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Effect of perpendicular plasma response on ion heating in RFPs[1]
VLADIMIR SVIDZINSKI, VLADIMIR MIRNOV, STEWART PRAGER, The University of Wisconsin-Madison and the Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasmas — During a sawtooth crash in the Madison Symmetric Torus RFP the ion temperature can spontaneously double in $\sim 100\,\mu$s. It is also observed that high Z impurities are heated stronger than bulk ions. The heating may arise from tearing instabilities due to irreversible transfer of kinetic flow energy into heat caused by ion-ion collisions (viscosity). In our analysis we solve the kinetic equation with Landau collision operator in a given perpendicular electric field numerically. The heating rate is proportional to the square of the ion Larmor radius such that it is strong in low magnetic field configurations. An estimate of fluctuating electric field and velocity is based on the numerical solution of nonlinear resistive MHD equations. We found that velocity amplitude is comparable to the ion thermal velocity and that it is very localized near resonance surface. Results show that for bulk ions on ion-ion collision time scale viscous heating is effective only for strong localized sheared flows. High Z impurities are heated more effectively than the bulk because of their higher collision rates, slower thermal velocities and stronger response in given electric field. On shorter time scales ion-ion collisions are not important but the experimentally observed ion temperature rise can be explained by the modification of ion distribution function in strong perpendicular electric field of the tearing mode.

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