

CEA/CADARACHE

DIRECTION DES SCIENCES DE LA MATIÈRE (DSM)

INSTITUT DE RECHERCHE SUR LA FUSION PAR CONFINEMENT MAGNETIQUE (IRFM)

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Title : Plasma fluctuations and radio-frequency current drive in tokamaks

Summary : The use of rf waves for driving toroidal current in a magnetized plasma is now standard, and form a powerful tool for ITER tokamak project, either for stabilizing MHD instabilities or pre-shaping the current density profile in the early phase of the discharge. Up to now, calculations are based on ray-tracing coupled with a 3-D relativistic kinetic Fokker-Planck solver using both mean plasma values for density, temperature but also magnetic field. But these waves may be very sensitive to fluctuations along their paths, which may affect deeply parametric dependencies predicted without it. Recently, the ray-tracing incorporates the fluctuations in the ray dynamics, and therefore, it opens the possibility to study how the power absorption profile compares with the experimental observations. This can be done for the Tokamak Tore Supra, who is particularly well equipped for this purpose. The goal is to quantify the level of sensitivity at the lower hybrid frequency to fluctuations, and to evaluate the consequences on the power absorption and driven current. Besides the theory/experiment investigation, predictive calculations should be carried out for ITER, but also smaller sized machines in which this effect could be prominent, in particular when toroidal effects on the refraction are small. In parallel, it will be interesting to evaluate the focusing capability of a beam of rf waves at the electron cyclotron frequency, in view to stabilize deleterious MHD modes for energy confinement.

This work is based on sophisticated calculation Tools, which require a good assimilation of the mathematical formalism on which they are based. An excellent mastering of the plasma physics is also mandatory. This work is performed within a small but active team working on the subject of current drive calculations in tokamaks since several years.

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Skills : Physics of plasma, radiations and rf waves. Statistical physics. Good knowledge in C and MatLab programming languages is appreciated.