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A new look at the origin of tokamak density limit scalings[1] D.A. GATES, L. DELGADO-APARICIO, Princeton Plasma Physics Laboratory — The empirical scaling law of the density limit in tokamaks and reversed-field pinches has long been known and is a surprisingly robust experimental result [1]. Whereas the form of the empirical scaling evolved over decades of experimental activities, the physics mechanism for the onset of the density limit has remained elusive. A novel theoretical approach [2] has been recently proposed, in which the onset criterion for radiation driven islands in combination with a simple cylindrical model of tokamak current channel behavior is consistent with the empirical scaling of the Greenwald density limit [1]. This quantitative model is derived from a power balance condition between Ohmic heating and radiative losses in the island interior, and sheds light at the phenomenon that may underlie the density limit and which is common to all reactor schemes. The development of this analytical model also provides - for the first time - a predictive capability that identifies critical local variables and is capable of relating these to global engineering parameters.

[1] M. Greenwald, *et al.*, Plasma Phys. Controlled Fusion, **44**, R27, (2002).
[2] D. A. Gates and L. Delgado-Aparicio, Phys. Rev. Lett., **108**, 165004, (2012).

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