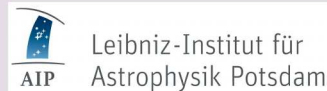




XMM-Newton survey legacy for Athena and beyond

Science for All: breaking barriers with diverse communication

Maite Ceballos, Rosa Domínguez and XMM2ATHENA WP10



The XMM-Newton survey legacy for
Athena and beyond workshop
February 26 - 29 , 2024

This project has received funding from the European Union's Horizon 2020
research and innovation programme under grant agreement No 101004168



Why Science Communication?

*The Declaration on Science and Use of Scientific Knowledge
(UNESCO sponsored World Conference on Science 1999):*

- Scientific knowledge should be shared*
- There is need for real cooperation between governments, civil society, business sectors and scientists*
- Scientists should be governed by ethical standards*
- Professionals who circulate scientific information see communicating with the public as a vital responsibility*



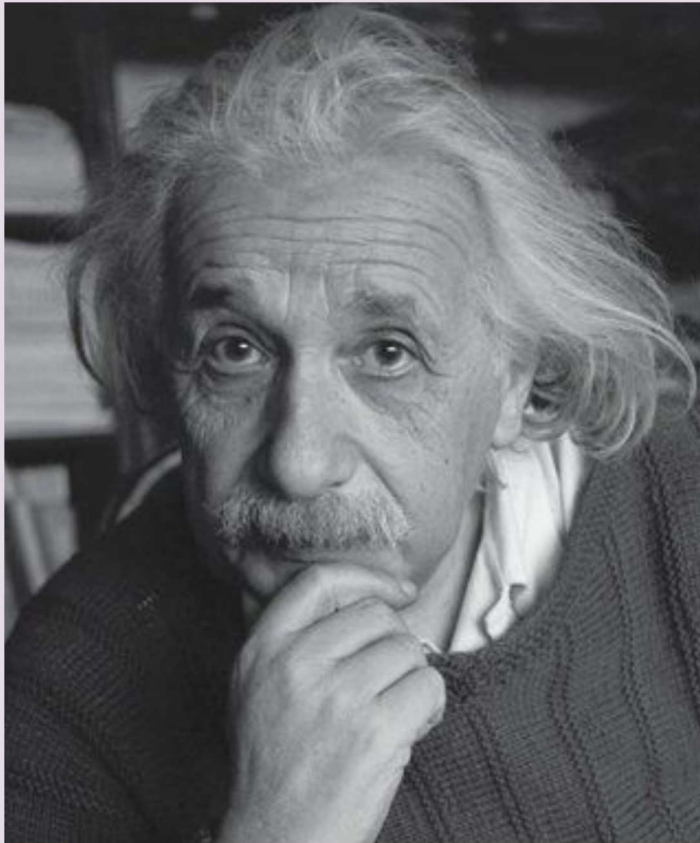
ChristineGeorge24 (slideshare)
The importance of science communication


Additional Motivation

***GA 29.1** Unless it goes against their legitimate interests, **each beneficiary must** — as soon as possible — **‘disseminate’ its results** by disclosing them to the public by appropriate means (other than those resulting from protecting or exploiting the results), including in **scientific publications** (in any medium)*

***GA 38.1** The beneficiaries must promote the action and its results, by **providing targeted information to multiple audiences** (including the media and the public) in a strategic and effective manner.*

But how?

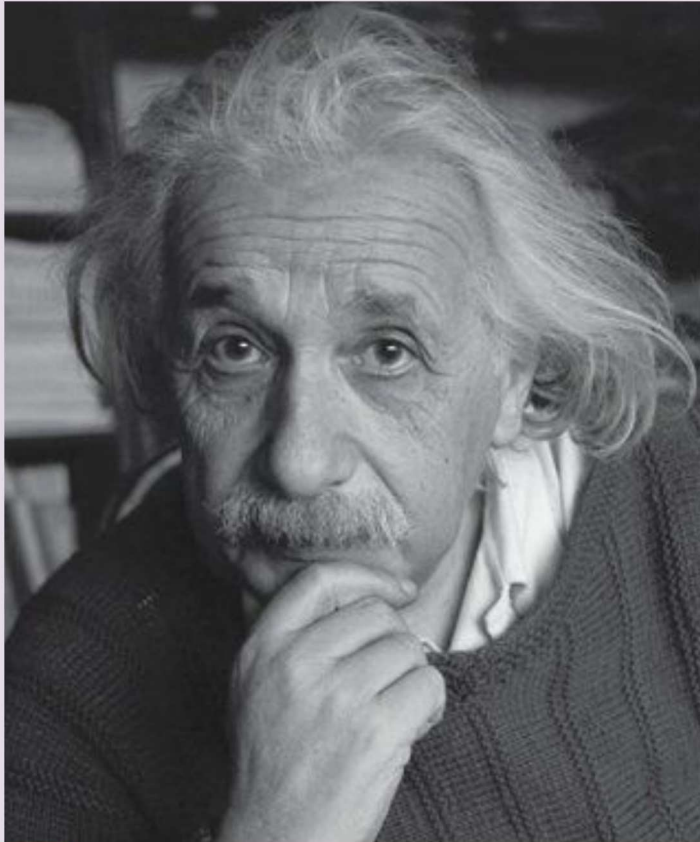


 targetintegration

“Everything
should be made
as simple as possible
but not simpler.”

Albert Einstein

But how?



“It can scarcely be denied that the supreme goal of all theory is to **make** the irreducible **basic elements** as **SIMPLE** and as few as possible **without having to surrender** the adequate representation of a single datum of experience.”

(1933 lecture)

Taking into account...

AUDIENCE



CHANNEL(S)

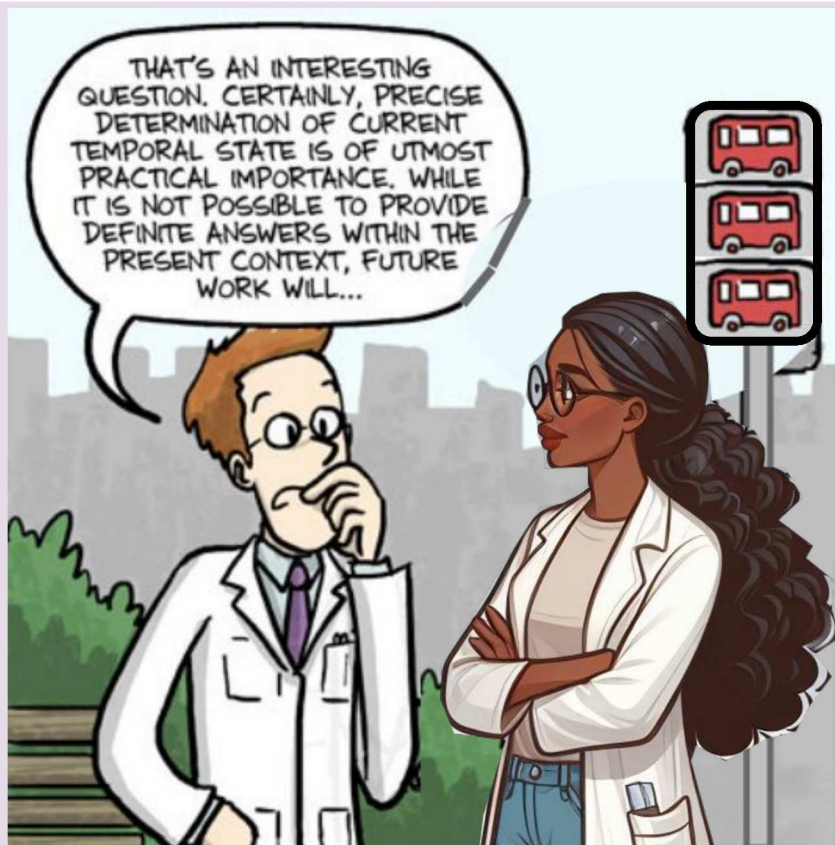


Taking into account...



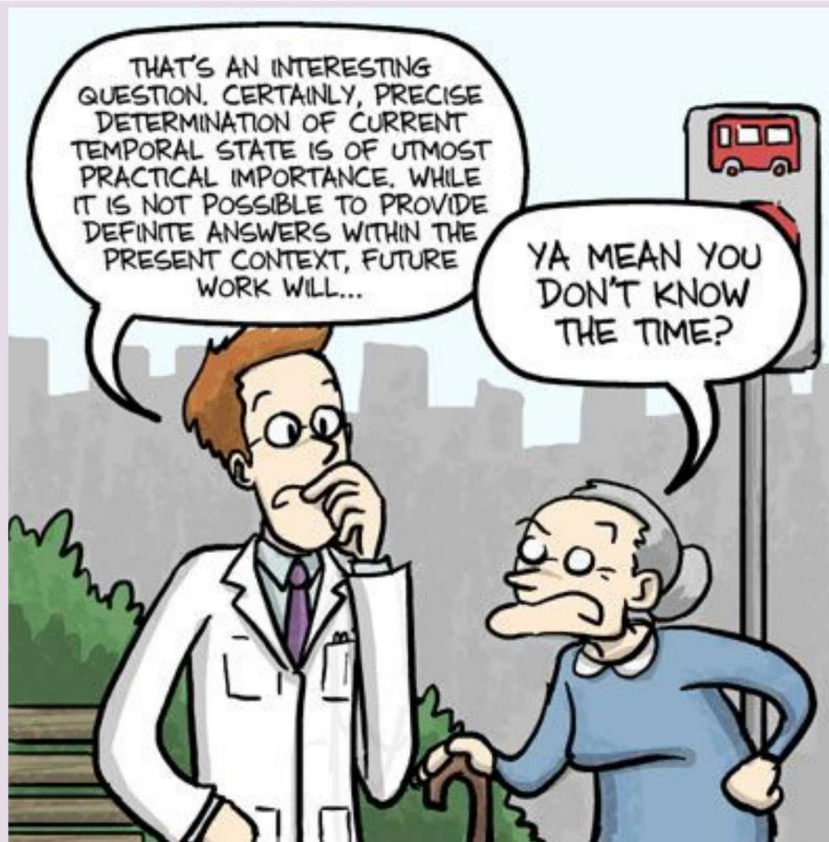
Credit: CoE

The audience: scientists?



