

Search for solar axions with the CAST experiment

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Axions are hypothetical particles arising in models which may solve the CP problem of strong interactions. They are practically stable neutral pseudoscalar particles and also viable candidates for the dark matter in the universe.

Most of the axion experimental searches are based on the axion coupling to two photons. As a consequence of this coupling, axion could transform into photon and vice versa in external electric and magnetic fields. Axions could be produced in the solar core by converting thermal photons in the Coulomb fields of nuclei and electrons - the Primakoff process, and back-converted into photons in a laboratory magnetic field.

CERN Axion Solar Telescope (CAST) is designed to search for these axions by using a Large Hadron Collider prototype dipole magnet which follows the Sun during sunrise and sunset throughout the year. To explore as wide as possible range of axion masses, the operation of CAST is divided in two phases. During the phase I the experiment operated with vacuum inside the magnet bores and covered axion masses up to 0.02 eV. In order to extend the sensitivity to higher axion masses, the magnet bores are filled with a buffer gas at various densities. In the first part of the CAST phase II, 4He was used as a buffer gas.

In the ongoing second part of the phase II, CAST has been using 3He to cover axion masses up to 1 eV. So far, no evidence of axion signal has been found and CAST set the most stringent experimental limit on the axion-photon coupling constant over a broad range of axion masses.

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