



AHEAD 2020



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AHEAD2020

The EU infrastructure for High energy astrophysics

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AHEAD2020 in a nutshell



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- AHEAD2020 (Integrated Activities for High Energy Astrophysics Domain) is the research infrastructure for High Energy Astrophysics selected as **advanced community** in the EU Horizon 2020 program.
- Its main goal is to improve the level of integration reached by the previous AHEAD program, funded in H2020 as starting community, while broadening its impact to include the new multi-messenger science and the European GW community.
- Started on 2 March 2020; scheduled end was 1 March 2024 (duration: 4 years); later extended for Covid mitigation to 2 Dec 2024
- Overall budget: 9.98 M€
- The Consortium is coordinated by INAF (coordinator: L.Piro) and counts 39 European institutions, including 3 SMEs and 1 large Company



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The AHEAD2020 goals



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- Integrate and coordinate national activities in high-energy astrophysics, reaching out multi-messenger domain.
- Push the limits of current technology and strengthen the infrastructure to **maximise the scientific return of selected future high energy and multimessenger facilities**: (new) *Athena*, *satellites for the transient and multimessenger Universe (nanosats, Einstein Probe, XRISM, Theseus,...)*, *neutrino and GW observatories (KM3NET, LIGO/VIRGO, Einstein Telescope)*.
- Give access to a network of ground-based test facilities for H/W development, calibration and testing.
- Ensure maximal scientific return from present and near future observing facilities in the field of high energy and multimessenger astronomy: **make accessible and usable multimessenger data**, develop and provide access to advanced data analysis and theory tools
- Promote HE and multimessenger astrophysics at various level
- Prepare the community to the scientific exploitation of the new facilities under development in Europe in high energy and multimessenger, by training the next generation of researchers.

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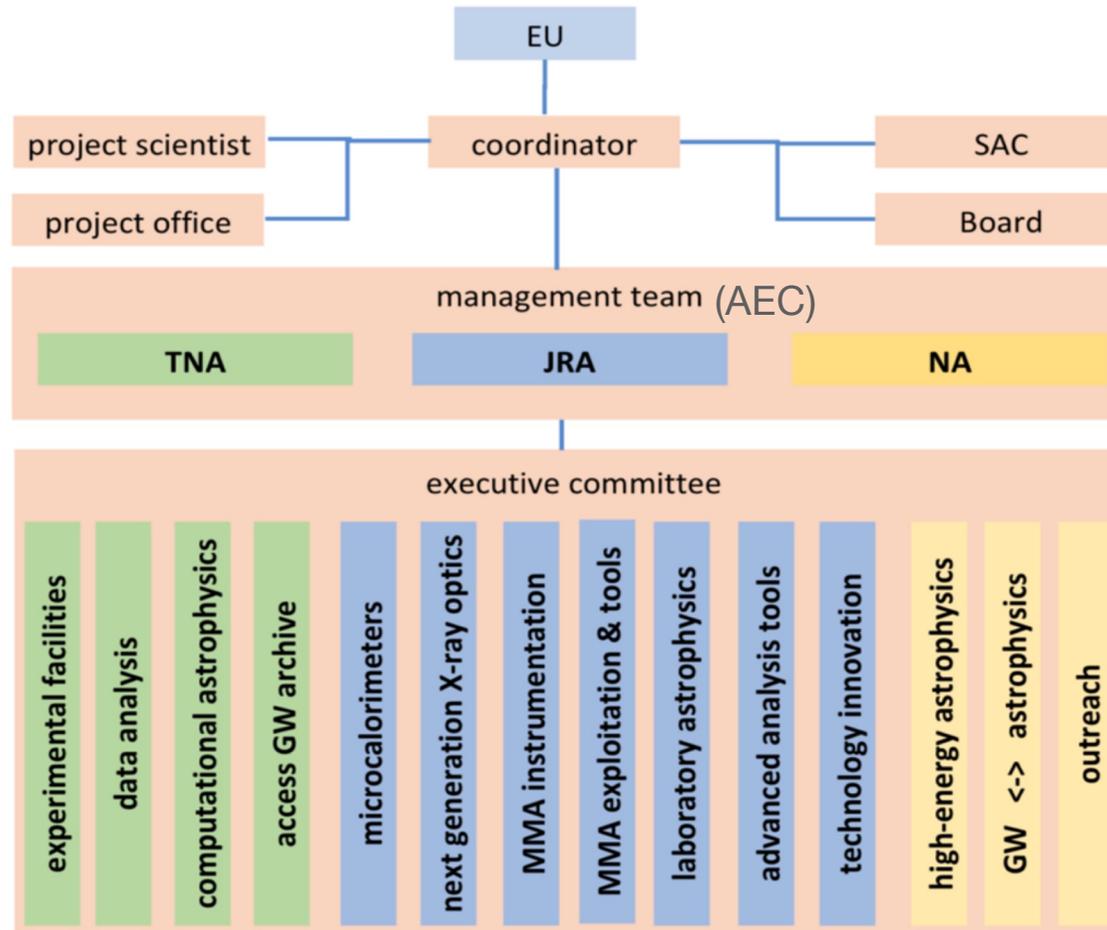


