A Radiofrequency System for the PEGASUS-III Experiment

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Development of radiofrequency (RF) injection and other non-solenoidal heating and current drive (CD) techniques is critical to the design of compact, electricity-producing fusion power plants–especially for spherical tokamak (ST) based designs. The PEGASUS-III Experiment is a new, solenoid-free, low A ST focused on non-solenoidal plasma startup and sustainment techniques with local helicity injection (LHI), coaxial helicity injection (CHI) and RF. PEGASUS-III will use a 28 GHz gyrotron based system for EC heating and EBW heating and CD. Modeling of EC & EBW injection in PEGASUS-III has been performed on projected LHI- and CHI-produced target plasmas to study propagation, absorption, heating, and CD. GENRAY calculations were used to obtain the optimal parameters for 2nd harmonic X-mode ECH for LHI plasmas with T_e = 15–300 eV resulting in 15–70% first-pass absorption as T_e is increased. EBW simulations in overdense plasmas show core heating near the 2nd harmonic EC resonance. RF on PEGASUS-III will provide key enabling reactor relevant technologies to directly test proposed startup and ramp-up scenarios for larger scale STs and investigate synergistic improvements to startup plasmas for bootstrap and NBI sustainment.

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