# Transport Model with Global Flow

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Anomalous transport in high temperature plasmas is an important issue for nuclear fusion research. This phenomenon is complicated due to the synergetic effect of the fluctuating density or temperature and the flows. To understand the transport in a system with flow, the conventional approaches are not enough and the more consistent approach is necessary. In this study, a transport model with flow is proposed, taking the fluctuating electrostatic field into account. This system consists of three components: transport, flow and turbulence. The flux-surface-averaged density and pressure evolve according to the conventional 1D transport equation with anomalous particle and heat fluxes. Then the neoclassical parallel flows are determined by the parallel momentum and the heat balance equations with turbulence source[1,2]. These neoclassical flows affect the saturation level of turbulence, hence change the anomalous particle and heat fluxes. The radial electric field which gives rise to zonal flow is determined by turbulence. As the first step, we investigate the linear stability of ideal and/or resistive ballooning mode with given neoclassical (global) flows solving the 2D eigenvalue problem and estimate the quasi-linear flux. The next step is to develop a global 3D turbulence code with equilibrium flows and evaluate the radial electric field and the anomalous fluxes. Simultaneously, impacts of spatially long-range fluctuations are also discussed[3]. The final goal is to couple the 3D code with the transport equations.

[1] S. P. Hirshman, D. J. Sigmar, Nucl. Fusion **21** (1981) 1079.
[2] M. Kikuchi and M. Azumi, Plasma Phys. Control. Fusion **37** (1995) 1215.
[3] M. Yagi, J. Plas. Fus. Res. **79** No.5 (2003) in press (in Japanese).