Contribution ID: **23** Type: **Oral**

Implementation of ion cyclotron resonance frequency heating in a kinetic-MHD hybrid code: MEGA

Monday, 6 December 2021 15:00 (20 minutes)

Ion cyclotron resonance frequency (ICRF) heating has been chosen as one of the fundamental auxiliary heating systems in many present-day fusion devices, as well as the upcoming ITER. Energetic ions generated by ICRF heating with energies up to several hundred-keV or several MeV can drive a variety of Alfven eigenmodes, such as reversed-shear, toroidal and ellipticity Alfven eigenmodes (RSAE, TAE, EAE). The destabilized Alfven eigenmodes will significantly modify the energetic ion distribution. Accurate evaluations of energetic ion distributions in present-day devices and the prediction in future burning plasmas require considering the interactions between Alfven eigenmodes and energetic ions during the distribution formation process. Additionally, the destabilized Alfven eigenmodes have a wide variety of nonlinear dynamics during the ICRF generated energetic ion pitch-angle scattering and slowing-down processes [1].

In this work, we have extended the MEGA code [2], which is a hybrid simulation code for energetic particles interacting with an MHD fluid, by implementing the ICRH acceleration, source, sink, and collisions. Both Coulomb collisions [3] and a quasilinear ICRF operator for wave–particle interactions [4,5] are solved by Monte Carlo method. We applied the extended MEGA code to an ICRF minority heating scenario in the Large Helical Device (LHD). The heating efficiencies, minority ion distributions, and AE stabilities at different RF input power and resonance layer locations in LHD will be presented.

References

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Session Classification: Effects of Energetic Particles in Magnetic Confinement Fusion Devices

Track Classification: Effects of Energetic Particles in Magnetic Confinement Fusion Devices