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Organisational scheme



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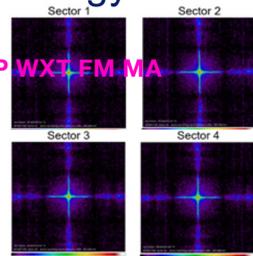
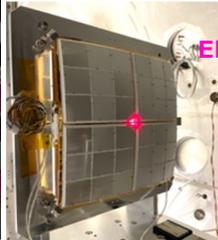
AHEAD2020 Activities



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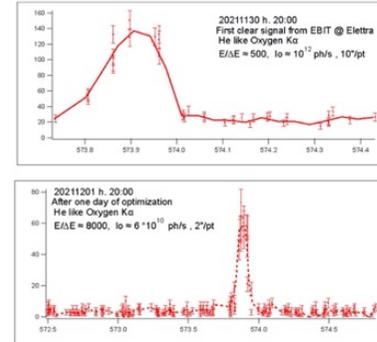
Space technology



Innovation



Laboratory Astrophysics



Networking & Media Communication

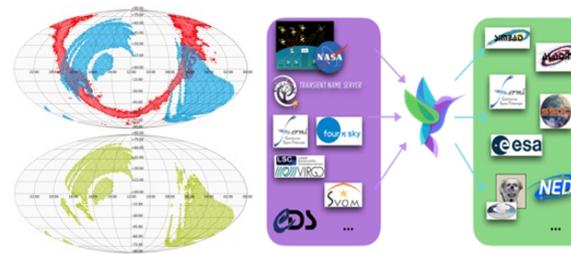
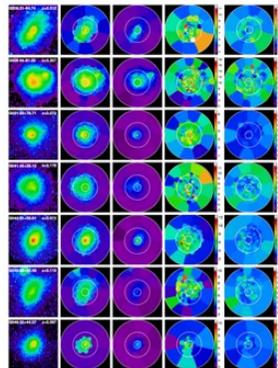


AHEAD 2020 - Activities in High Energy Astrophysics

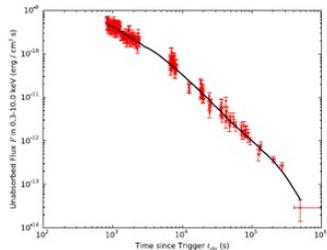
Access to facilities



Advanced analysis tools



Multimessenger Tools



Access to training for data analysis & models



Networking activities, Overview



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Networking activities in AHEAD deal with the following broad categories:

- AHEAD2020 Visitor Program
- Organisation of meetings and schools
- Public Outreach

A targeted activity is concerning the **Networking activities for the synergies between the Gravitational Wave and High Energy Astrophysics community.**

