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Physics-based integrated modeling of the energy confinement time scaling laws in tokamaks

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As an effort to clarify the physics origin of the global scaling laws of energy confinement time, a new analysis scheme is first proposed in which the total stored energy is divided into the two parts, one being almost directly decided by the marginal stability property and edge boundary condition through profile stiffness and the other by the profile deviation from marginal one through turbulent dynamics under external heating. Initial application to the two parameter cases of plasma current and input power show this scheme is quite effective for identifying the relative role of various physics elements, such as the linear stability, nonlinear turbulent dynamics, pedestal boundary and core-edge coupling, in determining the global scaling law. Particularly, in the plasma current case it is found most of its scaling is originated from the marginal part with the significant role of the pedestal boundary. More detailed analysis results, including the other parameter cases, will be reported in the conference paper.

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