

The Search for Heavy Photons with HPS

The Heavy Photon Search (HPS) is a new dedicated experiment at Jefferson Lab to search for a massive vector boson, the heavy photon (a.k.a. dark photon, A'), in the mass range 20-1000 MeV/c² and couplings to electric charge ϵe , with $\epsilon^2 \equiv \alpha'/\alpha$, where $\epsilon^2 \approx 10^{-5} - 10^{-10}$. The search for particles and forces with weak coupling to ordinary matter is well-motivated from general theoretical arguments. The simplest construct, a new $U'(1)$ symmetry, is particularly interesting as it may explain outstanding questions related to dark matter interactions and the muon anomalous magnetic moment. The HPS experiment employs both an invariant mass bump and a displaced decay vertex signature to discover heavy photons radiated off high-energy electrons in the field of a target nuclei. The compact, forward, large-acceptance spectrometer uses a lead-tungstate electromagnetic calorimeter to trigger the readout of a silicon vertex tracker placed immediately behind a thin high-Z target to measure the e^+e^- or $\mu^+\mu^-$ decay of the heavy photon. In Spring 2012, the HPS collaboration mounted the HPS Test run, a simplified version of the experiment, and demonstrated the technical feasibility of the design and verified background predictions for HPS. The experimental design and results of the HPS Test and the plans for the upcoming full HPS experiment are discussed.