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Perturbative radiative damping of RSAEs in NOVA-K code

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Several independent simulations were benchmarked to understand the fast-ion driven plasma transport due to Alfvénic eigenmodes in the linear regimes[1]. The total growth rates of the Reversed Shear Alfvénic Eigenmodes (RSAE) show reasonable agreement between the gyrokinetic codes and NOVA-K at low to medium toroidal mode numbers, $n = 2 - 4$. But they start to deviate from NOVA-K code results at $n > 4$. There are two damping mechanisms neglected by NOVA-K in those simulation, which are radiative damping and continuum damping. In this presentation the radiative damping, which is one of the most important damping mechanisms for present day tokamaks (such as DIII-D) and future burning plasmas and continuum damping of RSAE are studied.

First, we develop a new module for NOVA-K code to compute the radiative damping[2,3] of RSAEs in NOVAK code. The results show that the radiative damping can not sufficiently reduce the total growth rate of the RSAE mode in NOVAK as shown in figure 1. Fast particles contribute to the total radiative damping at the same level as thermal particles due to their large Gro-radius and high pressure which is comparable to the thermal ion pressure.

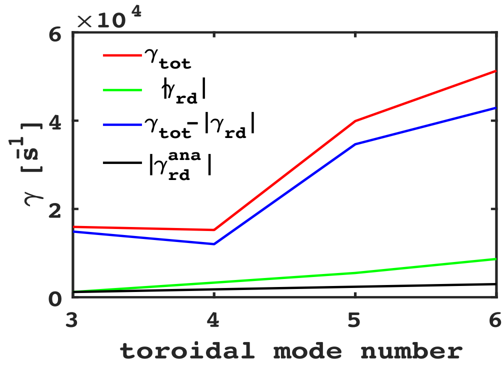

Figure 1. Growth radiative damping rates of RSAE vs toroidal mode number.

We also estimated the continuum damping with an analytical formula[4]. It shows the continuum damping decreased sharply with the increasing toroidal mode number. The continuum damping and radiative damping will give a negative growth rate, which is not consistent with the experiment. Further study of continuum damping is needed with non-perturbative kinetic code NOVA-KN.

Reference:

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