T 26: Axions/ALPs I

Time: Tuesday 16:15–17:45 Location: VG 0.110

T 26.1 Tue 16:15 VG 0.110

Towards a low background SDD for IAXO — Joanna Bilicki[1], Patrick Bongratz[1,2], Frank Edzards[1], Susanne Mertens[1,2], •Lucinda Schönfeld[1,2], Juan Pablo Ulloa Beteta[1], Christoph Wiesinger[1,2], and Michael Willers[1,2] for the IAXO-Collaboration — [1]Technische Universität München, Garching, DE — [2]Max Planck Institut für Kernphysik, Heidelberg, DE

Axions are hypothetical particles that solve the strong CP problem and are candidates for dark matter. The International Axion Observatory (IAXO) is aiming to find these elusive particles by converting solar axions to X-rays. Detecting this rare signal requires highly efficient ultra-low background X-ray detectors, for which Silicon Drift Detectors (SDDs) are well suited. I will present the current status of the TRISTAN SDD for IAXO (TAXO) project, which is developing such an SDD. A particular focus will be the latest results of background measurements above ground at TUM and deep underground at the Canfranc underground laboratory.

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T 26.2 Tue 16:30 VG 0.110

X-ray focus on axions: optics for the International AXion Observatory (IAXO) — •Julia K. Vogel for the IAXO-Collaboration — Fakultät für Physik, TU Dortmund, Otto-Hahn-Str. 4, Dortmund D-44221, Germany

Axions are one of the leading candidates for the hypothetical, non-baryonic dark matter expected to account for about 27% of the energy density of the Universe. Axion helioscopes are experiments searching for axions and axion-like particles (ALPs) produced in the core of the Sun via the Primakoff effect by utilizing strong magnetic fields, x-ray optics and ultralow-background detectors. The International Axion Observatory (IAXO) is a next generation axion helioscope aiming at a sensitivity to the axion-photon coupling of $1-1.5$ orders of magnitude beyond the current most sensitive axion helioscope, the CERN Axion Solar Telescope (CAST). BabyIAXO (BIAXO) is an intermediate scale helioscope with sensitivities to axion-photon couplings down to a few 10^{-11} GeV^{-1} reducing risks for IAXO while delivering first significant physics results. The optics for (B)IAXO are a key part of the experiment and consist of multilayer-coated Wolter-I approximations. Two pathfinder optics have been successfully tested at CAST and at the Panter x-ray test facility of MPE. Here we briefly introduce (B)IAXO and detail the optics and coating design along with the pathfinder performances.

T 26.3 Tue 16:45 VG 0.110

Development of a GridPix Detector for the International AXion Observatory — •Johanna von Oy, Klaus Desch, Jochen Kaminski, Tobias Schiffer, Sebastian Schmidt, and Markus Gruber for the IAXO-Collaboration — Physikalisches Institut der Universität Bonn

Axion searches with helioscope experiments like the International AXion Observatory (IAXO) focus mainly on the solar axion production. With its dense and high temperature environment, the sun's core can produce a high flux of axions through the Primakoff effect and ABC processes. To detect these solar axions, IAXO and also its intermediate stage BabyIAXO, will consist of a magnet that follows the sun for twelve hours a day. In the magnetic field the axions couple to X-rays which can then be focused onto dedicated detectors.

One of these detectors will be built in Bonn. Thanks to the solar axions' small coupling strengths and energies of about ∼1 keV the two main requirements for a detector are an ultra low background and the ability to detect low energy X-rays.

A GridPix based gas-filled detector made out of very radiopure materials is therefore a good fit for a helioscope experiment. The ultra-thin vacuum-tight window will allow for low energy X-rays to enter the gas volume and produce electrons. The aluminium grid on top of a pixelated readout chip, the Timepix3, makes the detection of single electrons and therefore low energy X-rays possible.

This talk will focus on the development and challenges of a GridPix based detector for axion searches with IAXO and BabyIAXO.

T 26.4 Tue 17:00 VG 0.110

Optimization 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 dielectric haloscope experiment targeting axion dark matter in a mass range of 40 to 400 μeV. 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 hardware continuously and automatically. The disc positions as parameter-space can be optimized to produce desired signal shapes. Multiple different optimization algorithms have been tested.

This talk discusses the strategies for optimizing a physical MADMAX-like setup in-place based on it's electrical microwave responses. Challenges are the sparse set of information, the time requirement of repositioning and the reliability of the algorithms.

T 26.5 Tue 17:15 VG 0.110

Probing electric fields insida a test setup for the dielectric axion haloscope MADMAX — •Max Zimmermann 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 dielectric haloscope experiment targeting axion dark matter in a mass range of 40 to 400 μeV. It consists of multiple, consecutive and movable dielectric discs to amplify the weak microwave signal of axion photon conversion in a strong magnetic field.

Without measuring an axion signal, the problem of calibrating the amplification of the microwave signal occurs. The Bead-pull method and the Gradient method will be presented and their results will be compared. The two methods can both be used to calibrate the setup.

The methods rely on the perturbation of the electric field and the measurement of the reflection. The Bead-pull method uses a bead to perturb the fields in the booster, allowing to probe them in three dimensions from the systems reflectivity. But this will not be possible in the final design of the MADMAX experiment. Instead, with the Gradient method the dielectric disks are moved to perturb the field. This yields less information of the electric field, but may be realized in the final setup.

T 26.6 Tue 17:30 VG 0.110

Development of a Cosmic Muon and Neutron Veto System for BabyIAXO — •Dhruv Chouhan[1], Elisa Ruiz Choliz[2], and Matthias Schott[1] for the IAXO-Collaboration — [1]Rhenish Friedrich Wilhelm University of Bonn, Germany — [2]Johannes Gutenberg University of Mainz, Germany

The International Axion Observatory (IAXO) experiment is a cutting-edge helioscope designed to search for axions and axion-like particles (ALPs) produced in the Sun. As a preliminary step, the BabyIAXO project has been proposed as a smaller-scale version of the helioscope, with the capability to achieve a sensitivity to the axion-photon coupling of $1.5 \cdot 10^{-11}\,\mathrm{GeV}^{-1}$ for axion masses up to $0.25\,\mathrm{eV}$. This region of parameter space is particularly intriguing for axion physics.

A key challenge of the experiment lies in the design of a cosmic muon and neutron veto system, which will ensure an ultra-low-background environment for the x-ray detection system. This talk highlights the simulation and hardware advancements in developing the BabyIAXO cosmic-ray veto system, which leverages light-guided organic plastic scintillators coupled with Silicon Photomultiplier (SiPM) sensors.

To further optimize the veto system, Geant4 simulation studies have been conducted to replicate the performance of scintillators integrated with embedded wavelength-shifting fibers, accurately modeling energy deposition by various interacting particles.