

Search for Dark Photons by the HPS experiment at Jefferson Lab

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Our present understanding of the properties of Dark Matter (DM), whose existence was confirmed decades ago through its gravitational interactions with ordinary matter, remain limited. A major scientific quest is to uncover its nature, origin, composition, and interactions beyond gravity.

Despite extensive efforts to identify viable Weakly Interacting Massive Particle (WIMP) candidates, no positive results have been achieved so far.

Recently, new hypotheses have emerged about the nature of Dark Matter. For instance, models for light (sub-GeV) DM suggest that its constituents belong to a Hidden Sector, that is uncharged under the Standard Model (SM) forces and interacts with the SM through a new force carrier. Specifically, well-supported theoretical models propose the existence of a new U(1) light gauge boson, known as the heavy (or dark) photon A' , which kinetically mixes with the SM photon.

The Heavy Photon Search (HPS) experiment at the Thomas Jefferson National Accelerator Facility (JLAB, USA) was primarily designed to search for heavy photons produced through electron interactions on a thin Tungsten target, that decay into electron-positron pairs.

This presentation will describe the design and performance of the HPS detector and outline the results of the analyses, based both on bump hunt and displaced vertices searches, from the data collected during the 2016 engineering run.

Additionally, the current status of the ongoing analysis of two larger datasets from 2019 and 2021 will be discussed, along with an estimated reach for these new data.

Primary author: FILIPPI, Alessandra (INFN Torino)

Presenter: FILIPPI, Alessandra (INFN Torino)

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