On X-ray telescopes in general and the Athena optics in particular
The optical design of the most common type of X-ray telescopes is reviewed in this contribution and the imaging properties of these are discussed. Then the newest mostly European large mission, Athena, is presented and some of the most important properties imaging-wise are reviewed. Finally the science program for Athena is described where the emphasis is on the cosmic web and the population of AGNs.

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Development and production of a multilayer-coated X-ray reflecting stack for the Athena mission

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Authors: Massahi, S. (Intern), Della Monica Ferreira, D. (Intern), Christensen, F. E. (Intern), Shortt, B. (Eksern), Girou, D. (Eksern), Collon, M. (Eksern), Landgraf, B. (Eksern), Barriere, N. (Eksern), Krumrey, M. (Eksern), Cibik, L. (Eksern), Schreiber, S. (Eksern)
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Simulating X-ray telescopes with McXtrace: A case study of ATHENA's optics

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Organisations: National Space Institute, Astrophysics and Atmospheric Physics, Department of Physics, Neutrons and X-rays for Materials Physics, National Institute for Astrophysics, University of Copenhagen, European Space Agency
Authors: Della Monica Ferreira, D. (Intern), Bergbäck Knudsen, E. (Intern), Westergaard, N. J. S. (Intern), Christensen, F. E. (Intern), Massahi, S. (Intern), Shortt, B. (Ekstern), Spiga, D. (Ekstern), Solstade, M. (Ekstern), Lefmann, K. (Ekstern)
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ATHENA, Ray tracing, McXtrace, Simulation, X-rays, SPO, Effective area, Mirror module

Simulation and modeling of silicon pore optics for the ATHENA X-ray telescope

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The ATHENA Optics Development

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A NuSTAR observation of the center of the coma cluster

We present the results of a 55 ks NuSTAR observation of the core of the Coma Cluster. The global spectrum can be explained by thermal gas emission, with a conservative 90% upper limit to non-thermal inverse Compton (IC) emission of $5.1 \times 10^{-14}$ erg cm$^{-2}$ s$^{-1}$ in a 12' x 12' field of view. The brightness of the thermal component in this central region does not allow more stringent upper limits on the IC component when compared with non-imaging instruments with much larger fields of view where claims of detections have been made. Future mosaic NuSTAR observations of Coma will further address this issue. The temperature map shows a relatively uniform temperature distribution with a gradient from the hot northwest side to the cooler southeast, in agreement with previous measurements. The temperature determination is robust given the flat effective area and low background in the 3-20 keV band, making NuSTAR an ideal instrument to measure high temperatures in the intracluster medium.

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Organisations: National Space Institute, Astrophysics, IT-Department, National Institute for Astrophysics, NASA Goddard Space Flight Center, SLAC National Accelerator Laboratory, University of California at Berkeley
Authors: Gastaldello, F. (Ekstern), Wik, D. R. (Ekstern), Molendi, S. (Ekstern), Westergaard, N. J. S. (Intern), Hornstrup, A. (Intern), Madejski, G. (Ekstern), Ferreira, D. D. M. (Intern), Boggs, S. E. (Ekstern), Christensen, F. E. (Intern), Craig, W. W. (Ekstern)
Investigation of Photolithography Process on SPOs for the ATHENA Mission
As part of the ongoing effort to optimize the throughput of the Athena optics we have produced mirrors with a state-of-the-art cleaning process. We report on the studies related to the importance of the photolithographic process. Pre-coating characterization of the mirrors has shown and still shows photoresist remnants on the SiO2-rb bonding zones, which influences the quality of the metallic coating and ultimately the mirror performance. The size of the photoresist remnants is on the order of 10 nm which is about half the thickness of final metallic coating. An improved photoresist process has been developed including cleaning with O2 plasma in order to remove the remaining photoresist remnants prior to coating. Surface roughness results indicate that the SiO2-rb bonding zones are as clean as before the photolithography process is performed.

