T 57: Axionen II

Zeit: Mittwoch 16:00–17:50 Raum: S09

Gruppenbericht T 57.1 Mi 16:00 S09
The ALPS II experiment — •Jan H. Põld[1] and Aaron D. Spector[2] for the ALPS-Collaboration — [1]AEI Hannover — [2]DESY Hamburg

ALPS II is a light-shining-through-a-wall experiment searching for undiscovered sub-eV elementary particles motivated by astrophysics and cosmology. These particles are not accessible with accelerator based experiments. ALPS II is located at DESY in Hamburg. In its final version it will use 20 superconducting HERA dipole magnets, ultra-stable lasers and two long-baseline cavities that are housed in a 200m long vacuum system. The installation and commissioning of the experiment will start next year and first data are expected in 2020. This talk will discuss the physics case for ALPS II and the sensitivity of the experiment. An explanation of the light-shining-through-a-wall approach will be provided as well as an overview of the ALPS II experiment.

T 57.2 Mi 16:20 S09
Control and Alignment of the Optical Systems in the ALPS II Experiment — •Todd Kozlowski and Aaron Spector for the ALPS-Collaboration — DESY, Hamburg, Germany

The Any Light Particle Search (ALPS) IIc is a light-shining-through-a-wall experiment that aims to detect laboratory-generated axions and axion-like-particles (ALPs) via axion-photon coupling. In order to improve detection sensitivity, the experiment requires two optical cavities to maintain simultaneous resonance with the generated axion field. One of the resonators, the production cavity (PC), increases the laser field amplitude on one side of a light-tight barrier by a factor of 70 (5000 in power) which improves the amplitude of the generated axion field. The second resonator, the regeneration cavity (RC), on the other side of the light-tight barrier builds up the regenerated laser field by a factor of 200 (40000 in power) which can then either be detected as the modulation of a reference field or counted by a photon counter. I will discuss the envisioned length and alignment sensing and control scheme of ALPS.

T 57.3 Mi 16:35 S09
Heterodyne detection in the ALPS II experiment — •Giuseppe Messineo for the ALPS-Collaboration — University of Florida, Gainesville FL (USA)

The Any Light Particle Search (ALPS) II is an experiment designed to search for weakly interacting sub-eV particles that couple to photons in the presence of a magnetic field. In order to detect the extremely weak photon fields associated with the existence of such hypothetical particles, the detector employed needs to be sensitive to power levels equivalent to a few photons per week. The ALPS group at the University of Florida has developed a detection method based on heterodyne interferometry that takes advantage of the coherent nature of the expected signal field. This technique relies on the ability to precisely track the signal phase, with a precision better than 0.1 cycles, over measurement times of several weeks. We use optical techniques similar to those found in modern day gravitational wave experiments to appropriately track and record phase information to achieve the required precision. I will report on the design and tests of the heterodyne optical setup and its associated shot-noise-limited detector.

T 57.4 Mi 16:50 S09
MADMAX - Towards a Dielectric Axion Haloscope — •Christoph Krieger for the MADMAX-Collaboration — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

The axion, a low-mass particle arising from an elegant solution to the strong CP problem, is a viable and natural candidate for (cold) dark matter. Its major coupling to ordinary matter is realized as a coupling to two photons allowing for axion photon conversion inside strong electromagnetic fields. Due to a linear relation between the axion mass and its coupling, for low axion masses, detection becomes non-trivial.

Especially, the range of 40 to 400 μeV, favored in one of the well motivated scenarios, cannot be accessed with the standard haloscope approach. Therefore, for the **MA**gentized **D**isc and **M**irror **A**xion e**X**periment the dielectric haloscope approach will be used, utilizing the axion photon conversion at dielectric surfaces in a strong magnetic field. By combining many surfaces, the conversion can be boosted significantly using constructive interference and resonances.

For MADMAX a booster consisting of 80 dielectric discs with 1 m^2 size inside a magnetic field in the order of 10 T are envisioned. The relative positions of these discs has to be adjustable in the range of a few to tens of millimeter with micrometer precision.

In this presentation, developments and first results towards a (technical) prototype, including production of tiled large area discs and characterization measurements, will be shown along prospects for the final experiment to be build at DESY in Hamburg.

T 57.5 Mi 17:05 S09
Simulation of axion-electrodynamics for the MADMAX experiment — •Jan Schütte-Engel for the MADMAX-Collaboration — University of Hamburg, Hamburg, Germany

Axions are hypothetical particles introduced to solve the strong CP problem of the Standard Model. In addition axions can resolve the dark matter mystery. Axions with masses in the range of a few μeV up to a few hundreds of μeV are furthermore motivated by the scenario in which the Peccei-Quinn symmetry is broken after inflation. These motivate the search for axions in direct detection experiments on Earth, and the development of new techniques to become sensitive to this specific axion mass region. The presence of axions modifies the Maxwell equations, which many direct axion search experiments on Earth exploit. In this talk we will discuss the simulation of axion-electrodynamics. The developed formalism is applied to the MADMAX direct detection axion experiment, where diffraction and near field effects can be important loss mechanism.

T 57.6 Mi 17:20 S09
Development of GridPix detectors for IAXO at CAST — •Sebastian Schmidt, Klaus Desch, Jochen Kaminski, Tobias Schiffer, and Hendrik Schmick for the CAST-Collaboration — Physikalisches Institut, Universität Bonn

The International AXion Observatory (IAXO) is a next generation axion helioscope aiming for an order of magnitude improvement on the axion photon coupling $g_{a\gamma}$ over the current best results by the CERN Axion Solar Telescope (CAST). Such helioscopes utilize the inverse Primakoff effect to reconvert solar axions (and potential other ALPs) into X-rays in their respective magnetic fields.

A gaseous detector based on 7 GridPixes, a combination of a 256×256 pixel Timepix ASIC and an integrated MicroMegas stage on top, together with veto scintillators and an FADC, are deployed at CAST to develop an ultra low background detector for IAXO.

The talk focuses on an overview of the data analysis framework for this detector, written in Nim. The likelihood based analysis for the GridPix data will be discussed and preliminary results of the achieved background rate with the 2017/18 data will be presented.

T 57.7 Mi 17:35 S09
Low Temperature MMC Detector Arrays for the IAXO — •Daniel Unger, Christian Enss, Andreas Fleischmann, Lisa Gamer, Loredana Gastaldo, Daniel Hengstler, Sebastian Kempf, and Dennis Schulz for the iaxo collaboration — Kirchhoff Institute for Physics, Heidelberg University

The International Axion Observatory (IAXO) is searching for axions or axion-like particles generated in the Sun. A large magnetic field is used to convert solar axions to photons via the Primakoff effect. The major part of the expected spectrum considering only axion-photon coupling covers an energy range up to 10 keV with its maximum at about 3 keV. X-ray detectors with high efficiency in this energy range and low intrinsic background are required. Low temperature metallic magnetic calorimeters (MMCs) fulfil these requirements and can reach very low thresholds below 100 eV.

We present the design of a new detector system for the IAXO experiment with the possibility to operate two different kinds of two-dimensional MMC arrays. The setup is designed to host a large MMC array with moderate energy resolution aiming to discover events related to axions. If axions were discovered the focus would move to study the spectral shape. In this case a smaller MMC array featuring a higher energy resolution would replace the initial array using the same setup.

We show the current status of the platform and discuss methods to recognize background events based on pulse shape analysis and event coincidence in several pixels.