Topics addressed are:

- Multimessenger Research
- Synergies with High Energy and Geoscience
- R&D concerning multi-messenger physics with application to next generation GW interferometers
- Low latency Triggers and Access to GW Data
- Definition of the enabling technologies and the key technical design elements of the next generation of large infrastructures (ET)



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The AHEAD2020 Visitor Program



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- Supporting research visits to institutes/laboratories located in European or associated countries, in order to foster new or strengthen existing collaborations.
- Eligible candidates are scientists or engineers from Astrophysics institutes in both EU and non-EU countries.

Visits are fully funded. Open to PhD students, postdocs, experienced scientist and engineers.

~40 visitor weeks/year are being granted

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Home Visitors Programme Workshops Schools Selection committee Documents

AHEAD2020 Transnational Visitor Programme now **closed**.

A02 approved visits available [here](#)

AHEAD2020 - GENERAL NETWORKING FOR THE HIGH ENERGY ASTROPHYSICS

Welcome to the AHEAD2020 General Networking for the High Energy Astrophysics Community web page. Here you will find information and news on:

- The Exchange Visitor Programme
- The AHEAD2020 Workshops
- The AHEAD2020 Schools

Important notice on COVID19 pandemic regarding the AHEAD2020 Transnational Visitor Programme.

- Grantees are expected to be covered by **their own** travel and health insurances during the visits.
- Remote access is not considered. However, proposals accepted for A01, that can not be carried out due to health or travel restrictions, can be automatically transferred to A02 visiting period (October 2021 - March 2022).

AHEAD2020 Transnational Visitor Programme **important dates**:

- Open of the second call: 12 July 2021
- Application Deadline: 30 August 2021, 17:00 CET
- Decision date: End of September 2021
- The ATVP can start from: 1st October 2021
- The ATVP has to be completed before: 31 March 2022
- Next call (A03): Early January 2022

Search

AHEAD2020 Project website

Universitat d'Alacant Universidad de Alicante

Latest News

A02 approved visits available Oct 25, 2021

A01 approved visits available Apr 23, 2021

AHEAD 2015-2019

Privacy settings



Networking for MM science

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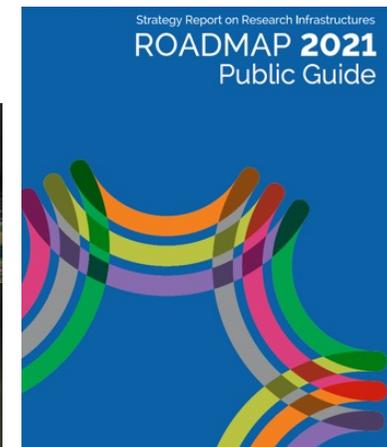
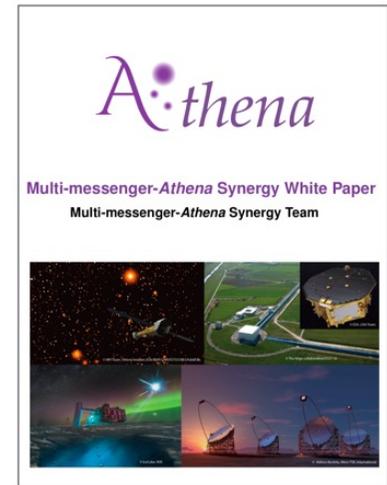
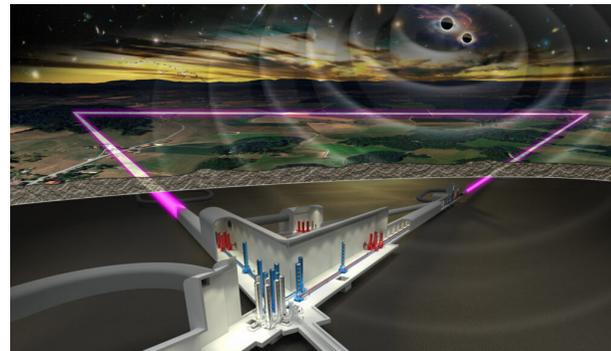
Topical meetings and broad community studies, e.g.

