Competition between trapped ion and trapped electron instabilities.

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The understanding of the transport in tokamak plasma is an important step in order to perform the nuclear fusion. It is well known that the particle and energy transport is dominated not by Coulomb collisions but by turbulence especially in the core plasma. It is recognized that ITG (ion temperature gradient instability) and trapped electrons mode (TEM) are held responsible for turbulence giving rise to anomalous transport [1] [2] [3].

The present work focuses on the building of a kinetic model including trapped ions and trapped electrons. First of all, we use the three periodic motions of trapped particles in tokamak to build the model with a set of action-angle variables that provides great simplifications. In addition, we reduce the dimensionality by averaging the motion over the cyclotron motion and the "banana" orbits, according to the fact that the TIM and TEM instabilities are characterized by frequencies of the order of the low trapped particle precession frequency. The final model is 2D, parametrized by the two first adiabatic invariants namely the particle energy and the trapping parameter.

The linear analysis of this model shows the predominance of the TEM instability, contrary to what is expected when ITG due to the passing particles are taken into account [4]. The addition of a factor decreasing the effect of the electrons allows to study different regimes for which electrons are not necessarily dominant.

This work is currently performed in order to include trapped electrons in an existing semi lagrangian code for which TIM modes are already taken into account [5]. The validation of the non linear code is in progress.

References