainties.

The XSCRC (Cross-Section for Cosmic Rays at CERN) workshop series aims at bringing together experimentalists, phenomenologists, and theorists from various communities (astroparticle, particle physics, nuclear physics, etc.), to build synergies and provide a detailed road map to close the most urgent gaps in cross-section data, in order to efficiently progress on many open physics cases. In this talk, I will present an overview of the discussions and outcomes of XSCRC2024, held at CERN in Oct. 2024 (https://indico.cern.ch/event/1377509/).

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Author: MAURIN, David (Centre National de la Recherche Scientifique (FR))

Co-authors: Prof. DONATO, Fiorenza (Torino University); MARIANI, Saverio (CERN)

Presenter: MAURIN, David (Centre National de la Recherche Scientifique (FR))

Session Classification: Institutionals and Highlights

Contribution ID: **11** Type: **Oral**

The EPSI R&D: Development of an innovative electron-positron discrimination technique for space application

Friday 16 May 2025 11:00 (25 minutes)

The direct measurement of the antimatter components in cosmic rays provides a crucial information on the mechanisms responsible for their acceleration/propagation and represent a powerful tool for the indirect search of dark matter. At present, charge sign discrimination has been performed by the use of magnetic spectrometers, which are not suited to extend the current measurements at higher energies in a relatively short time scale. Since most of present and future experiments in space dedicated to the high energy frontier are based on large size calorimeters, it would be important to develop an alternative charge sign discrimination technique that can be integrated with them.

This is the main goal of the Electron Positron Space Instrument (EPSI) project, an R&D that has been approved and financed in Italy as a PRIN (Research projects of relevant national interest), whose activity started in September 2023. To this end, we plan to exploit a principle that has been suggested long time ago, based on the synchrotron radiation emitted by charged particles as they travel into the geomagnetic field. The simultaneous detection of a electron/positron with an electromagnetic calorimeter and synchrotron photons with a X-ray detector is enough to discriminate among the two leptons at the event level. The main challenge of this approach is to develop a X-ray detection array with very large active area, high X-ray detection efficiency, low energy detection threshold and compliant with space applications.

In this contribution, we will discuss the feasibility of such a detection technique for a future space experiment, by sketching a basic design of the instrument geometry and examining the challenges due to astrophysical backgrounds. Then, we will describe the idea for the realization of the required X-ray detector, with the single cell based on a small scintillator, a large area SiPM and a thin aluminum layer deposition. Different solutions for the components and the geometry of the detection cell are currently under test, both with laboratory measurements and detailed simulations. We will present the current status of the R&D and the next steps for the fulfillment of the project goals.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: BERTI, Eugenio (Universita e INFN, Firenze (IT))

Presenter: BERTI, Eugenio (Universita e INFN, Firenze (IT))

Session Classification: R&D of novel approaches and instruments

Contribution ID: **12** Type: **Oral**

AMEGO-X: Status and plans

Wednesday 14 May 2025 09:50 (25 minutes)

Gamma-ray and multimessenger astrophysics are frontiers for discovery and uniquely provide access to the extreme processes that sculpt the universe. As a priority theme of the Astro2020 Decadal Survey report: New Messengers New Physics, this science is poised to revolutionize our understanding of the extreme universe. The All-sky Medium Energy Gamma-ray Observatory eXplorer (AMEGO-X) is designed to identify and characterize gamma rays from extreme explosions and accelerators. AMEGO-X will probe the medium energy gamma-ray band using a single instrument with sensitivity up to an order of magnitude greater than previous telescopes in the energy range 100 keV to 1 GeV and as low as 25 keV for transient sources.
During its proposed baseline 3 year mission, AMEGO-X will observe nearly the entire sky every two orbits, building up a sensitive all-sky map of gamma-ray sources and emission. It will also access >50% (<10 MeV) and >20% (>10 MeV) of the sky instantaneously, maximizing transient detections and rapid alerts, openly distributed to the astrophysics communities. As a result, AMEGO-X will deliver breakthrough discoveries for a MIDEX class in areas highlighted as the highest scientific priority for Explorer-scale missions in the Astro2020 Decadal Survey Report: gravitational waves, multimessenger astrophysics and time-domain astronomy. This talk presents an overview of the science, instrument, and mission and the current status of the technology development.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: CAPUTO, Regina (NASA Goddard Space Flight Center)

Presenter: CAPUTO, Regina (NASA Goddard Space Flight Center)

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **13** Type: **Poster**

Ultra high energy cosmic ray detection using SiPMs (silicon photomultipliers)

Thursday 15 May 2025 22:20 (2 minutes)

The silicon photomultiplier (SiPM) is increasingly used in single-photon or few-photon based applications such as spectroscopy, quantum experiments and distance measurements (LIDAR). Also, it founds its niche in fast timing applications such as time of flight positron emission tomography (TOF-PET) and in high energy physics (HEP).
In astrophysics, SiPM arrays find their use in the development of near-UV telescopes for the observation from space or from ground level of the ultraviolet tracks (290-430 nm) associated with giant extensive air showers produced by ultra-high energy primaries propagating in the earth's atmosphere with highest time precision.
The present paper presents our achievements in the development of SiPM array based instruments for the detection and characterization of the air showers generated in the atmosphere by collision of the high energy particles with the Earth atmosphere.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Authors: Dr POPESCU, Florin-Adrian (Institute of Space Science - subsidiary of NFLPR); Dr CHIRITOI, Gabriel (Institute of Space Science - subsidiary of INFLPR); Dr POPESCU, Eugeniu Mihnea (Institute of Space Science - subsidiary of INFLPR)

Presenter: Dr POPESCU, Florin-Adrian (Institute of Space Science - subsidiary of NFLPR)

Session Classification: Posters

Contribution ID: **14** Type: **Poster**

The X-□ detector onboard the POMMA-Balloon with Radio payload

Thursday 15 May 2025 22:22 (2 minutes)

The POEMMA-Balloon with Radio (PBR) is a NASA mission designed to study Ultra-High-Energy Cosmic Rays (UHECRs) and Very-High-Energy Neutrinos (VHENs) from a balloon platform. Serving as a precursor to the planned POEMMA (Probe of Extreme Multi-Messenger Astrophysics) satellite mission, PBR will be launched aboard a NASA Super Pressure Balloon for a targeted flight as long as 50 days at an altitude of 33 km. The launch is planned for Spring 2027 from Wanaka, New Zealand. The unique conditions of low pressure and high altitude will enable in-situ observations of High-Altitude Horizontal Air Showers (HAHAs), a poorly understood class of nearly horizontal Extensive Air Showers (EASs) induced by cosmic rays skimming the Earth's atmosphere without reaching the ground. Due to the reduced atmospheric grammage at these altitudes, HAHAs develop more gradually compared to typical downward-going EASs, with interaction lengths on the order of 100 km. This slow development allows balloon-borne instruments to probe the early stages of cosmic ray shower evolution.

At these early stages, high-energy electrons and positrons from the electromagnetic component of the shower can generate X-rays and gamma rays via synchrotron radiation. The X-γ detector onboard PBR is designed to measure these photons across a broad energy range. The instrument consists of four sub-detectors, each optimized for different overlapping energy bands: X-ray (10–30 keV), X-γ (30–300 keV), and γ-ray (100–4000 keV, with two detectors). The current design utilizes CsI(Tl)/NaI(Tl) scintillating crystals coupled with Silicon Photomultipliers (SiPMs) for photon detection. To suppress background noise, all detectors—except for the X-ray entrance window—are enclosed within an anti-coincidence system composed of plastic scintillators, also read by SiPMs, to reject charged particle events.

The X-γ detector is aligned with PBR's primary instruments—the Fluorescence Camera and the Cherenkov Camera—within a 30° field of view, overlapping with both imaging cameras. It can operate in a triggered mode, receiving signals from the other instruments, as well as autonomously, also during daylight hours, to maximize data collection.

This contribution will summarize the scientific objectives of the X-γ detector and provide an overview of its design, functionality, and current development status.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Authors: BATTISTI, Matteo; FOR THE JEM-EUSO COLLABORATION

Presenter: BATTISTI, Matteo

Session Classification: Posters

Contribution ID: **15** Type: **Oral**

HERMES Pathfinder

Monday 12 May 2025 18:10 (25 minutes)

HERMES Pathfinder is scheduled for launch on March 6th 2025 on board Space X Transporter 13. The commissioning phase will then start as soon as the six 3U CubeSat will be deployed from D-Orbit ION space tug, starting from one week after the launch. HERMES Pathfinder is an in-orbit demonstration to prove that high energy cosmic transients such as Gamma Ray Bursts can be efficiently detected by miniatured hardware. The three main characteristics of the payload and the mission architecture are: 1) very broad energy band, from a few keV to a few MeV, allowing detection of both hard-short GRB and high redshift GRB; 2) exquisite temporal resolution, down to a fraction of microsecond, allowing to open the sub-millisecond variability window for bright bursts; 3) localization capabilities at the level of a few degrees for highly variable GRBs using the triangularization technique. I will present a progress report focusing the discussion on early results from the commissioning phase and the scientific innovation of the project. I will finally discuss the prospects of applying similar distributed architectures for the creation of an observatory with the ability to cover the entire high-energy sky at all times to search for the high-energy counterparts of gravitational wave events that will be find by Advanced Ligo/Virgo/Kagra at the end of this decade and by the Einstein Telescope during the 2030s.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: FIORE, Fabrizio

Presenter: FIORE, Fabrizio

Session Classification: Institutionals and Highlights

Contribution ID: **16** Type: **Oral**

Characterisation of the first prototype of the LISA Radiation Monitor

Thursday 15 May 2025 17:50 (25 minutes)

LISA will be the first space-based gravitational wave observatory sensitive to the unexplored frequency band of 0.1 mHz –1 Hz. It will consist of three identical spacecraft (SC) 2.5 million km away from each other. Each SC will be equipped with lasers and free-falling Au/Pt solid cubes (known as Test Masses, TMs). Gravitational waves will be detected by measuring small variations in the distance between TMs of different SC. Background radiation interacting with the SC may charge the TMs, limiting LISA sensitivity, especially < 1mHz. Therefore, monitoring the background radiation flux is essential to understand the charging nature of the TMs and evaluate its associated systematic uncertainties.

For this purpose we have designed a low-power Radiation Monitor (RM) capable of detecting protons and alpha particles above ˜70 and ˜600 MeV, respectively. The RM consists of a telescopic arrangement of four plastic scintillators and three W absorbers. The scintillators are coupled to silicon photomultipliers and their readout is performed by the BETA ASIC, which can amplify, shape and digitize the signals of up to 64 channels with a power consumption of ˜1mW/ch. An FPGA controls the trigger and reduces the data digitised by BETA.

The RM will be capable of monitoring the cosmic-ray flux integral with ˜1% statistical uncertainty in ˜1 hour. It will have at least four energy channels for reconstructing the spectrum between ˜100 MeV and ˜1 TeV. During quiet solar activity, the RM has an expected trigger rate of a few tens of Hz. However, it was designed to handle up to a few kHz to be able to detect the high-energy tail of solar-energetic particle events.

We built a prototype of the RM suitable for a CubeSat, in the frame of the ILIADA experiment. ILIADA aims at demonstrating the technology developed for LISA and at characterizing the Birkland's currents near the Earth poles, through the data collected by the RM and high-precision magnetometers. We characterized our prototype with a proton beam and through dedicated MonteCarlo simulations. It will undergo vibration, vacuum and thermal tests during the first half of 2025 and its flight in a Small Satellite is scheduled for the beginning of 2026.

In this contribution I will discuss the design of the RM, the evaluation of the performance of its CubeSat prototype and the expectations for its on-flight operation.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Author: ORTA-TERRÉ, Marina (ICCUB - IEEC)

Co-authors: CATALÀ, Roger (ICCUB); DI VENERE, Leonardo (INFN Bari); ESPINYA, Albert (ICCUB - IEEC); GARGANO, Fabio (INFN Bari); GASCÓN, David (ICCUB); GUBERMAN, Daniel (ICCUB); LOIZZO, Pierpaolo (INFN Bari - University of Trento); MARTÍ, Laura (ICE - IEEC); NOFRARIAS, Miquel (ICE - IEEC); ROMA, David (ICE - IEEC); SALVANS-TORT, Josep (ICE - IEEC); SANUY, Andreu (ICCUB - IEEC); SERINI, Davide (INFN Bari)

Presenter: ORTA-TERRÉ, Marina (ICCUB - IEEC)

Session Classification: Instrumentation and missions for direct low-energy cosmic ray measurements

Contribution ID: **17** Type: **Oral**

The Antarctic calibration campaign for the GAPS experiment

Thursday 15 May 2025 17:25 (25 minutes)

The General Anti Particle Spectrometer (GAPS) is a balloon-borne cosmic-ray experiment expected to be launched during the Antarctic summer season 25/26.
Its primary science goal is to search for light antinuclei in cosmic rays at kinetic energies below 0.25 GeV/n, as a possible indirect dark matter signature.
GAPS will measure the antiproton component with unprecedented statistics in an unexplored low-energy range and will deliver leading sensitivity to cosmic antideutereon and antiheliumun nuclei.
It consists of a ten-layer silicon tracker, cooled by a novel oscillating heat pipe thermal system, and is surrounded on all sides by a precision timing plastic scintillator time-of-flight (TOF) and trigger system.
GAPS utilizes a novel exotic-atom-based particle identification technique, in which an incoming antinucleus is trapped within the tracker and identified by the resulting annihilation topology.
An extensive ground calibration campaign was performed at the Long Duration Balloon facility at the McMurdo base during the summer season 24/25.
The performance of the fully integrated payload was investigated with the muon ground data.
This talk will highlight some results from the Antarctic ground testing campaign and present an outlook for the next Antarctic season of 25/26 for which GAPS is scheduled to launch.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: MUNINI, Riccardo (INFN-TS)

Presenter: MUNINI, Riccardo (INFN-TS)

Session Classification: Instrumentation and missions for direct low-energy cosmic ray measurements

Contribution ID: **18** Type: **Oral**

Update on the Terzina payload development onboard NUSES

Thursday 15 May 2025 15:50 (25 minutes)

Understanding the universe at the highest energies requires innovative approaches, as the fluxes of CRs at these energies are exceedingly low due to the power-law nature of the CR spectra. Current state-of-the-art experiments, such as the Pierre Auger Observatory and Telescope Array (TA) ground-based detectors for CR physics and IceCube and KM3Net for neutrino observations, have already instrumented areas on the order of thousands of km^2 and volumes of about 1 km^3 (respectively). However, expanding these footprints further, with the objective of increasing instrumental acceptances, soon becomes unsustainable and prohibitively expensive. A promising strategy to extend the reach of UHE CR and neutrino measurements is to move the observations to space, where a single satellite in orbit can provide access to large mass targets.

Terzina, in fact, is a compact telescope that will serve as a technological pathfinder for the indirect space-based measurements of CRs and neutrinos. Terzina will operate at a sun-synchronous orbit to study two-types of events: above-the-limb events corresponding to UHE CRs and below-the-limb events associated with earth-skimming neutrinos –high-energy astrophysical neutrinos interacting with the Earth, converting into leptons which successively induce upward-moving showers in atmosphere. Using Schmidt-Cassegrain optics, the telescope will focus the Cherenkov emissions produced by secondary particles in EAS onto an innovative focal plane consisting of 640 SiPMs (10 arrays of 8x8 cells), generating a photon hit-map output of the shower.

This presentation will provide an overview of the Terzina payload onboard the NUSES mission and will deliver an update on the current status of the payload including its instrumental development, assembly, qualifications, and simulation framework.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: TORRES SAAVEDRA, Rodrigo Alberto (Gran Sasso Science Institute)

Presenter: TORRES SAAVEDRA, Rodrigo Alberto (Gran Sasso Science Institute)

Session Classification: Instrumentation and missions for indirect high-energy cosmic ray measurements

Contribution ID: **19** Type: **Oral**

Results from the ComPair balloon flight

Wednesday 14 May 2025 10:15 (25 minutes)

ComPair is a prototype of the probe-class All-Sky Medium Energy Gamma-ray Observatory (AMEGO), which aims to fill the MeV gap. The instrument consists of four detector subsystems: a Silicon strip tracker, CZT and CsI calorimeters, and a plastic scintillator anti-coincidence detector. ComPair completed a 6.5-hour high altitude balloon flight on August 23, 2023 from Fort Sumner, NM. I will present on results from each of the four subsystems' calibration efforts as well as results from the balloon flight. Finally, I will touch on upgrades underway for ComPair 2.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Authors: BOLOTNIKOV, Aleksey; Mr CALIGIURE, Thomas (University of Florida); Dr CANNADY, Nicholas (NASA GSFC); Dr CAPUTO, Regina (GSFC/UMCP); Mr CROSIER, Wilder (Princeton University); FRIED, Jack (Brookhaven National Laboratory (US)); GHOSH, Priyarshini (NASA Goddard Space Flight Center); Dr GRIFFIN, Sean (University of Wisconsin, Madison); Dr GROVE, Eric (Naval Research Laboratory); Dr HAYS, Elizabeth (NASA GSFC); KIERANS, Carolyn (NASA GSFC); Mr KIRSCHNER, Nicholas (George Washington University); Ms KONG, Emily (United States Navy); Mr LICEAGA-INDART, Iker (NASA GSFC); MCENERY, Julie; METZLER, Zachary; MITCHELL, John; MOISEEV, Alexander; Dr PARKER, Lucas (Los Alamos National Lab); PERKINS, Jeremy; Dr PHLIPS, Bernard (Naval Research Laboratory); Dr SASAKI, Makoto (University of Maryland, College Park); SCHOENWALD, Adam (NASA GSFC); SHY, Daniel (Naval Research Laboratory); Dr SLEATOR, Clio (Naval Research Laboratory); Mr SMITH, Lucas (University of Maryland, College Park); THOMPSON, David (NASA Goddard Space Flight Center); Dr VALVERDE, Janeth (University of Wisconsin, Milwaukee); Dr WASTI, Sambid (Harrisburg University of Science & Technology); Dr WOOLF, Richard (Naval Research Laboratory); WULF, Eric (Naval Research Laboratory); Dr ZAJCZYK, Anna (University of Maryland, Baltimore County)

Presenter: METZLER, Zachary

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **20** Type: **Oral**

The Zirè experiment on board the NUSES space mission

Thursday 15 May 2025 17:00 (25 minutes)

The Zirè detector is one of the two scientific payloads of the NUSES satellite, which is currently under construction and test. Zirè aims to measure electrons, protons, and light nuclei in an kinetic energy range spanning from a few MeVs up to several hundred MeVs, enabling the study of low-energy cosmic rays, space weather phenomena, and potential Magnetosphere-Lithosphere-Ionosphere Coupling (MILC) signals. The instrument is designed to also detect photons in the energy range from 0.1 MeV to 10MeV, which is very much relevant for the study of transient events as gamma-ray bursts (GRBs) and solar flares. All the Zirè subdetectors will be equipped with a readout system entirely based on the Silicon Photomultiplier (SiPM) technology. This work provides a general overview of the design activities, scientific goals, and the current development status of the payload.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: DE MITRI, Ivan (Gran Sasso Science Institute (IT))

Presenter: DE MITRI, Ivan (Gran Sasso Science Institute (IT))

Session Classification: Instrumentation and missions for direct low-energy cosmic ray measurements

Contribution ID: **21** Type: **Oral**

A high energy cosmic radiation modular telescope at the Moon: the MoonRay concept

Tuesday 13 May 2025 11:45 (25 minutes)

The MoonRay project is carrying out a concept study of a permanent lunar cosmic-ray (CR) and gamma-ray observatory, in view of the implementation of habitats on our satellite. The idea is to build a modular telescope that will be able to overcome the limitations, in available power and weight, of the present generation of CR instruments in Low Earth Orbit, while carrying out high energy gamma-ray observations from a vantage point at the South Pole of the Moon.
An array of fully independent modules (towers), with limited individual size and mass, can provide an acceptance one order of magnitude larger than instruments in flight or planned to be operative within the decade. The modular telescope is designed to be deployed progressively, during a series of lunar missions, while collecting meaningful scientific data at the intermediate stages of its implementation. The operational power will be made available by the facilities maintaining the lunar habitats.
With a geometric factor close to 15 m^2sr and about 8 times larger sensitive area than FERMI-LAT, MoonRay will be able to carry out a very rich observational program over a time span of a few decades with an energy reach of 10 PeV allowing the exploration of the CR "knee"and the observation of the Southern Sky with gamma rays well into the TeV scale.
Each tower is equipped with three instruments. A combined Charge and Time-of-Flight detector (CD-ToF) can identify individual cosmic elements, leveraging on an innovative two-layered array of pixelated Low Gain Avalanche Diode (LGAD) sensors, with sub-ns time resolution. The latter can achieve an unprecedented rejection power against back-scattered radiation from the calorimeter. It is followed by a tracker, providing also photon conversion, and by a thick crystal calorimeter (55 radiation lengths, 3 proton interaction lengths at normal incidence) with an energy resolution of 30-40% (1-2%) for protons (electrons) and a proton/electron rejection in excess of 10^5.
In this presentation, a time resolution close to 100 ps, obtained with prototypal arrays of 3mm x 3mm LGAD pixels, will be reported from a recent test campaign carried out at CERN with Pb beam fragments

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Author: Prof. MARROCCHESI, Pier Simone (University of Siena and INFN Pisa)

Presenter: Prof. MARROCCHESI, Pier Simone (University of Siena and INFN Pisa)

Session Classification: Instrumentation and missions for direct high-energy CR measurements

Contribution ID: **22** Type: **Oral**

The Pentadimensional Tracking Space Detector, R&D for spaceborne LGAD Si-microstrip trackers

Tuesday 13 May 2025 16:55 (25 minutes)

In the context of the Pentadimensional Tracking Space Detector
project (PTSD), we are currently developing a demonstrator to increase the Technological Readiness Level of LGAD Si-microstrip tracking detectors for applications in space-borne instruments.