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Organisations: National Space Institute, Astrophysics, ESTEC, Cosine Science and Computing B.V.
Authors: Massahi, S. (Intern), Girou, D. A. (Intern), Ferreira, D. D. M. (Intern), Christensen, F. E. (Intern), Jakobsen, A. C. (Intern), Shortt, B. (Ekstern), Collon, M. (Ekstern), Landgraf, B. (Ekstern)
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Athena, Silicon Pore Optics (SPO), AFM, SEM, Photoresist, Surface Roughness, Photolithography Process, O2 Plasma, Stacking

Bibliographical note
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NuSTAR observations of the bullet cluster: constraints on inverse compton emission
The search for diffuse non-thermal inverse Compton (IC) emission from galaxy clusters at hard X-ray energies has been undertaken with many instruments, with most detections being either of low significance or controversial. Because all prior telescopes sensitive at E > 10 keV do not focus light and have degree-scale fields of view, their backgrounds are both high and difficult to characterize. The associated uncertainties result in lower sensitivity to IC emission and a greater chance of false detection. In this work, we present 266 ks NuSTAR observations of the Bullet cluster, which is detected in the energy range 3-30 keV. NuSTAR's unprecedented hard X-ray focusing capability largely eliminates confusion between diffuse IC and point sources; however, at the highest energies, the background still dominates and must be well understood. To this end, we have developed a complete background model constructed of physically inspired components constrained by extragalactic survey field observations, the specific parameters of which are derived locally from data in non-source regions of target observations. Applying the background model to the Bullet cluster data, we find that the spectrum is well-but not perfectly-described as an isothermal plasma with kT = 14.2 ± 0.2 keV. To slightly improve the fit, a second temperature component is added, which appears to account for lower temperature emission from the cool core, pushing the primary component to kT ~ 15.3 keV. We see no convincing need to invoke an IC component to describe the spectrum of the Bullet cluster, and instead argue that it is dominated at all energies by emission from purely thermal gas. The conservatively derived 90% upper limit on the IC flux of 1.1 × 10^-12 erg s^-1 cm^-2 (50-100 keV), implying a lower limit on B ≥ 0.2 μG, is barely consistent with detected fluxes previously reported. In addition to discussing the possible origin of this discrepancy, we remark on the potential implications of this analysis for the prospects for detecting IC in galaxy clusters in the future.

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Preparing the optics technology to observe the hot universe

With the selection of “The hot and energetic Universe” as science theme for ESA’s second large class mission (L2) in the Cosmic Vision programme, work is focusing on the technology preparation for an advanced X-ray observatory. The core enabling technology for the high performance mirror is the Silicon Pore Optics (SPO) [1 to 23], a modular X-ray optics technology, which utilises processes and equipment developed for the semiconductor industry. The paper provides an overview of the programmatic background, the status of SPO technology and gives an outline of the development roadmap and activities undertaken and planned by ESA on optics, coatings [24 to 30] and test facilities [31, 33].

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Web of Science (2010): Indexed yes
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Scopus rating (2009): SJR 0.211 SNIP 0.271
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Science requirements and optimization of the silicon pore optics design for the Athena mirror
The science requirements for the Athena X-ray mirror are to provide a collecting area of 2 m² at 1 keV, an angular resolution of ~5 arc seconds half energy width (HEW) and a field of view of diameter 40-50 arc minutes. This combination of area and angular resolution over a wide field are possible because of unique features of the Silicon pore optics (SPO) technology used. Here we describe the optimization and modifications of the SPO technology required to achieve the Athena mirror specification and demonstrate how the optical design of the mirror system impacts on the scientific performance of Athena.

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BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.197 SNIP 0.264 CiteScore 0.31
Coating optimization for the ATHENA+ mission

The ATHENA mission concept, now called ATHENA+, continues to be refined to address important questions in modern astrophysics. Previous studies have established that the requirement for effective area can be achieved using a combination of bi-layer coatings and/or simple graded multilayers. We find that further coating developments can improve on the baseline specifications and present here preliminary results on the optimization of coating design based on the new specifications of the ATHENA+ mission. The performances of several material combinations are investigated with the goal of maximizing the telescope effective area within the energy envelope of the mission and simulation of mirror performance is carried out. © (2013) COPYRIGHT Society of Photo-Optical Instrumentation Engineers (SPIE). Downloading of the abstract is permitted for personal use only.