- support to the **Athena-Multimessenger study** (White Paper, published: 01 September 2022)

This White Paper highlighted the many synergies of science objectives between **Athena** and some other facilities that are key to future multi-messenger studies, like **LIGO A+**, **Advanced Virgo+**, **3rd generation ground interferometers** and **LISA** for space based observations of **GW**, **IceCube** and **KM3NeT** for neutrino observations, **CTA** for very high energy observations.

- support to the **Einstein Telescope studies** (in synergy with JRA4) and other investigations of future GW observatories (e.g. on the Moon)

AHEAD2020 has effectively supported a series of studies to evaluate perspectives of the next generation of GW detectors observing in synergy with EM observatories. This led to **design optimisation studies of ET and other facilities** and to the publication of a **milestone paper on ET design**.





Public Outreach and Communication



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Communication towards general public, students & professionals

- **Social media** channels (e.g. *facebook, twitter, youtube*) plus astrophysics related
e.g. **Facebook** has 1000s of new followers, 2-4 post per week, each about 10,000 reach per month)
- **Researcher's nights** and other initiatives, also including **STEM, Science and Art**, etc.
- The **EGO multimessenger Art Room**
- **Educational and multi-media products**
- **Summer schools, Tutorials and classroom activities and experiments**
- **And much more...**
- The **AHEAD2020 video for planetaria**, that won two international prizes, has been watched by ~10 million individuals





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AHEAD2020 Transnational Access



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The AHEAD2020 TNA program offered transnational visits to a pre-defined set of European infrastructures. The main goals are:

- [giving access free of cost to the best test/calibration facilities](#) (synergy research-industry)
- [providing expertise and training on data analysis and computational models](#), mostly for young astronomers paving the way to a new generation of researchers
- [enhancing the theoretical background](#) of high energy and gravitational wave astrophysics and facilitate application of complex models to users
- [improving the data analysis techniques and optimise the exploitation](#) of present observational facilities and data sets in Europe.

In this framework, TNA centres are providing expertise on a number of topics/tools/datasets, enabling “expert” access to the average astronomer over the broadest set of facilities in the MMA and HE context.

The TNA visits are also fully funded, under responsibility of the visited infrastructure.

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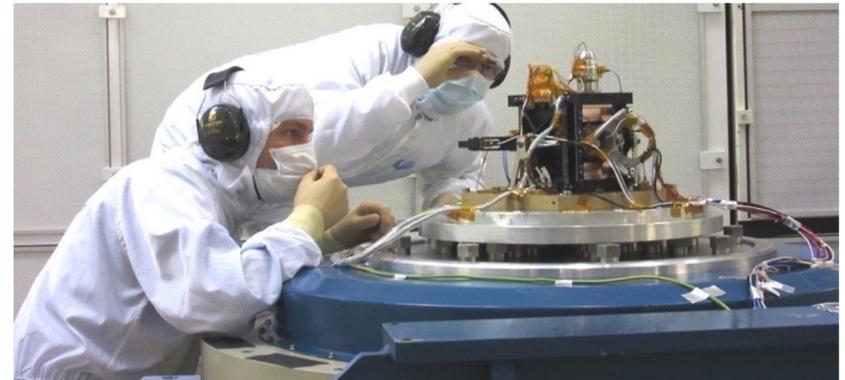
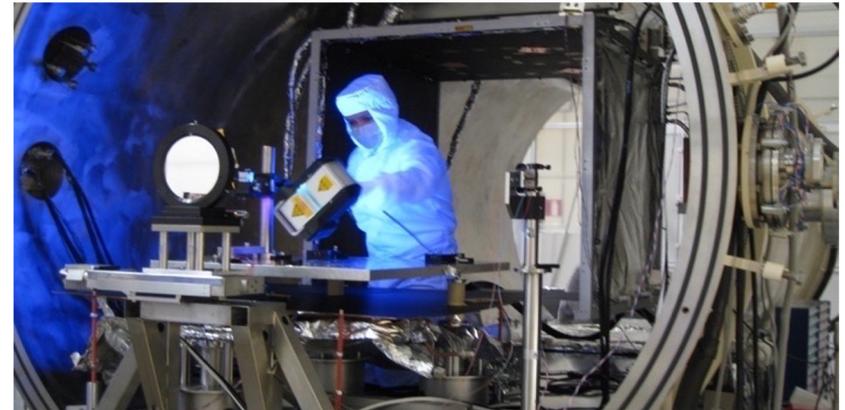
Offered experimental facilities



