# T 102: Axions/ALPs III

Time: Friday 9:00–10:30 Location: KH 02.019

T 102.1 Fri 9:00 KH 02.019

**X-ray Telescopes for Axion Searches** — •Francisco Rodríguez Candón — Fakultät für Physik, TU Dortmund, Otto-Hahn-Str. 4, 44221 Dortmund, Germany

X-ray telescopes have become powerful tools in the search for weakly interacting slim particles (WISPs), in particular QCD axions and axion-like particles (ALPs). Through the Primakoff effect, astrophysical magnetic fields can induce axion-photon conversion, giving X-ray observatories unique sensitivity over a broad axion-mass range. This talk reviews recent progress in ALPs searches with NASA's NuSTAR, the first and currently only focusing hard X-ray space telescope. First, observations of the starburst galaxy M82 yield stringent constraints on heavy decaying ALPs in the 30-500 keV range, probing axion-photon couplings in previously unexplored regions of parameter space. Second, NuSTAR observations of the red supergiant Betelgeuse set new and competitive limits on axion-nucleon couplings for masses below the neV, exploiting axion production via nuclear transitions in stellar interiors. Together, these results improve upon earlier astrophysical bounds and motivate future X-ray space missions such as Athena and AXIS, which are expected to extend sensitivity to even fainter axion signatures.

T 102.2 Fri 9:15 KH 02.019

**Axion searches with LOFAR** — •Merle Gizinski and Dominik J. Schwarz — Fakultät für Physik, Universität Bielefeld, 33613 Bielefeld

The axion is a promising candidate for cold dark matter, originating as a solution to the strong CP problem. The search for axions in neutron star magnetospheres provides a promising opportunity for detection and is complementary to existing laboratory experiments. The plasma surrounding of a neutron star and its strong magnetic field provide the environment for an axion to convert into a photon. This conversion results in a characteristic, sharp radio line, which may be detectable in the spectrum of the neutron star. The observed frequency of the line is directly linked to the axion mass. Since frequencies below 250 MHz are very hard to access in lab experiments and thus have not been tested, LOFAR ($10 - 240$ MHz) provides an unique opportunity to constrain the axion to photon coupling in the axion mass range $0.04 - 0.99\,\mu$eV.

T 102.3 Fri 9:30 KH 02.019

**Tuning structure of a dielectric haloscope for axion dark matter detection, MADMAX** — •Dominik Bergermann for the MADMAX-Collaboration — III. Physikalisches Institut A, RWTH Aachen University

Axions are promising candidates for cold dark matter and the absence of CP violation in strong interaction. The **MA**gnetized **D**isc and **M**irror **A**xion e**X**periment is a future dielectric haloscope experiment targeting axion dark matter in a mass range of 40 to 400 $\mu$eV. It consists of multiple, consecutive and movable dielectric discs to amplify the weak microwave signal of axion photon conversion in a strong magnetic field.

Covering this range with a single experimental setup, while simultaneously being able to finetune the resonance on potential signals, necessitates repositioning the experimental hardware continuously and automatically. The disc positions as parameter-space can be tuned to produce desired signal shapes, with reliably achieving sub $10\,\mu$m accuracy as the prime challenge. All respective hardware is required to be compatible with the high magnetic field strengths, vacuum and cryogenic temperatures.

This talk presents the piezo-motor driven MADMAX disc assembly and its control system, with the first results on disc positioning accuracy.

T 102.4 Fri 9:45 KH 02.019

**MADMAX Open Booster 300 Receiver Chain and Power Calibration** — •Alan Aliyali for the MADMAX-Collaboration — Institut für Experimentalphysik, Universität Hamburg, Deutschland

Originally proposed to solve the strong CP problem of QCD, the axion is also a prominent candidate for cold dark matter. Using the axion-to-photon conversion inside a magnetic field, the MAgnetized Disk and Mirror Axion eXperiment aims to probe the axion mass range of 40 to 400 $\mu$eV, corresponding to microwaves in the 10 to 100 GHz range. MADMAX makes use of a so-called booster, a series of dielectric disks placed in front of a metallic mirror, to resonantly enhance the expected axion signal over a frequency range adjustable via the spacing of the disks.

The Open Booster 300 is a booster configuration consisting of an aluminum mirror and three sapphire discs, all with a 300 mm diameter. In this configuration, the axion induced current excites gaussian modes that gets measured by a corrugated horn antenna. The resulting signal is amplified and filtered by a low-noise receiver chain, down-converted using heterodyne detection, and digitized by an ADC performing real-time FFTs from which power spectra are recorded.

Accurate measurements of the signal requires precise characterization of the entire receiver chain. In this presentation we show how the receiver chain is calibrated using the Y-factor method to determine the frequency dependent gain and noise temperature.

T 102.5 Fri 10:00 KH 02.019

**3D simulations of a dielectric haloscope for axion dark matter detection, MADMAX** — •Sebastian Baltschun for the MADMAX-Collaboration — III. Physikalisches Institut A, RWTH Aachen University

Axions are promising candidates for cold dark matter and the absence of CP violation in strong interaction. The MAgnetized Disc and Mirror Axion eXperiment is a planned dielectric haloscope experiment targeting axion dark matter in a mass range of 40 to 400 micro eV. It consists of multiple, consecutive and movable dielectric discs to amplify the weak microwave signal of axion photon conversion in a strong magnetic field.

This talk discusses the 3D simulation used to calculate the amplification factor of a certain disk configuration and differences between a narrowband scan and a broadband scan, two different strategies towards positioning disks.

T 102.6 Fri 10:15 KH 02.019

**Development of a radiopure GridPix detector for BabyIAXO** — •Johanna von Oy, Klaus Desch, Jochen Kaminski, and Tobias Schiffer — Physikalisches Institut der Universität Bonn

BabyIAXO is the intermediate stage experiment of the International AXion Observatory (IAXO), a next generation helioscope for the search for axions. BabyIAXO is planned to be built at DESY in Hamburg, and its components are currently under construction. Helioscopes consist of a magnet, where solar axions can convert into X-ray photons, optics to focus the X-rays and detectors to detect them.

Due to the existing stringent limits on the axion-photon coupling, the probability of an axion-induced X-ray reaching the detector is low. Therefore, all detectors built for IAXO and BabyIAXO have to have a low intrinsic background and be combined with active and passive shielding.

A detector technology that is suitable to detect X-rays in the energy range of different solar axion models is a GridPix detector. It is a gas-filled detector with an aluminium grid on top of a pixelated readout chip, which can detect individual electrons produced by particles in the gas. This detector can be constructed in a relatively radiopure form as most of its components can be made out of very pure copper, Teflon and Kapton.

The detector is currently in the assembly and commissioning phase, with the radiopure components having been produced last year. This talk will focus on the developments and steps necessary to reach the background levels required for BabyIAXO.