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Scopus rating (2015): SJR 0.187 SNIP 0.224 CiteScore 0.3
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.188 SNIP 0.231 CiteScore 0.3
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We present several concept designs of hard X-ray/soft γ-ray focusing telescopes for future astrophysics missions. The designs are based on depth graded multilayer coatings. These have been successfully employed on the NuSTAR mission for energies up to 80 keV. Recent advances in demonstrating theoretical reflectivities for candidate multilayer material combinations up to 400 keV including effects of incoherent scatter has given an experimental base for extending this type of designs to the soft γ-ray range. At the same time, the calibration of the in-flight performance of the NuSTAR mission has given a solid understanding and modelling of the relevant effects influencing the performance, including optical constants, roughness, scatter, non-uniformities and figure error. This allows for a realistic extension for designs going to much higher energies. Similarly, both thin slumped glass and silicon pore optics has been developed to a prototype stage which promises imaging resolution in the sub 10 arcsecond range. We present designs based on a 20 m and 50 m focal lengths with energy ranges up to 200 keV and 600 keV. © (2013) COPYRIGHT Society of Photo-Optical Instrumentation Engineers (SPIE). Downloading of the abstract is permitted for personal use only.
X-ray optics developments at ESA

Future high energy astrophysics missions will require high performance novel X-ray optics to explore the Universe beyond the limits of the currently operating Chandra and Newton observatories. Innovative optics technologies are therefore being developed and matured by the European Space Agency (ESA) in collaboration with research institutions and industry, enabling leading-edge future science missions.

Silicon Pore Optics (SPO) [1 to 21] and Slumped Glass Optics (SGO) [22 to 29] are lightweight high performance X-ray optics technologies being developed in Europe, driven by applications in observatory class high energy astrophysics missions, aiming at angular resolutions of 5" and providing effective areas of one or more square meters at a few keV.

This paper reports on the development activities led by ESA, and the status of the SPO and SGO technologies, including progress on high performance multilayer reflective coatings [30 to 35]. In addition, the progress with the X-ray test facilities and associated beam-lines is discussed [36].

© (2013) COPYRIGHT Society of Photo-Optical Instrumentation Engineers (SPIE). Downloading of the abstract is permitted for personal use only.

General information
ATHENA optimized coating design

The optimization of coating design for the ATHENA mission is described and the possibility of increasing the telescope effective area in the range between 0.1 and 10 keV is investigated. An independent computation of the on-axis effective area based on the mirror design of ATHENA is performed in order to review the current coating baseline. The performance of several material combinations, considering a simple bi-layer, simple multilayer and linear graded multilayer coatings are tested and simulation of the mirror performance considering both the optimized coating design and the coating baseline including on- and off-axis effective area curves are presented. We find that the use of linear graded multilayers can increase by 37% the integrated effective area of ATHENA in the energy range between 0.1 keV and 15 keV."© (2012) COPYRIGHT Society of Photo-Optical Instrumentation Engineers (SPIE). Downloading of the abstract is permitted for personal use only.

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Organisations: National Space Institute, Astrophysics, European Space Agency
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Scopus rating (2008): SJR 0.222 SNIP 0.289
Development and characterization of coatings on Silicon Pore Optics substrates for the ATHENA mission

We present description and results of the test campaign performed on Silicon Pore Optics (SPO) samples to be used on the ATHENA mission. We perform a pre-coating characterization of the substrates using Atomic Force Microscopy (AFM), X-ray Reflectometry (XRR) and scatter measurements. X-ray tests at DTU Space and correlation between measured roughness and pre-coating characterization are reported. For coating development, a layer of Cr was applied underneath the Ir/B4C bi-layer with the goal of reducing stress, and the use of N2 during the coating process was tested in order to reduce the surface roughness in the coatings. Both processes show promising results. Measurements of the coatings were carried out at the 8 keV X-ray facility at DTU Space and with synchrotron radiation in the laboratory of PTB at BESSY II to determine reflectivity at the grazing incidence angles and energies of ATHENA. Coating development also included a W/Si multilayer coating. We present preliminary results on X-ray Reflectometry and Cross-sectional Transmission Electron Microscopy (TEM) of the W/Si multilayer.

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Photometry and models of selected main belt asteroids: IX. Introducing interactive service for asteroid models (ISAM)

Context. The shapes and spin states of asteroids observed with photometric techniques can be reconstructed using the lightcurve inversion method. The resultant models can then be confirmed or exploited further by other techniques, such as adaptive optics, radar, thermal infrared, stellar occultations, or space probe imaging. Aims. During our ongoing work to increase the set of asteroids with known spin and shape parameters, there appeared a need for displaying the model plane-of-sky orientations for specific epochs to compare models from different techniques. It would also be instructive to be able to track how the complex lightcurves are produced by various asteroid shapes. Methods. Basing our analysis on an extensive photometric observational dataset, we obtained eight asteroid models with the convex lightcurve inversion method. To enable comparison of the photometric models with those from other observing/modelling techniques, we created an on-line service where we allow the inversion models to be oriented interactively. Results. Our sample of objects is quite representative, containing both relatively fast and slow rotators with highly and lowly inclined spin axes. With this work, we increase the sample of asteroid spin and shape models based on disk-integrated photometry to over 200. Three of the shape models obtained here are confirmed by the stellar occultation data; this also allowed independent determinations of their sizes to be made. Conclusions. The ISAM service can be widely exploited for past and future asteroid observations with various, complementary techniques and for asteroid dimension determination. © 2012 ESO.
The Large Observatory for X-ray Timing (LOFT)