2014 Nature Education

The audience: lay people?



2014 Nature Education

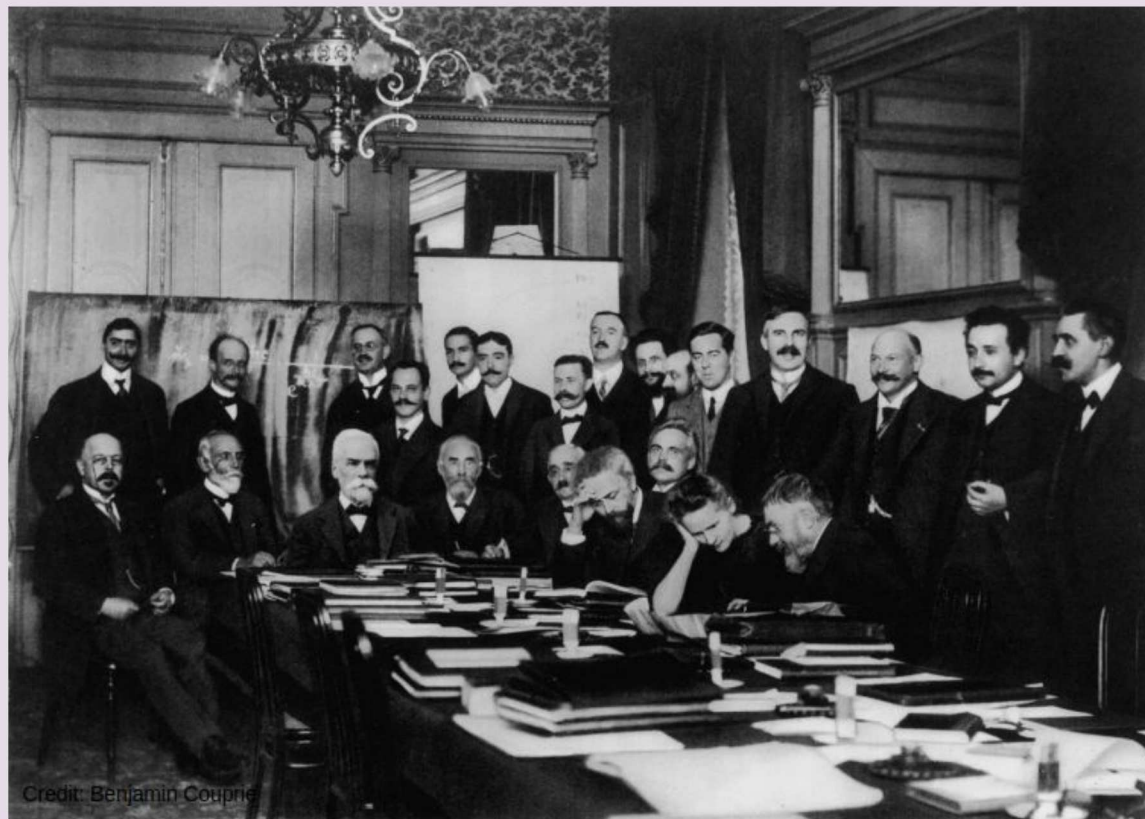
Who is our audience?



We
want
it all



The audience: experts



Credit: Benjamin Couprie

Credit: Benjamin Couprie

The audience: experts

[HOME](#)
[THE PROJECT](#)
[NEWS AND EVENTS](#)
[SCIENCE](#)
[OUTREACH](#)
[GALLERY](#)
[LINKS](#)
[JOBS](#)
[PRIVATE \(ATRIUM\)](#)

Publications

XMM2ATHENA

The link among X-ray spectral properties, AGN structure and the host galaxy

Mountrichas, George, et al.,
arXiv:2401.00045

XMM2ATHENA

The relationship between the incidence of X-ray selected AGN in nearby galaxies & star-formation rate

Birchall, Keir et al.,
arXiv:2306.10868

XMM2ATHENA

Tormund's return: Hints of quasi-periodic eruption features from a recent optical tidal disruption event

Erwan Quintin et al.,
arXiv:2306.00438

HORIZON 2020

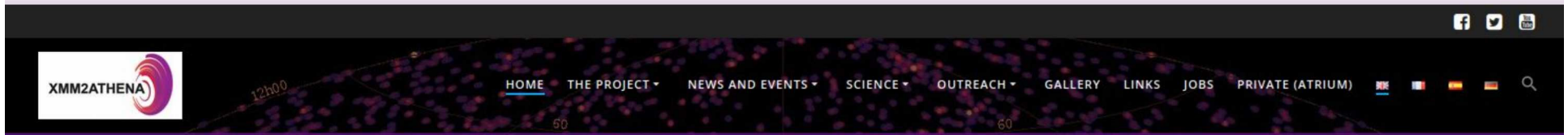
The XMM-Newton survey legacy for Athena and beyond workshop
 February 26 - 29, 2024

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101004168

12

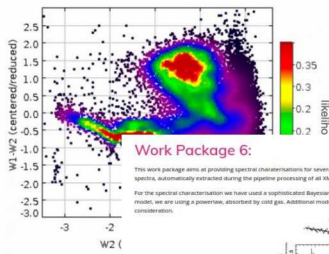


The audience: experts



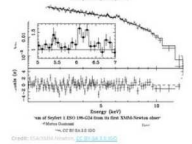
Work Package 2:

This work package aims at providing multi-wavelength statistical identifications and spectral energy distributions of XMM-Newton X-ray sources. During the first year of the project we have identified the main categories of interest as to cover different wavelengths and spectra. For a subset of these categories, we have computed preliminary statistical associations using the ANTS tool. This tool calculates the positions of detectors or different categories being associated to the same source based on their positions, positional errors and local densities. For all the possible matches we have investigated the corresponding values and spectral energy distributions and we have compared them to those of similar objects as well as to those associations. For the subset of categories we have worked on, we have found that a combination of X-ray and infrared colours helps in most of the cases to discern galactic and extragalactic sources from their associations. We have built a prototype tool to calculate the probabilistic classification of a set of matches based on a simple density correlation. This method combined with well defined learning samples allows us to give a first estimation of the true/false associations in a probabilistic perspective way. As a next step we would like to compare the probabilistic methods with the position probabilities following G. Pavesi et al (2017) and evaluate the obtained results. Once validated for the subset of categories we have worked on we would like to expand the study to other categories.



Work Package 6:

This work package aims at providing spectral characterizations for several subgroups of serendipitous XMM-Newton sources, taking advantage of their X-ray spectra, automatically extracted during the pipeline processing of all XMM-Newton products. For the spectral characterization we have used a sophisticated Bayesian fitting method (XSPEC) with a thorough exploration of the parameter space. As a reference model, we are using a power-law, absorbed by cold gas. Additional models, such as an absorbed blackbody and a thermal bremsstrahlung, are also under consideration.



The work is structured in several incremental steps, each building on the previous step, on the accumulated expertise of the participants and on the additional insight gained in the previous step. The end of each step is marked by a deliverable. The first deliverable (at the end of 2021) was a catalogue of spectral fits to the spectra of individual detections of X-ray sources in eSAS (2011), later replacing some quality filters, designed to ensure that the results are reliable and meaningful. The later deliverables (by the 31st of the quarters) will include spectra of which 17% (more than 20000 sources) are considered of acceptable quality. For each fit we provide the best fit parameter values, along with estimates of the 90% confidence interval. Many of those detections correspond to repeated observations of the same physical source. We aim at taking advantage of the corresponding increase in the signal by providing, in a second deliverable (due at the end of April 2022), fits to the merged spectra of all observations of the same physical source (more than 80000 sources after filtering). By the end of the reporting period the fits were filtered again for an associated power-law and for an associated blackbody model and the quality checks were well under way, not expecting any significant delay in the deliverable.

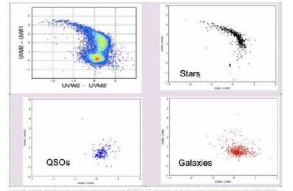
Work Package 3:

Work has concentrated on developing a first version of the sensitivity estimator which can return both fluxes and flux upper limits from a region of the XMM-Newton EPIC data, with both the position and the size of the region chosen by the user. The user can also specify the energy bands, reliability of the estimates required and provides (paralimited) overlays of the region of interest in a variety of wavelengths. This has been done by building on an earlier tool, the Flux Limits from Images from XMM-Newton (FLIM), adapting it to run on new servers and integrating the archive of the latest version of the XMM-Newton catalogue, eSAS (2011) (Webb et al., 2020) to run with the Sensitivity Estimator. We have provided simplifying, modernizing and harmonizing the interface to resemble other XMM-Newton interfaces and providing user-friendly documentation. The tool can now be accessed at: www.esasim.eu



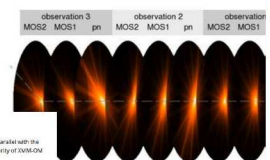
Work Package 7

WP7 is about classifying the ultraviolet and optical sources that are detected by the XMM-Newton Optical Monitor (XMM-OM) which observes in parallel with the X-ray sources. We intend to select the sources one-by-one and determine how they vary, in order to provide a subsequent classification for the majority of XMM-OM sources. The focus of the work carried out in the first year was to establish the training set: a group of sources for which the type and properties are well understood. The primary division of source types is between stars, galaxies and QSOs. For the stars, the key physical quantities are the spectral type and the luminosity. For the galaxies and QSOs, the key piece of information is the redshift, which for the training set will be spectroscopically defined. For the wider context of the training set, the main activity has been a complete cross-correlation of the dataset with lists to identify stars by proper motion and parallax. Given a European Space Agency coordinate, we were able to check the position and motion of stars in our archive. Gas Data Release Data were used for the cross-correlation. For each XMM-Newton QSOID, the positions of Gas sources have been transformed to the epoch of the XMM-Newton observation, taking into account the proper motion of the stars as measured by Gaia. The resulting 33500 sources is carried out using the publicly available software package. Parallax and proper motion are used to identify Galactic stars, and parallax is used to identify extragalactic sources. For the cross-correlation of the training set, quasars and galaxies, the XMM-OM was cross-correlated with the Sloan Digital Sky Survey. Extragalactic sources which spectroscopically were incorporated into the training set. In parallel with the creation of the training set, an updated XMM-OM FITS catalogue was created by adding to the FITS catalogue optical and infrared photometry from the large sky surveys of Pan-STARRS, SkyMapper, UGRSS, WISE and WISE.



