Eulerian approach to bounce-transit and drift resonance with magnetic drifts in tokamaks*

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Bounce-transit and drift resonance can be important to plasma confinement in tokamaks with broken symmetry [1,2]. Conventionally, the resonance is either treated by integrating along the unperturbed orbits or calculated using an action-angle approach [3,4]. An Eulerian approach has been developed so that momentum conservation property of the Coulomb collision operator can be taken into account [2]. The transport coefficients are the same in all these approaches. The difference between the Eulerian approach and other approaches is in the thermodynamic forces of the transport fluxes, and the corresponding toroidal plasma viscosity. The parallel flows appear in the thermodynamic forces in the Eulerian approach. However, in the existing Eulerian approach, only the $E \times B$ drift is kept in the theory; the magnetic drifts, i.e., $\nabla B$, and curvature drifts are neglected by adopting the large aspect ratio assumption [2]. Here, $E$ is the electric field, $B$ is the magnetic field, and $B = |B|$. The importance of the magnetic drifts to transport fluxes in finite aspect ratio tokamaks is clearly demonstrated in [4] using an action-angle approach. Here, the Eulerian approach is extended to include the magnetic drifts to calculate neoclassical toroidal plasma viscosity in finite aspect ratio tokamaks. The relation to the nonlinear plasma viscosity in the plateau regime [5] will also be discussed.

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