High-time-resolution X-ray observations of compact objects provide direct access to strong-field gravity, to the equation of state of ultradense matter and to black hole masses and spins. A 10 m²-class instrument in combination with good spectral resolution is required to exploit the relevant diagnostics and answer two of the fundamental questions of the European Space Agency (ESA) Cosmic Vision Theme "Matter under extreme conditions", namely: does matter orbiting close to the event horizon follow the predictions of general relativity? What is the equation of state of matter in neutron stars? The Large Observatory For X-ray Timing (LOFT), selected by ESA as one of the four Cosmic Vision M3 candidate missions to undergo an assessment phase, will revolutionise the study of collapsed objects in our galaxy and of the brightest supermassive black holes in active galactic nuclei. Thanks to an innovative design and the development of large-area monolithic silicon drift detectors, the Large Area Detector (LAD) on board LOFT will achieve an effective area of ~12 m² (more than an order of magnitude larger than any spaceborne predecessor) in the 2-30 keV range (up to 50 keV in expanded mode), yet still fits a conventional platform and small/medium-class launcher. With this large area and a spectral resolution of...
A Ly α blob and z abs ≈ z em damped Ly α absorber in the dark matter halo of the binary quasar Q 0151+048

Context. Q 0151+048 is a physical quasar (QSO) pair at z ∼ 1.929 with a separation of 3.3 arcsec on the sky. In the spectrum of the brighter member of this pair, Q 0151+048A, a damped Lyα absorber (DLA) is observed at a higher redshift. We have previously detected the host galaxies of both QSOs, as well as a Lyα blob whose emission surrounding Q 0151+048A extends over 5 × 3.3 arcsec. Aims. We seek to constrain the geometry of the system and understand the possible relations between the DLA, the Lyα blob, and the two QSOs. We also aim at characterizing the former two objects in more detail. Methods. To study the nature of the Lyα blob, we performed low-resolution, long-slit spectroscopy with the slit aligned with the extended emission. We also observed the whole system using the medium-resolution VLT/X-shooter spectrograph and the slit aligned with the two QSOs. The systemic redshift of both QSOs was determined from rest-frame optical emission lines redshifted into the NIR. We employed line-profile fitting technique, to measure metallicities and the velocity width of low-ionization metal absorption lines associated to the DLA and photo-ionization modeling to characterize the DLA further. Results. We measure systemic redshifts of zem(A) = 1.92924 ± 0.00036 and zem(B) = 1.92863 ± 0.00042 from the H β and H α emission lines, respectively. In other words, the two QSOs have identical redshifts within 2σ. From the width of Balmer emission lines and the strength of the rest-frame optical continuum, we estimate the masses of the black holes of the two QSOs to be 109.33 M⊙ and 108.38 M⊙ for Q 0151+048A and Q 0151+048B, respectively. We then use the correlation between black hole mass and dark matter halo mass to infer the mass of the dark matter halos hosting the two QSOs: 1013.74 M⊙ and 1013.13 M ⊙ for Q 0151+048A and Q 0151+048B, respectively. We observe a velocity gradient along the major axis of the Lyα blob consistent with the rotation curve of a large disk galaxy, but it may also be caused by gas inflow or outflow. We detect residual continuum in the DLA trough, which we interpret as emission from the host galaxy of Q 0151+048A. The derived H0 column density of the DLA is log NH0 = 20.34 ± 0.02 cm⁻². Metal column densities are also determined for a number of low-ionization species resulting in an overall metallicity of 0.01 Z ⊙. We detect C ii, which allows us to make a physical model of the DLA cloud. Conclusions. From the systemic redshifts of the QSOs, we conclude that the Lyα blob is associated with Q 0151+048A rather than with the DLA. The DLA must be located in front of both the Lyα blob and Q 0151+048A at a distance greater than 30 kpc and has a velocity relative to the blob of 640 ± 70 km s⁻¹. The two quasars accrete at normal Eddington ratios. The DM halo of this double quasar will grow to the mass of our local supercluster at z = 0. We point out that those objects therefore form an ideal laboratory to study the physical interactions in a z = 2 precursor of our local supercluster. © 2011 ESO.
Gas Mass Fractions from XMM-Newton

