Extended calculations of neoclassical viscosity for TJ-II

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Plasma rotation in tokamaks and quasisymmetric stellarators is a topic of great interest in connection with stability, confinement and access to H-mode. The magnetic pumping effect due to the in-out variations of |B| is expected to keep the poloidal velocities down to low levels. The toroidal mass flows, undamped in ideal axisymmetric configurations, will be affected by the discreteness of TF coils in real devices and by the magnetic perturbations used for ELM control, which cause finite levels of toroidal ripple, specially in the edge. This has renewed the interest in NC effects in 3D magnetic topologies (see e.g. Ref. [1]).

A new experimental method has been proposed [2] in order to measure the NC viscosity of stellarators. It has first been applied to TJ-II: the experimental results are to be compared with the calculations shown here. Previous viscosity measurements by means of electrode biasing are reported in Ref. [3] for TJ-II and also for the CASTOR tokamak. We estimate relaxation times of the same order of magnitude of the ones measured in both experiments.

As in our previous work [4], we follow Ref. [5] in order to estimate the NC viscosities from the monoenergetic transport coefficients calculated by DKES. We now extend the calculation in order to include: a) the effect of the electrons; b) non-linear effects due to the dependence of the poloidal flow damping on the poloidal flow itself. The flexibility of TJ-II makes it an ideal device for studying the dependence of the flow damping on the magnetic configuration. Moreover, calculations with DKES allow us to extract the contribution of the different Fourier harmonics of the magnetic field strength on the total damping. We therefore perform estimates for configurations of varying volume, toroidal mirror and rotational transform.

References


