T 89: Axions/ALPs III

Time: Friday 9:00–10:30 Location: VG 0.110

T 89.1 Fri 9:00 VG 0.110

Advancing Axion Detection: Cryogenic Calibration and Dark Matter Search with MADMAX — •Juan Maldonado for the MADMAX-Collaboration — maldonad@mpp.mpg.de

Discovery of the axion could solve both the strong CP problem, fundamental in particle physics, and the dark matter problem. The MAgnetized Disc and Mirror Axion eXperiment - MADMAX - is a project based on the novel dielectric haloscope concept to detect axion dark matter in the mass range around 100 ueV through enhancement of the inverse Primakoff process. The higher precision required to operate an axion haloscope at a mass range above 40*eV corresponding to a frequencies greater than 10 GHz poses additional challenges in the realm of microwave engineering and cryogenics, with potential applications to other fields of research. In this talk, I will present the cryogenic calibration of the experimental setup and discuss a first dark matter search using a MADMAX prototype at a temperature below 10 K, performed at CERN in 2024.

T 89.2 Fri 9:15 VG 0.110

Commissioning The RADES axion haloscope of MPP — Babette Döbrich, Cristian Cogollos, José María García Barceló, and •Ziheng Yang — Max-Planck-Institut für Physik, Munich

The Axion is a pseudoscalar particle to solve the problem of the non-observation of CP violation in strong interactions, in a simple and compelling fashion. In this framework axions will have a very small mass and interact with other particles very weakly which makes they are an idea candidate for dark matter. The inverse Primakoff effect is commonly employed as detection method. Axions will transform into photons under strong magnetic fields. We report on the status of the RADES experiment at MPP Munich. In this experiment, we place the cavity at a temperature of 7mK and a magnetic field of 12T. In this talk we will also elaborate on the injection of realistic synthetic axion signals to test that the setup is performing as foreseen.

T 89.3 Fri 9:30 VG 0.110

Study of Higgs decays into long lived Axion-Like Particles with the ATLAS Experiment — •Janek Both, Christian Schmitt, Kristof Schmieden, and Volker Büscher — Johannes Gutenberg-Universität Mainz

Axion-Like Particles (ALP) or more generally, pseudoscalars that are gauge singlets under the Standard Model gauge group, appear in many well-motivated extensions of the Standard Model. These particles are naturally assumed to be light compared to the electroweak scale and might for example provide insides into the nature of dark matter. In scenarios where the ALP couples to the Higgs boson, collider searches can provide sensitivity to ALPs in the GeV range and thus offer a complementary approach to other experiments that mainly focus on lighter ALPs. Depending on the coupling strengths of the ALP, it might decay displaced from the primary vertex inside the calorimeters of the ATLAS detector. Such a signature would be almost background free and hence can be reconstructed with high efficiency. In this talk, a study of long-lived ALP decays inside the ATLAS calorimeter is presented and projected exclusion limits in the ALP mass and photon-coupling plane for an integrated luminosity of 1000 fb^{-1} are shown. The future dataset will greatly improve upon the existing ATLAS run-2 and run-3 analyses, which focus on displaced ALP decays within the tracking system.

T 89.4 Fri 9:45 VG 0.110

Solar axion couplings from the Nuclear Spectroscopic Telescope Array — •Jaime Ruz and Julia Vogel — Fakultät für Physik. Technische Universität Dortmund. Dortmund, D-44221, Germany

Data from the Nuclear Spectroscopic Telescope Array (NuSTAR) collected during the 2020 solar minimum, along with advanced solar atmospheric magnetic field models, establish a new limit on the axion-photon coupling strength $g_{a\gamma} \lesssim 6.9 \times 10^{-12}$ GeV^{-1} at 95% C.L. for axion masses $m_a \lesssim 2 \times 10^{-7}$ eV. This constraint surpasses current ground-based experimental limits, studying previously unexplored regions of the axion-photon coupling parameter space up to masses of $m_a \lesssim 5 \times 10^{-4}$ eV. These findings mark a significant advancement in our ability to probe axion properties and strengthen indirect searches for dark matter candidates.

T 89.5 Fri 10:00 VG 0.110

First search for axion dark matter using a MADMAX prototype — •David Leppla-Weber for the MADMAX-Collaboration — Deutsches Elektronen-Synchrotron DESY, Germany

The nature of dark matter is one of the biggest open questions in physics today. One possible answer is the axion, which was originally predicted as a solution to the strong CP problem but also makes for an excellent cold dark matter candidate. The MAgnetized Disk and Mirror Axion eXperiment (MADMAX) aims at detecting axions from the galactic dark matter halo in the theoretically well motivated mass range around 100 μ eV using a dielectric haloscope. It utilizes a booster system consisting of a stack of dielectric disks and a mirror to resonantly enhance the axion-photon conversion in a magnetic field. Results of the first axion dark matter search using a MADMAX prototype are shown and the calibration procedure is explained. A system with three ø 200 mm sapphire disks in a < 1.6 T magnetic field was used. No dark matter signal was observed. The results demonstrate the feasibility of such systems and their capability to reach unexplored parameter space.

T 89.6 Fri 10:15 VG 0.110

First Results of the Any Light Particle Search II (ALPS II) — •Todd Kozlowski for the ALPS-Collaboration — Deutsches Elektronen-Synchrotron DESY

The Any Light Particle Search II (ALPS II) is an ongoing 'light-shining-through-a-wall' experiment located at DESY in Hamburg, designed to probe the existence of lightweight bosons through their coupling to photons in a background magnetic field. ALPS II leverages technology developed specifically for this task, including a record-breaking long-baseline optical cavity, an ultra-sensitive detector capable of measuring coherent powers as low as 10^{-24} W, and a sophisticated optical control system. Since beginning operation in May 2023, ALPS II has conducted several successful measurement campaigns. In this talk, I will discuss the initial results and outline planned upgrades to further enhance the experiment*s sensitivity.