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Gas Mass Fractions from XMM-Newton

General information
State: Published
Organisations: National Space Institute, Astrophysics, Management
Authors: Ferreira, D. D. M. (Intern), Pedersen, K. (Intern)
Number of pages: 105
Publication date: 2011

Publication information
Publisher: Niels Bohr Institute
Original language: English
Main Research Area: Technical/natural sciences
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Ferreira_PhDThesis.pdf
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Publication: Research › Ph.D. thesis – Annual report year: 2011

Preliminary coating design and coating developments for ATHENA
We present initial novel coating design for ATHENA. We make use of both simple bilayer coatings of Ir and B4C and more complex constant period multilayer coatings to enhance the effective area and cover the energy range from 0.1 to 10 keV. We also present the coating technology used for these designs and present test results from coatings.

General information
State: Published
Organisations: Astrophysics, National Space Institute, European Space Research and Technology Center, Cosine Science and Computing B.V.
Authors: Jakobsen, A. C. (Intern), Ferreira, D. D. M. (Intern), Christensen, F. E. (Intern), Shortt, B. (Ekstern), Collon, M. (Ekstern), Ackermann, M. D. (Ekstern)
Pages: 81470T-8
Publication date: 2011
Main Research Area: Technical/natural sciences
Resolving the discrepancy between lensing and X-ray mass estimates of the complex galaxy cluster Abell 1689

There is a long-standing discrepancy between galaxy cluster masses determined from X-ray and gravitational lensing observations of which Abell 1689 is a well studied example. In this work, we take advantage of 180 ks of Chandra X-ray observations and a new weak gravitational study based on a Hubble Space Telescope mosaic covering the central 1.8 Mpc × 1.4 Mpc to eliminate the mass discrepancy. In contrast to earlier X-ray analyses where the very circular surface brightness has been inferred as Abell 1689 being spherically symmetric and in hydrostatic equilibrium, a hardness ratio map analysis reveals a regular and symmetric appearing main clump with a cool core plus some substructure in the northeastern part of the cluster. The gravitational lensing mass model supports the interpretation of Abell 1689 being composed of a main clump, which is possibly a virialized cluster, plus some substructure. In order to avoid complications and misinterpretations due to X-ray emission from the substructure, we exclude it from the mass reconstruction. Comparing X-ray and lensing mass profiles of the regular main part only, shows no significant discrepancy between the two methods and the obtained mass profiles are consistent over the full range where the mass can be reconstructed from
X-rays (out to ≈ 1Mpc). The obtained cluster mass within ≈ 875 kpc derived from X-rays alone is \((6.4 \pm 2.1) \times 10^{14} \text{ M}_\odot\) compared to a weak lensing mass of \((8.6 \pm 3.0) \times 10^{14} \text{ M}_\odot\) within the same radius.
Spatially resolved properties of the GRB 060505 host: implications for the nature of the progenitor

GRB 060505 was the first well-observed nearby possible long-duration gamma-ray burst (GRB) that had no associated supernova. Here we present spatially resolved spectra of the host galaxy of GRB 060505, an Sbc spiral, at redshift $z = 0.0889$. The GRB occurred inside a star-forming region in the northern spiral arm at 6.5 kpc from the center. From the position of the emission lines, we determine a maximum rotational velocity for the galaxy of $v \sim 212 \text{ km s}^{-1}$, corresponding to a mass of $1.14 \times 10^{11} \text{ M}_\odot$ within 11 kpc from the center. By fitting single-age spectral synthesis models to the stellar continuum, we derive a very young age for the GRB site, confirmed by photometric and Ha line measurements, of around $\sim 6 \text{ Myr}$, which corresponds to the lifetime of a 32 M$_\odot$ star. The metallicity derived from several emission-line measurements varies throughout the galaxy and is lowest at the GRB site. Using the two degree field galaxy redshift survey we can locate the host galaxy in its large-scale ($\sim \text{Mpc}$) environment. The galaxy lies in the foreground of a filamentary overdensity, extending southwest from the galaxy cluster Abell 3837 at $z = 0.0896$. The properties of the GRB site are similar to those found for other long-duration GRB host galaxies with high specific star formation rate and low metallicity, which is an indication that GRB 060505 originated from a young, massive star that died without making a supernova.