Low Gain Avalanche Diodes (LGAD) is a consolidated technology developed for particle detectors at colliders which allows for simultaneous and accurate time (<100 ps) and position (˜ 10 μm) resolutions with segmented Si sensors. It is a candidate technology that could enable for the first time 5D tracking (position, charge, and time) in space using LGAD Si-microstrip tracking systems. The intrinsic gain of LGAD sensors may also allow to decrease the sensor thickness while achieving signal yields similar to those of Si-microstrips currently operated in Space.

In this contribution we discuss the ongoing activities for the design,
development, and test of a breadboard laboratory model for verification of requirements, functionalities and space qualification of LGAD
Si-microstrip devices for 5D tracking in space.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Authors: BARBANERA, Mattia (Universita e INFN, Perugia (IT)); CAVAZZUTI, Elisabetta; DURANTI, Matteo (Universita e INFN, Perugia (IT)); FORMATO, Valerio; FORMATO, Valerio; FORMATO, Valerio (INFN - Sezione di Roma Tor Vergata); HU, Jiayu (Universita e INFN, Perugia (IT)); Dr MERGE', Matteo (INFN - National Institute for Nuclear Physics); MILIUCCI, Marco (INFN - National Institute for Nuclear Physics); MOVILEANU, Maria; MOVILEANU, Maria (Universita e INFN, Perugia (IT)); Dr NEGRI, Barbara Maria (ASI); OLIVA, Alberto (Universita e INFN, Bologna (IT)); Ms SAVINELLI, Martina (UniPG & INFN-Perugia); VAGELLI, Valerio; VAGELLI, Valerio (Italian Space Agency (ASI) and INFN); OLIVA, alberto (INFN Perugia)

Presenter: DURANTI, Matteo (Universita e INFN, Perugia (IT))

Session Classification: R&D of novel approaches and instruments

Contribution ID: **23** Type: **Poster**

Particle identification in high-granularity 3D calorimeters for space-borne applications

Tuesday 13 May 2025 22:00 (2 minutes)

High granularity 3D calorimeters offer the potential to precisely reconstruct the 3D topology of electromagnetic and hadronic showers originating from isotropic sources. This distinctive capability creates the opportunity for applying reconstruction and analysis methods that could yield additional information compared to those based on the traditional layer-by-layer energy deposit analysis common in particle and astroparticle physics experiments using calorimeters with layer segmentation.

In this study, we present a strategy for analyzing the energy deposit in a crystal array calorimeter, using the three-dimensional parametrization of both longitudinal and transversal shapes of showers to implement likelihood tests on single events. This test has the potential to serve as a robust tool for discriminating signals from electrons and positrons against those from hadronic particles —an essential feature expected by calorimeters in cosmic-ray measurements in space. Prospects for employment of artificial intelligence algorithm for the analysis of the shower footprint image in the crystal array will also be presented.

While this analysis was specifically developed using the High Energy cosmic Radiation Detector (HERD) calorimeter as a case study, its applicability may extend to any high granularity, homogeneous, isotropic calorimeter employed in particle physics experiments.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: BRUGNONI, Claudio (Universita e INFN, Perugia (IT))

Co-authors: DURANTI, Matteo (Universita e INFN, Perugia (IT)); FORMATO, Valerio (INFN - Sezione di Roma Tor Vergata); TABARRONI, Luca (INFN e Universita Roma Tor Vergata (IT)); VAGELLI, Valerio (Italian Space Agency (ASI) and INFN)

Presenter: BRUGNONI, Claudio (Universita e INFN, Perugia (IT))

Session Classification: Posters

Contribution ID: **24** Type: **Oral**

COSI mission overview

Wednesday 14 May 2025 10:55 (25 minutes)

The Compton Spectrometer and Imager (COSI) is an upcoming NASA Small Explorer (SMEX) satellite mission with a planned Falcon 9 launch in 2027. COSI operates as a Compton telescope in the 0.2-5 MeV gamma-ray bandpass, it has an instantaneous field of view of >25%-sky, and it obtains coverage the entire sky every day. COSI provides imaging, spectroscopy, and polarimetry of astrophysical sources, and its germanium detectors have excellent energy resolution for emission line measurements. Science goals for COSI include studies of 0.511 MeV emission from antimatter annihilation in the Galaxy, mapping radioactive elements from nucleosynthesis, determining emission mechanisms and source geometries with polarization measurements, and detecting and localizing multimessenger sources. COSI has completed its Critical Design Review and is moving into construction of flight hardware. In this presentation, I will describe the final instrument design, the current hardware and software testing, and the general status of the mission.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: TOMSICK, John (Space Sciences Laboratory / University of California, Berkeley)

Co-authors: Prof. HARTMANN, Dieter (Clemson University); KIERANS, Carolyn (NASA GSFC); Dr ZOGLAUER, Andreas (UC Berkeley)

Presenter: TOMSICK, John (Space Sciences Laboratory / University of California, Berkeley)

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **25** Type: **Poster**

WINK: A pathfinder towards innovation in X and Gamma Ray detection from Space

Thursday 15 May 2025 22:24 (2 minutes)

WINK is a test prototype for the innovative technology of Crystal Eye, a detector developed for the all-sky detection of gamma and X rays in 0.1-30 MeV range aimed to study the EM emissions associated with extreme phenomena in the Universe as, for example, production of gravitational waves, and to investigate phenomena such as the prompt emissions of Gamma Rays Bursts (GBRs), while also acting as a pointing system for studying the subsequent afterglow.

WINK consists of 3 full pixels of the original concept of Crystal Eye. Each pixel is made of two layers of LYSO crystal each read by Silicon Photomultipliers (SiPM) and an anti-coincidence system. The final detector will feature 112 pixels arranged on a hemisphere with a radius of 14 cm, which will ensure a wide FoV and an excellent localization capability.

WINK will fly for two months in low Earth orbit (LEO) aboard Space Rider (SR), an ESA vehicle. Its positioning in the module will guarantee a 30° field of view. This not only will permit field tests to further consolidate the design of the final detector, but it will allow WINK to be used for the characterization of the cosmic background. Moreover, when aimed towards earth, WINK will allow for the study of atmospheric phenomena such as Terrestrial Gamma-Ray Flashes (TGFs).
The mechanical components and the ESA compliant version of electronic boards (DAQrevision1) of WINK are already been build, and in this contribution the results of the first tests will be presented.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Authors: BARBATO, Felicia (Gran Sasso Science Institute (IT)); COLALILLO, Roberta; SARKAR, Ritabrata (Gran Sasso Science Institute); Ms SIDDIQUE, Iqra; SMIRNOV, Aleksei (Gran Sasso Science Institute (IT)); TAMBONE, Matteo (Università degli Studi di Napoli Federico II, INFN Sezione di Napoli)

Presenter: TAMBONE, Matteo (Università degli Studi di Napoli Federico II, INFN Sezione di Napoli)

Session Classification: Posters

Contribution ID: **26** Type: **Poster**

Characterization and Calibration of the FIT SiPM Read-Out System

Tuesday 13 May 2025 22:02 (2 minutes)

The use of scintillating fiber detectors, read out with silicon photomultiplier (SiPM) arrays, has emerged as a promising technology for particle tracking in high-energy physics, cosmic-ray and gamma-ray astrophysics. The FIber Tracker (FIT), proposed for the upcoming High Energy cosmic-Radiation Detection (HERD) facility, provides a spatial resolution at the scale of tens of micrometers with precise charge reconstruction measurements. The custom-made BETA ASIC has been developed to read out the SiPM arrays, fulfilling the stringent requirements for noise, linearity, dynamic range, and power consumption of space applications.
In this contribution, we present the performance of the SiPMs and the BETA read-out system used for FIT. The setup has been optimized, characterized, and calibrated using an LED light source. Furthermore, we discuss the system's performance in generating efficient triggers for the identification of ionizing particles.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Author: LATHIKA, Keerthana Rajan (Institut de Física d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology (BIST), E-08193 Bellaterra, Barcelona, Spain)

Co-authors: AZZARELLO, Philipp (Département de Physique Nucléaire et Corpusculaire (DPNC), Université de Genève, 24 quai Ernest-Ansermet, CH-1211 Genève 4, Switzerland); BLANCH, Oscar (Institut de Física d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology (BIST), E-08193 Bellaterra, Barcelona, Spain); BOIX, Juan (Institut de Física d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology (BIST), E-08193 Bellaterra, Barcelona, Spain); CARDIEL SAS, Laia (Institut de Física d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology (BIST), E-08193 Bellaterra, Barcelona, Spain); ESPINYA, Albert (ICCUB (Department of Física Quàntica i Astrofísica, Institut de Ciències Del Cosmos, Universidad de Barcelona, E-08007, Barcelona, Spain)); GASCON, David (ICCUB (Department of Física Quàntica i Astrofísica, Institut de Ciències Del Cosmos, Universidad de Barcelona, E-08007, Barcelona, Spain)); GUBERMAN, Daniel (ICCUB (Department of Física Quàntica i Astrofísica, Institut de Ciències Del Cosmos, Universidad de Barcelona, E-08007, Barcelona, Spain)); LUCCHETTA, Giulio (Institut de Física d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology (BIST), E-08193 Bellaterra, Barcelona, Spain); MARIA FRIEDEN, Jennifer (Institute of Physics, Ecole Polytechnique Fédérale de Lausanne (EPFL), Bâtiment PH, Station 3, CH-1015 Lausanne, Switzerland); MARTINEZ, Manel (Institut de Física d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology (BIST), E-08193 Bellaterra, Barcelona, Spain); MAURICIO, Joan (ICCUB (Department of Física Quàntica i Astrofísica, Institut de Ciències Del Cosmos, Universidad de Barcelona, E-08007, Barcelona, Spain)); ORTA, Marina (ICCUB (Department of Física Quàntica i Astrofísica, Institut de Ciències Del Cosmos, Universidad de Barcelona, E-08007, Barcelona, Spain); PERRINA, Chiara (Institute of Physics, Ecole Polytechnique Fédérale de Lausanne (EPFL), Bâtiment PH,

Station 3, CH-1015 Lausanne, Switzerland); RICO, Javier (Institut de Física d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology (BIST), E-08193 Bellaterra, Barcelona, Spain); SANUY, Andreu (ICCUB (Department of Física Quàntica i Astrofísica, Institut de Ciències Del Cosmos, Universidad de Barcelona, E-08007, Barcelona, Spain)); SARAH KEYSER, Kimberly (Institute of Physics, Ecole Polytechnique Fédérale de Lausanne (EPFL), Bâtiment PH, Station 3, CH-1015 Lausanne, Switzerland)

Presenter: LATHIKA, Keerthana Rajan (Institut de Física d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology (BIST), E-08193 Bellaterra, Barcelona, Spain)

Session Classification: Posters

Contribution ID: **27** Type: **Oral**

The Galactic Annihilation Line Explorer (GALE) ULDB Pioneers Experiment

Wednesday 14 May 2025 11:45 (25 minutes)

The Galactic Annihilation Line Explorer (GALE) mission will address a long-outstanding question in our understanding of the sources of Galactic positrons: whether they are produced by unresolved astrophysical sources or created via diffuse processes, possibly due to dark matter decays and/or interactions. This problem of Galactic positrons that produce 511-keV gamma-ray emission from the Galactic plane and Galactic Center has existed for years and is well-defined with the measurements by INTEGRAL/SPI. GALE is designed to achieve the needed angular resolution (fraction of a degree) and point source sensitivity (< 10ˆ-4 ph/cmˆ2/s) required to understand the 511-keV emission structure in the Galactic Center. The GALE instrument combines a coded-aperture mask (CAM) with a cadmium-zinc-telluride (CZT) imaging calorimeter (ImCAL) to form a combined CAM/Compton telescope. The ImCal is based on the design used in the successful ComPair-2023 balloon mission where its performance was demonstrated. The Wallops Arc-Second Pointer (WASP) support system will be used to achieve the precise telescope pointing control required for the GALE pointing to the GC and for the coded aperture imaging operation. In this talk, the science goals, GALE instrument design, anticipated performance and mission will be discussed.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Authors: CANNADY, Nicholas (NASA GSFC); DUTRA VASCONCELOS DOS SANTOS, Maira (NPP/GSFC); GHOSH, Priyarshini (NASA Goddard Space Flight Center); GONZALEZ, Francisco (ORNL); HARTMANN, Dieter (Clemson University); KARWIN, Christopher (NPP/GSFC); KIERANS, Carolyn (NASA GSFC); KRIZMANIC, John Francis (NASA-Natl. Aeronaut. & Space Admin. (US)); LAURENT, Philippe (CEA Paris-Saclay); MITCHELL, John; MOISEEV, Alexander; ONATE-MELECIO, Karla (NRL); PARSOTAN, Tyler (NASA/GSFC); PHLIPS, Bernard (Naval Research Laboratory); PROFUMO, Stefano (University of California, Santa Cruz); SASAKI, Makoto (University of Maryland, College Park); SHY, Daniel (Naval Research Laboratory); SMITH, Lucas (University of Maryland, College Park); STEINHEBEL, Amanda (ORNL); THOMPSON, David (NASA Goddard Space Flight Center); TIAN, Lucia (NASA/GSFC); TOMSICK, John (Space Sciences Laboratory / University of California, Berkeley); Dr WADIASINGH, Zorawar (NASA GSFC); WOOLF, Richard (Naval Research Laboratory); ZIOCK, Klaus-Peter (ORNL); ZOGLAUER, Andreas (UC Berkeley)

Presenter: KRIZMANIC, John Francis (NASA-Natl. Aeronaut. & Space Admin. (US))

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **28** Type: **Oral**

Unsupervised machine learning techniques for the selection of cosmic-ray electrons and positrons in Fermi-LAT data

Friday 16 May 2025 13:05 (25 minutes)

In astroparticle physics, machine learning (ML)-based analyses often rely heavily on Monte Carlo (MC) simulations, yet discrepancies between simulated and real experimental data can pose significant challenges, particularly in the context of supervised ML techniques. In its 2017 publication, the Fermi-LAT collaboration conducted an analysis of the cosmic electrons and positrons spectrum, exploiting supervised ML techniques for particles identification. While effective, these techniques are inherently model-dependent, as they require training on MC simulations, making them susceptible to systematic uncertainties and biases. To address this limitation, we implemented a novel approach based on unsupervised learning (UL) techniques, which autonomously identify patterns within experimental data. This method enables an almost model-independent selection, reducing potential biases and enhancing the robustness of the analysis. Applied to Fermi-LAT data, this method enhances the robustness of cosmic electron and positron spectrum measurements. Beyond this application, our work highlights the broader potential of UL in astroparticle physics, offering a powerful alternative for ML-based analyses.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: CIBRARIO, Nicolo’

Presenter: CIBRARIO, Nicolo’

Session Classification: R&D of novel approaches and instruments

Contribution ID: **29** Type: **Oral**

Crystal Eye hard X and gamma ray all sky monitor

Wednesday 14 May 2025 11:20 (25 minutes)

The Crystal Eye detector is an all-sky spaceborne gamma-ray monitor intended to cover the energy range between 10 keV - 30 MeV, a region currently lacking of extensive observations and monitoring. To optimize its design and estimate its scientific potential, it is essential to understand the environment where it will operate and how it could affect the observation process. With this aim, we assumed the orbital parameters of a potential future mission to be ∼550 km in near equatorial orbit, where the main backgrounds include cosmic diffuse and albedo gamma radiation, primary and secondary protons and neutrons. The effective area and efficiency are calculated by simulating low energy gamma-ray sources, and used to estimate the detector sensitivity to transient and steady sources. A method to estimate the online transient localization performance of the detector is also developed and discussed.
The GEANT4 simulations were driving the engineering design optimization, which is now at the end and the production of an EQM is going to start.
In the talk the optimization process and the expected performances will be discussed.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Authors: BARBATO, Felicia (Gran Sasso Science Institute (IT)); SARKAR, Ritabrata (Gran Sasso Science Institute); SAVINA, Pierpaolo (Gran Sasso Science Institute); Ms SIDDIQUE, Iqra; SMIRNOV, Aleksei (Gran Sasso Science Institute (IT))

Presenter: BARBATO, Felicia (Gran Sasso Science Institute (IT))

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **30** Type: **Oral**

The POEMMA Balloon Radio mission

Thursday 15 May 2025 15:00 (25 minutes)

To measure particles with energies above 10ˆ19 eV, enormous exposures are needed. The Probe Of Extreme Multi-Messenger Astrophysics (POEMMA) is a new design for such a mission. It is a proposed as a dual-satellite mission to observe Ultra-High-Energy Cosmic Rays (UHECRs) at the highest energies and Very-High-Energy Neutrinos (VHENs) following multi-messenger alerts of astrophysical transient events.
POEMMA Balloon with Radio (PBR) is a small-scale version of this design; it is a planned mission that will fly on a NASA Super pressure Balloon in 2027 from Wanaka, New Zealand. It uses an hybrid focal surface consisting of a fluorescent camera (FC) and a Cherenkov camera (CC) to exploit three main science goals: measure ultra-high energy cosmic rays showers with energies above a few EeV; observe high-altitude horizontal air showers with energies above the cosmic ray knee by a novel hybrid system consisting of optical and radio measurements and follow up astrophysical event alerts to search for very high energy neutrinos. In this talk an overview of the mission and the current developments will be presented.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Authors: ESER, Johannes (Columbia University); Prof. OLINTO, Angela V (The University of Chicago); OSTERIA, Giuseppe

Presenter: OSTERIA, Giuseppe

Session Classification: Instrumentation and missions for indirect high-energy cosmic ray measurements

Contribution ID: **31** Type: **Poster**

The scintillating fiber tracker of the Zirè detector onboard the NUSES satellite

Tuesday 13 May 2025 22:10 (2 minutes)

NUSES is a pathfinder satellite that will be deployed in a low Earth orbit, designed with new technologies for space-based detectors. Zirè is one of the payload of NUSES and aims to measure electrons, protons, and light nuclei in an kinetic energy range spanning from a few MeVs to several hundred MeVs, as well as photons in the energy range from 0.1 MeV to 10 MeV. Zirè consists of a Fiber TracKer (FTK), a Plastic Scintillator Tower (PST), a calorimeter (CALOg), an AntiCoincidence System (ACS) and a Low Energy Module (LEM). The FTK will be based on thin scintillating fibers readout by SiPM arrays. We assembled a prototype of Ziré (Zirettino) equipped with a single FTK layer, a reduced number of PST layers and a partially instrumented CALOg. A first version of the Ziré custom Front-End Board (FEB) featuring the on-the-shelf ASIC CITIROC by Omega/Weeroc was used for the readout. We carried out several beam test campaigns at the CERN PS and SPS facilities, as well as a dynamic test. The performance of FTK will be presented and discussed.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Authors: GILIBERTI, Mario (Universita e INFN, Bari (IT)); LIGUORI, Antonio; LOPARCO, Francesco (Universita e INFN, Bari (IT)); LORUSSO, Leonarda (INFN Bari); MAZZIOTTA, Nicola (Universita e INFN, Bari (IT)); PANZARINI, Giuliana (Universita e INFN, Bari (IT)); PILLERA, Roberta (Universita e INFN, Bari (IT))

Presenter: LORUSSO, Leonarda (INFN Bari)

Session Classification: Posters

Contribution ID: **32** Type: **Poster**

Pile-up studies and statistics: numerical simulations and experimental results with MAPMTs in single photoelectron counting mode

Thursday 15 May 2025 22:08 (2 minutes)

The counting process of individual physical events in the presence of an extended dead time (EDT) in the electronics results in the saturation and quenching of the counting rate, due to pile-up. This effect can be accounted for, on average, by inverting the saturation curve, provided the electronics double pulse resolution associated with the counting process is known. In the present work, we investigate the resulting statistical uncertainty on the reconstructed (i.e. corrected for pile-up) event rates. To this end, we perform extensive numerical simulations of the pile-up itself and of its inversion procedure, and compare the results with direct measurements of the saturation curve and its statistical properties, as obtained with multi-anode photomultiplier tubes (MAPMTs) in single photoelectron counting mode, using the SPACIROC-3 ASIC.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Authors: M’SIHID, Enzio (APC —Laboratory Astroparticle & Cosmology); PARIZOT, Etienne (Université Paris Cité / APC)

Co-author: FOR THE JEM-EUSO COLLABORATION

Presenter: M’SIHID, Enzio (APC —Laboratory Astroparticle & Cosmology)

Session Classification: Posters

Contribution ID: **33** Type: **Poster**

Correction for pile-up in the photon counting measurements of the Mini-EUSO experiment onboard the ISS

Thursday 15 May 2025 22:10 (2 minutes)

