Understanding LOC/SOC Phenomenology in Tokamaks

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ABSTRACT
Phenomenology of Ohmic confinement saturation in tokamaks is reviewed. Characteristics of the new Ohmic confinement (LOC) and saturated Ohmic confinement (SOC) regimes are documented and transformations in all transport channels across the LOC/SOC transition are described, including rotation reversals, non-local cutoff and density peaking, in addition to changes in turbulence. Unification of results from nearly 20 devices indicates that the LOC/SOC transition occurs at a critical collisionality, which itself increases with toroidal magnetic field. Comparison with gyro-kinetic simulations suggests that sub-dominant TEMs are important in the LOC regime while ITG mode turbulence dominates with SOC.

SUMMARY AND CONCLUSIONS
LOC/SOC transition is ubiquitous. Occurs at a critical density which depends upon q and R, such that \( n_{\text{crit}} \propto \frac{1}{R} \). The critical \( \eta = \frac{q}{r/a} \) is near 1 for low Zeff values. Sub-dominant modes are present in LOC and SOC.

OPEN QUESTIONS
- Why is the transition so sharp in collisionality?
- Sub-dominant modes are present in LOC and SOC. What is special about them?
- Do rotation reversals drive turbulence or do turbulence changes drive the rotation?

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