Photons as signature for dark matter and dark energy: The Cast experiment at CERN

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The CAST experiment is designed to search for solar axions which are produced in the dense plasma the interior of the sun via the Primakoff effect. Detection of axions and their energy spectrum will immediately reveal the temperature of the core plasma. The central part of the experiment, the helioscope is an LHC prototype magnet that has attached different types of sensitive detectors for x-rays in the regime of 1-10 keV. The experiment has been taking data since 2003 and provided the most restrictive limits on the axion-photon coupling in a broad mass range. Beyond 0,02eV/c**2 the mass the sensitivity is degraded due to coherence loss. In order to restore coherence, the magnet was filled with a buffer gas providing an effective mass to the photon. By changing the pressure of the buffer gas in steps, CAST did scan the range of axion mass values from 0.02eV to 1.18eV. CAST has set the strongest limit yet on Axion-photon coupling across a wide range of Axion masses (i.e., any rest mass below 1.18eV), surpassing astrophysical limits for the first time. An overview of the total data set and data analysis will be presented.

The significant upgrades of CAST in 2014 allows first experiments to shed some light into the dark energy sector by searching for axions with its better performance due to a 2nd XRT, while continuing the search for solar chameleons in the sub-keV range. Gravitational lensing may enhance the sensitivity by many orders of magnitude. At this point the equation of state of Jupiter and other planets play a significant role. Proposals for the future include an International Axion Observatory (IAXO) as a 4th generation Axion Helioscope. This proposal is currently under review/approval by CERN SPS committee.