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Microwave Heating and Current Drive of Overdense Plasmas in the Upgraded Pegasus Experiment

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Identifying attractive means of initiating current without using induction from a central solenoid remains a critical challenge facing the spherical tokamak (ST) concept, and is desirable for tokamaks in general. An electron Bernstein wave (EBW) heating and current drive system is being designed for use in overdense ST plasmas on the upgraded Pegasus Toroidal Experiment. The research program on Pegasus is studying the physics of non-solenoidal plasma startup, ramp up and sustainment in the ST geometry. Recent startup research on Pegasus has focused on Local Helicity Injection (LHI). This effort will be expanded upon by an EBW heating and current drive system to provide viable means for non-inductive startup and sustainment of ST plasmas. Additionally, EBW has the potential to reduce resistive losses during LHI startup by increasing the electron temperature, simplifying injector requirements, and may also offer current profile control capabilities for transition to post-startup sustainment methods. The upgraded Pegasus Experiment will increase the toroidal field by a factor of 4, allowing for EBW experiments with a source frequency of 8 GHz, providing absorption near the fundamental electron cyclotron resonance. The flexibility of the university-scale experiment allows for the ability to explore different coupling schemes such as low-field side O-mode to X-mode to EBW coupling as well as high field injection of the slow X-mode to directly couple to the EBW.

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