General information
State: Published
Organisations: Stockholm Observatory, University of Amsterdam, Instituto de Astrofísica de Andalucía, Thüringer Landessternwarte Tautenburg, Space Telescope Science Institute, University of Warwick, University of Copenhagen, Niels Bohr Institute
Pages: 1151-1161
Publication date: 2008
Main Research Area: Technical/natural sciences
Supernova 2008ez in NGC 5222

General information
State: Published
Organisations: Aarhus University, Instituto Superior Técnico, University of Copenhagen
Authors: Fynbo, J. (Ekstern), Ferreira, D. D. M. (Intern), Michalowski, M. (Ekstern), Zafar, T. (Ekstern), Thomsen, B. (Ekstern), Sollerman, J. (Ekstern), Stanishev, V. (Ekstern)
Publication date: 2008
Main Research Area: Technical/natural sciences

Publication information
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Volume: 1477
Original language: English
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http://adsabs.harvard.edu/abs/2008CBET.1477....1F
Source: orbit
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Publication: Research › Journal article – Annual report year: 2008

Supernova 2008fb in UGC 2813

General information
State: Published
Organisations: Oulo University, University of Copenhagen
Authors: Kajava, J. (Ekstern), Fynbo, J. (Ekstern), Ferreira, D. D. M. (Intern), Michalowski, M. (Ekstern), Zafar, T. (Ekstern), Sollerman, J. (Ekstern)
Publication date: 2008
Main Research Area: Technical/natural sciences

Publication information
Journal: Central Bureau Electronic Telegrams
Volume: 1479
Original language: English
Links:
http://adsabs.harvard.edu/abs/2008CBET.1479....2K
Source: orbit
Source-ID: 314992
Publication: Research › Journal article – Annual report year: 2008
Mellem stjerner og planeter

General information
State: Published
Organisations: Niels Bohr Institute, Technical University of Denmark
Authors: Juul Hansen, C. (Ekstern), Ferreira, D. D. M. (Intern), Laursen, P. (Ekstern), Riemer-Sørensen, S. (Ekstern)
Number of pages: 12
Publication date: 2006

Publication information
Publisher: Nationalmuseet
Original language: Danish
Main Research Area: Technical/natural sciences
Source: dtu
Source-ID: u::7535
Publication: Education › Book – Annual report year: 2006

Projects:

The role of coating composition on the development of the optics for the Athena X-ray Observatory

National Space Institute
Period: 15/06/2017 → 14/06/2020
Number of participants: 3
Phd Student:
Svendsen, Sara (Intern)
Supervisor:
Christensen, Finn Erland (Intern)
Main Supervisor:
Della Monica Ferreira, Desiree (Intern)

Financing sources
Source: Internal funding (public)
**The Wide Field Imager for the Athena X-ray Observatory**

The WFI is one of the two scientific instruments proposed for Athena, the mission selected to address the “Hot and Energetic Universe” science theme identified by ESA (Athena@ESA) for its L2 large satellite mission with launch in 2028. The WFI will provide imaging in the 0.2-15 keV energy band over a wide field, simultaneously with spectrally and time-resolved photon counting. The instrument is designed to make optimal use of the grasp (product of collecting area and solid angle) provided by the optical design of the ATHENA mirror system, by combining a sensitive approx. 40’x40’ field of view DEPFET detector with a pixel size properly sampling the angular resolution of 5’ on-axis (half energy width).

National Space Institute
Astrophysics and Atmospheric Physics

MPE
Dr. Karl Remeis-Observatory and Erlangen Centre for Astroparticle Physics

IAA-Tuebingen
University of Vienna
CEA Saclay
INAF Istituto di Astrofisica Spaziale e Fisica Cosmica, Bologna
National Institute for Astrophysics
University of Leicester
The Open University
Pennsylvania State University
SLAC National Accelerator Laboratory
Massachusetts Institute of Technology
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Space Research Center
Period: 28/03/2014 → …
Number of participants: 6
Acronym: WFI
Contact person:
Kuvvetli, Irfan (Intern)
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Brandt, Søren (Intern)
Tcherniak, Denis (Intern)
Della Monica Ferreira, Desiree (Intern)
Project Manager, organisational:
Pedersen, Søren Møller (Intern)
Approving authority:
Hornstrup, Allan (Intern)

**Relations**
Activities:
6th WFI Proto-­Consortium Meeting
WFI Proto-­Consortium Meeting
5th Athena/WFI Proto-­Consortium Meeting
Publications:
WFI electronics and on-board data processing