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Based on AHEAD experience we have built a TNA offer that covers a range of possible applications and needs and includes:

- one big thermal vacuum chamber (FOCAL2 at CSL),
- two shakers (at CSL and COSINE),
- a facility for testing thin filters (BBOTOC at CSL),
- a system of two beam lines at the Electra Synchrotron covering an ample range of energies (BABE at IOM-CNR),
- general purpose beam-lines for X-rays and gamma-rays (LARIX and XACT, respectively)
- a soft X-ray beam line specialized for testing Silicon Pore X-ray optics (BeaTRiX).



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AHEAD2020 Virtual Access to GW data



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A desktop app, ***GW Data Plotter*** has been developed that can be used to easily download and visualize GW data adding a minimal post-processing. The app is running on different OS and can be downloaded on Zenodo:

<https://zenodo.org/records/13778828>

It allows data recorded by the LIGO, Virgo, KAGRA and GEO Gravitational Wave detectors to be downloaded in various ways: by time interval, by **choosing known gravitational wave events or periods of transient noise mimicking signals of astrophysical origin.**

The user can select a gravitational wave event and inspect its astrophysical parameters and skymap, or plot the parameter distributions of all the events recorded so far.

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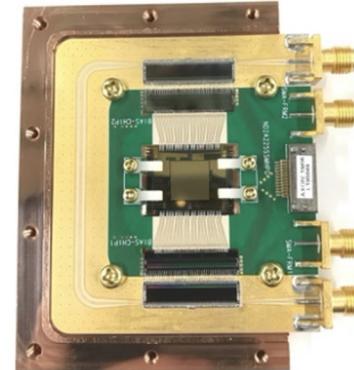
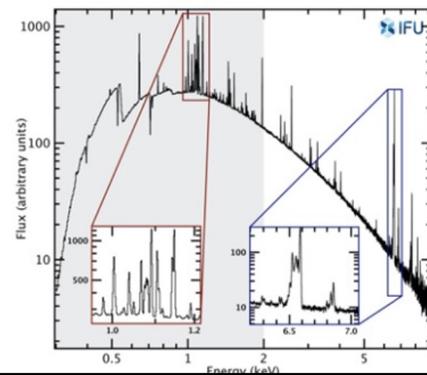
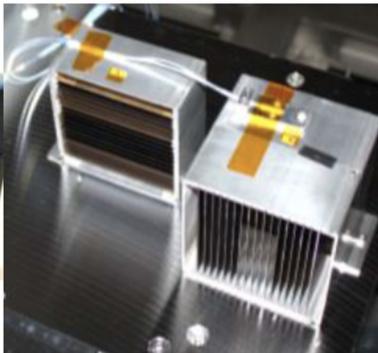
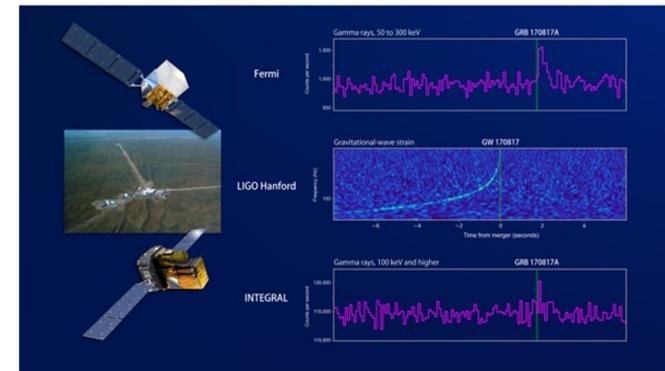
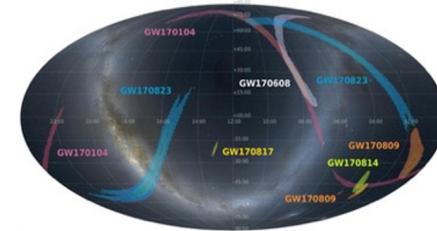
Joint Research Activities



