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Non-Invasive Beam Detection in a High-Average Power Electron Accelerator JOEL WILLIAMS, SANDRA BIEDRON, JOHN HARRIS, JORGE MARTINEZ, STEPHEN MILTON, Colorado State University, S. BENSON, P. EVTUSHENKO, G NEIL, S. ZHANG, Jefferson National Labs — For a free-electron laser (FEL) to work effectively the electron beam quality must meet exceptional standards. In the case of an FEL operating at infrared wavelengths the critical phase space tends to be in the longitudinal direction. Achieving high enough longitudinal phase space density directly from the electron injector system in an FEL is difficult due to space charge effects, thus one needs to manipulate the longitudinal phase space once the beam energy reaches a sufficiently high value. However, this is fraught with problems. Longitudinal space charge and coherent synchrotron radiation can both disrupt the overall phase space, furthermore, the phase space disruption is exacerbated by the longitudinal phase space manipulation process required to achieve high peak current. To achieve and maintain good FEL performance, one needs to investigate the longitudinal emittance during operation, preferably in a non-invasive manner. Using electro-optical (EO) methods, we plan to measure the bunch longitudinal profile of an energy ($\sim$ 120-MeV), high-power ($\sim$ 10kW or more average FEL output power) beam. Such a diagnostic could be critical in efforts to diagnose and help mitigate deleterious beam effects for high output power FELs.

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