The Mini-EUSO mission operates from inside the International Space Station (ISS) to detect UV photons produced by ultra-high-energy cosmic rays (UHECRs), ELVES, meteors or other transient atmospheric or ground phenomena, using multi-anode photomultiplier tubes (MAPMTs) in single photoelectron counting mode. Because of the $\sim$ 6 ns extended dead time (EDT) associated with the use of the SPACIROC-3 ASIC, the measured counting rates underestimate the actual incoming photon flux in the case of high-intensity signal. Using the results of a detailed numerical and experimental study of the pile-up statistics presented in an accompanying communication, we demonstrate: i) how the (corrected) rate of photons hitting a given pixel of the camera as well as its uncertainty can be derived from the recorded counts, provided that the so-called double pulse resolution of that pixel is known, and ii) how the latter can be derived directly from the data themselves, on a pixel-by-pixel basis, using the histograms of the photon counts recorded over a sufficient large period of time. The procedure, using machine learning for the systematic treatment, is applied to the 2304 pixels of the Mini-EUSO camera

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Authors: M’SIHID, Enzio (APC —Laboratory Astroparticle & Cosmology); Mr PARIZOT, Etienne (Université Paris Cité / APC)

Co-author: FOR THE JEM-EUSO COLLABORATION

Presenter: M’SIHID, Enzio (APC —Laboratory Astroparticle & Cosmology)

Session Classification: Posters

Contribution ID: **34** Type: **Poster**

Design of a CubeSat flight-demonstrator for LGAD Si-microstrip devices

Tuesday 13 May 2025 22:24 (2 minutes)

In the context of the Pentadimensional Tracking Space Detector project (PTSD), we are currently developing a demonstrator to increase the Technological Readiness Level of LGAD Si-microstrip tracking detectors for applications in space-borne instruments. Low Gain Avalanche Diodes (LGAD) is a consolidated technology developed for particle detectors at colliders which allows for simultaneous and accurate time (<100 ps) and position (˜ 10 μm) resolutions with segmented Si sensors. It is a candidate technology that could enable for the first time 5D tracking (position, charge, and time) in space using LGAD Si-microstrip tracking systems. The intrinsic gain of LGAD sensors may also allow decrease the sensor thickness while achieving signal yields similar to those of Si-microstrips currently operated in Space.
As part of the project activities, a conceptual flight-demonstrator is being designed to be housed in a 6U CubeSat platform. This demonstrator will serve as a proof-of-concept for 5D tracking in space and will open new diagnostic opportunities for cosmic-ray and gamma-ray detection. The successful development of LGAD Si-microstrip based 5D tracking will enable sensitivities to perform ambitious objectives otherwise hardly achievable in the next generation of space-borne cosmic-ray instruments, paving the way for future discoveries in particle astrophysics. In this contribution we discuss the ongoing activities for the definition of preliminary CubeSat mission requirements in view of their consolidation in a dedicated study to be carried at the Concurrent Engineering Facility (CEF) of the Italian Space Agency in the second half of 2025.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Authors: BARBANERA, Mattia (Universita e INFN, Perugia (IT)); CAVAZZUTI, Elisabetta (Agenzia Spaziale Italiana); DURANTI, Matteo (INFN); FORMATO, Valerio (INFN); HU, Jiayu (INFN); IONICA, Maria (INFN); MERGÈ, Matteo (Agenzia Spaziale Italiana); MILIUCCI, Marco (Agenzia Spaziale Italiana); NEGRI, Maria Barbara (Agenzia Spaziale Italiana); OLIVA, Alberto (INFN); SAVINELLI, Martina (Università di Perugia); VAGELLI, Valerio (Agenzia Spaziale Italiana)

Presenters: CAVAZZUTI, Elisabetta (Agenzia Spaziale Italiana); MILIUCCI, Marco (Agenzia Spaziale Italiana)

Session Classification: Posters

Contribution ID: **35** Type: **Oral**

newASTROGAM: The MeV to GeV gamma-ray observatory for ESA's M8 mission

Wednesday 14 May 2025 09:25 (25 minutes)

newASTROGAM is a breakthrough mission concept for the study of the non-thermal Universe from space with gamma rays in the energy range from 100 keV to 3 GeV. It is based on an advanced space-proven detector technology, which will achieve unprecedented sensitivity, angular and energy resolution combined with polarimetric capability. Since the MeV gamma-ray energy range is the most under-explored electromagnetic window to the Universe, a mission in this energy range can address fundamental astrophysics questions connected to the physics of compact objects and merger events, jets and their environments, supernovae and the origin of the elements, potentially constrain the nature of dark matter and many more. newASTROGAM provides in addition unique continuation of sensitivity into the GeV energy range and to transients, and will detect and follow-up many of the key sources of multi-messenger astronomy in the 2040s.
newASTROGAM consists of a silicon tracker followed by a crystal calorimeter, which are both wrapped into an anti-coincidence detector to reject chaged cosmic rays. Such a mission can detect gamma rays via Compton scattering interactions or the production of pairs of electrons and positrons. This mission concept will be proposed to the ESA call for medium-class mission ideas (M8). In this talk we will review the main science cases for an MeV to GeV general purpose observatory and introduce the mission concept.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Authors: BERGE, David (DESY & Humboldt-University Berlin); MAZZIOTTA, Nicola (Universita e INFN, Bari (IT)); Prof. OBERLACK, Uwe Gerd (Johannes Gutenberg University Mainz); TATISCHEFF, Vincent (IJCLab); TAVANI, Marco (INAF)

Presenter: TATISCHEFF, Vincent (IJCLab)

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **36** Type: **Poster**

A new measurement of Light Yield Quenching in EJ-200 and LYSO scintillators

Tuesday 13 May 2025 22:04 (2 minutes)

Scintillators such as EJ-200 plastic and LYSO inorganic crystals are widely used in current and future astroparticle physics experiments. However, significant discrepancies exist among reported measurements of light yield quenching for these materials that impacts the accuracy of expected detector responses. This study presents new experimental data obtained using muons, protons, carbon ions, and x/gamma rays, addressing these inconsistencies and providing a more precise characterization of quenching effects for these scintillators. By applying an analysis based on the modified Birks-Onsager model, we also improve the understanding of LYSO's non-linear response to low-energy x/gamma rays.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Authors: LEGA, Alessandro (INFN); NICOLAIDIS, Riccardo (Universita degli Studi di Trento and INFN (IT)); NOZZOLI, Francesco (Universita degli Studi di Trento and INFN-TIFPA (IT)); RICCI, Ester (Universita degli Studi di Trento and INFN (IT))

Co-authors: Dr DIMICCOLI, Francesco (Universita degli Studi di Trento and INFN (IT)); FOLLEGA, Francesco Maria (Universita degli Studi di Trento and INFN (IT)); IUPPA, Roberto (Universita degli Studi di Trento and INFN (IT)); VERROI, enrico; Prof. ZUCCON, Paoloz (Universita degli Studi di Trento and INFN (IT)); Mr GHEZZER, Luigi Ernesto (dip. Fisica Università di Trento)

Presenter: NOZZOLI, Francesco (Universita degli Studi di Trento and INFN-TIFPA (IT))

Session Classification: Posters

Contribution ID: **37** Type: **Oral**

High-Efficiency WLS Plastic for a Compact Cherenkov Detector

Tuesday 13 May 2025 17:20 (25 minutes)

The PHeSCAMI project (Pressurized Helium Scintillating Calorimeter for AntiMatter Identification) aims to detect anti-deuterium in cosmic rays by utilizing delayed annihilations (˜µs) expected within a pressurized helium target. This technique relies on capturing the helium scintillation signal (80 nm), which requires a two-stage Wavelength Shifter (WLS) conversion.
This study presents experimental measurements of the second-stage WLS, using the FB118 material developed by "Glass To Power."The absence of residual scintillation and the high efficiency of UV photon conversion in FB118 demonstrate its strong potential as a compact Cherenkov detector for CubeSats, enabling precise particle velocity measurements in the range of 0.75c to 0.95c. Furthermore, its possible application as a trigger layer for large-acceptance detectors operating at Lagrange Point 2 (L2), such as AMS-100 or ALADInO, will be explored. This could help address challenges related to the high trigger rate caused by the intense flux of sub-GeV protons beyond Earth's magnetic field.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Authors: GHEZZER, Luigi Ernesto (dip. Fisica Università di Trento); NOZZOLI, Francesco (Universita degli Studi di Trento and INFN-TIFPA (IT)); Prof. ZUCCON, Paoloz (Universita degli Studi di Trento and INFN (IT))

Co-authors: RICCI, Leonardo; SPINNATO, Piero (I); VERROI, enrico

Presenter: NOZZOLI, Francesco (Universita degli Studi di Trento and INFN-TIFPA (IT))

Session Classification: R&D of novel approaches and instruments

Contribution ID: **38** Type: **Oral**

Flexible and Low-Material-Budget Packaging for Particle Detectors in Space

Tuesday 13 May 2025 16:30 (25 minutes)

This study presents an innovative approach to manufacturing flexible printed circuit boards (PCBs) with a low-material-budget stack, inspired by developments in the ALICE ITS1 and STAR tracker. The core of this method is the use of ultra-thin flexible cables, composed of aluminum and polyimide with thicknesses on the order of tens of micrometers, to establish connections between a sensor and its readout electronics. This design optimizes flexibility while minimizing the material budget around the sensor. The sensor interconnection is achieved through single-point Tape Automated Bonding (spTAB), an advanced alternative to traditional wire bonding, which is often unsuitable for non-planar integrations. This methodology was developed in collaboration with the University of Trento, the University of Turin, and the cleanrooms of Fondazione Bruno Kessler, and was validated within the SPES project (SuPErconducting Spectrometer for cosmic nuclear antimatter), funded by ASI. The proposed flexible PCB architecture offers significant advantages for satellite-based applications, as the minimized material budget reduces the impact of supporting electronics, ultimately enhancing experimental performance. To validate the packaging technology, a Monolithic Active Pixel Sensor (MAPS) chip, thinned to 50 µm, was integrated using this method. The resulting package consists of a flexible PCB made of Kapton and aluminum, with a two-layer architecture: one dedicated to power and digital communication and the other for grounding. The total stack thickness is approximately 100 µm, achieving a material budget X/X0 of about 0.06%. This work details the complete PCB manufacturing process, including rigorous quality assurance assessments via Plasma Focused Ion Beam (PFIB) and Scanning Electron Microscopy (SEM) imaging. Additionally, preliminary chip readout results and an analysis of sensor performance are presented. This research marks a significant step toward the adoption of this technology for space applications, demonstrating the successful integration of a MAPS detector and the viability of the proposed method. Finally, future directions, including steps toward space qualification, will be discussed.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Authors: LEGA, Alessandro (INFN); NOVEL, David

Co-authors: BELLUTTI, Pierluigi (FBK); Prof. BEOLE, Stefania Maria (Universita e INFN Torino (IT)); FACCHINELLI, Tiziano (Fondazione Bruno Kessler); IUPPA, Roberto (Universita degli Studi di Trento and INFN (IT)); PERINELLI, Alessio; RICCI, Ester (Universita degli Studi di Trento and INFN (IT))

Presenter: NOVEL, David

Session Classification: R&D of novel approaches and instruments

Contribution ID: **39** Type: **Oral**

R&D on Plasma-Etched Gas Electron Multipliers for X-ray Polarimetry in Space

Friday 16 May 2025 09:25 (25 minutes)

Gas Electron Multipliers (GEMs) play a critical role in high-resolution X-ray polarimetry, enabling precise measurements for astrophysical missions such as IXPE, Polarlight, and the upcoming eXTP telescope. These detectors rely on the ability to amplify electron signals generated by incoming X-rays with high spatial resolution while maintaining optimal detection efficiency in the 2–8 keV range. The IXPE collaboration has successfully refined Gas Pixel Detector (GPD) technology using laser-drilled GEMs and collecting the amplification signals with a dedicated detector called XPOL. The polarization of the incoming X-ray is retrieved by tracking the secondary electrons emitted through photoelectric and Auger processes after the incoming particle interacts with the gas (dimethyl ether - DME) in the chamber. Regarding microstructural aspects, the overall sensor performance in detecting the polarization of the incoming radiation is affected by three main error contributors: local or global misalignments of the GEM pattern between the top and bottom layers, inconsistencies in GEM hole geometry, and inhomogeneity across the GEM effective area. These three factors introduce systematic errors in the measurement which are difficult to quantify and thus challenging to subtract from the actual measurement. For this reason, further optimization of the GEM hole patterning is essential to maximize detector performance. To address these challenges, we investigated a plasma-based Reactive Ion Etching (RIE) technique developed at Fondazione Bruno Kessler (FBK) for GEM fabrication, in contrast to the laser-drilling approach used for IXPE and the standard wet-etch process employed by traditional manufacturers. This method allows for the production of GEM foils with more vertical and uniform hole profiles, potentially improving polarization resolution. We introduce a novel plasma-etched GEM design featuring holes with a 30 μm diameter and a 50 μm pitch. These structures have been extensively characterized using Scanning Electron Microscopy (SEM) and Plasma-Focused Ion Beam (PFIB) analysis to assess their geometry and uniformity. In collaboration with INFN , we conducted comprehensive electrical testing and performance validation within GPDs, supported by detailed Garfield++ simulations. Initial experimental results indicate that plasma-etched GEMs exhibit gain vs. voltage behavior, tested with 55Fe in a 70/30 Ar/CO_2 mixture at 1 bar, comparable to the detectors currently deployed in IXPE. While still in the early stages of research and development, this plasma-etching technique holds significant promise for enhancing the sensitivity of future space-based X-ray polarimeters. By improving the uniformity of charge amplification, it has the potential to refine polarization measurements and advance detector technology for next-generation missions. A detailed explanation of the future steps of the project, focusing on evaluating performance in terms of polarimetry resolution and comparing it to IXPE detectors, will also be provided.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Authors: LEGA, Alessandro (INFN); NOVEL, David

Co-authors: BALDINI, Luca (INFN-Pisa); BOSCARDIN, Maurizio (FBK Trento); FACCHINELLI, Tiziano (Fondazione Bruno Kessler); HALL-WILTON, Richard (Fondazione Bruno Kessler (IT)); IUPPA, Roberto (Universita degli Studi di Trento and INFN (IT)); LATRONICO, Luca; MINUTI, Massimo (INFN Pisa); Dr PEPPONI, Giancarlo; SGRO', Carmelo

Presenter: LEGA, Alessandro (INFN)

Session Classification: R&D of novel approaches and instruments

Contribution ID: **40** Type: **Oral**

Advancing Monolithic Active Pixel Sensors for Space Applications: Results from the ARCADIA MD3 Demonstrator

Tuesday 13 May 2025 15:50 (25 minutes)

Monolithic Active Pixel Sensors (MAPS) have emerged as a key enabling technology in particle physics, offering μm-level spatial resolution, low material budget, simplified assembly, and lower production costs compared to alternative detector technologies.
Following the success of ALPIDE, designed by the ALICE collaboration and currently operational in LHC Run 3, interest in MAPS has expanded beyond collider experiments. In particular, astroparticle physics has begun exploring this technology with the development of a MAPS-based tracker for the HEPD-02 detector onboard the CSES-02 satellite.

The ARCADIA collaboration, funded by INFN CSN 5, developed a versatile fully-depleted MAPS platform based on a 110nm CIS technology node, and ultra low-power architectures for frontier detectors in space. This contribution will discuss the architecture of the ARCADIA-MD3 system-grade demonstrator, highlighting the key design solutions implemented to meet the strict requirements of space environments, particularly for minimizing power consumption. We will discuss the detector characterisation and performance, and present the plans for space qualification and current and future developments of the MAPS technology.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: RICCI, Ester (Universita degli Studi di Trento and INFN (IT))

Presenter: RICCI, Ester (Universita degli Studi di Trento and INFN (IT))

Session Classification: R&D of novel approaches and instruments

Contribution ID: **41** Type: **Oral**

Development of ultra-compact detectors based on oriented crystals for the observation of high energy e+/e- and gamma rays in space

Wednesday 14 May 2025 13:00 (25 minutes)

High-density and high-Z crystals are a key element of most detectors used to observe High Energy (HE) $\gamma-$rays and cosmic rays from space, such as Fermi-LAT and DAMPE. The lattice structure of these materials is usually ignored for all practical purposes, such as instrument calibration or simulation. However, recent studies have shown that this is a rough approximation, since $e^{\pm}$ and photons with an energiy above few GeV impinging along the axis of an oriented crystals interact differently from the ordinary. Specifically, if the angle between the $e^{\pm}$ (photon) trajectory and the crystal axis is smaller than $\sim 0.1^{\circ}$, a large enhancement of the bremsstrahlung (pair production) cross-section is observed. A weaker enhancement effect can be observed even for incidence angles as large as 1°. These enhancements grow for energies as large as few TeV and then saturates.

These effects could be exploited to develop novel ultra-compact space-borne telescopes for the detection of HE photons and $e^{\pm}$. For instance, a calorimeter composed of oriented scintillating crystals could contain the e.m. showers as efficiently as a much thicker (and thus heavier and more expensive) non-oriented one. This allows to either dramatically extend its energy range, or to reduce its thickness and significantly improve its effective area, without increasing the overall volume and weight. The acceleration of the e.m. shower allows also a better discrimination of hadrons from $\gamma-$rays and $e^{\pm}$. Another possibility is the design of a silicon-tungsten tracker for $\gamma-$ray astronomy using oriented crystalline converters: the detector could be made much thinner, thus improving the low-energy angular resolution, without losing in high-energy photon conversion efficiency.

This detector concept is highly interesting for both cosmic ray astrophysics and $\gamma-$ray astronomy. In the latter, oriented crystals could allow the development of larger effective area or lighter-weight detectors sensitive to multi-GeV photons. Coupled with a high spatial resolution, such a detector could be operated to monitor the γ-ray sky, resolve unknown sources in the galactic plane and investigate the nature of the gamma excess in the galactic center, while also providing a high sensitivity to fast e.m. transients, taking advantage of the enhanced compactness of the oriented calorimeter for swift satellite repointing.

In this contribution we discuss the scientific opportunities that will be opened by the use of oriented crystal in compact detectors for cosmic-ray and $\gamma-$ray astronomy, along with the techniques used to simulate and assemble such instruments. We will also present some results obtained by the OREO collaboration, which at present time is the first and only group that was ever able to fully develop and test an oriented calorimeter composed of $PbWO_4$ crystals.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Authors: MONTI GUARNIERI, Pietro (Universita e INFN, Ferrara (IT)); BANDIERA, Laura (Istituto Nazionale di Fisica Nucleare - Ferrara); CANALE, Nicola (Universita e INFN, Ferrara (IT)); CARSI, Stefano (Universita degli Studi dell’Insubria, Como (IT) & INFN, Milano-Bicocca (IT)); COSTAMANTE,

Luigi (ASI); CUTINI, Sara (INFN sezione Perugia); DE SALVADOR, Davide (Universita e INFN, Ferrara (IT)); DURANTI, Matteo (Universita e INFN, Perugia (IT)); GUIDI, Vincenzo (Universita e INFN, Ferrara (IT)); HAURYLAVETS, Viktar (Institut for Nuclear Problems, Belarusian State University); KORJIK, Mikhail (Byelorussian State University (BY)); LEZZANI, Giulia (University of Insubria & INFN Milano-Bicocca); LONGO, Francesco; MALAGUTTI, Lorenzo (INFN Ferrara); MANGIACAVALLI, Sofia (University of Insubria & INFN Milano-Bicocca); Dr MAZZOLARI, Andrea (INFN); MOULSON, Matthew (INFN e Laboratori Nazionali di Frascati (IT)); NEGRELLO, Riccardo (Universita e INFN, Ferrara (IT)); Dr PATERNÒ, Gianfranco (Istituto Nazionale di Fisica Nucleare); PERNA, Leonardo (Universita & INFN, Milano-Bicocca (IT)); PREST, Michela (Universita & INFN, Milano-Bicocca (IT)); ROMAGNONI, Marco (Universita e INFN, Ferrara (IT)); SAIBENE, Giosue' (Universita & INFN, Milano-Bicocca (IT)); SELMI, Alessia (Universita & INFN, Milano-Bicocca (IT)); SGARBOSSA, Francesco (INFN - National Institute for Nuclear Physics); SOLDANI, Mattia (INFN e Laboratori Nazionali di Frascati (IT)); SYTOV, Alexei (Universita e INFN, Ferrara (IT)); TIKHOMIROV, Viktor (Byelorussian State University (BY)); VAGELLI, Valerio (Italian Space Agency (ASI) and INFN); VALLAZZA, Erik (Universita & INFN, Milano-Bicocca (IT)); VALZANI, Davide (University of Padova & INFN LNL)

Presenter: MONTI GUARNIERI, Pietro (Universita e INFN, Ferrara (IT))

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **42** Type: **Oral**

The LEM-X all-sky monitor: first results of the detector prototype

Thursday 15 May 2025 11:45 (25 minutes)

