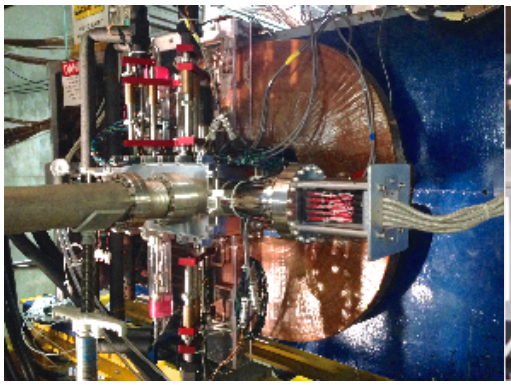
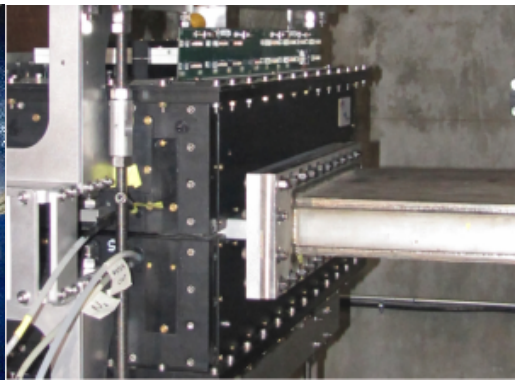
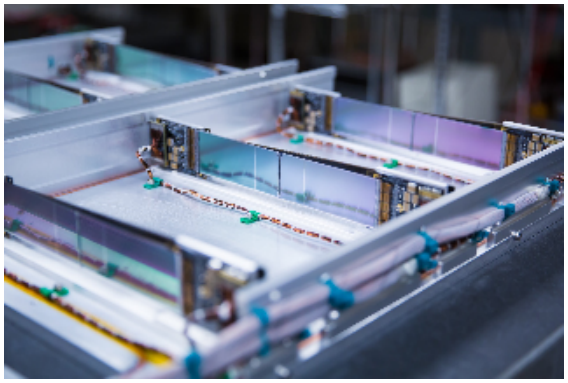
Heavy Photon Search Experiment

About the HPS Experiment

The Heavy Photon Search Group at SLAC is collaborating with physicists at Jefferson Lab, INFN, IN2P3, UNH and UCSC in an experiment aimed at discovering a hidden-sector photon (aka "dark" photon or "heavy" photon). Such a particle could have mass in the range 0.01 to 0.5 GeV, couple weakly to electrons, and decay to $e^+ e^-$. It would be produced by electron bremstrahlung on a heavy target, and be identified as a narrow $e^+ e^-$ resonance. Weak couplings of this heavy photon to electrons account for its not yet having been discovered and, if weak enough, can give rise to separated vertices in its decay, providing a spectacular signature. Dark photons have become very topical because ongoing searches for SUSY WIMPs have so far been unsuccessful, leading to speculation that the dark matter may be light, < 1 GeV. If the dark matter is light, then it must interact through a new, light mediator if it was produced thermally in the big bang and responsible for the present relic density. Dark photons may also be linked to high energy electrons and positrons in cosmic rays, presumably arising through dark matter annihilation or decay, help explain galactic dark matter halos, or perhaps account for particle physics anomalies like the mismatch in the experimental and theoretical values of g-2 for the muon. Dark matter interactions with regular matter would also be mediated by dark photons, leading to new predictions for dark matter direct detection experiments.

The experiment measures forward going electrons and positrons produced in a thin tungsten target with a very high rate silicon tracker/vertexer situated in a dipole magnet. Heavy photons are identified as bumps in the invariant mass spectrum of the electron-positron pairs, and by observing that their decay vertex is separated from the target. A lead tungstate crystal calorimeter, situated behind the tracker, provides the fast trigger and timing. The experiment employs the latest in high speed electronics and data acquisiton, and explores new experimental territory, only millimeters away from the incident electron beam.

The Heavy Photon Search Experiment (HPS) was installed at JLAB in February 2015. Engineering runs during March and April 2015 and May 2016 demonstrated that the experiment worked and produced physics quality data. Five Ph.D theses have been based on this data to date. A bump hunt analysis of the 2015 data was made public in 2017, and the first HPS physics publication will be submitted in Spring, 2018. On the basis of these early results, JLAB has approved 165 days of running for the experiment. The first protracted run, eight weeks at 4.5 GeV incident energy, is scheduled for Summer, 2019.

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New PRD on HPS Analysis of Engineering Run data