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Status of the JLab Eta Factory (JEF) experiment¹

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The JLab Eta Factory (JEF) experiment is an approved experiment in Hall D at Jefferson Lab that focuses on decays of η mesons produced in the reaction $\gamma p \rightarrow p\eta$ with emphasis on the rare $\eta \rightarrow \pi^0\gamma\gamma$ channel. In addition to providing a rare window into higher-order chiral perturbation theory, this channel can be used to search for evidence of dark matter. A potential extension to the Standard Model posits a dark gauge boson B that couples predominately with quarks and can be observed in the $\eta \rightarrow \gamma B$, $B \rightarrow \pi^0\gamma$ channel². The same set of final state particles can also be used to look for a scalar dark matter mediator S in the $\eta \rightarrow \pi^0 S$, $S \rightarrow \gamma\gamma$ channel³. In order to achieve the requisite resolution to clearly identify these rare channels, this experiment calls for an upgrade to the existing GlueX equipment, which is a fixed target apparatus based on a 2-Tesla solenoid magnet (which enables reconstruction of the momentum of the recoil proton). Neutral particles emerging after the interaction of the photon beam with a liquid hydrogen target are detected in the forward direction in the Forward Calorimeter (FCAL), an array of lead glass blocks. We plan to replace the $\sim 80 \times 80$ cm² region of the FCAL closest to the beam line with an array of $2 \times 2 \times 20$ cm³ lead tungstate crystals. The current status of the JEF project will be presented.

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²S. Tulin, Phys. Rev. D **89**, no. 11, 114008 (2014).

³B. Batell, A. Freitas, A. Ismail and D. McKeen, arXiv:1812.05103 [hep-ph].