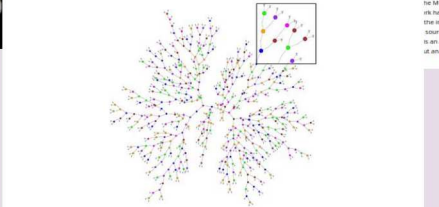
Work Package 4:

"The enhanced stacked catalogue", aims at optimising sensitivity towards faint sources in merging observations. A new source detection scheme is being implemented to achieve it. The first year was mostly dedicated to re-structuring the respective XMM-Newton software. Its sub-routines were documented and validated in many more details than available so far, providing the basis for the following code changes. Several routines needed substantial modification to accommodate the new scheme, in which the source flux is assumed to be constant during all observations. The exact conversion factors from the measured counts, which depend on the instrumental set-up, to astrophysical fluxes in Jy are calculated, and an interface to the source-detection software will be provided, to access and use them efficiently during upgrades as are on-going.



Work Package 8:

The main objectives in WP8 are: (1) the development of an Artificial Intelligence algorithm for the classification of XMM sources in various classes and (2) the estimation of the parameters characterizing the fit to the astrophysical populations in the visible catalogue. The star group worked on the classification of X-ray sources. A machine learning tool has been developed which can classify sources among the stars, X-ray binaries, extragalactic variables and others. The tool uses the spectral information, variability as well as the photometric information. The design of the algorithm and the testing results have been presented in a scientific paper under the title 'Probabilistic classification of X-ray sources applied to both EPIC and XMM-Newton catalogues' (Thorn et al. 2022, A&A, 650, 138).

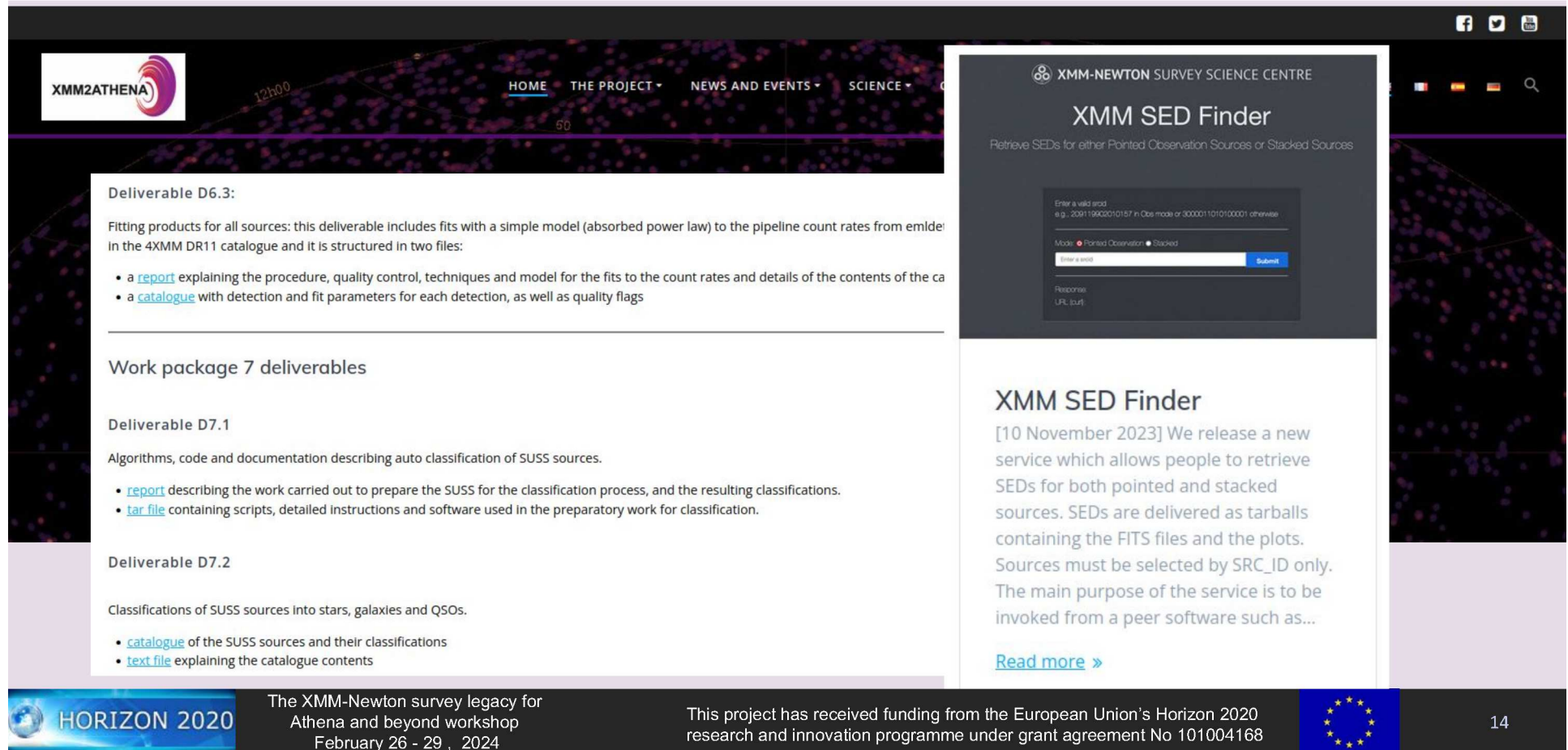


Work Package 5:

During the first year of the project we have concentrated on developing the software to determine long term and very faint, short term variability in XMM-Newton pointed EPIC data. To develop the long term variability we have taken the X-ray catalogues in addition to the XMM-Newton pointed data to extend the time duration and to increase the number of points in the lightcurve. These include the Chandra Source Catalogue (CSC 2.0; Evans et al. 2010), the Swift X-ray Point Source Catalogue (2SPX; Evans et al. 2010), the Rossi X-ray Survey (RXIS; Butler et al. 2016), the ROSAT pointed pointed survey, the XMM-Newton view survey (Galloway et al. 2008) and the early release Ericdata (ERED; Brunner et al. 2021), which we further augmented with XMM-Newton upper limits using Regiomontium (Joshi et al. 2022). To do this we developed an algorithm based on the matching method described in Smeets et al. (2016). We have identified the best X-ray bands to be compared and the spectral model to be used to determine the fluxes, in order to create reliable comparisons, as well as the basic criteria for determining variability. From a pilot study on two months of data, we determined the number and type of events expected. We also extended the search to probe spectral variability and variability in the optical/UV data from the OM telescope on board XMM-Newton.



The audience: experts



The screenshot displays the XMM2ATHENA website interface. On the left, a sidebar lists deliverables: Deliverable D6.3 (fitting products for all sources), Work package 7 deliverables, Deliverable D7.1 (auto classification of SUSs sources), and Deliverable D7.2 (classifications of SUSs sources). On the right, a pop-up window for the 'XMM SED Finder' tool is shown, featuring a search input field, a 'Submit' button, and a 'Read more' link. The background of the website shows a star field with a red line and the text '12h00' and '50'.

Deliverable D6.3:
Fitting products for all sources: this deliverable includes fits with a simple model (absorbed power law) to the pipeline count rates from emlded in the 4XMM DR11 catalogue and it is structured in two files:

- a [report](#) explaining the procedure, quality control, techniques and model for the fits to the count rates and details of the contents of the catalogue
- a [catalogue](#) with detection and fit parameters for each detection, as well as quality flags

Work package 7 deliverables

Deliverable D7.1
Algorithms, code and documentation describing auto classification of SUSs sources.

- [report](#) describing the work carried out to prepare the SUSs for the classification process, and the resulting classifications.
- [tar file](#) containing scripts, detailed instructions and software used in the preparatory work for classification.

Deliverable D7.2
Classifications of SUSs sources into stars, galaxies and QSOs.


- [catalogue](#) of the SUSs sources and their classifications
- [text file](#) explaining the catalogue contents

XMM SED Finder
[10 November 2023] We release a new service which allows people to retrieve SEDs for both pointed and stacked sources. SEDs are delivered as tarballs containing the FITS files and the plots. Sources must be selected by SRC_ID only. The main purpose of the service is to be invoked from a peer software such as...

[Read more »](#)

HORIZON 2020
The XMM-Newton survey legacy for Athena and beyond workshop
February 26 - 29 , 2024

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101004168

 14

The audience: ~ scientists



The audience: ~ scientists

Science “to go”

Detecting faint rapid transient sources with Athena

Maitrayee GUPTA
Institut de Recherche en Astrophysique et Planétologie (CNRS/IRAP)

EXOD program output identifying the fast transients in a field of view.
(credits: NASA/CXC/M.Weiss.; Getty Images.; NASA/CXC/CfA/R.Kraft et al.; NSF/VLA/Univ.Hertfordshire/M.Hardcastle; ESO/WFI/M.Rejkuba et al.)

<http://xmm-ssc.irap.omp.eu/xmm2athena/>
<https://www.facebook.com/XMM2Athena>
[@XMM2Athena](https://twitter.com/XMM2Athena)
[XMM2 Athena](#)

The dynamic sky is a treasure trove of information, though it is relatively unexplored compared to the static sky. Variability in the X-ray band is one part of multiband time-domain astronomy that focuses on this transient sky. Searching for X-ray variability on the shortest possible time scales allow us to identify rare variable phenomena such as Quasi-Periodic eruptions (QPE), identify previously undetected compact objects, and help find variable AGN and even X-ray counterparts for events in other bands, such as Fast Radio Bursts (FRBs). To search for faint, short term variable sources we have developed the EPIC XMM-Newton outburst detector (EXOD) algorithm.

