Physics Plan for Access to High Toroidal Beta and Normalized Current in the Pegasus Toroidal Experiment

Author: Unterberg E.A.
Coauthor: N.W. Eidietis, R.J. Fonck, G.D. Garstka
Institution : University of Wisconsin-Madison
Abstract text: The Pegasus Toroidal Experiment is an ultralow aspect ratio ST with a mission to study the limits of magnetohydrodynamic stability at extremely low aspect ratio and high toroidal beta and to explore the transition region between the tokamak and spheromak configurations. The program is now completing a full redesign of all the coil power systems and supporting infrastructure, and is entering a new phase of operation. These upgrades include arbitrary, programmable waveform control for 8 independent coil currents, a factor of 3 increase in toroidal field, a factor of 2 increase in available ohmic flux, divertor coils,and improved pumping and conditioning. Results from earlier campaigns with the original facility showed that persistent low m/n tearing modes were responsible for limiting toroidal field utilization (I_p/I_tf) and toroidal beta. The first phase of operations of the next campaign will involve the development of startup scenarios that suppress the tearing modes. This will be accomplished by lowering the plasma current ramp rate and controlling the growth of the plasma size in order to decrease resistivity, and if necessary startup at transiently high toroidal field. The next phase of experiments will focus on establishing operating points at high toroidal field utilization and high toroidal beta, including limited and diverted configurations. With these operating points established, experiments will be conducted to determine the boundaries of the external kink mode at very low A. Earlier results from Pegasus showed an unstable point at q_95=5, albeit with significant edge currents. Studies will focus on the effects of aspect ratio, elongation, and internal inductance on the kink stability boundary. Supported by U.S. DoE Grant No. DE-FG02-96ER54375