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Experimental Investigation of Beam Breakup in the Jefferson Laboratory 10 kW FEL Upgrade Driver[1] CHRISTOPHER TENNANT, DAVID DOUGLAS, KEVIN JORDAN, LIA MERMINGA, EDUARD POZDEYEV, HAIPENG WANG — In energy recovery linacs the maximum average current can be limited by the multipass beam breakup (BBU) instability, which occurs when the electron beam interacts with the higher-order modes (HOMs) of an accelerating cavity on the accelerating pass and again on the energy recovered pass. Experimental characterization and observations of the instability at the Jefferson Laboratory 10 kW Free Electron Laser (FEL) Driver are presented. Methods to measure the threshold current for the instability were developed and the results were used to compare with the predictions of several BBU simulation codes. This represents the first time in which the codes have been definitively benchmarked. With BBU posing a threat to high current beam operation in the FEL Driver, several suppression schemes were successfully developed. These include direct damping of the dangerous HOM and appropriately modifying the electron beam optics so as to reduce the coupling between the beam and mode.

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