EFFECT OF MAGNETIC SHEAR AND THE FINITE BANANA-ORBIT WIDTH ON THE NEOCLASSICAL TOROIDAL VISCOSITY IN PERTURBED TOKAMAKS
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- In previous studies, local and global NTV simulations showed discrepancy in low-collisionality regime.
- To clarify the reason, two simulation models for NTV calculation are benchmarked.
  - Zero-Orbit-Width model: Radially-local, without the magnetic-shear effect in magnetic precession frequency $\omega_D$.
  - Global model: With magnetic-shear effect and the finite-orbit-width effect.

Simulation condition: Circular cross-section tokamak, three different $q$-profiles (positive, weak, negative-shear). Weak, non-resonant magnetic perturbation is applied.

Results:
- Local model reproduce the plateau-$1/\nu$-superbanana-plateau (SBP) type dependence of NTV on collision frequency, as predicted from local, bounce-average theory which neglect the magnetic shear effect.
- Global model shows strong dependence on $q$-shear. In positive-shear case, the SBP resonance in velocity space at which $\omega_D = 0$ moves to the trapped-passing boundary and the resonance is lost. It results in the reduction of NTV in low collisionality.
- Finite magnetic drift causes a $\sqrt{\nu}$-type dependence of NTV as collisionality decreases even without $E \times B$ rotation.