EFDA Task Force Integrated Tokamak Modelling

EUROPEAN FUSION DEVELOPMENT AGREEMENT

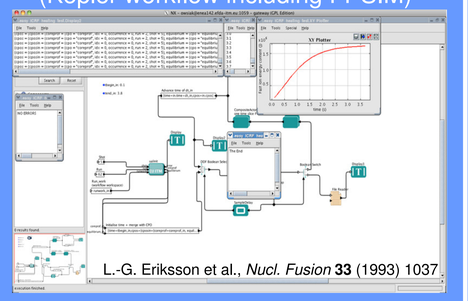
Heating, Current Drive and Fast Particles Physics (2)

IC&NBI physics

Ion Cyclotron (IC) modelling requires both:

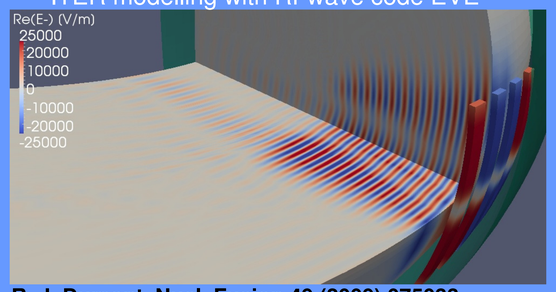
- Wave codes: e.g. TORIC, EVE
- Kinetic codes:
  - Simple model FPSIM (Fokker-Planck from PION), SELFO-light for e.g full pulse modelling
  - Advanced model New RF library, RFOF, for Monte Carlo codes build and coupled to ASCOT and SPOT

Simplified IC model
(Kepler workflow including FPSIM)



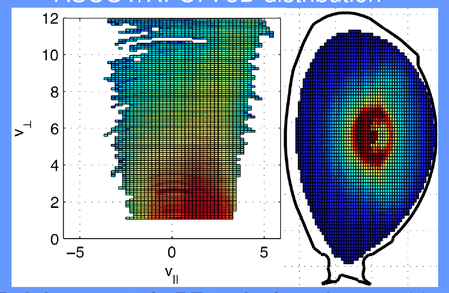
L.-G. Eriksson et al., *Nucl. Fusion* **33** (1993) 1037

ITER modelling with RFwave code EVE



R. J. Dumont, Nucl. Fusion 49 (2009) 075033

Advanced IC & NBI model
ASCOT/RFOF: 5D distribution

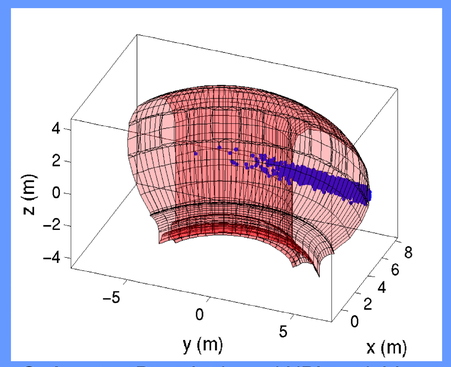


T. Johnson et al, RF-topical conference 2011

Neutral Beams (NBI) modelling requires

- NBI sources: e.g. BBNBI, NEMO,SNBI
- NBI slowing down modules:
  e.g. ASCOT, SPOT, NBISIM

NBI source from ASCOT module BBNBI



O. Asunta, "Beamlet-based NBI-model for ASCOT", P.001., 13th EFTC 2009

Fast particle physics

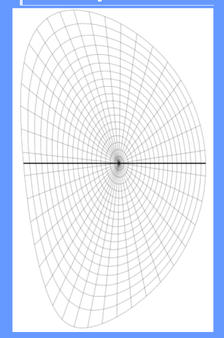
In a burning plasma, fast α particles are expected to transfer their energy via Coulomb collisions to the thermal plasma, thus providing a (nuclear self-) heating mechanism and a route to ignition.

The fusion reactions and/or auxiliary heating systems generate energetic particles characterized by velocities in the super-Alfvénic range, that can resonate with, and possibly destabilize, shear Alfvén modes (TAEs, EPMs, ...).

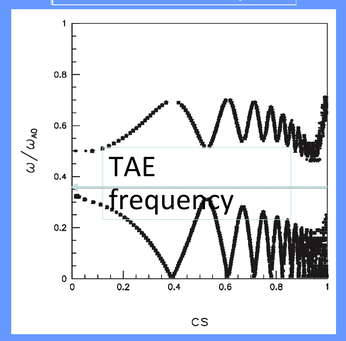
The mutual nonlinear interaction of shear Alfvén and energetic particles can, in turn, affect the energetic ion transport and confinement properties.

HYMAGYC is the new HYbrid MAGneto-hydrodynamic GYrokinetic Code currently being developed by ENEA-Frascati and fully integrated with the ITM data structure.

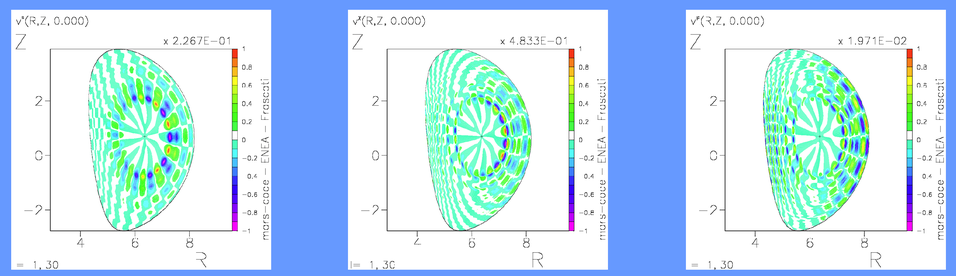
ITER equilibrium



Alfven continuum, n=9



TAE perturbed velocity components (v^s, v^χ, v^ρ)



EFDA ITM-TF Expo "The European Integrated Modelling effort : challenges and achievements" – 38th EPS 2011

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