The *Lunar Electromagnetic Monitor in X-rays* (LEM-X) is a proposed all-sky X-ray observatory to be installed on the surface of the Moon for the rapid identification of high-energy transients and the long-term monitoring of astrophysical sources in the 2 – 50 keV band. Developed within the *Earth Moon Mars* (EMM) project of the Italian National Recovery and Resilience Plan, LEM-X has been conceived as a fully modular structure. Its building block is a compact and lightweight 2-sr field-of-view coded-mask camera, featuring four Detector Assemblies (DAs), each one built around a large-area linear Silicon Drift Detector (SDD), read out by 22 analog front-end Application Specific Integrated Circuits (ASICs), specifically developed for this project and named NOVA. Each DA has single-photon sensitivity and both spectral and imaging capabilities. We will report on the status of the project as well as the first experimental results on the breadboard of the DA, equipped with a 64-anode prototype SDD and 2 NOVA ASICs.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Authors: CERAUDO, Francesco (INAF-IAPS); DELLA CASA, Giovanni (INAF-IAPS); ANTONELLI, Matias (INFN); Prof. BERTUCCIO, Giuseppe (Politecnico di Milano); CAMPANA, Riccardo (INAF-OAS); CENTIS VIGNALI, Matteo (FBK); DEDOLLI, Irisa (Politecnico di Milano); DEL MONTE, Ettore (INAF-IAPS); DEMENEV, Evgeny (FBK); DILILLO, Giuseppe (INAF-OAR); EVANGELISTA, Yuri (INAF-IAPS); FEROCI, Marco (INAF-IAPS); FICORELLA, Francesco (FBK); FIORINI, Mauro (INAF-IASF); GEMELLI, Alessandro (University of Pavia); GIANCARLI, Edoardo (INAF-IAPS); GRASSI, Marco (University of Pavia); LOMBARDI, Giovanni (INAF-IAPS); MALCOVATI, Piero (University of Pavia); MELE, Filippo (Politecnico di Milano); NUTI, Alessio (INAF-IAPS); Dr PEPPONI, Giancarlo (FBK); RACHEVSKI, Alexandre (INFN); RASHEVSKAYA, Irina (TIFPA); SAMUSENKO, Alina (FBK); SHARMA, Ajay (INAF-OAS); TAMBUSSI, Marco (University of Pavia); ZAMPA, Gianluigi (INFN); ZAMPA, Nicola (INFN); ZORZI, Nicola (FBK); ESPOSITO, Francesca (INAF-OACN); DONNARUMMA, Immacolata (ASI); CORTESI, Ugo (CNR-IFAC); D’AMICO, Fabio (INAF); TURCHI, Alessandro (ASI); GAI, Marco (CNR-IFAC); ARGAN, Andrea (INAF)

Presenter: CERAUDO, Francesco (INAF-IAPS)

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **43** Type: **Oral**

Machine Learning techniques for Cosmic Rays Physics analysis and simulations

Friday 16 May 2025 12:40 (25 minutes)

The growing demand for GPUs has led to the rapid development of machine learning research techniques in all areas of science, including High Energy Physics.
We present a study focused on the classification task of simulated electrons and protons as they would be detected by the High Energy Cosmic-Radiation Detection (HERD) Facility. HERD is a high-energy cosmic-ray detector based on a deep three-dimensional electromagnetic calorimeter, proposed to be installed on the Chinese Space Station. The main scientific objectives of HERD include detecting dark matter particles, studying cosmic ray composition, and observing high-energy gamma rays. Our classification task is based on data from Monte Carlo simulations of proton and electron particle showers in the HERD electromagnetic calorimeter, with energies ranging from 100 GeV to 20 TeV. We tackle the classification task with a Deep Convolutional Neural Network that can reach a background rejection of the order of 10ˆ(-4)˜10ˆ(-5). Given the size of our dataset, a few million events, the Neural Network has reached the highest separation power available. A systematic study of performance vs. complexity of the network is presented.
Machine learning finds applications also in the anomaly detection field. Therefore, we can think of using it also to detect possible rare heavy-antimatter nuclei in CRs. In this spirit, we present an anomaly detection algorithm to search for anti-helium in the events collected by the Alpha Magnetic Spectrometer (AMS-02).
Machine learning can be used not only for data analysis in High Energy Physics but also to model complex physical processes, enhancing the precision and velocity of data simulations. In this view, we present a sketch idea of how Physics-Informed Neural Networks can be employed to study the diffusion process of Cosmic Rays.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: TABARRONI, Luca (INFN e Universita Roma Tor Vergata (IT))

Co-authors: BRUGNONI, Claudio (Universita e INFN, Perugia (IT)); FORMATO, Valerio (INFN)

Presenter: TABARRONI, Luca (INFN e Universita Roma Tor Vergata (IT))

Session Classification: R&D of novel approaches and instruments

Contribution ID: **44** Type: **Poster**

Search for Primordial Black holes from the International Space Station with the SQM-ISS detector

Tuesday 13 May 2025 22:12 (2 minutes)

In this paper we discuss the observational capabilities and sensitivity of the SQM-ISS detector to primordial black holes.
Primordial black holes are hypothetical black holes that could have formed in the early Universe as a result of density fluctuations in the primordial plasma, and could span a wide range of masses, from microscopic to several solar masses.
Their detection would provide insights into the conditions of the early universe, inflationary scenarios, and could help constrain their possible role as a component of dark matter.
The SQM-ISS experiment aims to detect slow, non relativistic massive particles within cosmic rays, using a detector on board the International Space Station.
The device is designed to recognise the passage of highly penetrating and dense particles in a wide range of mass and charge states.
One particularly interesting candidate is Strange Quark Matter (SQM), which is composed of aggregates of up, down and strange quarks and could represent the fundamental state of hadronic matter.
These particles, travelling at speeds typical of gravitationally bound objects in the galaxy - around 250 km/s - are also possible candidates of dark matter.
The detector can recognise the characteristic signals of these particles by measuring their speed and distance travelled using four plastic scintillator layers read by silicon photomultipliers. Additionally, four interleaved metal plates equipped with piezoelectric sensors detect mechanical vibrations caused by the passage of particles.
The time-of-flight system determines the velocity of particles by recording signals through segmented planes of scintillators. The system can detect objects with travel times up to several 2.5 μs, allowing them to be distinguished from relativistic cosmic rays.The electronics integrate fast analogue-to-digital and time-to-digital converters, with a programmable logic trigger to select relevant events.
The ability of SQM-ISS to identify penetrating, massive and slow-moving objects allows it also to be sensitive to the detection of primordial black holes.
Primordial black holes are thought to have formed in the early Universe due to the collapse of density fluctuations upon reentry into the cosmological horizon during inflationary scenarios.
Alternative mechanisms include the role of cosmic strings, domain walls or phase transitions, which naturally induce peaks in the primordial balck holes mass function.
String theory suggests that primordial balck holes could be interpreted as fuzzballs, horizonless, non-singular objects that do not evaporate like traditional black holes. These fuzzballs emerge from string-theoretic models, such as those involving D-branes or highly excited strings with masses around 10^{17} GeV and a small perturbative coupling. This scenario suggests that Primordial black holes or fuzzballs could be long-lived and contribute to dark matter, avoiding complete evaporation via Hawking radiation.
If black holes evaporate by emitting Hawking radiation, the surviving ones should have a mass greater than 10^{11} g.
SQM-ISS will explore a range of low-mass PBHs ($10^9 - 10^{15}$ g), providing new constraints on their

abundance and potential connection to dark matter.
We will discuss how black holes, travelling through the detector at velocities compatible with galactic orbital speeds, can be identified based on their interaction signatures.
Their detection would confirm the existence of low-mass PBHs, and the absence of signals would set new experimental limits and guide future research on this class of exotic objects.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: LIBERATORI, Francesca (Tor Vergata)

Co-authors: CASOLINO, Marco (INFN - National Institute for Nuclear Physics); MARCELLI, Laura; PLEBANIAK, Zbigniew (INFN Rome and University of Rome, Tor Vergta, Italy); Dr REALI, Enzo (Tor Vergata)

Presenter: LIBERATORI, Francesca (Tor Vergata)

Session Classification: Posters

Contribution ID: **45** Type: **Poster**

Testing and characterization of XGIS detectors for THESEUS mission

Thursday 15 May 2025 22:28 (2 minutes)

Transient High-Energy Sky and Early Universe Surveyor (THESEUS), a multi-instrument space mission concept, is currently one of the three candidates of the European Space Agency (ESA) M7 medium size missions, with strong heritage derived from the M5 Phase-Assessment (Phase-A) study in 2018-2021.

With an intended launch in 2037, the main goals of this mission include exploring the early universe by identifying and localising Gamma Ray Bursts (GRBs) at high redshifts (potentially up to z = 10 and beyond) and contributing to multimessenger time-domain astrophysics through extensive X/gamma-ray transient universe monitoring. Crucial to THESEUS success is its comprehensive transient detection and characterization capabilities, provided by wide and deep sky monitoring across a broad energy band (0.3 keV –10 MeV) in which the X and Gamma-ray Imaging Spectrometer instrument (XGIS) plays an essential role. The X and Gamma-ray Imaging Spectrometer instrument is capable of covering an unprecedented wide energy band (2 keV –10 MeV), with imaging capabilities and location accuracy <15 arcmin up to 150 keV in a Field of View (FOV) of 77x117 deg2.

To ensure THESEUS mission's success, defining and finalizing the procedures for construction, testing, and qualification of instruments to be flown onboard is essential. Given the complexity of it's instruments, thorough procedures are essential. This work presents the **strategy adopted for the development of the test procedures implemented during development of various XGIS components**. Additionally, it discusses the current performance of XGIS detectors highlighting the potential areas for detector characterization improvement along with simplification of manufacturing processes to support large scale production of at least 100 detector modules per XGIS camera.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Author: SRIVASTAVA, Smiriti (INAF OAS Bologna, Italy)

Co-authors: Dr AMATI, Lorenzo (INAF OAS Bologna, Italy); BORCIANI, Edoardo (INAF OAS Bologna, Italy); CALABRETTO, Paolo; Dr CAMPANA, Riccardo (INAF OAS Bologna, Italy); DEMENEV, Evgeny (FBK); LABANTI, Claudio (INAF OAS Bologna, Italy); Dr MARCHESINI, Ezequiel (INAF OAS Bologna, Italy); MATTIOLI, Giulia (INAF-OAS Bologna); Mr SHARMA, Ajay (INAF OAS Bologna, Italy); Dr VIRGILLI, Enrico (INAF OAS Bologna, Italy)

Presenter: SRIVASTAVA, Smiriti (INAF OAS Bologna, Italy)

Session Classification: Posters

Contribution ID: **46** Type: **Poster**

The Large Area Detector for future spectral-timing space missions

Thursday 15 May 2025 22:30 (2 minutes)

The Large Area Detector (LAD) is an instrument concept for high-throughput spectral timing studies of compact astrophysical sources in the X-ray energy band (2-30 keV), originally proposed for the LOFT, eXTP and STROBE-X space missions. The LAD is based on an array of collimated large-area linear Silicon Drift Detectors (SDDs), that can be combined to accumulate a large effective area. The sensor architecture was specifically developed to provide the best possible performances in a constrained environment, with limited availability of volume and power. By introducing two major improvements in the detector layout, namely the almost complete suppression of charge-sharing between neighboring anodes and the reduction of the collecting anode size, we could reach promising spectral performances in previous tests. In the context of an upcoming ESA's F3 mission proposal, in which the LAD will feature as the main narrow field-of-view instrument, we combined a 10-anode prototype of the LAD sensor with a novel CMOS analog front-end Application-Specific Integrated Circuit (ASIC), named NOVA. Originally developed for the Italian Lunar Electromagnetic Monitor in X-rays (LEM-X) observatory, the NOVA ASIC demonstrated from preliminary tests to perform optimally when coupled with a large-area SDD. In this work, we will present the first performance results of the integrated detector system (NOVA ASIC and SDD prototype).

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Authors: DELLA CASA, Giovanni (INAF-IAPS); CERAUDO, Francesco; ANTONELLI, Matias (INFN); Prof. BERTUCCIO, Giuseppe (Politecnico di Milano); CAMPANA, Riccardo (INAF/OAS); DEL MONTE, Ettore (INAF-IAPS); EVANGELISTA, Yuri (INAF-IAPS); FEROCI, Marco (INAF-IAPS); CENTIS VIGNALI, Matteo (FBK); DEDOLLI, Irisa (Politecnico di Milano); DEMENEV, Evgeny (FBK); DILILLO, Giuseppe (INAF-OAR); FICORELLA, Francesco (Fondazione Bruno Kessler); FIORINI, Mauro (INAF-IASF); GEMELLI, Alessandro (University of Pavia); GIANCARLI, Edoardo (INAF-IAPS); GRASSI, Marco (University of Pavia); LOMBARDI, Giovanni (INAF-IAPS); MALCOVATI, Piero (University of Pavia); MELE, Filippo (Politecnico di Milano); NUTI, Alessio (INAF-IAPS); Dr PEPPONI, Giancarlo; RACHEVSKI, Alexandre (INFN, Section of Trieste); RASHEVSKAYA, Irina (TIFPA INFN); SAMUSENKO, Alina (FBK); SHARMA, Ajay (INAF-OAS Bologna); TAMBUSSI, Marco (University of Pavia); ZAMPA, Gianluigi; ZAMPA, Nicola (Universita e INFN Trieste (IT)); ZORZI, Nicola (FBK - Fondazione Bruno Kessler (IT))

Presenter: DELLA CASA, Giovanni (INAF-IAPS)

Session Classification: Posters

Contribution ID: **47** Type: **Poster**

The ANTARES4 Readout ASIC for the Second Flight of the GAPS Experiment

Tuesday 13 May 2025 22:26 (2 minutes)

The General Antiparticle Spectrometer (GAPS) is a stratospheric balloon experiment designed to search for low-energy cosmic-ray antinuclei as potential indirect evidence of dark matter annihilation or decay. Flying over Antarctica, GAPS will complete three flights for a combined mission duration of approximately 100 days. By targeting the largely unexplored sub-250 MeV/n energy range, GAPS will enhance sensitivity to antideuterons and antihelium while also extending low-energy antiproton measurements below 100 MeV.

The GAPS instrument consists of a segmented tracker composed of over 1000 custom lithium-drifted silicon (Si(Li)) detectors, which enable x-ray spectroscopy and charged-particle tracking of antimatter interactions. The readout of the Si(Li) strip detectors is performed by a full-custom application-specific integrated circuit (ASIC), for which an upgraded version has been designed for the second flight.

This work will present ANTARES4 (ANTiparticle Asic REadout for SiLi detectors), a prototype ASIC designed in a commercial 65 nm CMOS technology, which includes eight analog channels, each featuring a Charge Sensitive Amplifier (CSA) with dynamic signal compression. A key innovation in this design is the implementation of a non-linear feedback capacitor using a dynamic threshold MOSFET (DTMOS) in the CSA. In this prototype, four different configurations of the DTMOS-based feedback capacitor have been included to be studied and compared with simulations, which indicate increased performance over a traditional MOS device employed as a nonlinear capacitor. This is required to handle the wide input dynamic range from 10 keV to 100 MeV, while preserving the necessary sensitivity for x-rays below 100 keV. Each silicon strip is expected to exhibit approximately 5 nA of leakage current at the operating temperature of -40 ℃. To accommodate this, charge restoration in the feedback capacitor is performed using a Krummenacher network, capable of handling up to 100 nA of leakage current. This ensures proper operation of the readout electronics both in flight and during ground testing at room temperature. Following the CSA, the signal is processed by a time-invariant CR–RC semi-Gaussian unipolar shaper with eight selectable peaking times.

The design for the chip has been submitted to the foundry. This work will present the readout channel of ANTARES4, detailing its architecture, noise optimization strategies, calibration capabilities, and the novel design solutions implemented in the ASIC.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: GHISLOTTI, Luca (University of Bergamo and INFN Pavia)

Co-authors: Mr LAZZARONI, Paolo (University of Bergamo & INFN Pavia); MANGHISONI, Massimo (Università di Bergamo - Italy); RICEPUTI, Elisa

Presenter: GHISLOTTI, Luca (University of Bergamo and INFN Pavia)

Session Classification: Posters

Contribution ID: **48** Type: **Oral**

The TIGERISS Galactic Cosmic Ray Mission

Tuesday 13 May 2025 10:55 (25 minutes)

The Trans-Iron Galactic Element Recorder for the International Space Station (TIGERISS) is a NASA Astrophysics Pioneers mission in Phase B development with a planned launch to the ISS in 2027 and manifested on the Starboard Overhead X-Direction (SOX) location on the Columbus External Payload Facility. TIGERISS will be the first Galactic Cosmic Ray (GCR) detector to measure elemental abundances from $_5$B to $_{82}$Pb over ∼400 MeV/nucleon to ∼10 GeV/nucleon with single-element resolution. It builds on the heritage of the predecessor TIGER and SuperTIGER stratospheric balloon-borne experiments flown from Antarctica and uses the proven combination of ionization (dE/dx) detectors with acrylic (n = 1.5) and silica aerogel (n = 1.05) Cherenkov-light-radiator ($\propto\beta$) detectors for charge and energy measurement. Introducing silicon strip detectors (SSDs) in place of both scintillating fiber hodoscopes for track reconstruction and large area scintillator detectors for dE/dx measurement and the instrument trigger reduces material in beam and shortens instrument stack height, and CERN beam tests have demonstrated that SSDs provide superior charge resolution (σ_Z < 0.25) and signal linearity over the full dynamic range. TIGERISS is using silicon photomultipliers (SiPMs) instead of photomultiplier tubes to avoid the need for high voltage and to provide more compact Cherenkov detector readout needed to maximize the instrument geometry within the SOX payload envelope. The shorted stack height and maximized instrument area provide a geometry factor of 1.21 m^{2}sr that allows for TIGERISS in one year to have comparable GCR exposure to that achieved in the first 55-day SuperTIGER flight over their common measurement range without the systematics from atmospheric propagation corrections. Aiming to extend TIGERISS operations through the end of the ISS, the data collected would allow it to make the best test of models of GCR origins, including their source environments and acceleration mechanisms. TIGERISS measurements over nearly the entirety of the s-process and r-process (slow and rapid) neutron capture processes and the rp-process rapid-proton capture process of heavy-element nucleosynthesis will enable it to make a significant contribution to the wider multi-messenger effort to determine the relative contributions of supernovae and neutron star merger events to r-process nucleosynthesis.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: RAUCH, Brian

Presenter: RAUCH, Brian

Session Classification: Instrumentation and missions for direct high-energy CR measurements

Contribution ID: **49** Type: **Oral**

The Cherenkov Camera for the PBR mission

Thursday 15 May 2025 15:25 (25 minutes)

POEMMA-Balloon with Radio (PBR) is designed as a payload for a NASA suborbital Super Pressure Balloon that will circle over the Southern Ocean and a mission duration as long as 50 days. The PBR instrument consists of a 1.1 m aperture Schmidt telescope similar to the POEMMA design with two cameras in its focal surface: a Fluorescence Camera (FC) and a Cherenkov Camera (CC). The CC camera is mainly devoted to the observation of cosmic-ray induced high-altitude horizontal air showers (HAHAs) and search for neutrino-induced upward-going EAS. It will be made of 2048 SiPM with a surface of 3x3 mm2 and a FoV of 12°by 6°, covering a spectral range of 320-900 nm. The CC camera is an innovative detector currently under construction. In this talk information about the current status will be given.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: Dr PANICO, Beatrice (University of Naples Federico II - INFN Sez. Napoli)

Co-authors: AMMENDOLA, Roberto (INFN e Universita Roma Tor Vergata (IT)); Mr ANASTASIO, Antonio (INFN Napoli); BADONI, Davide (INFN Sezione di Roma Tor Vergata); BERTAINA, Mario (Univ. & INFN Torino); CAFAGNA, Francesco (Universita e INFN, Bari (IT)); Dr CAMPANA, Donatella (INFN); CASOLINO, Marco (INFN - National Institute for Nuclear Physics); DE SANTIS, Cristian (Universita degli Studi di Roma Tor Vergata (IT)); DI SALVO, Andrea (Istituto Nazionale di Fisica Nucleare); Mr GARGIULO, Raffaele (INFN Roma Tor Vergata); Mr MARCELLI, Alessandro (INFN Roma Tor Vergata); MARCELLI, Laura; Mr MASONE, Vincenzo (INFN Napoli); MESE, Marco (University of Naples Federico II); MIGNONE, Marco (Universita e INFN Torino (IT)); OSTERIA, Giuseppe; PASSEGGIO, Giuseppe (University Federico II and INFN, Naples (IT)); Dr PERFETTO, Francesco (INFN Napoli); Dr QURESHI, Haroon Akhtar (INFN Napoli); REALI, Enzo (Tor Vergata); RICCI, Ester (Universita degli Studi di Trento and INFN (IT)); SCOTTI, Valentina

Presenter: Dr PANICO, Beatrice (University of Naples Federico II - INFN Sez. Napoli)

Session Classification: Instrumentation and missions for indirect high-energy cosmic ray measurements

Contribution ID: **50** Type: **Oral**

The Antarctic Demonstrator for Advanced Particle-astrophysics Telescope (ADAPT) Project Status

Wednesday 14 May 2025 12:10 (25 minutes)

The astrophysical community is currently focusing on the development of next-generation gamma-ray telescopes designed to detect low-energy photons in the MeV-GeV range, operating in both the Compton and pair conversion regimes. The proposed Advanced Particle-astrophysics Telescope (APT) is a MeV-TeV gamma-ray space-based planned mission aimed at providing an order of magnitude improvement in sensitivity over any current mission with a design optimized for dark-matter and multimessenger science. The APT collaboration is an international team focused now on designing and building a high-altitude balloon-borne prototype, the Antarctic Demonstrator for APT (ADAPT), which is anticipated to fly in the 2026-27 season. The current design of the ADAPT instrument includes an imaging CsI calorimeter (ICC) and a scintillating fiber tracker. An ICC module is composed of a 3 $\times$ 3 array of 150 mm $\times$ 150 mm $\times$ 5mm CsI(Na) tiles, with top and bottom surfaces covered by 2 mm wavelength-shifting (WLS) fibers, oriented orthogonally along the x- and y-axes are read out by silicon photomultipliers (SiPMs). The fiber tracker consists of 1.5 mm round scintillating f ibers, arranged in two interleaved layers for both the x- and y-coordinates. Additionally, the ADAPT design includes a Silicon Strip Detector (SSD) to enhance Compton reconstruction and cosmic ray (CR) measurements. The instrument is also equipped with an Anti-Coincidence Detector (ACD) made of plastic scintillators as outermost detector. The ACD's primary role is to discriminate gamma-rays from charged particles and provide complementary measurements for nuclei identification. The performance of each sub-detector, as well as the overall performance of ADAPT, has been extensively evaluated through simulation modeling, laboratory tests, and beam tests. In this contribution, we present an overview of the current design of the ADAPT instrument, its scientific objectives, and its ongoing performance assessment, (with a focus on event reconstruction in the Compton regime and real-time gamma-ray burst localization).

