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The DarkLight Experiment at the JLab FEL

PETER FISHER, MIT

DarkLight will study the production of gauge bosons associated with Dark Forces theories in the scattering of 100 MeV electrons on proton a target. DarkLight is a spectrometer to measure all the final state particles in $e^- + p \to e^- + p + e^- + e^+$. QED allows this process and the invariant mass distribution of the e^+e^- pair is a continuum from nearly zero to nearly the electron beam energy. Dark Forces theories, which allow the dark matter mass scale to be over 1 TeV, predict a gauge boson A' in the mass range of 10-1,000 MeV and decays to an electron-positron pair with an invariant mass of $m_{A'}$. We aim to search for this process using the 100 MeV, 10 mA electron beam at the JLab Free Electron Laser impinging on a hydrogen target with a 10^{19}cm^{-2} density. The resulting luminosity of $6\times10^{35}/\text{cm}^2$-s gives the experiment enough sensitivity to probe A' couplings of $10^{-9}\alpha$. DarkLight is unique in its design to detect all four particles in the final state. The leptons will be measured in a large high-rate TPC and a silicon sensor will measure the protons. A 0.5 T solenoidal magnetic field provides the momentum resolution and focuses the copious Møller scattering background down the beam line, away from the detectors. A first beam test has shown the FEL beam is compatible with the target design and that the hall backgrounds are manageable. The experiment has been approved by Jefferson Lab for first running in 2017.