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Theory verification and numerical benchmarking on neoclassical toroidal viscosity[1] Z.R. WANG, J.-K. PARK, PPPL, Y.Q. LIU, CCFE, N.C. LOGAN, J.E. MENARD, PPPL — Systematic verification and numerical benchmarking has been successfully carried out among three different approaches of neoclassical toroidal viscosity (NTV) theory and the corresponding codes: IPEC-PENT is developed based on the combined NTV theory but without geometric simplifications [1]; MARS-K originally calculating the kinetic energy is upgraded to calculate the NTV torque based on the equivalence between kinetic energy and NTV torque [2]; MARS-Q includes smoothly connected NTV formula [3]. The derivation and numerical results both indicate that the imaginary part of kinetic energy calculated by MARS-K is equivalent to the NTV torque in IPEC-PENT. In the benchmark of precession resonance between MARS-Q and MARS-K/IPEC-PENT, it is first time to show the agreement and the correlation between the connected NTV formula and the combined NTV theory in different collisional region. Additionally, both IPEC-PENT and MARS-K indicates the importance of the bounce harmonic resonance which could greatly enhance the NTV torque when E cross B drift frequency reaches the bounce resonance condition. Since MARS-K also has the capability to calculate the plasma response including the kinetic effect self-consistently, the self-consistent NTV torque calculations have also been tested. [1] J.-K. Park et al Phys. Rev. Lett 065002 (2009) [2] J.-K. Park, Phys. Plasmas 18 110702 (2011) [3] K.C. Shaing et al Nucl. Fusion 50 025022 (2010)

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