Though XMM-Newton was not built as a transient detector, the high sensitivity and time resolution of its European Photon Imaging Cameras (EPIC) allow it to record fast X-ray transients. Nevertheless, the detection of these transients and potential follow-up with other instruments depends on the sensitivity and performance of the variability detection pipeline.

Traditionally variable sources were identified by generating the lightcurves of all sources detected by the data processing pipeline. This is a very computationally intensive process, which sometimes fails to detect faint, short term variable sources. In our algorithm, we compute the variability of the whole field of view of the detector. Since this process works independently of the source detection pipeline, we can detect very faint, short term variable sources which can be missed by the detection pipeline. Our algorithm computes the variability over the entire field of view and is much faster than generating light curves for each individual source.

The EXOD algorithm can be seamlessly extended to work on images produced by the ESA's Athena X-ray observatory WFI (Wide Field Imager) instrument. The WFI instrument is one of two complementary focal plane cameras, with a large 40' x 40' field of view and an excellent high count-rate capability. This will provide unprecedented simultaneous high-time resolution for the observation of bright sources with low pile-up and high efficiency. Similar to XMM, we will use EXOD in Athena to detect faint rapid transient sources for which time series would not otherwise be generated due to low counts, or whose source may, if generated, be drowned in background noise and thus not be identified by the pipeline. EXOD will also help identify objects whose variability timescales are shorter than the bin sizes, as they would otherwise be disregarded by the χ^2 test which is generally used in the pipeline to identify variability. Employing EXOD will thus help identify new and exciting sources with Athena.

[XMM2 Athena](#)



The audience: ~ scientists

Science "to go"

Detecting faint rapid transient sources with Athena

Maitrayee GUPTA
Institut de Recherche en Astrophysique et Planétologie (CNRS/IRAP)

The dynamic sky is a treasure trove of information, though it is relatively unexplored compared to the static sky. Variability in the X-ray band is one part of multidimensional domain astronomy that focuses on this transient sky. Searching for X-ray variability on the shortest possible time scales allow us to identify rare variable phenomena such as Quasi-Periodic Eruptions (QPEs), identify previously undetected compact objects, and help find variable AGN and even X-ray counterparts for events in other bands, such as Fast Radio Bursts (FRBs). To search for faint, short-term variable sources we have developed the EPIC XMM-Newton outburst detector (EXOD) algorithm.

Traditionally variable sources were identified by generating the lightcurves of all sources detected by the data processing pipeline. This is a very computationally intensive process, which sometimes fails to detect faint short-term variable sources.

In our algorithm, we compute the variability of the whole field of view of the detector. Since this process works independently of the source detection pipeline, we can detect very faint, short-term variable sources which can be missed by the detection pipeline. Our algorithm compares the variability over the entire field of view and is much faster than generating light-curves for each individual source.

The EXOD algorithm can be seamlessly extended to work on images produced by the ESA's Athena X-ray observatory (WFI (Wide Field Imager) instrument). The WFI instrument is one of two complementary focal plane cameras, with a large $40^\circ \times 40^\circ$ field of view and an excellent high-count-rate capability. This will provide unprecedented simultaneous high-time resolution for the observation of bright sources with low pile-up and high efficiency. Similar to XMM, we will use EXOD in Athena to detect faint rapid transient sources for which time series would not otherwise be generated due to low counts, or whose sources may, if generated, be drowned in background noise and thus not identified by the pipeline. EXOD will also help identify objects whose variability timescales are shorter than the bin time, as they would otherwise be obscured by the 42 bins which is generally used in the pipeline to identify variability. Employing EXOD will thus help identify new and exciting sources with Athena.

<https://www.cosmos.esa.int/athena/> <https://www.facebook.com/XMM2ATHENA> <https://twitter.com/XMM2ATHENA>

The tale of the vanishing neutron star

Erwan Quentin
Institut de Recherche en Astrophysique et Planétologie (CNRS/IRAP)

To understand the interest in observing P13, we must first understand what is extraordinary about pulsating ULXs. Accreting objects are thought to respect the Eddington limit, which is the maximum rate at which a compact object can accrete based on our understanding of accretion physics; this also translates into a maximum luminosity, the Eddington luminosity. This limit increases with mass: the larger the object, the more luminous it can be without violating the limit. ULXs are sources that are usually bright, about 100 times brighter than usual X-ray binaries, and were first discovered in the late 90s. They were at first thought to be very massive black holes, so that they could be the luminous walls still requiring the Eddington limit. However, in 2004, coherent pulsations were discovered in a ULX, and those pulsations could only be explained by the presence of a neutron star at the center of the system. Neutron stars cannot be much more massive than a few solar masses; being this luminous and this small thus meant that at least some ULXs largely violate the Eddington limit, by one or more orders of magnitude. Since this discovery, large studies have been undertaken to understand super-Eddington accretion and detect new pulsating ULXs, with only ~17 certain candidates to this date.

Understanding super-Eddington accretion was the reason why P13 was observed by XMM-Newton several times. In the November 2013 observation, P13 was much brighter than the first time it was observed a year and a half before in May 2012 (see white circle in the figure). But by comparing both observations, one can notice a very interesting feature: a very luminous source in May 2012, even brighter than P13 in 2013, had completely disappeared in the second observation (see green circle in the figure). This means that the source saw its flux drop below the detection limit between 2012 and 2013. The automatic detection pipeline of XMM-Newton only works on one observation at a time, and doesn't use prior knowledge of existing sources: no information was extracted for the green source from the 2013 non-detection. However, by comparing the stability level of XMM-Newton at the position of the source in 2013, one can put an upper limit on the source's flux, and this constrains its overall variability. It was by looking for variable sources using upper limits that the green source was identified as an object of interest that reached the ULX level of luminosity at its peak. Further study led to the detection of a candidate pulsation in the X-ray peak lightcurve.

The use of sensitivity computation was thus instrumental in the detection of what is a candidate to be the first known pulsating ULX.

<https://www.cosmos.esa.int/athena/> <https://www.facebook.com/XMM2ATHENA> <https://twitter.com/XMM2ATHENA>

Measuring distances of galaxies emitting in X-rays

Angel Ruit
Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing at the National Observatory of Athens (NOA)

One of the first questions that comes to our minds when we look at the night sky is "how far the stars are from us". This question is very important for astronomers and over the years we discovered many different methods to measure distances for stars and even for very distant galaxies. But why are distances important? Without knowing the distances, to different celestial objects it is impossible to compare their "intrinsic" properties. For example, the Sun is the brightest star that we can observe, but this is just because it is very close to us. Once we took distances into account, we found out that there are much more luminous stars in our Galaxy.

In XMM2Athens we want to measure the distances of X-ray emitting objects that are detected by the XMM-Newton observatory. Most of these objects are active galactic nuclei very far from us, at what we call "cosmological" distances. This means that they are receding from our galaxy at very high velocities, as a consequence of the expansion of the Universe. And thanks to this, we can estimate its distance by measuring a simple observational property: the redshift. The light emitted by distant galaxies moving away from us shifts towards lower frequencies, towards the red part of the electromagnetic spectrum.

The most direct way of knowing the redshift of a galaxy is by measuring its spectrum (photometric redshift). This is very time consuming and it is not feasible when you want redshifts for hundreds of thousands of sources, as in the case of XMM2Athens. However, we have available a different method for measuring redshifts, called photometric redshifts. This is based on the fact that the different colors observed in a galaxy depend on its distance. This technique is less accurate than spectroscopic redshift, but it gives good results. We calculate photometric redshifts using Machine Learning methods. We use a small sample of X-ray sources with known spectroscopic redshifts to train an Artificial Intelligence so it can assign redshifts for X-ray sources based on their observed colors. In the figure we show the results of this method, comparing our values for the photometric redshifts with known spectroscopic redshifts. The dark areas are the regions where most of our measurements are concentrated. If these regions lie within the dashed lines, then for most sources the photometric redshifts are calculated correctly. When including more colors (bands) in our calculations, the results get better.

<https://www.cosmos.esa.int/athena/> <https://www.facebook.com/XMM2ATHENA> <https://twitter.com/XMM2ATHENA>

Running the Science Analysis Software on any Region of the XMM-Newton sky with Amora

Alexandre VIALA (intern)
Université Technologique de Belfort-Montbéliard - France
Supervised by Laurent MICHEL and the SSC Team
Strasbourg Observatory

Many astrophysical objects emit photons in the X-ray energy band; these photons can travel millions or light-years in straight lines and eventually reach our solar system. However, these highly energetic photons are absorbed by the Earth's atmosphere; this is why to study these objects we built space observatories like XMM-Newton. The main detector of these photons is in fact a CCD camera that takes 'photos' at a very fast speed, enabling us to collect the electric charge deposited in the pixels by single photons, in what we call as events. An event contains information about the position, time of arrival, and energy of the incident photon. The processing of such event lists is quite complicated because the signal count rate is often low and/or the background containing many events that do not come from the source of interest or are not even due to X-ray photons. In addition to this, the integration of X-ray photons with CCD pixels is complex: a photon can create signal in more than just one pixel, or multiple photons can hit the same pixel in the same frame.

Retrieving science data from event lists requires advanced statistical processing that is run on ground. In a nutshell, the workflow consists in first filtering the events (to solar flare, uncorrected noise, electronic working well...) and then building images. The images are processed to detect areas with photon excess and then detect source candidates that will be studied later on. The photons issued from these sources are then processed to evaluate source brightness and to build spectra or time series which are ready for further analysis. These science products are made available to the community through different interfaces among those the SSC team, operated by the Observatory of Strasbourg. This will allow to plan the all-sky EXOD different sources detected by XMM upon any of the ~1100 available image surveys across the whole electromagnetic spectrum and to combine them with data from more than 22000 catalogues.