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Author: MAZZIOTTA, Nicola (Universita e INFN, Bari (IT))

Presenter: MAZZIOTTA, Nicola (Universita e INFN, Bari (IT))

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **51** Type: **Oral**

A SiPM-based RICH detector with timing capabilities for ion identification

Tuesday 13 May 2025 17:45 (25 minutes)

In this contribution we present a novel compact particle identification (PID) detector concept based on Silicon Photomultipliers (SiPMs) optimized to perform combined Ring-Imaging Cherenkov (RICH) and Time-of-Flight (TOF) measurements using a common photodetector layer. The system consists of a Cherenkov radiator layer separated from a photosensitive surface equipped with SiPMs by an expansion gap. A thin glass slab, acting as a second Cherenkov radiator, is coupled to the SiPMs to perform Cherenkov-based charged particle timing measurements. We assembled a small-scale prototype instrumented with different Hamamatsu SiPM array sensors with pixel pitches ranging from 1 to 3 mm and coupled with 1 mm thick fused silica window. The RICH radiator consisted of a 2 cm thick aerogel tile with a refractive index of 1.03 at 400 nm. The prototype was successfully tested in beam test campaigns at the CERN PS T10 beam line with pions and protons. We have measured an angular resolution better than 1 mrad at the Cherenkov angle saturation value and a time resolution better than 50 ps for charged particles with Z = 1. The present technology makes the proposed SiPM-based PID system particularly attractive for space applications due to the limited detector volumes available. In this contribution we present beam test results obtained with the detector prototype and we discuss a possible configuration optimised for the identification of ions.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: MAZZIOTTA, Nicola (Universita e INFN, Bari (IT))

Co-authors: GILIBERTI, Mario (Universita e INFN, Bari (IT)); LIGUORI, Antonio; LORUSSO, Leonarda (INFN Bari); NICASSIO, Nicola (Universita e INFN, Bari (IT)); PANZARINI, Giuliana (Universita e INFN, Bari (IT)); PILLERA, Roberta (Universita e INFN, Bari (IT))

Presenter: MAZZIOTTA, Nicola (Universita e INFN, Bari (IT))

Session Classification: R&D of novel approaches and instruments

Contribution ID: **52** Type: **Oral**

IXPE Gas Pixel Detector test and characterization with the X-ray Calibration Facility

Friday 16 May 2025 10:15 (25 minutes)

The Imaging X-ray Polarimetry Explorer (IXPE) is a NASA-ASI space mission launched in 2021 and it is the current state-of-the-art of astrophysical X-ray polarimetry. It measures the linear polarization of different astrophysical sources over the photon energy range 2-8 keV.
Its core detector is the Gas Pixel Detector (GPD): it employs the photoelectric effect and the polarization is recovered from the azimuthal distribution of the photoelectron directions of emission.
GPDs are the only space-qualified detectors currently used for X-ray polarization, making systematic testing and monitoring essential, especially in view of future X-ray polarimeters. This can be implemented on ground, by testing and characterizing spare GPDs with the X-ray Calibration Facility (XCF) hosted at the University of Turin. It is an open-design setup providing photon beams with various spatial and energy configurations and offering both unpolarized and linearly polarized beams, the latter obtained through Bragg diffraction. It enables different kind of studies like GPD systematic effects, the intrinsic source polarization or long-term GPD response variations.
Initially conceived as a calibration source to qualify GPDs, the XCF can satisfy evolving requirements to support R&D programs of innovative position, energy and polarization-sensitive X-ray detectors.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: Mr TUGLIANI, Stefano (UNITO - INFN Sezione Torino)

Co-authors: Prof. BONINO, Raffaella (UNITO - INFN Sezione Torino); Dr CIBRARIO, Nicolò (UNITO - INFN Sezione Torino); Dr MALDERA, Simone (INFN Sezione Torino); Mr FRASSÀ, Andrea (UNITO - INFN Sezione Torino); Dr LATRONICO, Luca (INFN Sezione Torino); Dr GORGI, Alessio (INFN Sezione Torino - INAF)

Presenter: Mr TUGLIANI, Stefano (UNITO - INFN Sezione Torino)

Session Classification: R&D of novel approaches and instruments

Contribution ID: **53** Type: **Oral**

The HEPD-02 cosmic-ray experiment ready for flight on-board the CSES-02 satellite.

Thursday 15 May 2025 16:35 (25 minutes)

The High Energy Particle Detector HEPD-02 is primarily devoted to observe fluxes of cosmic-ray electrons, protons and light nuclei, with kinetic energies in the MeV range –up to a few hundreds. HEPD-02 will be hosted on-board the China Seismo-Electromagnetic Satellite CSES-02, on a quasi-polar, low-Earth orbit; the launch is currently foreseen during 2025.
The CSES mission, coordinated by China National Space Administration (CNSA) and Italian Space Agency (ASI), aims at developing a series of satellites for studying the near-Earth environment, by means of electromagnetic, ionospheric, magnetospheric and cosmic-ray observations. The first High Energy Particle Detector, HEPD-01, has been launched in 2018 with the CSES-01 satellite.
HEPD-02 is a state-of-the-art instrument for the identification of various particle species, measuring their energy and arrival direction. Several improvements were applied with respect to HEPD-01, in an effort to optimize the measurement quality, while satisfying multiple requirements for on-satellite operation: size, weight, power and data bandwidth limitations, mechanical robustness, operation between -10 ℃ and +35 ℃ in high vacuum, compatibility with radiation effects, adequate failure mitigation to guarantee at least 6 years of in-flight operation.
The core of HEPD-02 is a tower of superposed plastic and crystal scintillator layers, surrounded by containment planes on lateral and bottom sides, all read-out by PMTs for acquisition triggering and measuring particle energy and range. On the top part of the tower, a tracking system with monolithic active pixel sensors (MAPS) constitutes the first ever satellite application of this technology.
Technical tests have been performed according to space qualification requirements, in particular to assess immunity from mechanical stresses at launch, operation in expected temperature/pressure environment and electromagnetic compatibility with satellite instrumentation. Beam tests have been executed to evaluate scientific performances with different particle species and energies.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: Dr RICCIARINI, Sergio Bruno (IFAC - CNR (Firenze, Italy))

Presenter: Dr RICCIARINI, Sergio Bruno (IFAC - CNR (Firenze, Italy))

Session Classification: Instrumentation and missions for direct low-energy cosmic ray measurements

Contribution ID: **54** Type: **Poster**

Characterization and quality control of the SMART board for the ADAPT hodoscope and calorimeter

Tuesday 13 May 2025 22:28 (2 minutes)

The Advanced Particle Astrophysics Telescope (APT) is a proposed next-generation space-based observatory designed for gamma-ray astronomy in the MeV-TeV energy range. To validate its technology and design, a small-scale prototype, the Antarctic Demonstrator for APT (ADAPT), is currently under development for a high-altitude balloon flight during the 2026-2027 Antarctic summer. Among its sub-detectors, there are a hodoscope that consists of four layers of interleaved scintillating fibers coupled to Silicon Photomultipliers (SiPMs), and an Imaging CsI calorimeter (ICC), formed by 4 layers of CsI(Na) crystals with crossed WLS fibers readout by SiPMs. Our work focuses on the development and characterization of a multichannel readout electronics system for the hodoscope's SiPM signals. Specifically, we employ the SMART (SiPM Multichannel ASIC for high Resolution Cherenkov Telescopes) ASIC, which offers a compact, cost-effective, and highly integrated solution for signal amplification. In this contribution, we present the quality control and performance characterization of the SMART readout board for the ADAPT hodoscope and ICC layers. This system is crucial for accurately reconstructing particle trajectories within the ADAPT detector stack, leveraging the high precision and efficiency of the SMART ASIC.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Author: DE PALMA, Gaia (Universita e INFN, Bari (IT))

Presenter: DE PALMA, Gaia (Universita e INFN, Bari (IT))

Session Classification: Posters

Contribution ID: **55** Type: **Poster**

A Nanosatellite-sized detector for sub-MeV charged Cosmic Ray Fluxes in Low Earth Orbit: The Low Energy Module (LEM) onboard the NUSES Space Mission

Thursday 15 May 2025 22:00 (2 minutes)

Operating a space-based detector in high-radiation regions such as the South Atlantic Anomaly (SAA) presents challenges for both hardware design and data acquisition. The Low Energy Module (LEM) has been conceived to address these demands, offering robust measurement capabilities even under hostile conditions. NUSES is a forthcoming space mission intended to test innovative observational and technological methods for studying relatively low-energy cosmic rays, gamma rays, and high-energy astrophysical neutrinos. Two scientific payloads will be aboard: Terzina and Zir\‘e. Terzina is an optical telescope equipped with SiPM arrays for detecting and analyzing Cherenkov light generated by Extensive Air Showers produced by high-energy cosmic rays and neutrinos in the atmosphere. Zir\‘e, meanwhile, will detect protons and electrons up to a few hundred MeV as well as photons in the MeV range, and it incorporates the LEM.

The LEM is a compact particle spectrometer dedicated to measuring fluxes of relatively low-energy electrons (0.1–7\,MeV) and protons (3–50\,MeV) in Low Earth Orbit. For event-based particle identification, it employs the well-established ΔE–E (Delta E–E) technique, commonly used in particle physics. Observing Particle Bursts (PBs) in this energy regime may illuminate correlations between seismic or volcanic events and the collective motion of particles in the Van Allen belts. With its limited acceptance and small footprint ($10 \times 10 \times 10\,\mathrm{cm}^3$), the LEM can effectively operate in high-radiation areas such as the SAA and the inner Van Allen belt, where electron fluxes can reach 10^6–$10^7\,\mathrm{cm}^{-2}\,\mathrm{s}^{-1}\,\mathrm{sr}^{-1}$.

In this presentation, we will discuss the design of the Flight Model, the current integration status, experimental results from proton beam tests on the silicon detectors, and the expected performance of the system, drawing on both Monte Carlo simulations and preliminary data analysis.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Authors: NICOLAIDIS, Riccardo (Universita degli Studi di Trento and INFN (IT)); NOZZOLI, Francesco (Universita degli Studi di Trento and INFN-TIFPA (IT))

Presenter: NICOLAIDIS, Riccardo (Universita degli Studi di Trento and INFN (IT))

Session Classification: Posters

Contribution ID: **56** Type: **Oral**

SQM-ISS: A dual-mode detector for the search of Strange Quark Matter and other Dark Matter candidates in space

Tuesday 13 May 2025 12:10 (25 minutes)

The SQM-ISS detector is an advanced instrument designed to search from the International Space Station (ISS) for heavy, slow-moving particles, such as strange quark matter (SQM), Q-balls or primordial black holes. These particles, if they exist and form a part of dark matter, are expected to travel at speeds of up to 250 km/s, which corresponds to typical galactic orbital velocities. The detection of such objects could provide new insights into cosmic rays and the possible role of exotic nuclear states in dark matter. Unlike many dark matter searches relying on physics beyond the Standard Model, SQM-ISS explores scenarios explainable within quantum chromodynamics, where SQM may represent a stable phase of hadronic matter.

The detector combines two complementary measurement techniques: plastic scintillators with silicon photomultipliers for charge detection, and piezoelectric sensors on metal plates to measure vibrations caused by passing massive particles. A time-of-flight system provides precise velocity measurements, helping to distinguish exotic candidates from the cosmic ray background. This unique combination provides sensitivity to both charged and neutral particles, extending the range of detectable mass and charge.

Operating on the International Space Station, SQM-ISS benefits from microgravity, which eliminates atmospheric absorption and seismic noise, allowing direct sampling of interstellar and solar system material. Real-time data processing and adaptive triggering allow efficient event selection, long-term autonomous operation and fast data transfer to Earth. Its modular design allows for future upgrades and integration into next-generation space missions. The mission was selected by the European Space Agency (ESA) under the SciSpacE programme in recognition of its scientific and technological value. The results from SQM-ISS can refine our understanding of cosmic-ray composition, constrain flux limits for exotic matter, and provide valuable data for exploring the possible role of stable quark matter in dark matter models.

In this work, I will present the detector design, its science objectives, and the perspectives for flight under the ESA evaluation.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: PLEBANIAK, Zbigniew (INFN Rome and University of Rome, Tor Vergta, Italy)

Co-authors: CASOLINO, Marco (INFN - National Institute for Nuclear Physics); LIBERATORI, Francesca (Tor Vergata); REALI, Enzo (Tor Vergata); MARCELLI, Laura; PARIZOT, Etienne (Université Paris Diderot / APC)

Presenter: PLEBANIAK, Zbigniew (INFN Rome and University of Rome, Tor Vergta, Italy)

Session Classification: Instrumentation and missions for direct high-energy CR measurements

Contribution ID: **57** Type: **Poster**

The Anti Coincidence Detector for the APT Antarctic Demonstrator

Thursday 15 May 2025 22:32 (2 minutes)

The Antarctic Demonstrator for the Advanced Particle-Astrophysics Telescope (ADAPT) is a NASA suborbital mission planned for a high-altitude balloon flight over Antarctica during the 2026-2027 season. ADAPT aims to validate key detector technologies for the forthcoming space-based Advanced Particle-Astrophysics Telescope (APT) mission, an MeV-TeV gamma-ray telescope designed to provide an order of magnitude improvement in sensitivity over any current mission, with a focus on dark matter and multimessenger science.

A segmented anti-coincidence detector (ACD) covers the ADAPT detector to select gamma-rays against the charged cosmic-ray background, thereby enhancing the detection sensitivity to gamma-ray events. A secondary objective of the ACD is to identify heavy nuclei that exploit the proportionality of the energy deposition to Z^2 (where Z is the atomic number of the nucleus). The ACD consists of a set of plastic scintillator tiles coupled with Silicon Photomultipliers (SiPMs), arranged to envelop the detectors in a configuration that ensures the veto of charged particle interactions while providing complementary measurements for nuclei identification.

This presentation will explore the technical specifications and design considerations of the ADAPT ACD, as well as its expected performance, which has been extensively evaluated through simulation modeling, tests in laboratory and with beam particles.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Authors: GARGANO, Fabio (Univ. + INFN); LOIZZO, Pierpaolo (INFN Sezione di Bari (IT), University of Trento (IT))

Co-authors: Dr BISSALDI, Elisabetta (INFN, Università e Politecnico di Bari); DE PALMA, Gaia (Universita e INFN, Bari (IT)); DI VENERE, Leonardo (INFN - National Institute for Nuclear Physics); ESPIÑA, Albert; GASCON, David (ICCUB (Department of Física Quàntica i Astrofísica, Institut de Ciències Del Cosmos, Universidad de Barcelona, E-08007, Barcelona, Spain)); GUBERMAN, Daniel Alberto (University of Barcelona (ES)); LICCIULLI, Francesco (Universita e INFN, Bari (IT)); MAZZIOTTA, Nicola (Universita e INFN, Bari (IT)); SANUY, Andreu (University of Barcelona); SERINI, Davide (Universita e INFN, Bari (IT))

Presenter: GARGANO, Fabio (Univ. + INFN)

Session Classification: Posters

Contribution ID: **58** Type: **Oral**

COCOA: a compact Compton camera for astrophysical observation of MeV-scale gamma rays

Thursday 15 May 2025 10:55 (25 minutes)

COCOA (COmpact COmpton cAmera) is a next-generation, cost-effective gamma-ray telescope designed for astrophysical observations in the MeV energy range. The detector comprises a scatterer volume employing the LiquidO detection technology and an array of scintillating crystals acting as absorber. Surrounding plastic scintillator panels serve as a veto system for charged particles. The detector's compact, scalable design enables flexible deployment on microsatellites or high-altitude balloons. Gamma rays at MeV energies have not been well explored historically (the so-called "MeV gap") and COCOA has the potential to improve the sensitivity in this energy band by up to two orders of magnitude.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Author: SOLETI, Stefano Roberto (Donostia International Physics Center)

Presenter: SOLETI, Stefano Roberto (Donostia International Physics Center)

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **59** Type: **Poster**

On-board and on-ground operations for the Mini-EUSO telescope on-board the International Space

Thursday 15 May 2025 22:16 (2 minutes)

Since 2019, the Mini-EUSO (Multiwavelength Imaging New Instrument for the Extreme Universe Space Observatory) telescope has been observing the Earth from the International Space Station (ISS) with a field of view of 44 degrees and a spatial resolution of about 6 km at Earth's surface. Mini-EUSO main detector is a UV camera consisting of two Fresnel lenses and a focal surface composed of an array of 36 Hamamatsu multi-anode photo-multiplier tubes, for a total of 2304 pixels. The telescope is capable of observing UV emissions (290-430 nm) of cosmic, atmospheric and terrestrial origin on different time scales: 2.5 μs, 320 μs, and 40.96 ms. To date Mini-EUSO has completed nearly 150 observation sessions over five years, accumulating approximately 750 hours of data.
The instrument is located in the interior of the ISS and is positioned by the crew on an UV-tranparent, nadir facing window when observation sessions are planned. After each session, a sample of the scientific and engineering data are downlinked to the ground to assess the status of the instrument. The full amount of data can be physically sent to Earth via Soyuz capsule or downlinked gradually. Conversely, new software patches and operating parametes can be uplinked from the ground, copied on USB sticks and uploaded on the instrument, ensuring maximization of the observational capabilities of the detector.
To this purpose, various ground-based operations are required: planning sessions on moonless nights (to reduce the background light) or in combination with meteor showers, processing in quasi-real time the newly available data for fine-tuning the acquisition parameters of later sessions, and performing periodic ground-to-station end-to-end calibrations from the ground.
In this work we will provide an overview of the on-board and on-ground operations performed during these five years of mission on the Mini-EUSO instrument.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Author: MARCELLI, Laura

Presenter: MARCELLI, Laura

Session Classification: Posters

Contribution ID: **61** Type: **Poster**

Silicon sensors for the AMS-L0 Upgrade: beam test setup and results

Tuesday 13 May 2025 22:06 (2 minutes)

The Alpha Magnetic Spectrometer (AMS) was installed on the International Space Station in 2011. This particle physics experiment is designed to measure the composition of cosmic rays in low Earth orbit, with the primary goal of distinguishing between antimatter and matter. AMS is equipped with a permanent magnet and multiple detectors, allowing it to analyze incoming cosmic rays with rigidities ranging from 1 GV to several TV.

To maximize the remaining data collection period before the ISS planned retirement in 2030, the AMS collaboration plans to install in 2026 an additional silicon tracking layer, on top of the existing instrument. This tracking layer, L0, consists of two planes of silicon microstrip detectors, each composed of 36 fundamental units called "ladders," with a total effective detection area of 8 m^2. This upgrade will not only increase the acceptance of multiple analysis channels by a factor of three and extend the measurable energy range of AMS, but it will also enhance the identification of incoming particles before they interact with the detector material and undergo fragmentation.

To thoroughly validate the charge identification and spatial resolution capabilities of L0 and its ladders, we conducted multiple beam tests at CERN. These tests include beams of heavy ions and muons. In this work, we will first introduce the relevant background information, with a detailed discussion of the experimental setup used in the recent L0 beam tests. Specifically, we installed two sets of beam telescopes, one upstream and one downstream with respect to the ladder to reconstruct particle trajectories. This let us estimate the particles position at the ladder location with a precision of approximately 2 μm. We also exploited a charge detector to assist in analyzing the charge resolution of the ladder in offline analysis by having a precise reference. Finally, we will present and discuss the preliminary results from these L0 beam tests.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Authors: AMBROSI, Giovanni (Universita e INFN, Perugia (IT)); BARBANERA, Mattia (Universita e INFN, Perugia (IT)); Dr BETTI, Pietro (INFN sezione di Firenze); CAI, Xudong (Massachusetts Inst. of Technology (US)); DETTI, Sebastiano (Universita e INFN, Firenze (IT)); DURANTI, Matteo (Universita e INFN, Perugia (IT)); FENG, Mingjie (Chinese Academy of Sciences (CN)); FORMATO, Valerio

(INFN - Sezione di Roma Tor Vergata); GRAZIANI, Maura (Universita e INFN, Perugia (IT)); JIANG, Xiaojie (Chinese Academy of Sciences (CN)); JIANG, Yaozu (Universita e INFN, Perugia (IT)); KOUTSENKO, Vladimir (Massachusetts Inst. of Technology (US)); LI, Qinze (Chinese Academy of Sciences (CN)); LI, Tiange (Hunan University (CN)); LIU, Pingcheng (Shandong Institute of Advanced Technology (CN)); MIAO, Dexing (The Institute of High Energy Physics of the Chinese Academy of Sciences (CN)); MORI, Nicola (INFN Florence); MOVILEANU, Maria (Universita e INFN, Perugia (IT)); OLIVA, Alberto (Universita e INFN, Bologna (IT)); PACINI, Lorenzo (INFN, Firenze (IT)); SHENG, Shuqi (Chinese Academy of Sciences (CN)); SILVESTRE, Gianluigi (INFN Perugia (IT)); STARODUBTSEV, Oleksandr (Universita e INFN, Firenze (IT)); WANG, Jianchun (Chinese Academy of Sciences (CN)); WU, Zibing (Shandong University (CN)); XU, Zijun (Chinese Academy of Sciences (CN))

Presenter: JIANG, Yaozu (Universita e INFN, Perugia (IT))

Session Classification: Posters

Contribution ID: **62** Type: **Oral**

BeER: a multi-purpose, high-resolution, high dynamic-range charge detector well suited for cosmic ray measurements and various applications.

