NONDIMENSIONAL TRANSPORT EXPERIMENTS ON DIII–D AND PROJECTIONS TO AN IGNITION TOKAMAK*

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The confinement properties of future magnetic fusion devices can be extrapolated from existing experiments using the scaling of heat transport with nondimensional parameters such as the relative gyroradius (ρ_*) and the plasma beta (β). The ρ_* scaling for ions was found to vary from gyro-Bohm-like (the theoretically expected value) for plasmas with broad density and current profiles to worse than Bohm-like for peaked density and current profiles; the ρ_* scaling for electrons was always found to be gyro-Bohm-like. The ρ_* scaling of dimensionally similar discharges has been compared between DIII–D and JET for H–mode plasmas in order to test the extrapolation of heat transport between different sized machines. This extrapolation from DIII–D to smaller ρ_* on JET is complicated by the requirement that the loss power from core transport remain above the H–mode threshold power along the dimensionally similar path. Experimentally the core transport power scales gyro-Bohm-like in H–mode plasmas with low safety factor, whereas the H–mode threshold power scales worse than Bohm-like. Choosing a scaling path at high beta (and low collisionality), along which the loss power remains above the H–mode threshold to the point of ignition, allows one to take full advantage of the gyro-Bohm-like scaling of heat transport in H–mode plasmas in the design of an ignition tokamak. An outline design of such a device with $R < 3$ m and $B_T < 6$ T is presented which does not exceed the Troyon beta limit or the Greenwald density limit. Experimental results from DIII–D will also be presented on the scaling of heat transport with β for L–mode and H–mode plasmas.

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