A new XMM2Athens feature, named Amora for 'Asynchronous Multi-Observation Region-based Analysis', allows users to access all the event photons that were collected by the XMM-Newton mission in the region of interest and to process them interactively. Users can draw a polygon or a circle isolating that region; they can also define another area that will be used as a background region. Once the region is selected, Amora lists observations that cover it along with their properties, allowing the user to choose which observations to use for further analysis. On these selected data, the user has just to select the processing tasks (e.g. building spectra) that will run on the server. The processing output is displayed in real time on the screen, allowing an efficient monitoring of the task progress. Results are provided as both previews for a quick look and as science products that can be downloaded for further analysis (<https://github.com/athena-xmm2athena/Amora> green button).

<https://www.cosmos.esa.int/athena/> <https://www.facebook.com/XMM2ATHENA> <https://twitter.com/XMM2ATHENA>

The link among X-ray spectral properties, AGN structure and the host galaxy

George Mountrichas
Instituto de Física de Cantabria (IFCA)

One of the most important questions in Astrophysics revolves around how galaxies form stars, evolve across cosmic time. In the last two decades, our observations have shown that at the heart of most, if not all, galaxies reside supermassive black holes (SMBHs). These black holes are incredibly massive, ranging from hundreds of thousands to billions of times the mass of the Sun. The SMBHs grow through accretion of material that originates either from the host galaxy or the intergalactic environment. When this happens the SMBH becomes active and the galaxy is called an active galactic nuclei (AGN). Recent studies have established a compelling link between the growth of these SMBHs and the evolution of the galaxies they inhabit. Therefore, to truly comprehend how galaxies evolve, it becomes crucial to unveil the true nature and characteristics of these SMBHs.

One important aspect of this pursuit is to decipher why some galaxies have their SMBHs obscured from view while others do not. There are two primary modes that seek to explain these distinct manifestations of AGN. According to the unification model, AGN are obscured by a dusty gas torus structure that acts as a shield and absorbs radiation emitted from the SMBH and its surrounding accretion disk. This obscured radiation is then re-emitted at longer (infrared) wavelengths. In the context of this model, an AGN is classified as obscured or unobscured, depending on the inclination of the ring of light with respect to the viewing axis of the accretion disk, and how. When the AGN is observed edge-on the source is characterised as obscured, while it is classified as unobscured when the AGN is viewed face-on.

An alternative interpretation of the AGN observation arises from the class of the evolutionary models. These models propose that different AGN types result from observing SMBHs and their host galaxies at various developmental phases. The main idea of these models is that obscured AGN is observed at an early stage when the energy output from the accretion disk around the SMBH is relatively weak and incapable of expelling the gas that surrounds it. As material eventually pushes away the obscuring material, revealing an unobscured AGN.

A powerful method to study the two AGN populations and their light in the many different aspects of the AGN activity is hereby to compare the properties of galaxies that host the two types of AGN. In the context of the XMM2ATHENA project, we conducted an analysis involving about 35,000 AGN emission-line ratios versus wavelengths of the electromagnetic spectrum, spanning from X-ray to optical are inferred. Our goal was to compare the rate at which galaxies hosting the two AGN populations form stars (star-formation rate, SFR) and the total mass of their stellar populations (M^*). Our results revealed significant trends. Galaxies that host obscured SMBHs tend to be more massive than their unobscured counterparts. They also form stars at a lower rate in comparison to galaxies that host unobscured AGN. The figure presents the distributions of the two host galaxy properties for the different AGN classes. The evidence of these significant differences provides support for the evolutionary theory of obscured AGN.

<https://www.cosmos.esa.int/athena/> <https://www.facebook.com/XMM2ATHENA> <https://twitter.com/XMM2ATHENA>

Running the Science Analysis Software on any Region of the XMM-Newton sky with Amora

Alexandre VIALA (intern)
Université Technologique de Belfort-Montbéliard - France
Supervised by Laurent MICHEL and the SSC Team
Strasbourg Observatory

Many astrophysical objects emit photons in the X-ray energy band; these photons can travel millions or light-years in straight lines and eventually reach our solar system. However, these highly energetic photons are absorbed by the Earth's atmosphere; this is why to study these objects we built space observatories like XMM-Newton. The main detector of these photons is in fact a CCD camera that takes 'photos' at a very fast speed, enabling us to collect the electric charge deposited in the pixels by single photons, in what we call as events. An event contains information about the position, time of arrival, and energy of the incident photon. The processing of such event lists is quite complicated because the signal count rate is often low and/or the background containing many events that do not come from the source of interest or are not even due to X-ray photons. In addition to this, the integration of X-ray photons with CCD pixels is complex: a photon can create signal in more than just one pixel, or multiple photons can hit the same pixel in the same frame.

Retrieving science data from event lists requires advanced statistical processing that is run on ground. In a nutshell, the workflow consists in first filtering the events (to solar flare, uncorrected noise, electronic working well...) and then building images. The images are processed to detect areas with photon excess and then detect source candidates that will be studied later on. The photons issued from these sources are then processed to evaluate source brightness and to build spectra or time series which are ready for further analysis. These science products are made available to the community through different interfaces among those the SSC team, operated by the Observatory of Strasbourg. This will allow to plan the all-sky EXOD different sources detected by XMM upon any of the ~1100 available image surveys across the whole electromagnetic spectrum and to combine them with data from more than 22000 catalogues.

A new XMM2Athens feature, named Amora for 'Asynchronous Multi-Observation Region-based Analysis', allows users to access all the event photons that were collected by the XMM-Newton mission in the region of interest and to process them interactively. Users can draw a polygon or a circle isolating that region; they can also define another area that will be used as a background region. Once the region is selected, Amora lists observations that cover it along with their properties, allowing the user to choose which observations to use for further analysis. On these selected data, the user has just to select the processing tasks (e.g. building spectra) that will run on the server. The processing output is displayed in real time on the screen, allowing an efficient monitoring of the task progress. Results are provided as both previews for a quick look and as science products that can be downloaded for further analysis (<https://github.com/athena-xmm2athena/Amora> green button).

<https://www.cosmos.esa.int/athena/> <https://www.facebook.com/XMM2ATHENA> <https://twitter.com/XMM2ATHENA>



The XMM-Newton survey legacy for Athena and beyond workshop
February 26 - 29 , 2024

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101004168

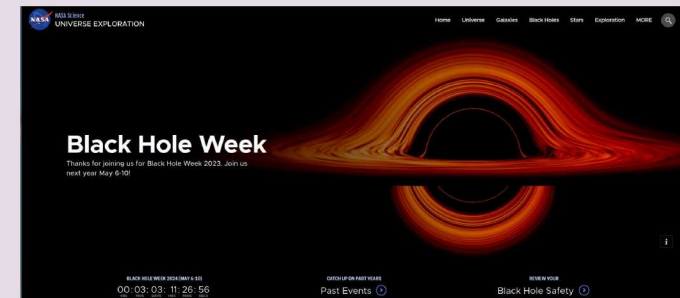


The audience: general public

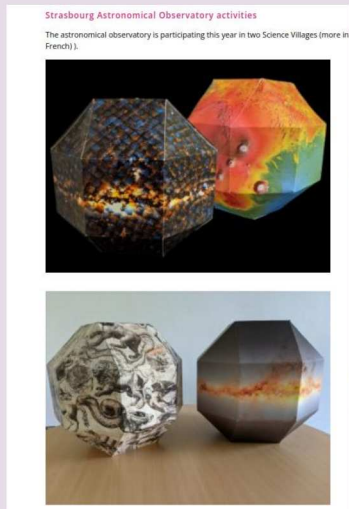


The audience: general public

WWW
INITIATIVES
(no age)



The audience: general public



The audience: general public

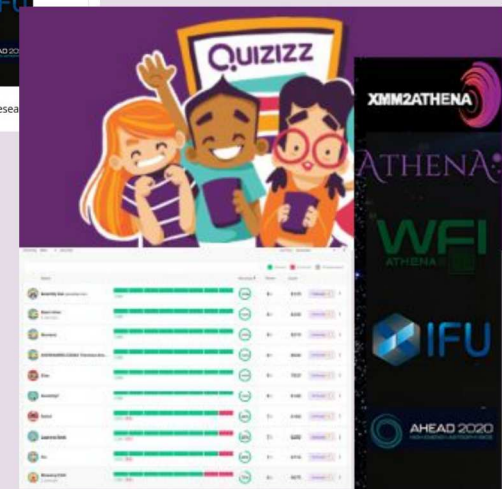


European Researchers' Night 2022: Memes contest

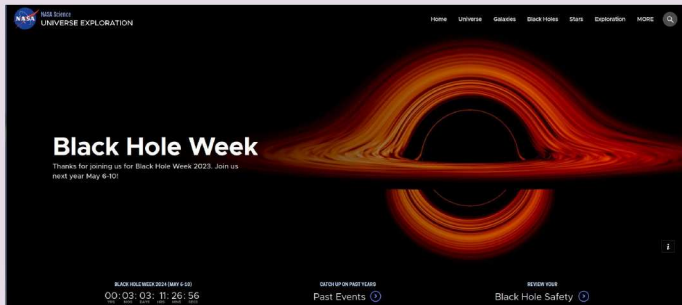


	Día 20	Día 21	Día 22	Día 23	
10:00-11:00	<p>LO QUE NO SABÍAS</p> <p>IFCA Kahoot!</p> <p>4º - 6º primaria</p>	<p>EXPERIMENTOS DE METEOROLOGÍA</p> <p>AEMET Cantabria</p> <p>3º - 4º ESO y FP Medio</p>	<p>PON CONGRUENCIA SOBRE EL SOLAR</p> <p>IFCA Kahoot!</p> <p>4º - 6º primaria</p>	<p>DEL MAR AL PLATO: UN MODELO ECOLÓGICO</p> <p>Grupo DoPRO</p> <p>1º - 2º Bach y FP Sup.</p>	
12:00-13:00	<p>MATEMÁTICAS PARA ENTENDER EL MUNDO</p> <p>Dpto. Matemáticas, estadística y computación</p> <p>1º - 3ª primaria</p>	<p>- MI BEBIDA ES UNA LINTERNA... ¿Y ESO CÓMO PUEDE SER? (1ª - 2ª ESO)</p> <p>- POLARIZACIÓN DE LA LUZ: EL JUEGO DEL OJO NEGRO (1ª - 2ª ESO)</p> <p>- ADIVINA EL COLOR DE LAS COSAS (4ª - 6ª primaria)</p> <p>Grupo de Ingeniería Fotónica</p> <p>4º - 6ª primaria / 1ª - 2ª ESO</p>	<p>UNIVERSO Y RAYOS X: ¿CUÁNTO SABES?</p> <p>IFCA Kahoot!</p> <p>1ª - 2ª ESO</p>	<p>DESARROLLANDO MENTES CREATIVAS</p> <p>AMENTURATE</p> <p>Ed. Especial (a partir de 12 años)</p>	<p>MINI-INVESTIGA GALAXIAS DE RAYOS X</p> <p>IFCA</p> <p>1ª - 2ª Bach y FP Sup.</p>

