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Difficulties in Statistical Extrapolations of Confinement Scalings, and Prospects for Improved Confinement Regimes G.W. HAMMETT, M.C. ZARNSTORFF, PPPL, W. DORLAND, M. KOTSCHENREUTHER, IFS[1] — Empirical global scalings have been useful in fusion research to describe experimental trends, particularly in L-mode regimes. However, a 30% change in confinement can be the difference between ignition and $Q = 5$, requiring very accurate projections or additional margin to meet objectives. The statistical uncertainties in extrapolating these scalings are larger than previously realized, due to non-ideal systematic errors from machine-to-machine and regime-to-regime variability. Cross-validation statistical tests such as the jackknife are used to estimate these uncertainties for the present ITER design. In addition to statistical issues, there are several factors that are experimentally correlated with favorable confinement (such as sheared $E \times B$ flows, high T_i/T_e, edge conditions, density and current profiles, operational limits in density, β, H-mode power threshold, etc.), but which are not explicitly accounted for in present empirical scalings and may have unfavorable scalings to larger reactors. The exciting discoveries in recent years of various methods to reduce turbulence and improve performance may eventually solve these problems.

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