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NEOCLASSICAL TRANSPORT CALCULATIONS FOR OPTIMIZATION STUDIES*

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At present, neoclassical transport coefficients and equilibrium currents are numerically computed using kinetic equation solvers. If many iterations of this computations are needed, e.g. in optimization problems, a faster and simpler method is much more desirable. To meet this requirements, new formulas for neoclassical transport coefficients and equilibrium currents have been obtained within our group. This formulas hold in any coordinate system and no simplifying assumptions about the magnetic field are needed. The formulas can be used also for complex magnetic fields which, for actual field coils, are sometimes only available in real space coordinates. It has to be mentioned that the numerical effort for such a numerical computation is rather small, since all the results can be gathered during the magnetic field line integration. Formulas are now available for transport in the $1/\nu$ regime, in the plateau regime and for equilibrium currents (Bootstrap and Pfirsch-Schlüter). The coefficients are always expressed in terms of a weighted integral of the geodesic curvature along the magnetic field line. Up to now there exist two versions of the numerical realization, one version of the code in real space coordinates and one in Boozer coordinates.

Minimization of neoclassical transport in the so called $1/\nu$ regime is one of the key issues in stellarator optimization. Therefore, our transport analysis was applied to existing configurations as well as to a variety of candidate configurations in international optimization studies - PPPL, ORNL, CHS-qa - and to the joint effort in stellarator optimization of IPP Greifswald, Russian Research Center "Kurchatov Institute" and IPP at the National Science Center "Kharkov Institute of Physics and Technology". Within all this efforts, a clear definition of an effective ripple has been introduced which on one hand allows to compare various configurations from the point of view of their transport properties and on the other hand gives a clear link to other definitions of the effective ripple specific to magnetic coordinates.

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