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- **Key technologies & systems for future observing facilities:**
 - Microcalorimeters
 - X-ray optics
 - Instrumentation for HE astrophysics and multimessenger astronomy
- **Maximize science exploitation of present & future HE & MM:**
 - Exploitation of multimessenger science from current and future observatories
 - Laboratory Astrophysics
 - Background studies
 - Development of advanced data analysis tools
- **Technology Innovation and exploitation for society**
 - Upgrade of the PIXE technique for material diagnostics, pollution and cultural heritage applications
 - Robots system for seismic monitoring



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A few highlights from JRAs (1/3)

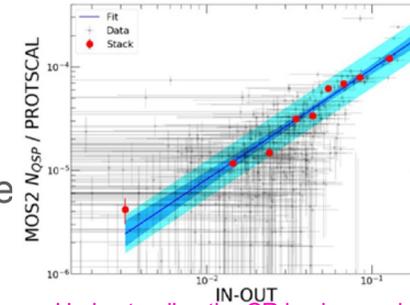


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Microcalorimeter Detectors and Background

Continuing the Improvements within AHEAD2020 on the comprehensive development of **cryogenic detectors for future facilities**, including particle environment, detectors and thermal filters. **Improvement in understanding of background for existing observatories (XMM-Newton)**

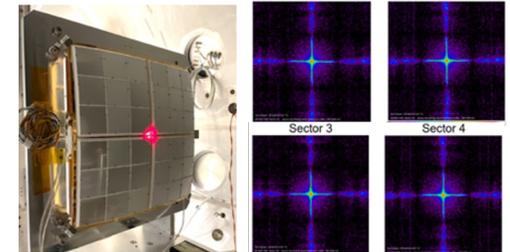


Understanding the CR background via the EPIC MOS and pn detectors onboard XMM Newton

Next generation X-ray optics and system studies for Athena

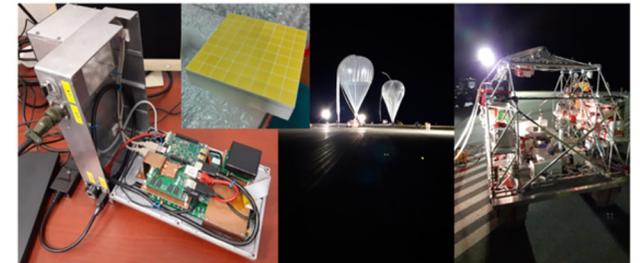
Mirror testing and calibration in tenths of measurements campaigns for new missions, including **SVOM** and **Einstein –Probe Flight Models** (launched recently)

Commissioning and operation of Beatrix Facility, now offered in TNA



Future HE space missions for time domain and MMA

System studies and **dedicated GRB and gamma-ray Compton-telescope detectors for nanosat constellations**. Flight instruments tested on stratospheric balloon flights. Final design and implementation of a first ground system antenna network for nanosat. **Theseus** selected as a candidate for ESA/M7 mission.





