A Performance Upgrade for DIII-D to Resolve the Integrated Tokamak Exhaust and Performance Gap for a Fusion Pilot Plant

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Abstract. *The critical challenge to develop a viable concept for a compact fusion 'pilot' plant is to resolve a highly dissipative divertor and its compatibility with a high-performance core. An upgrade to DIII-D is proposed to close gaps on reactor physics regimes in divertor, SOL, pedestal and core in order to test critical physics, pioneer solutions and resolve their integrated compatibility. The key is to raise pressure in order to sustain high density dissipative regimes with hot, low collisionality core plasmas. This is achieved through power upgrades combined with increased plasma shaping, volume and current. Key flexibilities are introduced in core and divertor configurations, and in plasma interacting technologies, in order to resolve innovative solutions from the wall to the core, and how to integrate them together.*

Performance Upgrade

The performance upgrade will be achieved by combining a shape and volume rise with increased heating and current drive power. EPED [Snyder] simulations show the benefits of increasing the shaping and volume capability of DIII-D by removing its upper inner cryopump (Fig. 1), while retaining two outer cryopumps that are calculated to provide sufficient remaining capacity for density control. A significant rise in pedestal pressure is possible even with conventional pedestals (dark blue arrow), while a valley of improved stability, termed 'super-H mode', discovered on DIII-D in 2014 [Solomon], offers exciting further potential to

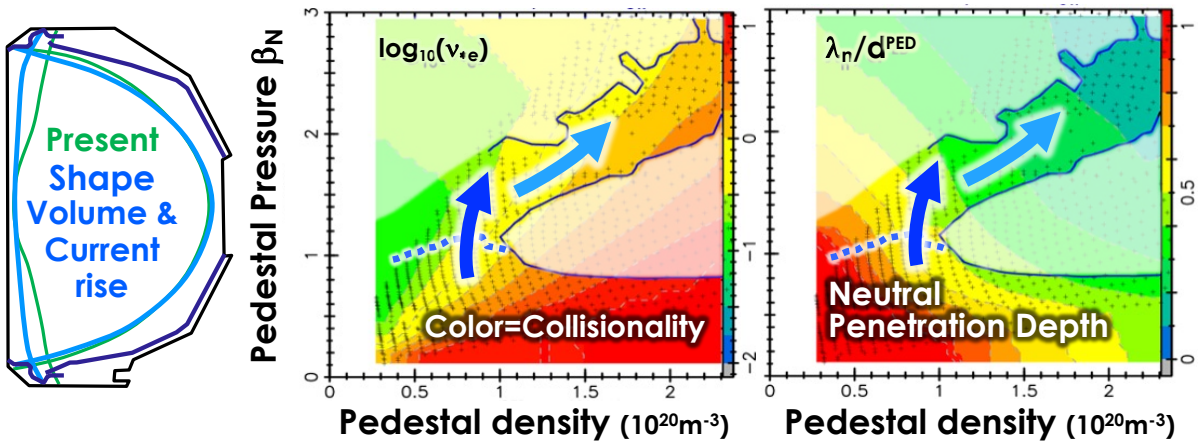

Fig. 1: High shaping (left) accesses high pressure & density at low ν (mid) and high opacity (right).*