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First Analysis of the Updated ITPA Global H-Mode Confinement Database

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We report on an ongoing task within the ITPA concerning a revision of the global H-mode energy confinement scaling in tokamaks, known as IPB98(y,2). The objectives of the task are to update the database with data closer to ITER baseline and hybrid conditions, to expand the parameter range and include new data from devices with reactor-relevant metallic walls, to explore predictor variables and possibly decouple core and pedestal scaling, and to employ advanced regression techniques with an emphasis on the robustness of the scaling.

In this work, first results are presented of a description of the most recent version of the global H-mode confinement database, following addition in 2017 of new data from JET with the ITER-like wall and ASDEX Upgrade with its tungsten wall. The so-called "standard set", based on ITER-relevant selection criteria, presently contains 5718 entries from 18 machines. Considerable reduction of the linear correlation between the predictor variables has been observed, in comparison with the database used for the IPB98 scaling. Correlation coefficients above 0.5 remain between plasma current and major radius (0.74), current and loss power (0.65), and accordingly between major radius and loss power (0.60).

In pursuing the analysis of the updated database, the classic power-law dependence is assumed and regression analysis is being performed using ordinary least squares, a robust Bayesian technique and robust geodesic least squares. Examination of individual device scalings, both for low-Z and high-Z walls, has given insight into similarities and differences among these individual datasets, and this may lead to the resolution of some of the recently observed discrepancies between IPB98 and single-machine scans.

A significant part of the ongoing analysis effort will concentrate on exploring hidden variables not represented in the IPB98 scaling, in light of recent insight into the physics governing energy transport in tokamaks. This might resolve issues related to collinearity of predictor variables and may eventually contribute to a multi-machine scaling that better reflects the underlying physical dependences. This would also benefit interpretation of the scaling in terms of dimensionless variables. For similar reasons, the power-law form of the scaling may need to be re-evaluated in future work.

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Primary author: Dr VERDOOLAEGE, Geert (Ghent University)

Co-authors: Dr ANGIONI, Clemente (Max-Planck-Institut fuer Plasmaphysik, EURATOM Association, D-85748 Garching, Germany); Dr RYTER, Francois (IPP-Garching); Dr THOMSEN, Knud (Max Planck Institute for Plasma Physics); Dr ROMANELLI, Michele (CCFE); Dr MASLOV, Mikhail (CCFE); Dr KAYE, Stanley (Princeton Plasma Physics Laboratory, Princeton University, Princeton NJ, 08543 USA)

Presenter: Dr VERDOOLAEGE, Geert (Ghent University)

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