A few highlights from JRAs (2/3)

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Tools for MMA and generation of alerts from different facilities

- Tools to **generate science alerts** and **correlation analysis** from different satellites with **LIGO/Virgo** data
- Public tools for **theoretical modeling** of data from **follow-up observations**
- **Low latency** and **improved GW data tools**
- While for the **future Einstein Telescope facility**, different instrument designs have been developed

Laboratory astrophysics

Improving the knowledge of the atomic physics relevant for the next generation high resolution X-ray telescopes has progressed, also **in view of the operation of XRISM**.

- considerably enhanced the comprehensiveness and precision of the **plasma models used in X-ray astronomy**.
- First **measurements of inner shell transitions from ionized elements** at with EBIT at Elettra

Background studies

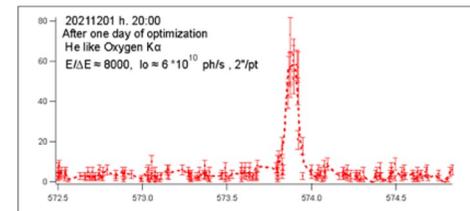
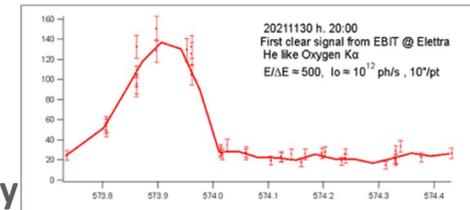
- **Measurements and simulations** to estimate the effect of low energy proton scattering and secondary electrons in the optics have been performed.



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Astro-COLIBRI is a central point for information about astrophysical sources and transient events



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A few highlights from JRAs (3/3)



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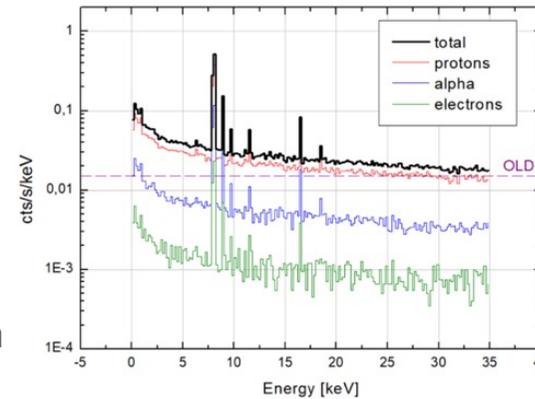
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Advanced analysis tools

- Exploitation tools for (new)Athena and high resolution spectroscopy
- **newAthena background:** modeling background spectrum for XIFU/CryoAC; model for the determination of in-band noise from the GCR induced background detected at higher energies
- **Detection of X-ray lines** in high-res spectra
- **Photoionization models** and **Comptonisation models** for soft excess in AGN

Technology innovation for society

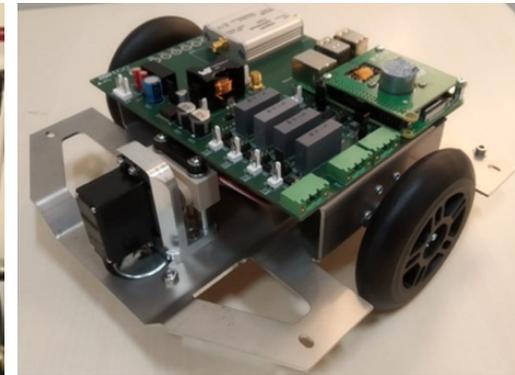
- **PIXE based systems** for cultural heritage and material sample analysis:
- **Mobile sensor array for environmental monitoring:** developed to help Newtonian Noise cancellation in the Virgo interferometer.



