**L to H mode Transition: Parametric Dependencies of the Temperature Threshold**

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**Context**

- The L to H mode transition occurs at T threshold which depends on B, n and more [Burrell 89, Sutrop 97, Hubbard 98, Righi 2000, Meakins 2010, etc.]
- ExB is stabilizing turbulence [Burrell review 97] more recently observed in AUG [P. Sauter NF2012], JET [Delabie this conf] and dithering transition identified as the result of an interplay between turbulence, zonal and mean E, flows [Schmitz PRL 2012, Tynan NF 2013]
- The nature of the stabilized turbulence matters: Resistive Ballooning Modes key player in the highly collisional edge [Rogers-Drake-Zeiler 96-97]. Coherent with lower P_h, observed for lower Z_eff in JET [Maggi NF2014, EPS2014, Bourdelle NF Letters 2014], AUG [Neu JNM2013], and earlier [Takizuka ITPA 2004]

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**Driving idea**

Transition when ExB time is shorter than turbulence time, or \( \gamma_{\text{source}} / \gamma_{\text{turb}} \) below a certain number. Account for both the ExB stabilization and the nature of the turbulence.

**Nature of Turbulence prior to Transition**

- JET-ILW, prior to transition, \( \rho_0 = 0.97 \), linear stability analysis with GENE: RBM unstable [Bourdeul NF2014]

**ExB Shear Derivation**

- At \( \rho = 0.97 \), E, neo-classical: without \( V_T \) in JET at low NBI, \( V_a \) negligible, [Delabie this conf] in AUG no \( V_a \) gradient in this region [Viezer, NF13] with \( V_a \) from banana to P-S regimes
- At LCFS, E, scales (at least as) \(-3V_T\), assuming \( L_T \) constant across separatrix: \( E_r(1) = 3 \frac{T(0.97)}{0.03 a B/L_T} \)

**Minimum in density due to modified underlying turbulence**

At low density, i.e. lower collisionalities, ITG-TEM dominate over RBM, \( \gamma_{\text{ITG-TEM}} \) increases as \( n \) decreases
- High density, i.e. higher collisionalities, RBM dominate over ITG-TEM, \( \gamma_{\text{RBM}} \) increases as \( n \) increases

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**At low T RBM unstable, as T increases ITG-TEM take over Min \( \gamma \) for T in experimental range. NB: \( \alpha \) stabilization for T>> T_exp**

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**Higher threshold in H vs D and in He vs D, at fixed Z_eff**

Coherent with AUG key role of ion heat flux at plasma edge [Ryter NF2014]

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**Appendix:**

- See the Appendix of F. Romanelli et al., Proceedings of the 24th IAEA Fusion Energy Conference 2012, San Diego, US.