Resistive Wall Mode physics and control

WPSA Project Planning Meeting
Group discussion: MHD modelling and control

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Contributors

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Ideal MHD stability & RWM

Investigating stability to pressure-driven global MHD modes with MARS-F/K codes: above n=1,2,3 no-wall limits

Rotational stabilization of RWM in drift-kinetic model (n=1)
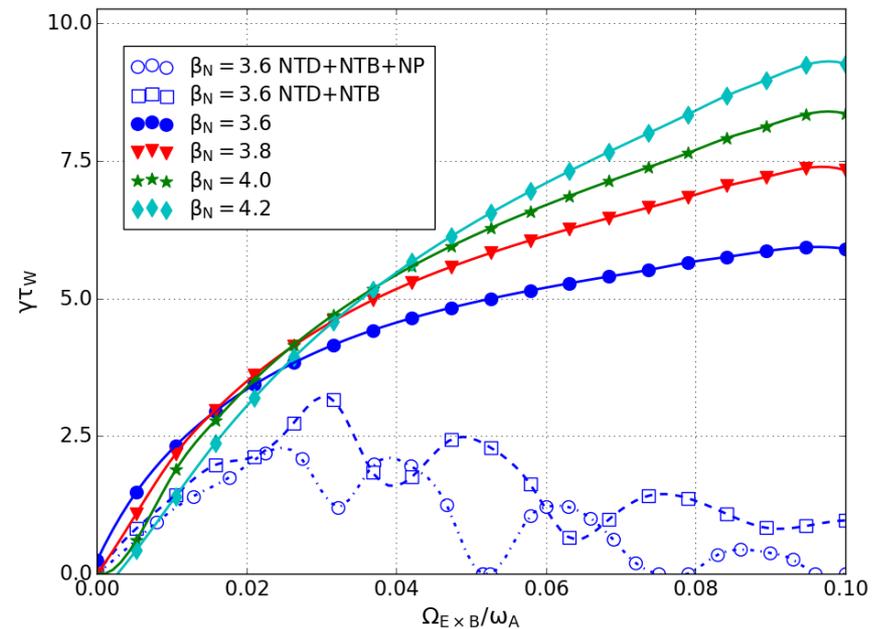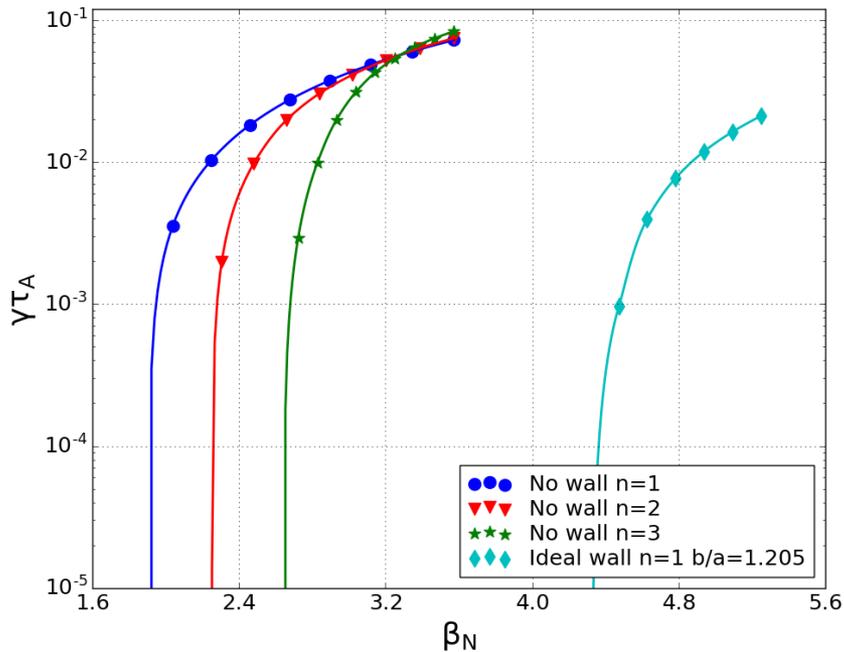
Feedback control of RWMs