Improved bkg model for X-IFU



Testing PIXE cryostat system at KAON



First prototype unit of mobile sensor array



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Brief summary of the results



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- Overall, activities are in schedule and in line with the goals. Outstanding results from many WPs in the NA and JRA domains; increasing overbooking for the visitor program
- Community request for [Transnational access](#) has constantly increased along the years, starting from previous AHEAD program
- [Disseminating high energy astrophysics](#) at all levels (from general public to highly specialised professionals) has continued profitably and with continuous effort. Reaching a few millions people worldwide
- [Technologies for detectors and optics and innovation](#) for the benefit of society through industrial involvement: fabrication of new instrumentation is ongoing, after completion of design phases
- Strong community support in the area of [calibration and testing of X-ray optics](#); opening of a new test facility
- Step forward in [development of analysis and modelling tools](#) in all areas: multi-messenger, laboratory astrophysics and advanced analysis for new generation instrumentation; new ground-based infrastructure for nanosats
- [Ensuring sustainability](#): pushing forward technology and tools for the upcoming and future observatories. Creating a network of training centres to be also potentially integrated in the future.

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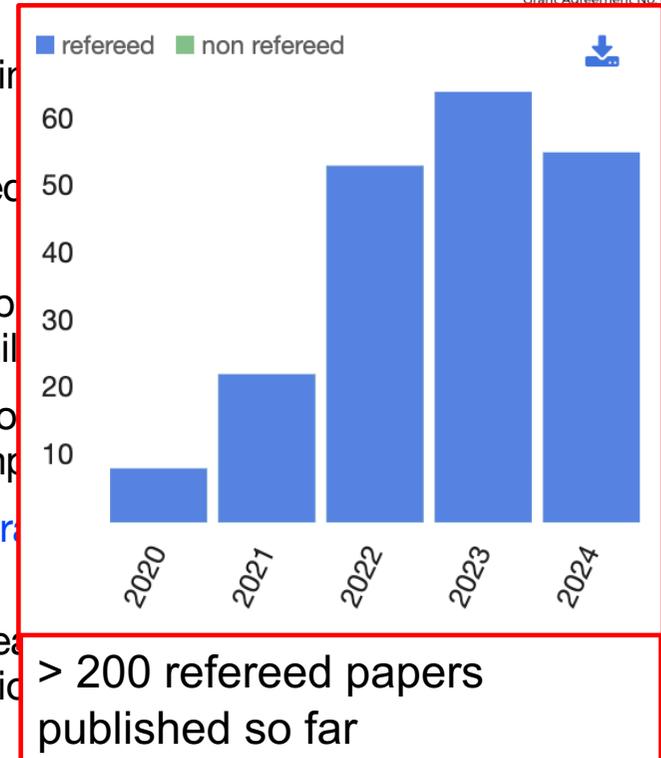
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Brief summary of the results



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- Overall, activities are in schedule and in line with the goals. Outstanding in JRA domains; increasing overbooking for the visitor program
- Community request for [Transnational access](#) has constantly increased since the previous AHEAD program
- [Disseminating high energy astrophysics](#) at all levels (from general public to researchers) has continued profitably and with continuous effort. Reaching a few million people
- [Technologies for detectors and optics and innovation](#) for the benefit of the community: involvement: fabrication of new instrumentation is ongoing, after completion of the first generation
- Strong community support in the area of [calibration and testing of X-ray](#) facility
- Step forward in [development of analysis and modelling tools](#) in all areas of astrophysics and advanced analysis for new generation instrumentation for nanosats
- [Ensuring sustainability](#): pushing forward technology and tools for the upcoming and future observatories. Creating a network of training centres to be also potentially integrated in the future.



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Final remarks



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- AHEAD has successfully reached the goal of integrating the HE community at all levels, **developing synergies among many fields of science and technology**, spanning multiwavelength, multimessenger and astroparticle physics.
- This emphasizes the role of AHEAD as an infrastructure and displays the potential of **creating collaborations across different communities**.
- **Multiwavelength science is increasingly topical favoring synergies with other astrophysics communities**. Common keywords can be exploited in the near future , e.g. studies of the transient universe, training centres, support to observation proposals.
- **Space technology themes for astrophysics** have important analogies with other science domains