Tipo di tesi: Laurea Magistrale
Corso di Laurea: Fisica
Tipologia: Teorico/Modellistica
Titolo della tesi: Drift-kinetic modeling of Resistive Wall Mode stability with fast ion anisotropy
Proponente: Leonardo Pigatto
Relatore Accademico: Tommaso Bolzonella
Capogruppo: David Terranova

Argomento della tesi:

Demonstrating the capability of achieving high fusion power density and good confinement properties has been one of the main targets of present day magnetic fusion experiments, and an even more crucial one for the next generation of devices with are under construction or design. A possible way towards substantial performance improvement is operating a thermonuclear fusion device at high normalized pressure, with a high fraction of non-inductive current drive and exploiting both external and internal transport barriers for confinement.

The so-called Advanced Tokamak (AT) scenarios could represent a viable way for steady-state operation with the aforementioned characteristics. In such plasmas an important fraction of heating and current drive is provided by Neutral Beam Injection (NBI) systems, which also lead to increasing the fraction of high energy ions in the plasma. Under the point of view of stability however, advanced scenarios are challenging to achieve. This thesis will focus on the study of ideal MHD instabilities that cause a global displacement of the plasma column and grow on Aflvén time scales. In presence of a close-fitting resistive wall the mode is slowed down to the time scale of the magnetic field penetration, being then called Resistive Wall Mode.

Many experiments over the last decade have been performed (both on Tokamak and Reversed Field Pinch devices) to study RWM physics and tackle the issue of stabilization. Strong evidence suggests that RWMs interact (by exchanging energy) with particle populations within the plasma, this effect can be exploited for stabilization. The thesis work starts with understanding the drift-kinetic MHD model that explains the aforementioned interaction, familiarizing with some of the most common numerical tools, with foreseeable tuning and customization. RFX-mod plasmas can be the first application to focus on in the thesis, studying the effect of NBI fast ions on RWM stability in both Tokamak and RFP plasmas. The problems of modelling mode-particle interaction as well as the fast ion distribution will be addressed. These analyses will stand as base for the extension to more challenging high performance scenarios. Multi-machine modelling and comparison is foreseeable in the horizon of the thesis, including e.g. JT-60U, TCV, JET.

Competenze richieste (se necessarie):
Ambienti Python e Matlab.
Conoscenza degli argomenti trattati nei seguenti corsi della Laurea Magistrale in Fisica:
- Physics of fluids and plasmas
- Physics of nuclear fusion and plasma applications

Data della proposta: 23/11/2021

Stato: non assegnata

Laureando/a: (quando sarà assegnata)