Tuesday 13 May 2025 09:50 (25 minutes)

We present Beam-monitor with Extreme Range (BeER), an innovative charge detector with high resolution and a wide dynamic range, initially designed to provide unique information on high-energy ion beams, which are commonly used in cosmic ray experiments for detector characterization. Several detector prototypes, built using Si photodiodes and custom readout electronics, have undergone extensive testing during beam tests at CERN-SPS and LNF-BTF (Frascati, Italy) facilities. Furthermore, BeER data has already been successfully used by the HERD and AMS-02 experiments. The detector features exceptional performance, enabling BeER to measure nuclei with atomic numbers ranging from 1 to 80 with a resolution better than 2.5 charge units. Here, we present the results from the prototype testing phase and discuss ongoing detector development and potential applications, including the direct measurement of cosmic rays in space, off-line and on-line beam monitoring, and cross-section measurements.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: PACINI, Lorenzo (INFN, Firenze (IT))

Co-authors: MORI, Nicola (INFN Florence); STARODUBTSEV, Oleksandr (Universita e INFN, Firenze (IT))

Presenter: PACINI, Lorenzo (INFN, Firenze (IT))

Session Classification: Instrumentation and missions for direct high-energy CR measurements

Contribution ID: **63** Type: **Poster**

The Fluorescence Camera for the PBR mission

Thursday 15 May 2025 22:12 (2 minutes)

The Probe Of Extreme Multi-Messenger Astrophysics (POEMMA) Balloon with Radio (PBR) is an instrument designed to be borne by a NASA suborbital Super Pressure Balloon (SPB), in a mission planned to last as long as 50 days. The PBR instrument consists of a 1.1 m aperture Schmidt telescope, similar to the POEMMA design, with two cameras in its hybrid focal surface: a Fluorescence Camera (FC) and a Cherenkov Camera (CC), both mounted on a frame that can be tilted to point from nadir up to 13 degrees above the horizon. The FC camera is designed to detect the fluorescence emission of Extensive Air Showers produced by Ultra-High Energy Cosmic Rays from sub-orbital altitudes. This measurement will validate the detection strategy for future space-based missions, such as POEMMA. The FC will be made of 4 Photo Detection Modules (PDMs), each consisting of a 6x6 matrix of 64-channel Multi Anode PhotoMulTipliers (MAPMT), for a grand total of 2304 pixels for each PDM. Custom-designed SPACIROC-3 ASICs perform single photoelectron counting on each pixel as well as charge integration on groups of 8 pixels to measure extremely bright or fast signals, reaching a double pulse resolution in the order of 10 ns for a 1 microsecond acquisition gate. A field flattener lens and a BG3 filter, to match the wavelength range of interest (300-400 nm), are mounted in front of the PDM. The camera will be able to detect showers in a field of view of 24x24 square degrees, with a pixel size on ground corresponding to 115 m. Details on the camera design and implementation will be given, along with the expected performance and the state of the construction.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Authors: CAFAGNA, Francesco (Universita e INFN, Bari (IT)); THE JEM-EUSO COLLABORATION

Presenter: CAFAGNA, Francesco (Universita e INFN, Bari (IT))

Session Classification: Posters

Contribution ID: **64** Type: **Poster**

Measurements on capacitance mitigation approaches for LGAD Si-microstrip tracking devices

Tuesday 13 May 2025 22:32 (2 minutes)

In the context of the Pentadimensional Tracking Space Detector project (PTSD), we are currently developing a demonstrator to increase the Technological Readiness Level of LGAD Si-microstrip tracking detectors for applications in space-borne instruments. Low Gain Avalanche Diodes (LGAD) is a consolidated technology developed for particle detectors at colliders which allows for simultaneous and accurate time (<100 ps) and position (˜ 10 μm) resolutions with segmented Si sensors. It is a candidate technology that could enable for the first time 5D tracking (position, charge, and time) in space using LGAD Si-microstrip tracking systems. The intrinsic gain of LGAD sensors may also allow to decrease the sensor thickness while achieving signal yields similar to those of Si-microstrips currently operated in Space.
Mitigation of the device input capacitance to the readout electronics must be assessed to achieve the required timing resolution with long LGAD Si-microstrip devices. In this contribution we discuss the ongoing laboratory measurements on a breadboard model for verification of requirements, functionalities and space qualification of LGAD Si-microstrip devices for 5D tracking in space, with details about device capacitance mitigation approaches.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Authors: BARBANERA, Mattia (Universita e INFN, Perugia (IT)); CAVAZZUTI, Elisabetta (Agenzia Spaziale Italiana); DURANTI, Matteo (Universita e INFN, Perugia (IT)); FORMATO, Valerio (INFN); HU, Jiayu (INFN); MERGÈ, Matteo (Agenzia Spaziale Italiana); MILIUCCI, Marco (Agenzia Spaziale Italiana); MOVILEANU, Maria; NEGRI, Barbara Maria (ASI); OLIVA, Alberto (INFN); SAVINELLI, Martina (UniPG & INFN-Perugia); VAGELLI, Valerio

Presenter: HU, Jiayu (INFN)

Session Classification: Posters

Contribution ID: **65** Type: **Poster**

Event reconstruction strategies for the High-Energy Particle Detector (HEPD-02) onboard the ready-to-launch CSES-02

Thursday 15 May 2025 22:02 (2 minutes)

The forthcoming second China Seismo-Electromagnetic Satellite (CSES-02) will host the novel generation High-Energy Particle Detector (HEPD-02), optimized for the detection of 30 MeV - 200 MeV protons and 3 MeV - 100 MeV electrons. HEPD-02 is equipped with a silicon pixel tracker, a stack of plastic scintillators, and a segmented LYSO crystal scintillator. The complex design of the detector requires an efficient event reconstruction pipeline, which will be presented in this talk: the pipeline combines the information collected by multiple sub-detectors in order to accurately interpret the HEPD-02 response in terms of arrival direction, energy and particle classification. Moreover, as for its predecessor HEPD-01, standard algorithmic event reconstruction is coupled with deep learning tools designed to exploit correlation of low-level signals to further enhance the detector performance. Thanks to this advanced pipeline, the instrument will be able to provide estimates of cosmic ray fluxes with an increased accuracy and acceptance. In addition, a dedicated part of the pipeline will enable reliable photon detection above 0.5 MeV and thus detect and characterize Gamma-Ray Bursts.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: Dr PERINELLI, Alessio (University of Trento)

Co-author: CSES-LIMADOU COLLABORATION

Presenter: Dr PERINELLI, Alessio (University of Trento)

Session Classification: Posters

Contribution ID: **66** Type: **Poster**

Preliminary results of the 64-channel MIZAR ASIC for SiPMs readout

Tuesday 13 May 2025 22:36 (2 minutes)

This work describes the development of the Multi-channel Integrated Zone-sampling Analogue-memory based Readout (MIZAR) ASIC. This 64-channel chip was designed as part of NASA's POEMMA Balloon with RADIO (PBR) mission, which aims to detect Ultra-High Energy Cosmic Rays (UHECRs) and showers produced by the interaction of Cosmic Neutrinos (CNs) in the crust. The ASIC was implemented to read out a tile of 8x8 Silicon Photo-Multipliers (SiPMs) used to acquire the optical Cherenkov signals generated by Extensive Air Showers (EASs). A channel is partitioned into 256 cells where each one integrates an analogue memory, a Wilkinson Analog-to-Digital Converter (ADC) and a digital memory operating at the nominal sampling rate of 200 MS/s (5 ns integration time). The signal is digitized on-chip, then the converted data is read out by an FPGA. MIZAR also provides a 64-bit hitmap as first-level trigger which can be elaborated by an external firmware. This ASIC can also be configured to further segment the channels into units of 32 or 64 cells each and the ADC resolution can be set in a range between 8 and 12 bits. The chip was designed in a commercial 65 nm CMOS technological node and it was submitted for production in December 2024. The ASICs are expected to be delivered in March 2025, with chip characterization planned for the following months.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Author: DI SALVO, Andrea (Istituto Nazionale di Fisica Nucleare)

Co-authors: BERTAINA, Mario (Univ. & INFN Torino); Dr DELLACASA, Giulio (INFN Torino (IT)); GARBOLINO, Sara (Universita e INFN Torino (IT)); MAZZA, Gianni (Universita e INFN Torino (IT)); MIGNONE, Marco (Universita e INFN Torino (IT)); PALMIERI, Pietro Antonio; RIVETTI, Angelo (Universita e INFN Torino (IT)); WHEADON, Richard James (INFN - National Institute for Nuclear Physics); ZUGRAVEL, Stefan Cristi (INFN Torino (IT), DET Politecnico di Torino (IT))

Presenter: DI SALVO, Andrea (Istituto Nazionale di Fisica Nucleare)

Session Classification: Posters

Contribution ID: **67** Type: **Oral**

Current Status of the HERD Space Project

Tuesday 13 May 2025 09:25 (25 minutes)

The High Energy cosmic-Radiation Detection facility (HERD) is an international space-borne experiment set to be installed on the China Space Station (CSS). HERD will address several major problems in fundamental physics and astrophysics, including cosmic ray (CR) direct measurements up to PeV energies, dark matter searches, and a gamma-ray survey above 0.1 GeV. The current design of HERD comprises five sub-detectors. At its core is a 3D imaging calorimeter (CALO), which consists of 7,489 cubic LYSO crystals, each with an edge length of 3 cm, arranged in an octagonal prism shape. The CALO is read out by two independent systems: an image intensified CMOS (IsCMOS) camera and photodiodes (PD). On the top side of the CALO, a micro Silicon Strip Tracker (STK) is installed to determine the trajectory of incident particles. Surrounding the CALO, a five-sided Plastic Scintillator Detector (PSD) is employed for gamma-ray selection. The Silicon Charge Detector (SCD) provides precise measurements of the absolute charge of particles. Additionally, a transition radiation detector (TRD) is positioned on one of the lateral sides to provide accurate energy calibration. This report will discuss the current status of the HERD project and results from recent beam tests.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: WANG, Zhigang (Chinese Academy of Sciences (CN))

Presenter: WANG, Zhigang (Chinese Academy of Sciences (CN))

Session Classification: Instrumentation and missions for direct high-energy CR measurements

Contribution ID: **68** Type: **Poster**

The SiSMUV Project: Development and Characterization of SiPM-Based UV-Light Detectors for Space Telescope Applications

Tuesday 13 May 2025 22:34 (2 minutes)

The study of Ultra High Energy Cosmic Rays is made possible by space telescopes that allow recording signals generated by Extensive Air showers (EAS) in the night side of the Earth's atmosphere. One of the requirements for these telescopes is the detection of very low photon fluxes, achievable using the latest generation SiPMs characterized by high intrinsic gains, low power consumption, low weight, and robustness against accidental exposure to light.
Despite these advantages, some technological issues still need to be addressed, such as the radiation hardness for operation in space. Therefore, the design of a SiPM-based focal surface for UHECR detection must consider the space qualification of SiPM arrays, with the development of compact arrays optimized for low dead-area focal surfaces.
SiSMUV (SiPM-based Space Monitor for UV light) is a project dedicated to developing a compact and modular UV detector for use in space telescopes designed to study the fluorescence and Cherenkov signals produced by Ultra-High Energy Cosmic Rays (UHECRs).
Each SiSMUV module incorporates a matrix of SiPMs, a readout ASIC (Radioroc by Weeroc), and an FPGA into a monolithic block. This design enables the acquisition and processing of signals from the sensors. The system can connect to a PC for standalone operation or with back-end electronics for integration into more complex systems.
In this contribution, I will describe the prototype electronics, the experimental setup and the measurements performed to obtain parameters such as the gain of the SiPMs, the dark count rate (DCR) and their photon detection efficiency (PDE). I will also present the firmware developed to interface with the readout ASIC and to transmit data to other peripherals.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Author: MESE, Marco (University of Naples Federico II)

Co-authors: ANASTASIO, Antonio (INFN Napoli); BOIANO, Alfonso (INFN - National Institute for Nuclear Physics); BUCKLAND, Isaac (INFN Trieste); MASONE, Vincenzo (INFN Napoli); MUNINI, Riccardo (INFN - Universita Studi Trieste); OSTERIA, Giuseppe; Dr PANICO, Beatrice (University of Naples Federico II - INFN Sez. Napoli); QURESHI, Haroon Akhtar (INFN Napoli); SCOTTI, Valentina

Presenter: SCOTTI, Valentina

Session Classification: Posters

Contribution ID: **69** Type: **Oral**

Nuclear Cross Section for Cosmic Rays Experiments

Tuesday 13 May 2025 10:15 (25 minutes)

Apparent discrepancies exist among cosmic-ray (CR) nuclei flux measurements from recent precision experiments such as AMS, CALET, and DAMPE. While it is difficult to determine the origin of these discrepancies, a predominant source of systematic error in these measurements arises from understanding nuclear interactions in detector materials.
Interactions of heavy nuclei with detector materials (such as carbon, aluminum, silicon, etc., or composites such as plastic, BGO, LYSO, etc.) are modeled using a sparse dataset of nucleus-nucleus cross-section measurements and are often extrapolated into regions where no data is available.
In 2024, taking advantage of the high-intensity, high-energy heavy-ion beam available at the CERN Super Proton Synchrotron, a test beam campaign was conducted to study the feasibility of measuring nuclear cross sections with experimental devices originally built for cosmic ray experiments in space. In this work, we report on the experimental setup and the preliminary results obtained, with an outlook on future developments.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Authors: Dr BETTI, Pietro (INFN sezione di Firenze); DURANTI, Matteo (Universita e INFN, Perugia (IT)); FORMATO, Valerio (INFN); JIANG, Yaozu (Universita e INFN, Perugia (IT)); MORI, Nicola (INFN Florence); OLIVA, Alberto (Universita e INFN, Bologna (IT)); PACINI, Lorenzo (INFN, Firenze (IT))

Presenter: OLIVA, Alberto (Universita e INFN, Bologna (IT))

Session Classification: Instrumentation and missions for direct high-energy CR measurements

Contribution ID: **70** Type: **Poster**

Early operations and first data of the high-energy HERMES payload onboard SpIRIT

Thursday 15 May 2025 22:26 (2 minutes)

The Space Industry Responsive Intelligent Thermal (SpIRIT) is a 6U CubeSat nano-satellite mission born from a collaboration between Australia and Italy in high-energy astrophysics. The 6U CubeSat carries an actively cooled detector system payload in a Sun-synchronous orbit. This payload unit hosts advanced X-ray and gamma-ray detectors identical to those on board the High Energy Rapid Modular Ensemble of Satellites (HERMES) Technologic and Scientific Pathfinder ASI mission. These detectors are designed to localize high-energy astrophysical transients, such as Gamma-ray Bursts (GRBs).
Successfully launched on 2023 December 01 aboard a SpaceX Falcon 9, SpIRIT has completed the majority of its payload commissioning, with the final stages currently underway. This poster provides an overview of SpIRIT's scientific payload, highlighting its initial in-orbit operations, in-flight calibrations and scientific data observation.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Author: BARONI, Giulia (INAF/OATS)

Co-authors: CAMPANA, Riccardo (INAF/OAS); CHAPMAN, Airlie; CITOSSI, Marco; DELLA CASA, Giovanni (INAF-IAPS); DILILLO, Giuseppe (INAF-OAR); EVANGELISTA, Yuri (INAF-IAPS); FIORE, Fabrizio; GUZMAN CABRERA, Alejandro Daniel (University of Tübingen); HEDDERMAN, Paul; LEONE, Wladimiro; MARCHESINI, Ezequiel Joaquin (INAF-OAS Bologna); MCROBBIE, Jack; MEARNS, Robert; PERRI, Matteo; PIRROTTA, Simone; PUCCETTI, Simonetta; SANTANGELO, Andrea; THERAKAM, Clint; THOMAS, Matthew; TRENTI, Michele; TREVISAN, Sara; DEL CASTILLO, Miguel

Presenter: BARONI, Giulia (INAF/OATS)

Session Classification: Posters

Contribution ID: **71** Type: **Oral**

The WFM (Wide Field Monitor) onboard of eXTP and its adaptability to future mission proposals

Thursday 15 May 2025 11:20 (25 minutes)

The eXTP (enhanced X-ray Timing and Polarimetry) mission is a major project of the Chinese Academy of Sciences (CAS), that had a large involvement of Europe, until it was de-scoped to a "China-only" mission in 2024. The scientific payload of the former eXTP included four instruments: SFA (Spectroscopy Focusing Array) and PFA (Polarimetry Focusing Array) - led by China - and LAD (Large Area Detector) and WFM (Wide Field Monitor) led by Europe. Italy led the LAD and Spain (with M.Hernanz as PI) led the WFM. The WFM reached phase B2, after successfully undergoing the I-SRR (Instrument System Requirements Review) in mid-2023.

The WFM for eXTP is a wide field X-ray monitor instrument in the 2-50 keV energy range. It has an unprecedented combination of large field of view and imaging, with a very good spectral resolution, down to 2 keV. A reduced version, with for instance just 2 or 4 cameras, would lead to very relevant discoveries of the variable and transient X-ray sky, as a standalone instrument or complementing others.

In view of the current situation, a reduced WFM can be considered as the payload of future ESA missions or even missions of other agencies, like ISRO in India. The world done so far with the WFM of the former eXTP led by us will be presented, together with a description of the landscape in the near future.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Author: Prof. HERNANZ CARBO, MARGARITA (Institute of Space Sciences (ICE-CSIC) & IEEC)

Presenter: Prof. HERNANZ CARBO, MARGARITA (Institute of Space Sciences (ICE-CSIC) & IEEC)

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **72** Type: **Oral**

Solar Flare Hard X-ray Polarimetry with the CUbesat Solar Polarimeter (CUSP) mission

Thursday 15 May 2025 09:50 (25 minutes)

The CUbesat Solar Polarimeter (CUSP) project is a CubeSat mission planned for a launch in low-Eart orbit and aimed to measure the linear polarization of solar flares in the hard X-ray band by means of a Compton scattering polarimeter. CUSP will allow to study the magnetic reconnection and particle acceleration in the flaring magnetic structures of our star. CUSP is a project in the framework of the Alcor Program of the Italian Space Agency aimed to develop new CubeSat missions. It is undergoing a 12-months Phase B that started last December.

The Compton polarimeter on-board CUSP is composed of two acquisition chains based on plastic scintillators read out by Multi-Anode PhotoMultiplier Tubes for the scatterer part and GAGG crystals coupled to Avalanche PhotoDiodes for the absorbers. An event coincident between the two readout scheme will lead to a measurement of the incoming X-ray's azimuthal scattering angle, linked to the polarization of the solar flare in a statistical manner. The current status of the CUSP mission design, mission analysis and payload scientific performance will be reported. The latter will be discussed based on preliminary laboratory results obtained in parallel to Geant4 simulations.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Author: Dr DE ANGELIS, Nicolas (INAF-IAPS)

Presenter: Dr DE ANGELIS, Nicolas (INAF-IAPS)

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **73** Type: **Oral**

Cosmic anti-deuteron observation in space with a gas He detector

Tuesday 13 May 2025 11:20 (25 minutes)

The formation of low-energy anti-deuterons in cosmic ray collisions with the Interstellar Medium (ISM) is kinetically unfavored, while several Dark Matter (DM) models foresee the production of these light nuclei even at low energy.
The search of cosmic anti-deuterons in the kinetic energy range from a few MeV to several hundred MeV is an interesting channel for DM indirect observation. Currently, the balloon-borne GAPS experiment pursues the detection of cosmic anti-deuteron, and its major limitation is the exposure, limited by the availability and the duration of the balloon flights.

We here present a space mission based on a different detection approach and on modularity as mean to ease access to space and incrementally build larger acceptance.
The detection principle, already illustrated by us, is the capture by He atoms of anti-protons or anti-deuteron at rest into special atomic orbitals.
An anti-proton or anti-deuteron losing energy while crossing gaseous He induces a scintillation signal, if this anti-particle enters into an atomic orbital (˜ 3% prob), it annihilates with a considerable delay. When this occurs, there is a characteristic delayed coincidence that is a strong signature of this occurrence over the background.
The amplitude of the second signal allows for distinguishing between the anti-proton and the anti-deuteron events.

