Scaling of core intrinsic rotation in ASDEX Upgrade L-mode plasmas using a robust regression technique

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Abstract

The scaling of the intrinsic rotation in ASDEX Upgrade (AUG) has recently been the subject of several studies aimed at clarifying the underlying mechanisms that potentially explain the rich phenomenology in terms of a number of key plasma parameters [1, 2]. In a database of intrinsic rotation measurements that was obtained via charge exchange spectroscopy during neutral beam blips in AUG L-mode plasmas, a multiple regression analysis revealed a number of physically relevant dependencies of the intrinsic normalized rotation gradient u' at mid-radius. Whereas the electron density gradient showed the strongest correlation with u', the dependence on other quantities could not be ruled out. However, a quantitative assessment of the relative importance of various predictor variables for explaining the observed rotation gradients and rotation reversal, is complicated by the considerable scatter in the database. Among other factors, this is caused by the challenging requirements for the rotation measurements and the wide range of plasma conditions represented in the database. Indeed, significant measurement uncertainty on response and predictor variables has been a source of concern in previous studies of fusion scaling laws [3]. In this work, we deploy the recently developed method of *geodesic least squares regression* (GLS) [4, 5] to estimate the dependencies of the intrinsic toroidal rotation in AUG L-mode plasmas. Based on regression in spaces of probability distributions, GLS provides the robustness and flexibility that is required in cases of substantial uncertainties with arbitrary distributions. We present results of the GLS rotation scaling that indicate the necessity of a dedicated methodology in estimating fusion scaling laws under challenging measurement conditions.

References

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