Topic: TH/C

Study of Neoclassical Toroidal Viscosity in Tokamaks with a δf Particle Code and Resonant Nature of Magnetic Braking

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Non-axisymmetric magnetic perturbations can fundamentally change neoclassical transport in tokamaks by distorting particle orbits on deformed or broken flux surfaces. Understanding transport under non-axisymmetric magnetic perturbations is a critical issue for ITER and future fusion devices where non-axisymmetric perturbations are potentially important control elements to actively stabilize locked modes, edge localized modes, and resistive wall modes. Neoclassical transport with non-axisymmetry, often called Neoclassical Toroidal Viscosity (NTV) transport in tokamaks, is intrinsically non-ambipolar, and highly complex depending on parametric regimes. Thus a numerical approach is required to achieve its precise description. This paper reports the study of non-ambipolar transport and NTV torque with a new δf particle code, and the improved understanding of magnetic braking in perturbed tokamaks. Initial calculation of non-ambipolar particle flux clearly indicates the strong resonant nature of magnetic breaking, which is typically supposed as driven by non-resonant perturbations, while bootstrap current shows resonant or non-resonant features depending on collisionality. In addition, NTV torque is directly estimated by calculating anisotropic pressures and utilizing magnetic field spectrum method. Calculation results of NTV compared with theory and experiments will be reported, and detailed analyses on magnetic braking in tokamaks such as NSTX will be discussed.

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