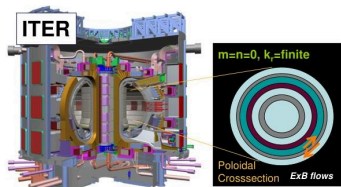


# Nonlinear dynamics of zonal flows and geodesic acoustic modes in ITER, De Vinci Research Center, Paris

D. GOSSARD, A. BIANCALANI, A. BOTTINO, T. HAYWARD-SCHNEIDER, P. LAUBER, A. MISCHCHENKO, M. PUJOL, M. RAMPONT, J.N. SAMA, L. VILLARD

- Turbulence develops in tokamak plasmas, due to the gradients of the density and temperature profiles.
- Zonal, i.e. axisymmetric, flows take part in the nonlinear saturation of turbulence.
- Two kinds of zonal flows exist:
  - **Zero Frequency Zonal Flows (ZFZF)**,
  - finite frequency **Geodesic Acoustic Modes (GAM)**.
- GAMs can also be driven by energetic particles (EP) due to inverse Landau damping, → **EP-driven GAMs (EGAM)**.



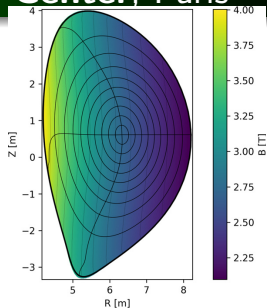
P. H. Diamond et al., *Plasma Phys. Control. Fusion*, 2005

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- Nonlinear interaction of EPs and EGAMs is investigated by using **ORB5** which is a multispecies electromagnetic gyrokinetic particle-in-cell code.
- Magnetic equilibrium from experimental predictions is considered.

## Few results :

- In the nonlinear phase, the resonance moves towards higher velocities.
- The saturation is occurring due to the redistribution of EPs in velocity-space.
- The gradient of EP distribution function in velocity-space flattens and the drive decreases.



T. Hayward-Schneider, et al., *Nucl.*

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