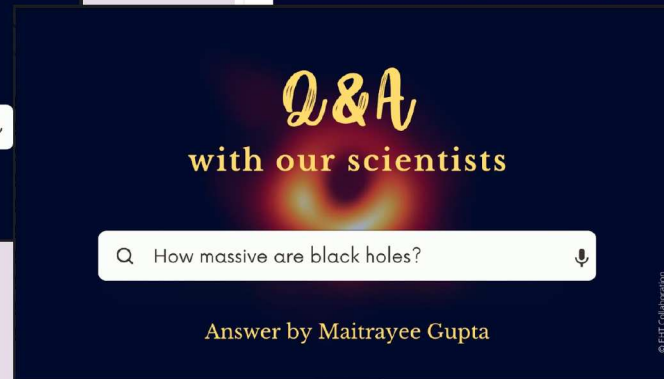
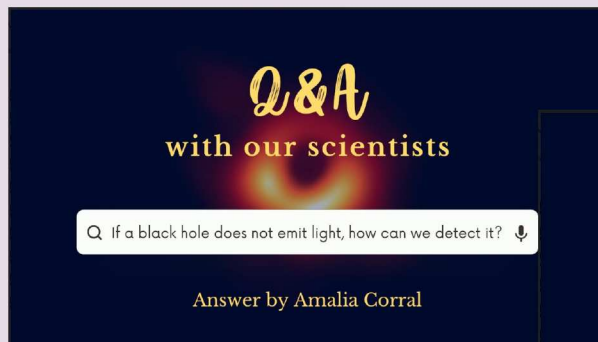
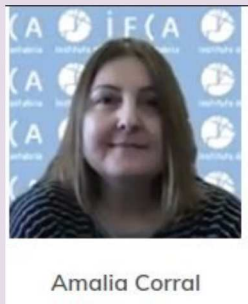
Initiatives of AstroSiskus and The Black Hole Week, we are preparing a meme contest framed in the European Resea



The audience: general public

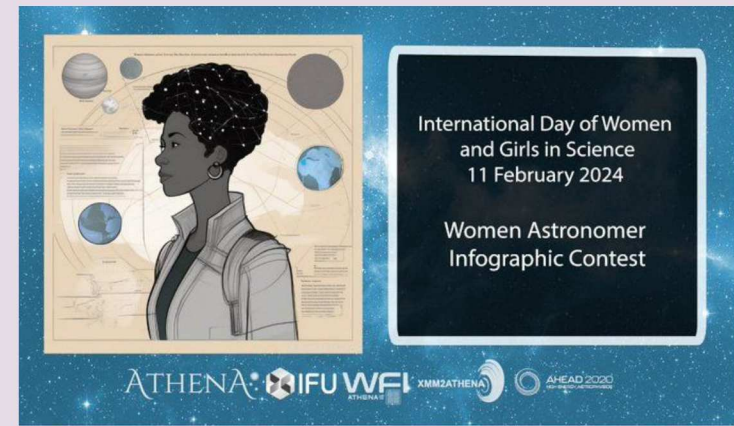
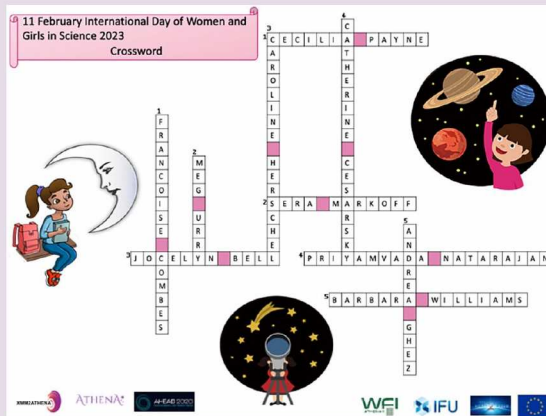


