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Explaining Cold-Pulse Dynamics in Tokamak Plasmas using Local Turbulent Transport Models

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This work demonstrates that cold-pulse phenomena in tokamak plasmas can be fully explained by local transport models [1], including the existence of core temperature inversions at low density and disappearance at high density, thus resolving an enigmatic but universal transient transport phenomenon that has challenged the standard local model of transport for more than twenty years [2]. The TRANSP power balance code coupled with the quasilinear transport model TGLF-SAT1 [3], with a new saturation rule that came about as a consequence of cross-scale coupling physics and that captures the nonlinear upshift of the critical gradient, are shown to fully describe the cold-pulse phenomenology after laser blow-off injections in the Alcator C-Mod tokamak. By means of experimentally-constrained self-consistent modeling of cold-pulse experiments, this work provides the strongest evidence to date that the existence of non-local transport phenomena may not be necessary for explaining the behavior and timescales of cold-pulse experiments in tokamak plasmas.

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[1] P. Rodriguez-Fernandez et al 2018 (accepted, Phys. Rev. Lett.)

[2] K. Ida et al 2015 Nucl. Fusion 55 013022

[3] G.M. Staebler et al 2017 Nucl. Fusion 57 066046

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