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Kinetic effects of energetic particles on MagnetoHydroDynamics instabilities in tokamaks plasmas

Guillaume Brochard¹

Supervised by Dr. R.Dumont¹, Dr. H.Lütjens², Dr. X.Garbet¹

1) IRFM, CEA Cadarache
2) CPhT, Ecole Polytechnique

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Magnetic confinement fusion





Fusion reactions occurs naturally in the Universe

Fusion on Earth extremely challenging

Magnetic confinement fusion, a promising way forward

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Internal kink mode structure



- Energetic particles perturb MHD stability
- Kinetic-MHD instabilities induce transport of energetic particles
- Energetic particles are needed to sustain the plasma heat

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Kinetic-MHD theory





- Resonant interaction between the MHD mode and the particles orbit frequencies
- Non-linear hybrid code needed to study these instabilites
- Linear verification against analytical theory







XTOR-K validated against linear model/code MHD-K

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- Validation completed at lower energies (100keV) due to intrinsic assumptions
- Quantitative study of the instability thresholds on ITER in process

Early non-linear results

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- Early phase non-linear simulations retrieved experimental features (mode chirping, particle transport)
- Code currently being written to observe in phase space the non-linear evolution of the resonances

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Non-linear hybrid code XTOR-K verified against analytical theory

Study of the thresholds for the ITER reactor ongoing

Numerical tools for the study of the non-linear resonances underway

