

Search for the X17 QCD Axion in the $\eta \rightarrow \pi^+ \pi^- e^+ e^-$ decay with the HADES Detector

Monday, 9 December 2024 13:00 (1 hour)

The High-Acceptance Di-Electron Spectrometer (HADES) operates at the GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt, using pion, proton, and heavy-ion beams provided by the SIS-18 synchrotron. In February 2022, the HADES Collaboration measured proton-proton collisions at 4.5 GeV momentum using the upgraded setup as part of the FAIR-Phase0 program.

One of the key objectives of the HADES physics program is to test the predictions of the Standard Model and search for potential hints of new phenomena beyond current theoretical frameworks (BSM – Beyond Standard Model Physics). In particular, by studying η meson decays into dilepton (e^+e^-) channels, we investigate the possible existence of the X17 boson, a candidate for an axion-like particle (ALP). In this scenario, an intermediate state of the η decay could involve the creation of a QCD axion through the sequence $\eta \rightarrow \pi^+ \pi^- X17 (\rightarrow e^+ e^-)$. The X17 particle is hypothesized to be isoscalar or axial-vector gauge boson, which may mediate a fifth force with couplings to Standard Model particles.

These studies are further motivated by recently observed anomalies in the invariant mass distribution of e^+e^- pairs in isoscalar magnetic nuclear transitions of ^8Be and ^4He nuclei. These anomalies have been interpreted as evidence for the creation and decay of an intermediate particle, X17, with a mass of approximately 17 MeV/ c^2 and suppressed mixing with the neutral pion.

In this talk, we will discuss the general motivations for X17 studies, present our analysis methodology, and share preliminary results from data collected using the high-resolution HADES spectrometer.

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