Black Hole Week: May 2-6



The audience: general public

11 February
International day of women
and girls in science

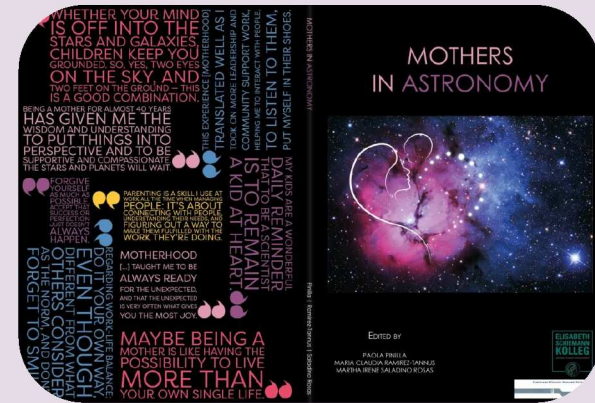


The audience: general public



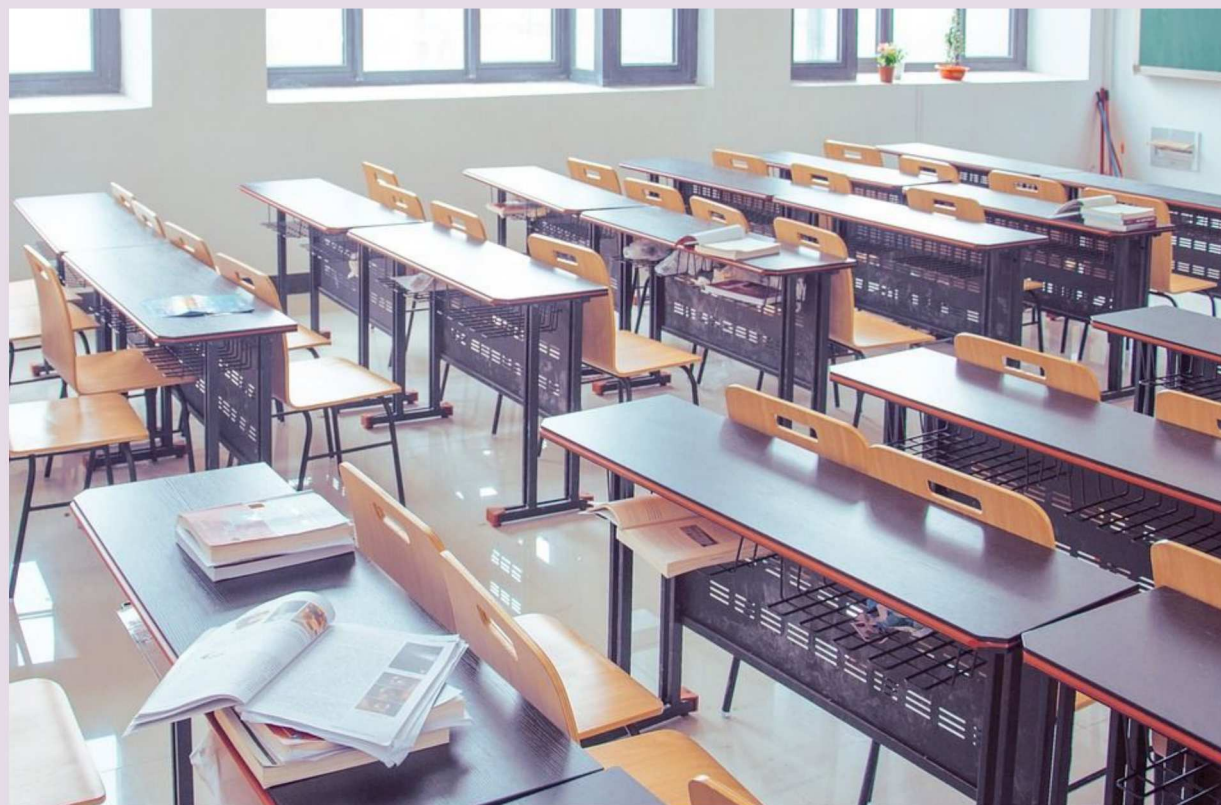
The audience: general public

Collaborations

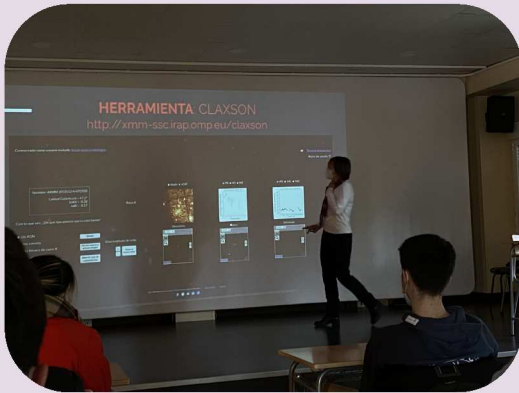


The audience: general public

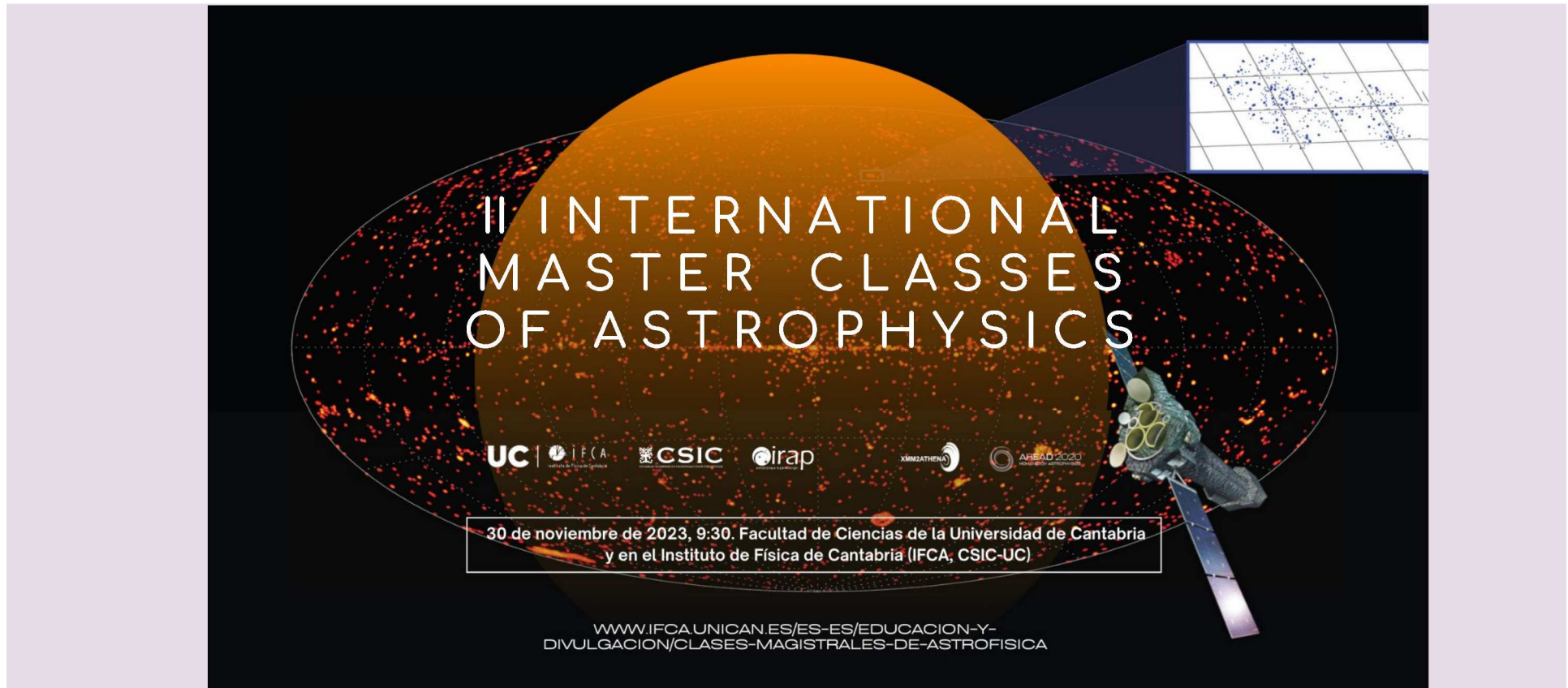
Initiatives
for students



The audience: students



The audience: students



II INTERNATIONAL
MASTER CLASSES
OF ASTROPHYSICS

UC | IFCA | CSIC | irap | XMM2ATHENA | AHEAD 2020

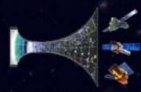
30 de noviembre de 2023, 9:30. Facultad de Ciencias de la Universidad de Cantabria
y en el Instituto de Física de Cantabria (IFCA, CSIC-UC)

WWW.IFCA.UNICAN.ES/ES-ES/EDUCACION-Y-DIVULGACION/CLASES-MAGISTRALES-DE-ASTROFISICA

The audience: students

Welcome to CLAXSON!

(Classification of X-ray Sources for Novices)



[For astronomers](#)

[About us](#)

[The project](#)

[Tutorial](#)

[Contact](#)

[Log in](#)

[Sign up](#)



CLAXSON is a platform designed to identify new objects observed in the X-ray sky with the European Space Agency X-ray telescope XMM-Newton. Be the first to find new supermassive black holes, stars, galaxies and other exotic objects in observations taken over the last 20 years, and help astronomers unravel the mysteries of the X-ray sky.

[Begin!](#)

[Presentation](#)



Original image credit: NASA/JPL-Caltech

The audience: students



The audience: for all

The people
behind the
scenes



The audience: for all

<http://xmm-ssc.irap.omp.eu/xmm2athena/> @XMM2Athena
<https://www.facebook.com/XMM2Athena> XMM2 Athena



Natalie Webb

Organization: IRAP/CNRS
Position: Principal Investigator,
 Coordinator for IRAP

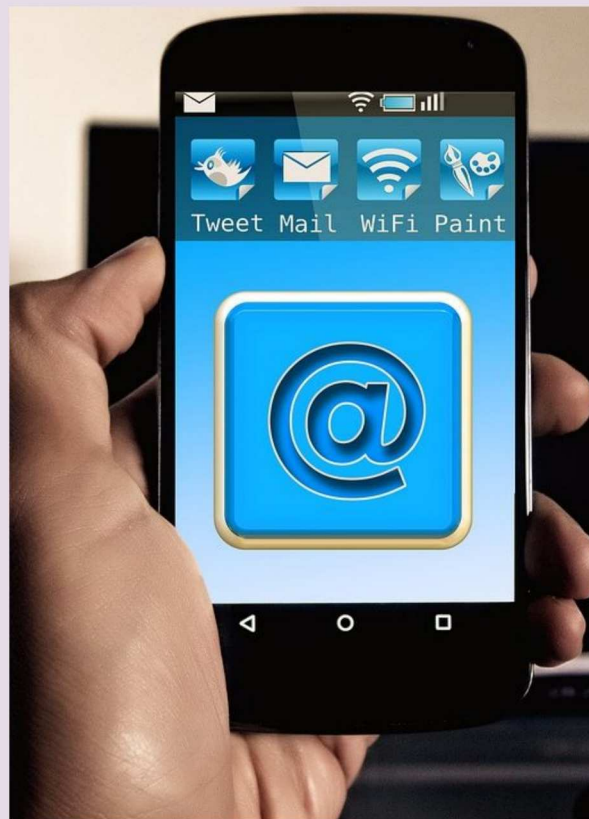


Natalie is a multi-wavelength astronomer at the Institut de Recherche en Astrophysique et Planétologie (IRAP), Toulouse, France. She is Coordinator for the XMM2ATHENA project, as well as head of the XMM-Newton Survey Science Centre, the science ground segment for ESA's current X-ray mission and Project Scientist for the X-IFU Instrument and Science Centre, the science ground segment for the X-IFU instrument that will fly on ESA's next big X-ray mission, *Athena*. Natalie's research is focussed on the origin and the growth of supermassive black holes seeds, and on constraining the nature of the supra-dense matter inside neutron stars.

XMM2ATHENA will accompany the revolution that has taken place in astronomy over the 21 years since XMM-Newton was launched, helping scientists to exploit populations of sources, rather than single objects, by providing multi-wavelength and multi-messenger information, along with source identification, redshifts and high level science products such as fitted spectra. It will also embrace time domain astronomy by producing long term variability information and providing alerts for transients. At the same time we will be preparing for *Athena* by providing robust and innovative software to enable the X-ray community to exploit the ground-breaking data that will come from this cutting edge mission.

Which channels or which media?

formal
&
traditional



informal
&
new

The channels

The more,
the
merrier!



