

Multi-Machine Studies of the L-H Power Threshold Dependence on Aspect Ratio

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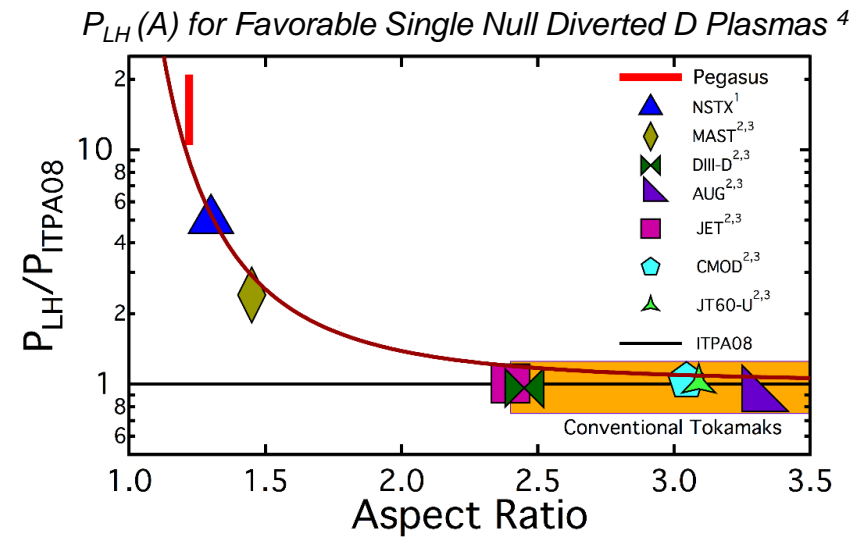


PEGASUS



L-H Power Threshold Diverges From Multi-Machine Scalings as $A \rightarrow 1$

- L-H transition has aspect ratio dependent effects¹⁻⁴
 - Magnitude of transition power
 - $P_{LH}/P_{ITPA08} \sim 1$ at conventional A
 - $P_{LH}/P_{ITPA08} \geq 10$ in Pegasus
 - Magnetic topology for minimum P_{LH}
 - Conventional A ~ 3 : SN, favorable ∇B
 - Low-A ~ 1.5 : CDN
 - A ~ 1 (Pegasus): None observed to date
 - ITPA calls for P_{LH} studies at low A



¹ R. Maingi *et al.*, Nucl. Fusion **50**, 064010 (2010)

² Y.R. Martin *et al.*, J. Phys.: Conf. Ser. **123**, 012033 (2008)

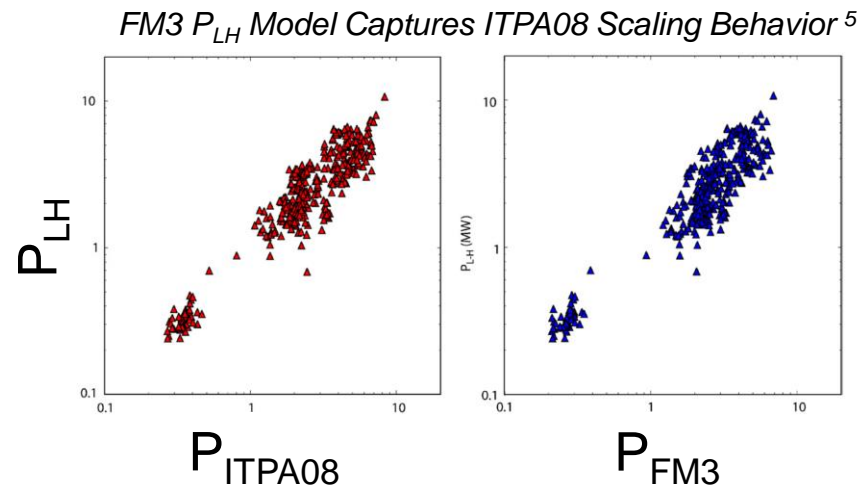
³ J. Wesson, *Tokamaks* (4th ed.), Oxford Univ. Press (2011), p. 630

⁴ K.E. Thome *et al.*, EPR 2014



Multi-Machine Experiments Necessary to Characterize $P_{LH}(A)$ Over Appropriate Range

- Recent analytic P_{LH} model⁵ (FM3) may explain other observed effects
 - Captures ITPA08 scaling in: B , n_e , S
 - $P_{LH,limited} / P_{LH,diverted}$ related to edge q
 - Links $P_{LH} n_{e,min}$ to edge collisionality
- Multi-machine experiments in US facilities can collectively span wide range of A
 - **Low A (NSTX-U)**
 - Conventional A (DIII-D)
 - Near-unity A (Pegasus)





NSTX-U Experimental Proposal

- Goal: Measure P_{LH} in NSTX-U scenarios relevant to FM3 model
 - Magnetic geometry scan
 - Limited, Favorable SN, Unfavorable SN, DN
 - Edge q scan
 - Edge collisionality scan via edge fueling control
 - Match dimensionless parameters, where possible, to facilitate inter-machine comparisons
 - ρ^* , q , β_N , v^*
- Document edge parameters, dynamics with 2D BES
- Runtime request: 1 day (pre-Li)
 - Compatible with boronization
- Contributes to several NSTX-U milestones
 - R(15-1): Assess H-mode energy confinement, pedestal, and scrape-off-layer characteristics with higher BT, I_p and NBI heating power
 - R(15-3): Develop the physics and operational tools for obtaining high-performance discharges in NSTX-U
 - NSTX-U 5-Year High-Priority Research Goal 5: Access reduced collisionality and high-beta combined with varied q and rotation to dramatically extend ST understanding