Status and Plans of the Pegasus Toroidal Experiment[*]

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The PEGASUS Toroidal Experiment is an extremely low aspect ratio toroidal facility developed to explore quasi-spherical high-pressure plasmas by minimizing the central column while maintaining good confinement and stability. It provides a mid-scale experiment to study high β_t plasmas as $A \rightarrow 1$ where increasingly low toroidal field is required for stability. Earlier operation with ohmic heating demonstrated the high-β_t capabilities of operation at near-unity aspect ratio. Since 2002, the PEGASUS experimental facility was completely rebuilt and upgraded. All coil power systems were upgraded to state-of-the-art programmable power supplies driven by high-power solid-state switch bridges. The entire laboratory was upgraded to provide a variety of new tools for advancing stability studies at near-unity aspect ratio. These include coil current feedback control, adjustable loop voltage waveform, increased and time-variable toroidal field, and extended poloidal field coil systems with new divertor coils. These new power systems will be coupled to a sophisticated feedback control system to control plasma current, position, and shape. Initial operations with the new facility have rapidly recovered the operating space of the first phase of operations. We plan to exploit these new capabilities to explore three specific areas of interest. First, we will use the new programmable coil systems to control the plasma evolution to access high-$\beta_{\square}$ plasmas with very high I_N and I_p/I_{tf}. We will examine the current and pressure stability boundaries in this unique $A \rightarrow 1$ parameter regime. Secondly, we will deploy an array of clean, high-current electrostatic plasma injectors to study noninductive startup via current and helicity injection. These experiments will include use of the injectors as "seed" plasmas for PF startup experiments. Initial tests with two injectors demonstrate reconnection of the plasma streams and a twofold increase in toroidal current over the injected current multiplied by the stacking factor. Finally, we plan to install a MW-class electron Bernstein wave system to test the potential of EBW heating and current drive at high power density. This system will operate at 2.45 GHz, which is a good match for first harmonic absorption near the magnetic axis. Many parts of this system will be taken from the PLT lower hybrid system. Raytracing studies have indicated that good localized absorption can be obtained, and that a dimensionless current drive efficiency of at least 0.5 can be obtained with the Fisch-Boozer CD mechanism.

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