The channels: formal

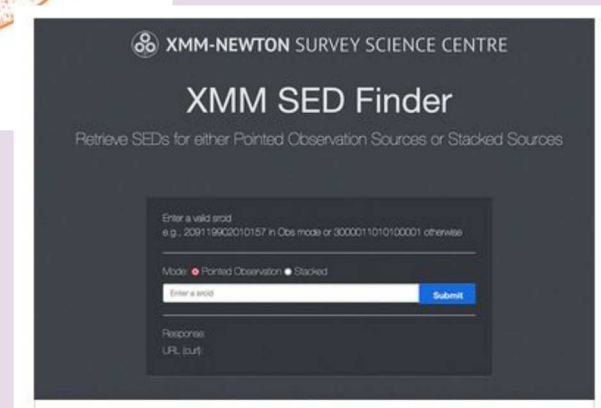


Scientific papers



The channels: formal

WEB services

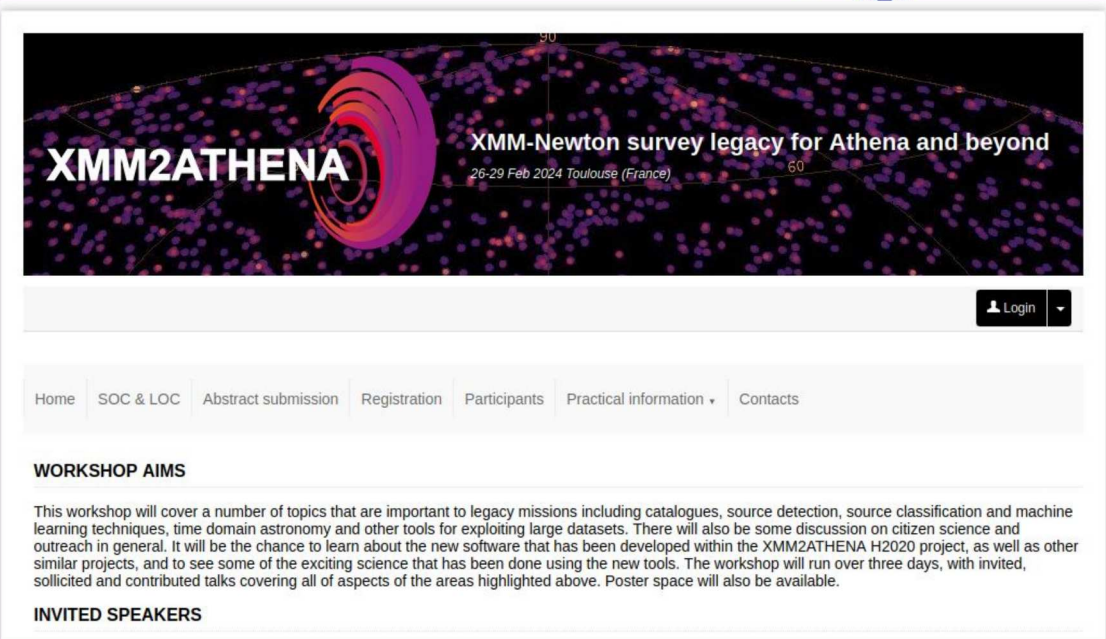


The channels: formal



workshops

Natalie's talk



WORKSHOP AIMS

This workshop will cover a number of topics that are important to legacy missions including catalogues, source detection, source classification and machine learning techniques, time domain astronomy and other tools for exploiting large datasets. There will also be some discussion on citizen science and outreach in general. It will be the chance to learn about the new software that has been developed within the XMM2ATHENA H2020 project, as well as other similar projects, and to see some of the exciting science that has been done using the new tools. The workshop will run over three days, with invited, solicited and contributed talks covering all of aspects of the areas highlighted above. Poster space will also be available.

INVITED SPEAKERS





The channels: formal

<http://xmm-ssc.irap.omp.eu/xmm2athena/>

XMM2ATHENA


EU H2020 project: April 1, 2021 to September 30, 2024



 HORIZON 2020

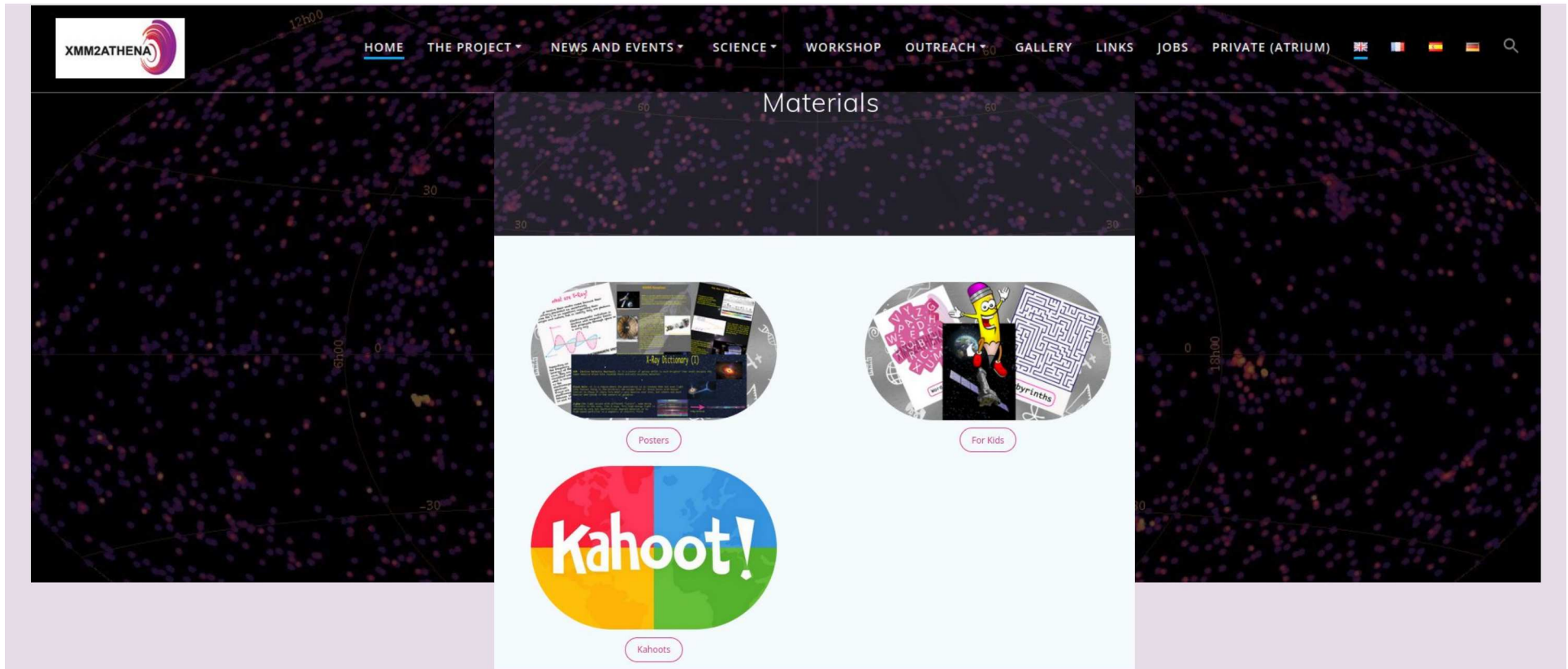
The XMM-Newton survey legacy for Athena and beyond workshop
February 26 - 29, 2024

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101004168



39

The channels: formal

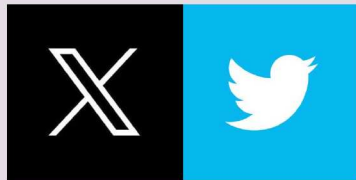


The channels: formal/classical





The channels: (in)formal



← **XMM2Athena**
372 posts




XMM2Athena
@XMM2Athena

This project receives funding from the @HorizonEU Research & Innovation Programme GA 101004168. Any related tweets reflect only the views of the project owner

xmm-ssc.irap.omp.eu/xmm2athena/ Joined June 2021

Edit profile



XMM2Athena
63 likes · 97 followers

Posts About Photos Videos

Intro
EU H2020 SPACE project to build the bridge between XMM-Newton and Athena X-ray missions.

XMM2Athena
4d · 🌐
Tomorrow is the last day to participate in our contest. If you haven't submitted your infographic yet, there's still time! On our website you have all the information... [See more](#)

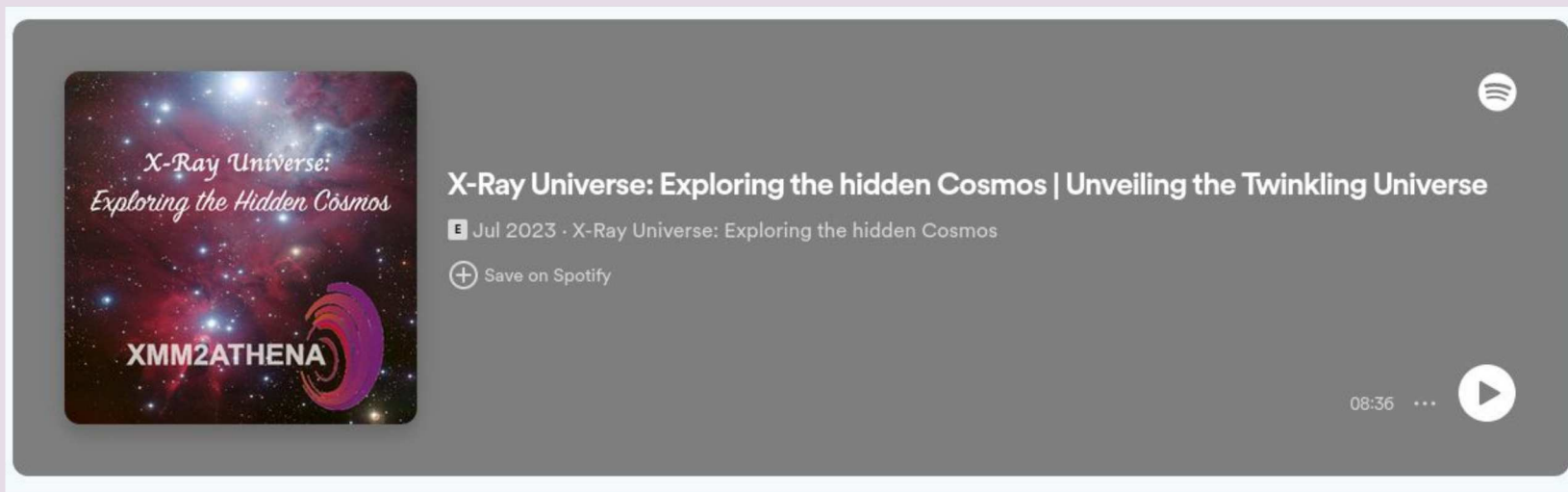
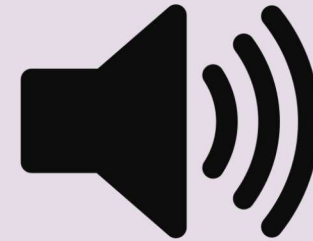


The XMM-Newton survey legacy for Athena and beyond workshop
February 26 - 29 , 2024

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101004168



The channels: (in)formal




*X-Ray Universe:
Exploring the Hidden Cosmos*

X-Ray Universe: Exploring the hidden Cosmos | Unveiling the Twinkling Universe

Jul 2023 · X-Ray Universe: Exploring the hidden Cosmos

+ Save on Spotify

08:36 ... 

The channels: (in)formal



bit.ly/XMM2ATHENA_VIDEO



lessons learnt



Formal channels for experts have to be maintained (but boosted)



Student-oriented activities always work!



Do not underestimate new channels for broad communication: SSMM, podcasts, videos...
However:

- continuity is important
- the market is saturated – difficult to engage



Difficult to find a niche for new/small/time-limited projects



Collaboration in the team is mandatory



Take away message

Broad audience means different content

Broad audience means different channels

Rely on institutions and bigger projects



Take away message

Broad audience means different content

Broad audience means different channels

Rely on institutions and bigger projects



Everybody deserves science knowledge