MHD simulations of Edge Localised Modes in Tokamaks

Guido Huysmans
Association Euratom-CEA, CEA/DSM/DRFC,
Centre de Cadarache, 13108 St. Paul lez Durance, France

The magneto-hydro-dynamic instability called ELM for Edge Localized Mode is commonly observed in the standard tokamak operating scenario. The energy losses the ELMs are predicted to induce in ITER plasmas are a real concern with respect to the lifetime of the plasma facing components.
The MHD instabilities responsible for the ELMs, ballooning modes and external kink modes have been known for some time. The MHD stability limits imposed by these modes agree well with the experimental pressure limit. However, the current understanding of what sets the size of these ELM induced energy losses is extremely limited. Non-linear MHD simulations can be valuable to identify the non-linear saturation mechanisms but the simulation of a complete cycle of the ELM remains a challenge.
The non-linear MHD code JOREK is being developed to study the evolution of the MHD instabilities responsible for the ELM. Since ELMs occur at the interface between the main plasma and the surrounding 'vacuum', the complete magnetic geometry including the x-point needs to be taken into account. The x-point has an important effect on the stability of the external kink mode. Simulations of medium-n ballooning modes show the formation of density filaments sheared off from the main plasma by an induced poloidal flow.