In this talk, I will report on the progress made in detecting the UV scintillation light from the gaseous He.
I will then discuss the plan to design a small satellite holding the He vessel, shield by scintillator ToF, and some basic avionics as a module for more advanced missions where we would deploy a constellation of several satellites to increase the exposure factor.
In our approach, the effort to design, build, and qualify a satellite is sustained only once.
The required acceptance/exposure factor can then be achieved at reduced costs, and opportunity vector launches may also be profitably used.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Authors: GHEZZER, Luigi Ernesto (dip. Fisica Università di Trento); NOZZOLI, Francesco (Universita degli Studi di Trento and INFN-TIFPA (IT)); Prof. ZUCCON, Paolo (Universita degli Studi di Trento and INFN (IT))

Presenter: Prof. ZUCCON, Paolo (Universita degli Studi di Trento and INFN (IT))

Session Classification: Instrumentation and missions for direct high-energy CR measurements

Contribution ID: **74** Type: **Oral**

Unlocking the Future of X-ray Polarimetry with IXPE: Lessons Learned and Next Steps.

Thursday 15 May 2025 09:00 (25 minutes)

The launch of the Imaging X-ray Polarimetry Explorer (IXPE) on December 9, 2021, marked a transformative milestone in high-energy astrophysics, solidifying X-ray polarimetry as the "Holy Grail" of this field. IXPE has not only met but has consistently upheld its pre-launch performance expectations, operating with an impressive duty cycle close to 100%. In particular detectors are compliant with all the requirements and the few contingencies encountered thus far have never been attributed to the instrument itself.
Throughout IXPE's operational lifetime, we have continuously monitored and addressed key pre-flight-identified challenges, refining our understanding to inform the development of next-generation X-ray polarimetry missions. Specifically, we have tackled:
1. The gain drop caused by charging effects in the Gas Electron Multiplier (GEM).
2. The gain increase resulting from gas absorption within the Gas Pixel Detector.
3. Limitations imposed by detector dead-time, requiring in-flight filtering.
for very few extremely bright sources.
4. Pixel-to-pixel response variations to unpolarized radiation, mitigated through in-flight dithering for improved calibration.
5. Significantly higher background levels—approximately 20 times greater than those of a proportional counter
in the same energy range.
6. The "leakage" effect, where spurious modulation arises in presence of strong intensity gradients in bright sources.
While for the upcoming eXTP of the China Acedemy of Science some of these issues have been already resolved,
in this talk, we will discuss these limitations, the solutions currently being implemented, and the crucial advancements needed for the next generation of X-ray polarimetry. By leveraging IXPE's insights, we aim to pave the way for future missions that will further revolutionize our understanding of the high-energy universe.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Author: Dr SOFFITTA, Paolo (INAF-IAPS)

Co-authors: Dr COSTA, Enrico (INAF-IAPS); Dr FABIANI, Sergio (INAF-IAPS); Dr MULERI, Fabio (INAF-IAPS)

Presenter: Dr SOFFITTA, Paolo (INAF-IAPS)

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **75** Type: **Poster**

Evaluation of Timepix3 for applications as a Compton scatter polarimeter for hard X- and soft γ-rays

Tuesday 13 May 2025 22:20 (2 minutes)

Timepix3 [1] is a hybrid pixel detector with $55\,\mu\mathrm{m}$ pixel pitch in a matrix 256×256 pixels. It can measure in data-driven mode when it detects both the deposited energy and time of arrival (ToA) in the pixels. The ToA is written with $1.56\,\mathrm{ns}$ precision. The fine ToA resolution permits 3D reconstruction of tracks within the sensor [2]. This makes Compton camera imaging possible.

The reference [3] evaluates a single Timepix3 detector with a 1 mm thick silicon sensor for the use as a Compton scatter polarimeter, relying on the detection of coincident Compton scattering and photoabsorption. The evaluated energy range was $30-220\,\mathrm{keV}$ in simulation and $32.5-67.5\,\mathrm{keV}$ in a laboratory experiment. It was shown that the detector offers a maximum modulation factor $\mu_{100} > 77\,\%$ in the energy range $45-80\,\mathrm{keV}$. However, a single detector is limited by its low efficiency of detection of the two coincident events, with $\varepsilon = 0.13\,\%$ being its peak value. The quality factor $q = \mu_{100}\sqrt{\varepsilon}$ reached its maximum $q = 2.9\,\%$ around the photon energy $50\,\mathrm{keV}$.

The Compton camera imaging of the X-ray source is also evaluated in the reference [3]. The reconstruction method used was origin ensemble with resolution recovery (OE-RR). This is a Monte Carlo Markov chain method that tries to maximize the image likelihood function by stochastically updating photon origins one by one until it reaches a dynamic equilibrium. The full width at half maximum of the image $16-21^\circ$ was achieved.

In this work, we will present the simulations of combining multiple Timepix3 detectors to enhance the efficiency of detection. The basic setup consists of 4 silicon Timepix3 detectors stacked behind each other with 4 cadmium telluride Timepix3 detectors around them to boost the detection efficiency of perpendicularly scattered photons. Using this setup of 8 Timepix3 detectors, the quality factor monotonically increases from $2.9\,\%$ at $35\,\mathrm{keV}$ to $10.6\,\%$ at $65\,\mathrm{keV}$. If we use two such setups together with 16 detectors in total, the quality factor monotonically increases from $3.9\,\%$ at $35\,\mathrm{keV}$ to $14.0\,\%$ at $65\,\mathrm{keV}$.

Fine pixelization of Timepix3 detector would also enable imaging of the X-ray sources. A stack of Timepix3 detectors could be placed in the focal plane of an X-ray mirror, or it could take images using the Compton camera principle. Given the rich space heritage of Timepix-family detectors [4], Timepix3 could be used in some of the future X-ray polarimetric missions. The new detector Timepix4 with a larger area and better time resolution could be even more promising.

[1] Poikela, T. et al. “Timepix3: a 65K channel hybrid pixel readout chip with simultaneous ToA/ToT and sparse readout”, JINST, 2014

[2] Bergmann, B. et al. “3D track reconstruction capability of a silicon hybrid active pixel detector”, The Eur. Phys. Jour. C, 2017

[3] Jelinek, J. et al. “Evaluation of Timepix3 with a 1 mm thick silicon sensor as a Compton imaging polarimeter in the hard X-ray band”, JINST, 2025.

[4] Bergmann, B. et al. “Results and Perspectives of Timepix Detectors in Space—From Radiation Monitoring in Low Earth Orbit to Astroparticle Physics”, Instruments, 2024

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: JELINEK, Jindrich (Universite de Geneve (CH), IEAP CTU (CZ))

Co-authors: BERGMANN, Benedikt; Dr SMOLYANSKIY, Petr (IEAP CTU in Prague)

Presenter: JELINEK, Jindrich (Universite de Geneve (CH), IEAP CTU (CZ))

Session Classification: Posters

Contribution ID: **76** Type: **Oral**

COMCUBE-S : Gamma-ray burst polarimetry with a swarm of CubeSats

Thursday 15 May 2025 10:15 (25 minutes)

COMCUBE-S is a new ESA gamma-ray space mission designed for gamma-ray burst (GRB) polarimetry and all-sky monitoring of the gamma-ray sky for time-domain astronomy and multi-messenger observations.
The mission is currently in phase A at ESA. The baseline configuration consists of a swarm of 27 16U CubeSats evenly spaced in a 500 km equatorial orbit. Each CubeSat embarks a Compton polarimeter and a BGO spectrometer to perform timing, spectroscopic and polarimetric measurements in the energy range 30keV - 10MeV. The use of several satellites gives the constellation a significant effective area for both detection and polarimetry. Furthermore, comparing the polarimetric measurements obtained from different lines of sight will help to reduce the systematic uncertainties in these measurements. The Compton polarimeter consists of 2 layers of double-sided silicon strip detectors (DSSDs) to detect Compton scattering interactions, as well as GAGG and CeBr3 scintillation detectors used to absorb the scattered gamma-rays. A reduced prototype of the instrument was recently tested in the near-space environment during the CNES TRANSAT2024 transatlantic stratospheric balloon flight.
I will present our work on estimating the performance of COMCUBE-S from simulations carried out with the MEGAlib software, and using data from the Fermi/GBM catalogue supplemented by a population of synthetic GRBs. I will also present first results from the stratospheric balloon flight experiment.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: FRANEL, Nathan

Co-authors: Dr COJOCARI, Ion (IJCLab); DE SEREVILLE, Nicolas; HANLON, Lorraine; Prof. LAURENT, Philippe (CEA); LE GALLIARD, Christine (IJCLab); Dr LOMMLER, Jan Peter; Dr MANGAN, Joseph (IJCLab); MC KENNA, Caimin (University College Dublin); MURPHY, David (University College Dublin); Prof. PEYRE, Jean (IJCLab); TATISCHEFF, Vincent (IJCLab); ULIYANOV, Alexey

Presenter: FRANEL, Nathan

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **77** Type: **Oral**

Instruments for focal plane X-ray polarimetry in the next decade

Thursday 15 May 2025 09:25 (25 minutes)

The successful detection by the IXPE mission of X-ray polarization from tens of celestial sources belonging to different classes has opened a new window in X-ray astronomy. While an impressive number of scientific topics have already been tackled by IXPE, many of them would benefit from a new class of instrumentation which could be launched in a relatively short time-scale. In this contribution, we will present the development activities of a focal plane polarimeter which has the goal of extending the energy range of IXPE up to tens of keV with a better sensitivity and lower background. Our design is based on the use of multilayer mirrors and a stacked instrumentation, comprising of either a low or medium energy imaging photoelectric polarimeter and an active Compton one. Such an approach is based on hardware with flight heritage, and, despite still in development for the specific application in the field of X-ray polarimetry, it promises to answer compelling scientific questions and to be soon competitive from the feasibility point of view for space application.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: MULERI, Fabio

Presenter: MULERI, Fabio

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **78** Type: **Poster**

Characterisation and calibration of SiPMs and read-out system for space-borne plastic scintillator detectors

Tuesday 13 May 2025 22:18 (2 minutes)

Plastic scintillator detectors can provide charge measurement and participate in the anti-coincidence trigger system for gamma detection in space-born cosmic ray experiments, such as HERD (High Energy Cosmic Radiation Detection). In order to achieve its objective, the plastic scintillator bars will be equipped with two different kinds of silicon photomultipliers (SiPMs) for HighZ and LowZ particles. We are currently conducting tests for this role using Hamamatsu SiPMs—models S14160-3050HS and S14160-1315. SiPMs are at the forefront of space-based applications, owing to their low-cost, high gain, excellent time resolution and high photon-detection efficiency amongst other advantages.
This work will report the calibration, characterization and optimization of the SiPMs with a custom-made BETA-ASIC readout electronics for the PSD setup.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: Ms GHOSE, Essna (INFN Lecce e University of Trento (IT))

Presenter: Ms GHOSE, Essna (INFN Lecce e University of Trento (IT))

Session Classification: Posters

Contribution ID: **79** Type: **Poster**

Study of performances and characterization of SiPMs (Hamamatsu S13161) for the next generation of telescopes in balloon-borne and space-based experiments

Thursday 15 May 2025 22:18 (2 minutes)

Silicon PhotoMultipliers (SiPMs), constitute the enabling technology for a diverse and rapidly growing range of applications: experimental physics, medical imaging and commercial applications are only a few examples. The development of detectors based on SiPM photosensors for acquisition of fast signals coming from Cherenkov and fluorescence emission started by particle showers in the atmosphere, is the main goal of the current ASI/INFN Agreement n.2021-8-HH.2-2022, named "EUSO-SPB2 (Extreme Universe Space Observatory –Super Pressure Balloon 2)"for the next generation of telescopes in balloon-borne and space-based experiments. In such framework, the study of performances of different SiPMs available on the market has been performed to identify the best sensors for space applications, where high thermal excursions and environmental radiation must be mainly taken into account with respect of ground-based experiment. In this work, a characterization protocol for SiPM qualification has been applied to Hamamatsu S13161-3050AE-08 SiPM (8 × 8) array in the (−40, +30)℃ temperature range. The protocol foresees to measure several parameters: breakdown voltage, quenching resistance, gain, dark count rate and probability of cross-talk. Methods to extract them and their dependence on temperature at fixed overvoltage are shown and the results are discussed.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Author: CARUSO, Rossella

Presenter: CARUSO, Rossella

Session Classification: Posters

Contribution ID: **80** Type: **Oral**

FIT: a scintillating-fiber tracker for new-generation space-borne experiments

Friday 16 May 2025 11:25 (25 minutes)

A new era of space missions is needed to address the unresolved questions raised by current experiments, and further advance our understanding of charged cosmic rays and gamma rays. The challenge of the direct detection at increasingly higher energies, combined with enhanced energy and angular resolutions, is shaping the design of future detectors. FIT is a modular, high-resolution particle tracking system made of scintillating fibers read out with silicon photomultipliers. A miniature of FIT, called MiniFIT, was designed, built and tested with particle beams at CERN. The FIT design, together with the design and physics performance of MiniFIT, will be presented in this contribution.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: Dr PERRINA, Chiara (EPFL - Ecole Polytechnique Federale Lausanne (CH))

Presenter: Dr PERRINA, Chiara (EPFL - Ecole Polytechnique Federale Lausanne (CH))

Session Classification: R&D of novel approaches and instruments

Contribution ID: **81** Type: **Oral**

A-STEP, the AstroPix Sounding rocked Technology dEmonstrator Payload: Multi-detector performance

Friday 16 May 2025 09:00 (25 minutes)

A gamma-ray observatory with high sensitivity in the MeV range (100 keV - 100 MeV) and with good spectral and polarimetric capabilities will bring unprecedented insights into many astrophysical domains such as cosmic ray production and propagation, nucleosynthesis processes and transient and extreme phenomena, and will be key in addressing fundamental physics questions such as the nature of dark matter. However, observing in this energy range is challenging because of high instrumental backgrounds and low photon interaction cross-section around 10 MeV as the dominant interaction transitions from Compton scattering to pair production, making event reconstruction challenging. Such an instrument will need a detector technology capable of detecting photons in both the Compton and pair regime. AstroPix is a high voltage CMOS monolithic active pixel sensor developed for future gamma-ray space telescopes. It is designed to achieve low-power (˜2 mW/cm2), high spectral resolution (˜5 keV at 122 keV) measurements in a multi-layer silicon tracker. An instrument called AstroPix Sounding rocket Technology dEmonstration Payload (A-STEP) will test three layers of 2x2 AstroPix detectors during a suborbital rocket flight in March 2026.
This will demonstrate the operation of AstroPix detectors in a space environment for the first time, and improve the technology readiness level of these detectors for future astrophysical and nuclear physics applications. In this talk, we overview the payload state of development and the instrument design and performances.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Authors: AFFOLDER, Anthony (Univ. of California Santa Cruz); BALDINI, Luca (INFN-Pisa); Dr CAPUTO, Regina (GSFC/UMCP); FADEYEV, Vitaliy (University of California,Santa Cruz (US)); FUKAZAWA, Yasushi; Dr JADHAV, Manoj; JOOSTEN, Sylvester; KIERANS, Carolyn (NASA GSFC); KIM, Bobae (Argonne National Lab.); KUMAR, Kavic (University of Maryland College Park); LAVIRON, Adrien (NASA Goddard Space Flight Center (GSFC), NASA Post-doctoral Program (NPP)); LEYS, Richard (KIT - Karlsruhe Institute of Technology (DE)); METCALFE, Jessica (Argonne National Laboratory (US)); MINUTI, Massimo (INFN Pisa); MITCHELL, John; NAKANO, Norito (Hiroshima University); PERIC, Ivan (KIT - Karlsruhe Institute of Technology (DE)); PESCE-ROLLINS, Melissa; Dr ROY, Abhradeep (Hiroshima University); SGRO', Carmelo; SOMMER, Grant (George Washington University); STRIEBIG, Nicolas; SUDA, Yusuke (Hiroshima University); VIOLETTE, Daniel (NASA/GSFC, ORAU); ZUREK, Maria

Presenter: LAVIRON, Adrien (NASA Goddard Space Flight Center (GSFC), NASA Post-doctoral Program (NPP))

Session Classification: R&D of novel approaches and instruments

Contribution ID: **82** Type: **Oral**

Expected performances of X and Gamma rays detectors being operated on the Moon and in the Earth Stratosphere developed within the NRRP EMM project

Thursday 15 May 2025 12:10 (25 minutes)

As part of the "Earth Moon Mars (EMM)"project, led by INAF (Instituto Nazionale di Astrofisica) in partnership with ASI (Agenzia Spaziale Italiana) and CNR (Consiglio Nazionale delle Ricerche) and funded under the National Recovery and Resilience Plan (NRRP), we are developing the Solar X Ray Moonitor (SXRM), a Moon-based instrument to monitor solar activity from the lunar surface in the energy range of 1 to 30 keV. SXRM has two main objectives: to provide alerts in case of solar storms (flares, CME) directed at the Moon –an essential feature for future permanent missions - and to deliver diagnostics about the parent events. The final delivery of the instrument is currently expected by end of 2025 at a Technology Readiness Level (TRL) of 4. We have drafted the SXRM engineering and development plan aiming at realizing a space-qualified instrument, starting form a design that incorporates extended-performance components and following a qualification test roadmap aimed at increasing the final TRL to 6. To this end, for the purpose of electronics qualification, a stratospheric balloon flight has been planned for late summer 2025. Due to the physical processes occurring in the upper layers of the atmosphere, we have decided to use a detector with sensitivity extended up to 1 MeV for the stratospheric experiment. This presentation will focus on detector simulations, radiometric computations and the identification of the critical parameters requiring the on-ground calibration and periodical in-flight calibration.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Author: CAPOBIANCO, Gerardo

Co-authors: NOCE, Vladimiro; LOREGGIA, Davide; PANCRAZZI, Maurizio; FINESCHI, Silvano; CARACCI, Valeria; BONINO, Donata; FRANCHI, Giovanni

Presenter: CAPOBIANCO, Gerardo

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **83** Type: **Poster**

AstroPix: HV-CMOS monolithic active pixel sensors for gamma-ray observatories

Tuesday 13 May 2025 22:22 (2 minutes)

A next-generation gamma-ray observatory operating in the medium-energy gamma-ray band (˜100 keV to 100 MeV) will provide crucial capabilities needed to identify and classify multi-messenger sources and to probe the explosive and energetic processes in the universe including relativistic jets and gamma-ray bursts. Advancements in tracker detector technologies and instrument design are critical for the operation of gamma-ray observatories searching for transients in the medium-energy gamma-ray regime. AstroPix is a high-voltage CMOS monolithic active pixel sensor under development for next-generation Compton and pair-production imaging telescopes. AstroPix detectors possess a large dynamic energy range (25-700 keV) with high spatial (500 x 500 um^2) segmentation and spectral (<10% FWHM at 60 keV) resolution. The 2x2 cm^2 AstroPix detector digitizes photon and charged particle interactions on-chip and is optimized for low power consumption, targeting <1.5 mW/cm^2. Command and data handling is managed through chip-to-chip communication and simplifies large-scale detector plane integration. Improvements to the AstroPix design continue, primarily seeking to achieve full pixel depletion (500 um thick) and to further reduce power consumption. In this talk, I will discuss the continued progress in AstroPix detector development and highlight recent testing and calibration efforts.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Author: Dr VIOLETTE, Daniel (NASA/GSFC, ORAU (US))

Co-authors: Dr AFFOLDER, Anthony (Univ. of California Santa Cruz (US)); Dr BALDINI, Luca (INFN-Pisa); Dr CAPUTO, Regina (GSFC/UMCP (US)); Dr FADEYEV, Vitaliy (Univ. of California Santa Cruz (US)); Dr FUKAZAWA, Yasushi (Hiroshima University); Dr JADHAV, Manoj (Argonne National Laboratory (US)); Dr JOOSTEN, Sylvester (Argonne National Laboratory (US)); Dr KIERANS, Carolyn (NASA/GSFC (US)); Dr KIM, Bobae (Argonne National Laboratory (US)); Mr KUMAR, Kavic (University of Maryland College Park (US)); Dr LAVIRON, Adrien (NASA/GSFC, ORAU (US)); Dr LEYS, Richard (KIT - Karlsruhe Institute of Technology (DE)); Dr METCALFE, Jessica (Argonne National Laboratory (US)); Dr MINUTI, Massimo (INFN Pisa); Dr MITCHELL, John (NASA/GSFC (US)); Mr NAKANO, Norito (Hiroshima University); Dr PERIC, Ivan (KIT - Karlsruhe Institute of Technology (DE)); Dr PESCE-ROLLINS, Melissa (INFN-Pisa); Mr ROY, Abhradeep (Hiroshima University); Dr SGRO’, Carmelo (INFN-Pisa); Mr SOMMER, Grant (George Washington University (US)); Mr STREIBIG, Nicolas (KIT - Karlsruhe Institute of Technology (DE)); Dr SUDA, Yusuke (Hiroshima University); Dr ZUREK, Maria (Argonne National Laboratory (US))

Presenter: Dr VIOLETTE, Daniel (NASA/GSFC, ORAU (US))

Session Classification: Posters

Contribution ID: **84** Type: **Poster**

Study of the response to antiprotons from HEPD-02 on CSES-02

Thursday 15 May 2025 22:04 (2 minutes)

The China Seismo-Electromagnetic Satellite (CSES) mission is a collaborative effort between China and Italy aimed at building a constellation of multi-payload space observatories dedicated to studying Earth's geophysical properties from space using non-imaging remote sensing methods. The project seeks to develop a network of small satellites that continuously gather data from the entire surface of the planet to characterize the spatial-temporal behavior of electromagnetic fields, particle fluxes and plasma composition within the iono-magnetospheric system. The primary objective of this space program is to investigate and validate lithosphere-atmosphere-ionosphere-magnetosphere coupling mechanisms that induce perturbations in the upper ionosphere and the lower boundary of the radiation belts.

