On the Determination of Plasma Rotation from Neoclassical Viscosity in Toroidal Plasmas

S.Nishimura, D.R.Mikkelsen[a], D.A.Spong[b], S.P.Hirshman[b],
L.P.Ku[a], H.E.Mynick[a], M.C.Zarnstorff[a]

National Institute for Fusion Science, 322-6 Oroshi-cho, Toki 509-5292, Japan
[a] Princeton Plasma Physics Laboratory, Princeton, New Jersey 08543-0451, USA
[b] Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6169, USA

The importance of rotational stabilization of resistive wall modes (RWM) has prompted more attention to momentum transport studies, particularly to momentum dissipation due to neoclassical toroidal viscosity arising from non-axisymmetric error fields. Some effects of MHD-induced error fields were discussed in Refs.[1-3]. An additional important aspect of trapped particle dynamics has recently been stressed: a positive correlation between neoclassical and anomalous transport through generation of zonal flows in non-symmetric toroidal plasmas [4,5]. In a recent formulation for the neoclassical viscosities in general toroidal plasmas [6], it was shown that three mono-energetic viscosity coefficients [M^*, N^*, L^*] are required to describe the full neoclassical properties of the plasmas. This differs from axisymmetric neoclassical transport codes such as NCLASS, and the additional complications require systematic investigation. For this purpose, these coefficients in two low aspect ratio stellarators (NCSX and QPS) have recently been investigated [7] with various numerical [6] and analytical [8] methods. Even though the basic framework of the unified theory [6] covers both tokamaks and stellarators, some further studies are still required to unify the analytical approximation techniques for the viscosity. Beginning with the recent transport analysis described in [7], the analytical theory for the $1/\nu$ regime is extended to include both the MHD-activity-induced error fields [1-3] and the ripple fields in stellarators.

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