EFDA Task Force Integrated Tokamak Modelling

EUROPEAN FUSION DEVELOPMENT AGREEMENT

From equilibrium reconstruction to stability analysis

A chain of codes allowing to reconstruct, refine, and analyse plasma equilibria for MHD stability

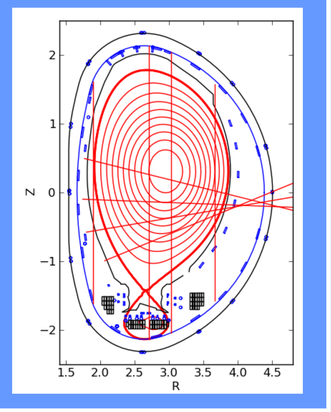
A generic tool for both experimental and theoretical analysis, featuring code interoperability (a given code can be replaced by another of the same type) and machine-independency. It has the capability to produce time-dependent information in a semi-automated way, and it is extensible beyond standard MHD.

Equilibrium Reconstruction

Equilibria are reconstructed by imposing a set of physical constraints:

- Standard or extended (pressure anisotropy, flow) Grad-Shafranov equation
- Diagnostics: magnetics, polarimetry, interferometry, LIDAR, ECE,…

Equilibrium reconstruction of a JET shot using EQUAL



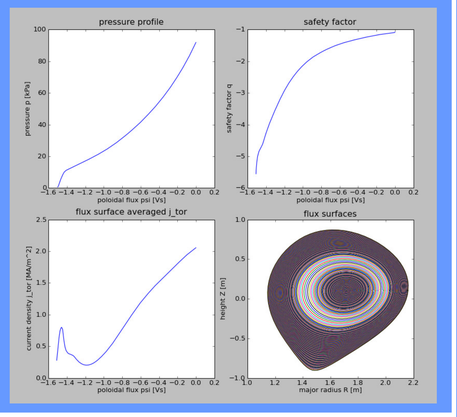
Other available codes: EQUINOX, FIXFREE, CLISTE,...

Equilibrium Refinement

Refinement is a necessary step to obtain magnetic geometry data with the precision required by the linear stability solver.

To achieve this, a suitable high resolution equilibrium code is employed, since it is computationally less costly than carrying out refinement at reconstruction time.

Equilibrium refinement using HELENA



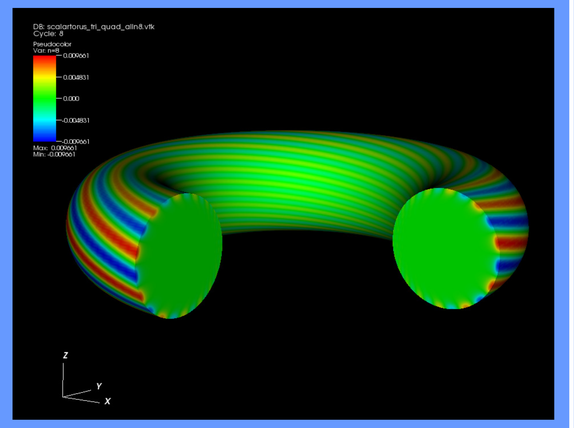
Other codes: CHEASE, CAXE,...

Stability analysis

Using the refined equilibrium, a linear MHD solver is employed to extract information on the MHD spectrum:

- Stable and unstable modes
- Eigenfunctions, frequency and growth rates

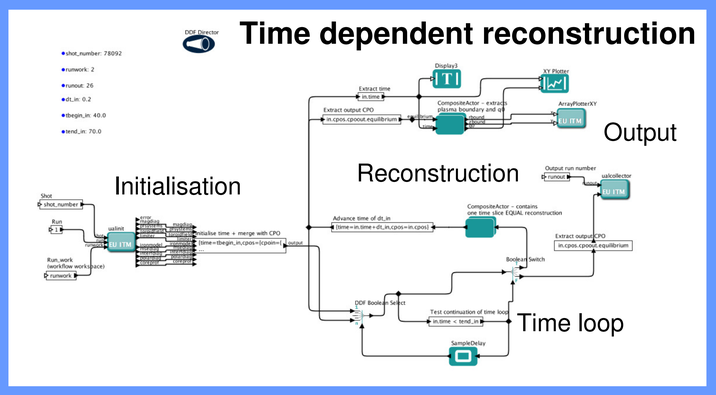
MHD stability analysis using ILSA

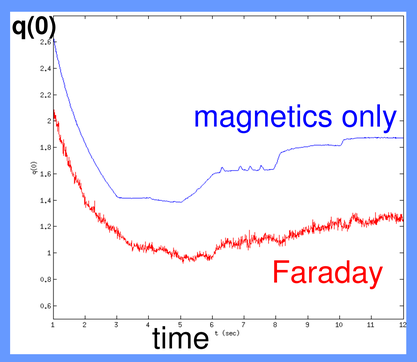


Example of n=8 peeling-ballooning mode

Other codes: KINX, MARS,...

Time dependent reconstruction





Prospects

The equilibrium reconstruction and MHD stability chain represents emblematically what the EFDA ITM Task Force can provide for the analysis of plasma discharges.

With the same integration approach, one can develop tools for micro-instability analysis, for power deposition analysis, for the interpretation of measurements of certain diagnostics,…

[Reference: C. Konz, this conference, 02.103]

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