Status and Plans for the New Solenoid-Free PEGASUS-III Spherical Tokamak

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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. The PEGASUS-III facility is under construction to provide a dedicated US platform for non-solenoidal tokamak startup and sustainment studies. This new solenoid-free, extremely low aspect ratio ST ($A \geq 1.22$, $I_p \leq 0.3$ MA, $B_T \leq 0.6$ T, pulse length ~ 100 ms) is focused on comparing, contrasting, and combining several of the leading non-solenoidal startup techniques, including: local helicity injection (LHI); coaxial helicity injection (CHI); RF-aided and RF-only startup; and PF induction. It will feature: new LHI systems capable of $I_p \sim 0.3$ MA and a dedicated port for testing the efficacy of non-circular injectors; a novel dual floating electrode CHI system capable of both transient and sustained CHI operation; a 28 GHz RF system for synergy and, eventually, RF only startup experiments; and an expanded PF system with improved control. The long-term goal of these studies is to provide an optimized scheme for achieving MA-class plasma startup that is compatible with non-inductive sustainment in NSTX-U and beyond.

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