By doing so, CSES also provides an excellent opportunity to study the magnetosphere, the heliosphere and the cosmic radiation reaching Earth. Protons and antiprotons play a fundamental role in particle physics and cosmology, offering insights into matter-antimatter asymmetry and annihilation processes. In the low kinetic energy region (< 50 MeV), CSES covers a range which are not accessible to other cosmic ray detectors. This motivated an investigation about possible distinctive signatures of antiprotons: we performed Monte Carlo simulation, applying specific selection criteria.

We simulated beam spots at different energies and spectra (monochromatic and flat) in the 1–20,000 MeV range, generating approximately 10,000 events along the Z-axis for protons and antiprotons. The analysis focused on comparing the total deposited energy in the calorimeter and trigger planes, along with additional observables such as the cluster size, which represents the number of activated pixels in the tracker planes, and the χ^2, which assess the quality of the track reconstruction. These parameters were examined to identify potential differences between protons and antiprotons, contributing to the optimization of the selection criteria for their discrimination.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Authors: CSES - LIMADOU COLLABORATION; PIETRONI, Silvia (University of Rome Tor Vergata - INFN); SORBARA, Matteo

Presenter: PIETRONI, Silvia (University of Rome Tor Vergata - INFN)

Session Classification: Posters

Contribution ID: **85** Type: **Oral**

Current status and future plans for HELIX

Monday 12 May 2025 18:35 (25 minutes)

HELIX is a ballon-borne experiment aiming to make mass-resolved measurements of the cosmic ray isotopes from 0.1 GeV/n up to 10 GeV/n to study the propagation of Galactic cosmic rays. The HELIX collaboration has adopted a staged approach and will modify the payload configurations over multiple flights to cover the wide energy range. The first stage of the HELIX detector is designed to measure from 0.1 GeV/n up to 3 GeV/n for particles lighter than neon (Z=10). This first stage of HELIX was successfully flown from Kiruna, Sweden, in 2024 spring for just over six days. While refurbishing the payload and performing data analysis is ongoing, the HELIX collaboration is optimizing the detector configuration for future flights, aiming to extend the measurements to a higher energy range. This talk will overview the current status of HELIX data analysis and detector developments for future flights.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: PARK, Nahee

Presenter: PARK, Nahee

Session Classification: Institutionals and Highlights

Contribution ID: **86** Type: **Oral**

Exploring the Potential of a 2π Field-of-View Gamma-Ray Detector for GRB Observations in Space

Wednesday 14 May 2025 12:35 (25 minutes)

Assessing the performance of a gamma-ray detector in the GeV energy range with an effective 2-pi field of view (FoV) in space is relevant for the design of future missions aimed at the study of the high energy emission of transient events. Such a design offers a significant advantage for detecting short-duration gamma-ray bursts (GRBs), which can be as short as only a fraction of a second. Traditional detectors with narrower FoVs may miss many of these events if their initial pointing is not ideal.
In this presentation, we explore the expected capabilities of a generic 2 pi-FoV gamma-ray detector in orbit, using simulations to evaluate its potential for GRB detection. As a case study, we apply this framework to the High Energy cosmic Radiation Detection (HERD) facility, a future cosmic-ray and gamma-ray detector planned for installation aboard the China Space Station. By comparing its expected performance on GRB models from the Fermi-LAT's Second Gamma-ray Burst Catalog, we assess the feasibility and scientific impact of such a wide-FoV instrument.
While the final design of HERD may differ from the one considered in this study, the results presented here remain broadly relevant to the development and optimization of future space-based gamma-ray detectors with wide FoVs.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Author: FARIÑA, Luis (IFAE-BIST)

Presenter: FARIÑA, Luis (IFAE-BIST)

Session Classification: Instrumentation and missions for direct X-ray and gamma-ray measurements

Contribution ID: **87** Type: **Oral**

Onboard machine learning for high-energy observatories for spacecraft autonomy and ground segment operations

Friday 16 May 2025 11:50 (25 minutes)

Machine Learning (ML) techniques have proven highly effective in gamma-ray data analysis performed in ground-based pipelines. Implementing ML analysis directly onboard satellites introduces transformative capabilities that enhance both spacecraft autonomy and ground segment efficiency. Onboard ML processing significantly reduces the required downlink bandwidth by selecting relevant data before transmission, minimizing operational costs and improving the scientific return of gamma-ray observatories. Additionally, real-time ML-based event classification enables rapid decision-making onboard, allowing instruments to autonomously prioritize and respond to transient astrophysical phenomena such as gamma-ray bursts (GRBs) and gravitational wave counterparts without relying on ground-based intervention.

This shift from centralized to decentralized data processing also has important implications for the role of the ground segment in space missions. By enabling spacecraft to autonomously filter and analyze scientific data, onboard ML reduces the workload on ground operators and optimizes the use of limited communication bandwidth. The growing availability of commercial off-the-shelf (COTS) edge computing devices equipped with AI accelerators facilitates the deployment of these advanced models in space environments, allowing also prototyping activities to advance in this new research field.

This contribution provides an overview of the advancements enabled by onboard ML and presents some use cases, with a focus on its application for future X- and gamma-ray observatories. Optimization techniques for neural networks, including quantization and pruning, facilitate the deployment of ML models on onboard computing platforms and can also impact ML applications for ground-based analysis by enabling more efficient use of computing resources. By integrating onboard ML capabilities with ground-segment data processing and mission control centers, it will be possible to enable autonomous, high-efficiency space science missions for high-energy astrophysics.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Authors: Dr BULGARELLI, Andrea (INAF/OAS Bologna); Mr CASTALDINI, Luca (INAF/OAS Bologna)

Presenter: Mr CASTALDINI, Luca (INAF/OAS Bologna)

Session Classification: R&D of novel approaches and instruments

Contribution ID: **88** Type: **Poster**

Using X-Ray Fluorescence to characterize lunar regolith

Tuesday 13 May 2025 22:30 (2 minutes)

X-ray fluorescence (XRF) techniques allow us to detect the characteristic X-rays from a material. This process has been used in several application fields, from environmental studies on air particulates to pigments composing a specific artwork.
Regolith covers the moon's surface for meters, and its thickness varies from micrometers up to centimeters. Its dust is electrically charged, and sticks to surfaces, abrasing them. This makes it one of the major technological concerns for lunar missions. Knowing how its composition correlates to other factors, such as its electric field and grain size, it is possible to provide meaningful insights on regolith geological properties, with the aim of improving the resistance to regolith of the next generation lunar missions.
Equipping one of the upcoming missions with an X-ray detector and radioactive sources makes it possible to perform the XRF analysis of the lunar regolith. The experimental setup will be shown, along with the results coming from simulation data and tests conducted in our laboratory.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Author: Dr SILVERI, Leandro (New York University Abu Dhabi)

Presenter: Dr SILVERI, Leandro (New York University Abu Dhabi)

Session Classification: Posters

Contribution ID: **89** Type: **Poster**

Simulation of a SiPM Based Cherenkov Camera

Thursday 15 May 2025 22:14 (2 minutes)

Future space detectors for Ultra High Energy neutrinos and cosmic rays will utilize Cherenkov telescopes to detect forward-beamed Cherenkov light produced by charged particles in Extensive Air Showers. A Cherenkov detector can be equipped with an array of Silicon Photo-Multiplier (SiPM) pixels, which offer several advantages over traditional photomultiplier tubes (PMTs). SiPMs are compact, lightweight, operate at lower voltages, and exhibit lower sensitivity to temperature variations, making them well-suited for space-based experiments.

To leverage these benefits, we designed, built, and tested a compact, modular UV detector that integrates a 64-pixel Multi-Pixel Photon Counter (MPPC) from Hamamatsu. This detector is coupled with low-power readout electronics based on the Radioroc ASIC by Weeroc and a Xilinx Artix FPGA.

To characterize the detector's performance, a simulation of its response to incident light is required. This simulation will account for the Photo Detection Efficiency (PDE) of individual MPPC pixels as a function of wavelength, the temporal response to individual photons, and the overall gain in terms of ADC counts recorded by the readout electronics per photoelectron, all under varying conditions.

A dedicated SiPM simulation module is currently under development within the OffLine detector simulation framework. The first step in validating this module will be to accurately reproduce the test setup in which SiPMs are exposed to different light sources. A global fit, based on expectation maximization, for the digitized signal of individual photo-electrons from the test setup informs the gain and pedestal of the SiPM data aquisition system.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Author: BUCKLAND, Isaac (INFN Trieste)

Co-authors: ANASTASIO, Antonio (INFN Napoli); BOIANO, Alfonso (INFN); MASONE, Vincenzo (INFN Napoli); MESE, Marco (University of Naples Federico II); MUNINI, Riccardo (INFN - Universita Studi Trieste); OSTERIA, Giuseppe; Dr PANICO, Beatrice (University of Naples Federico II - INFN Sez. Napoli); QURESHI, Haroon Akhtar (INFN Napoli); SCOTTI, Valentina

Presenter: BUCKLAND, Isaac (INFN Trieste)

Session Classification: Posters

Contribution ID: **90** Type: **Oral**

The Silicon Tracker L0 Upgrade of the AMS-02 experiment on the ISS

Tuesday 13 May 2025 09:00 (25 minutes)

The Alpha Magnetic Spectrometer (AMS) is a particle physics experiment on board the International Space Station (ISS) designed to accurately measure the principal and the rarest Cosmic Rays components in the rigidity range from 1 GV to several TV.
Following a long period of construction and testing, AMS was launched to the ISS and installed on May 19, 2011, and since then collects data and it is supposed to take data for the whole life of the ISS, that currently extends to 2030.
AMS has the unique capability of distinguishing matter from anti-matter, thanks to its capability of measuring the charge sign from the track deflection within its magnetic field. In order to make the best possible use of the remaining data taking time the Collaboration has decided to upgrade the silicon tracker with the installation of ad additional tracking layer of silicon micro strip detectors on the top of the existing instrument. The main advantages would be the increase of a factor 3 in the acceptance for many analysis channels and an improved charge measurement thanks to the low material budget in front of of the new detector.
The detector is currently in the integration phase of the flight hardware, and will undergo the space qualification procedure in autumn 2025, to be ready for the launch in spring 2026. In the presentation will be described in detail the technological choices made to build the detector in about two years. We will report on the assembly and test strategy and the expected performance based on beam test measurement, as well as on the space qualification procedure and test already performed and planned before the launch.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: AMBROSI, Giovanni (Universita e INFN, Perugia (IT))

Presenter: AMBROSI, Giovanni (Universita e INFN, Perugia (IT))

Session Classification: Instrumentation and missions for direct high-energy CR measurements

Contribution ID: **91** Type: **Oral**

The Lunar Adaptive Outpost for Remote Italian Experiments (LAORIE)

Monday 12 May 2025 17:00 (35 minutes)

Reduced atmospheric interference, the potential of stable and long-term observations free from Earth's Magnetosphere combined with tectonic stability and a field of view encompassing the entire Earth's disk make the Moon extremely attractive for observing the Earth and studying the Universe. The Earth-Moon-Mars (EMM) project aims to capitalize on these advantages.
EMM is an NRRP-funded project carried out by INAF, ASI and CNR, conceived to explore the Moon's potential as a multipurpose research laboratory and to develop innovative instruments for a range of in-situ lunar experiments, Earth monitoring and Universe observation. Specifically, EMM plans to deliver three main payloads to the Moon surface, which will be hosted on an ad-hoc lunar infrastructure: (i) the Lunar Electromagnetic Monitor in X-rays (LEM-X), an all-sky monitor for the X-ray band based on the concept of coded aperture camera; (ii) the LUNAr optical PO-Larimetry surveyor (LUNAPOL), a polarimeter for interstellar polarization survey ; (iii) the Lunar Earth Temperature Observatory (LETO), a Fourier-transform spectro-radiometer in the infrared to monitor the brightness temperature of the whole Earth's disk.
While the opportunities offered by the Moon are valuable, the technical and logistical challenges that must be addressed to bring these instruments there and carry out measurements are critical, such as the harsh environment and the need for long-term reliability. In the EMM framework, the infrastructure named Lunar Adaptive Outpost for Remote Italian Experiments (LAORIE) addresses these challenges. A phase-A study carried out by ASI and TAS-I to develop this infrastructure, which will host the three payloads on the Moon's surface, is ongoing. In designing LAORIE, the team has been focusing on defining the necessary strategies to cope with different environmental challenges, including long periods of darkness, extreme temperature variations, lunar dust, and lack of atmosphere, as well as challenges posed by the launch and transport constraints and long-term durability and maintenance.
The contribution will provide an overview of LAORIE and its current development status.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Author: TURCHI, Alessandro (Italian Space Agency)

Co-authors: Ms DONNARUMMA, Immacolata (Italian Space Agency); Ms ESPOSITO, Claudia (Italian Space Agency)

Presenter: TURCHI, Alessandro (Italian Space Agency)

Session Classification: Institutionals and Highlights

Contribution ID: **92** Type: **Poster**

Preliminary Design Study of a Superconducting Spectrometer for Light Galactic Antinuclei Detection

Tuesday 13 May 2025 22:08 (2 minutes)

We present a preliminary design study of a superconducting magnetic spectrometer aimed at detecting light galactic antinuclei in space. As an initial step, we are developing a smaller demonstrator spectrometer for testing aboard a stratospheric balloon above Antarctica. To assess the feasibility of this approach, we performed a Geant4 simulation to evaluate the survival probability of antimatter flux at balloon altitudes. Furthermore, we optimized the geometric configuration of the superconducting coils to enhance charged particle bending and improve the accuracy of momentum reconstruction. This study represents a crucial step toward the development of a space-based instrument for rare antimatter searches.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Authors: GRYNIUK, Oleksii; IUPPA, Roberto (Universita degli Studi di Trento and INFN (IT)); MASCIONE, Daniela (INFN - National Institute for Nuclear Physics); MASCIONE, Daniela (Universita degli Studi di Trento and INFN (IT)); PERINELLI, Alessio

Presenter: GRYNIUK, Oleksii

Session Classification: Posters

Contribution ID: **93** Type: **Poster**

An innovative technique for direct Cosmic Ray Detection based on the Monolithic Active Pixel Sensors tracker of HEPD-02

Thursday 15 May 2025 22:06 (2 minutes)

MAPS are silicon-based solid-state detectors used in high-energy physics experiments, such as the Inner Tracking System of the ALICE experiment at CERN, used for their high granularity and minimal material budget. Here we present the first application of this technology to a spaceborne detector, the High Energy Particle Detector (HEPD-02), scheduled for launch during 2025 onboard the China Seismo-Electromagnetic Satellite (CSES-02) mission.
The main novelty of HEPD-02 compared to past experiments is the first space application of ALTAI MAPS in the tracker system, whose main advantage is the digital read-out circuit integrated on the same silicon substrate.
The tracker system of HEPD-02 consists of 80 Mpixel divided in three layers, covering a region of 15 cm x 15 cm.
The high-granularity of the ALTAI MAPS-based tracker, with its 5 μm single-hit resolution, allows antimatter studies, since it is able to provide the reconstruction of the annihilation process, crucial for discriminating matter from antimatter.
This unprecedented granularity enables the potential detection of low-energy antimatter (p-bar or d-bar) annihilations in the 10–30 MeV/n range, a region unexplored by any current or past experiment, such as BESS-Polar II.
This contribution wants to highlight, from a detector perspective, a new experimental technique usage of MAPS-based tracking technology for the direct detection of antimatter in space.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

Yes

Authors: FOLLEGA, Francesco Maria (Universita degli Studi di Trento and INFN (IT)); IUPPA, Roberto (Universita degli Studi di Trento and INFN (IT)); NOZZOLI, Francesco (Universita degli Studi di Trento and INFN-TIFPA (IT)); PUCCETTI, Niccolo (Universita degli Studi di Trento and INFN (IT))

Presenter: PUCCETTI, Niccolo (Universita degli Studi di Trento and INFN (IT))

Session Classification: Posters

Contribution ID: **94** Type: **Poster**

Gamma-Ray Burst Polarimetry with the POLAR and POLAR-2 missions

Thursday 15 May 2025 22:34 (2 minutes)

Gamma-Ray Bursts (GRBs) are among the most powerful and violent events in the Universe. Despite over half a century of observations of these transient sources, many open questions remain about their nature and the physical emission mechanisms at play. Polarization measurements of the GRB prompt γ-ray emission have long been theorized to be able to answer most of these questions. With the aim of characterizing the polarization of these prompt emissions, a compact Gamma-Ray polarimeter called POLAR has been sent to space as part of the Tiangong-2 Chinese space lab for 6 months of operations starting September 2016. The instrument detected 55 GRBs as well as several pulsars. Time integrated polarization analysis of the 14 brightest detected GRBs has shown that the prompt emission is lowly polarized or fully unpolarized. However, time-resolved analysis depicted strong hints of an evolving polarization angle within single pulses, washing out the polarization degree in time integrated analyses. Energy-resolved polarization analysis has shown no constraining results due to limited statistics. Hence, a more sensitive γ-ray polarimeter is required to perform detailed energy and time resolved polarization analysis of the prompt γ-ray emission of GRBs.

Based on the success of the POLAR mission, a larger scale instrument, approved for launch to the China Space Station (CSS) in 2027, is currently being developed by a Swiss, Chinese, Polish, and German collaboration. Thanks to its large sensitivity in the 20-800 keV range, POLAR-2 will produce polarization measurements of at least 50 GRBs per year with a precision equal to or higher than the best results published by POLAR, allowing for good quality time and energy resolved analysis. Furthermore, thanks to its large effective area which exceeds 2000 cm2 at 100 keV, POLAR-2 will be able to observe faint GRBs such as 170817A and will be capable of sending alerts of such transients, including localization information to the ground within seconds to minutes. POLAR-2 thereby not only aims to make the prompt polarization a standard observable, but it will additionally play an important role in multi-messenger observations.

The scientific results of the POLAR mission will be presented followed by a discussion about the POLAR-2 mission, the future of GRB's prompt emission polarimetry.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Author: DE ANGELIS, Nicolas (Universite de Geneve (CH))

Co-author: WU, Xin (Universite de Geneve (CH))

Presenter: DE ANGELIS, Nicolas (Universite de Geneve (CH))

Session Classification: Posters

Contribution ID: **95** Type: **Oral**

High-Energy Adventures: Astroparticle Physics at NASA in the 2030's

Monday 12 May 2025 16:25 (35 minutes)

TBD

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

No

Author: PERKINS, Jeremy

Presenter: PERKINS, Jeremy

Session Classification: Institutionals and Highlights

Contribution ID: **96** Type: **Oral**

Mechanics for space-borne particle detectors

Monday 12 May 2025 17:35 (35 minutes)

TBD

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

Author: GARGIULO, Corrado (CERN)

Presenter: GARGIULO, Corrado (CERN)

Session Classification: Institutionals and Highlights

Contribution ID: **97** Type: **not specified**

Introduction from organizers, institutional, LOC

Monday 12 May 2025 14:30 (1h 5m)

Presenters: DURANTI, Matteo (Universita e INFN, Perugia (IT)); RICO, Javier (Institut de Física d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology (BIST), E-08193 Bellaterra, Barcelona, Spain); VAGELLI, Valerio (Italian Space Agency (ASI) and INFN)

Session Classification: Institutionals and Highlights

Contribution ID: **98** Type: **not specified**

Institutional introductions

Session Classification: Institutionals and Highlights

Contribution ID: **99** Type: **not specified**

Local Organizing Committee

Session Classification: Institutionals and Highlights

Contribution ID: **100** Type: **Poster**

Application of high-Temperature Superconducting (HTS) Magnets in space-based Cosmic Ray Detection and Radiation shielding

Tuesday 13 May 2025 22:38 (2 minutes)

The deployment of high-Temperature Superconducting (HTS) magnets in space has the ability to revolutionize astroparticle physics by enhancing the overall performance of cosmic ray detectors and radiation shielding systems. Traditional superconducting magnets face operational challenges in space because of high temperature variations and power constraints; however improvements in HTS technology offer a promising opportunity.

This study explores the application of HTS magnets in monitoring detectors, calorimeters, and radiation shielding for cosmic ray and high-energy particle detection aboard space missions. HTS materials exhibit amazing magnetic field stability at quite higher temperatures, reducing the need for complicated cryogenic structures while preserving high sensitivity for charged particle measurements. The integration of HTS magnets in direct cosmic ray detection instruments can improve trajectory resolution and permit extra efficient particle identification. Additionally, we investigate the capacity of HTS magnetic shielding to deflect low-energy ionizing radiation, mitigating its impact on sensitive space instrumentation.

Simulation results and feasibility assessments suggest that incorporating HTS magnets in future CubeSat's, small satellites, and large-scale space observatories could notably enhance astroparticle measurement skills. This research aligns with the continued efforts to develop novel instrumentation for particle and high-energy radiation measurements in space, contributing to future cosmic ray physics missions, dark matter searches, and space weather studies.

Eligibility for "Best presentation for young researcher" or "Best poster for young researcher" prize

Yes

Author: JAIN, Vidhi

Presenter: JAIN, Vidhi

Session Classification: Posters