- Multi-n RWM feedback
- Eigenvalue problem
- Time simulations: latency, detection thresholds
- Importance of non-ideal effects on RWM stability: CarMa-D
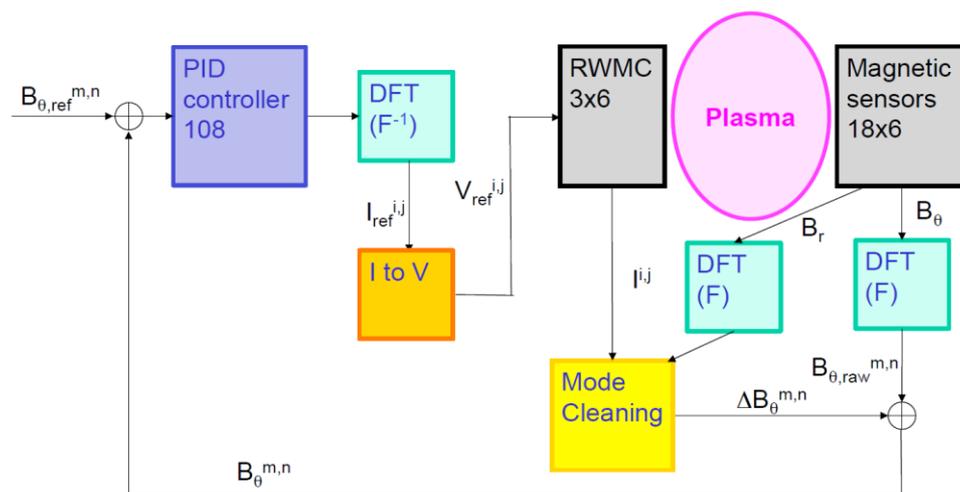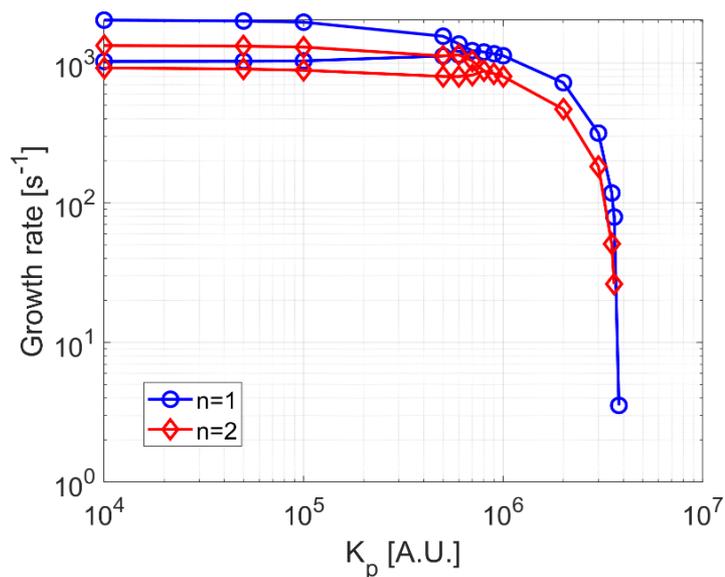
n=2 RWM gets strong stab. effect

MARS-K simulations with full kinetic pressure tensor (not including EPs though..)

α_D: scaling factor from fluid to kinetic model
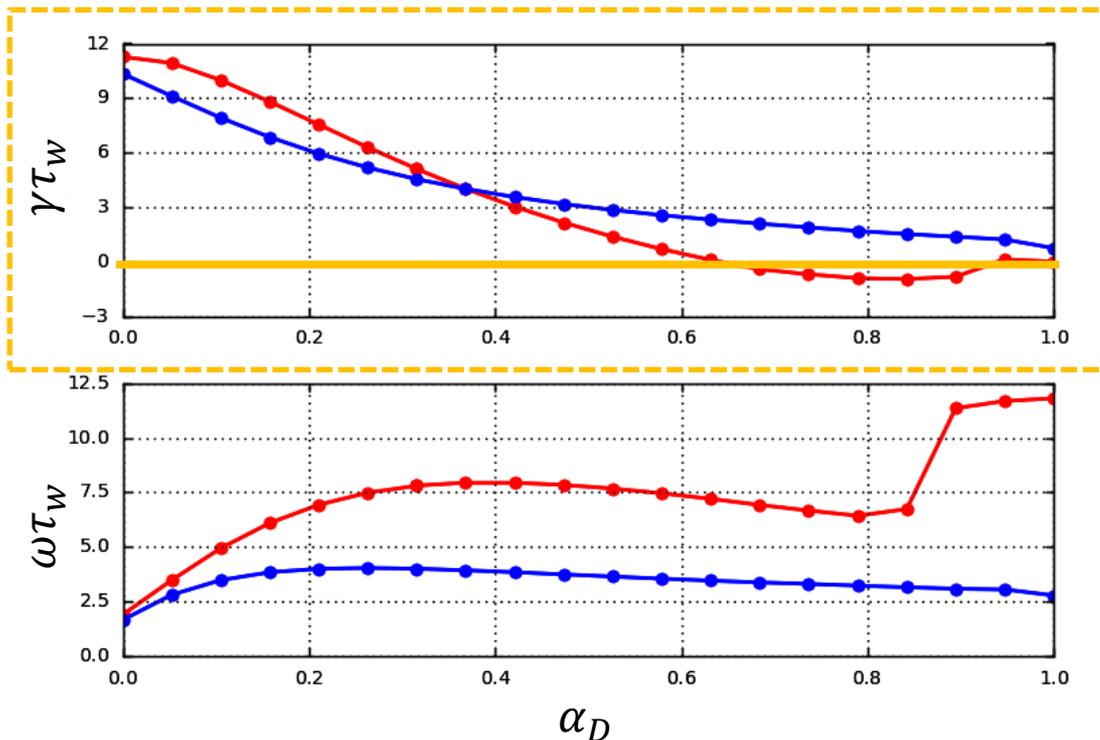
The n=2 mode is eventually **stabilized**

Robust with respect to flow magnitude

Modeling RWM in JT-60U

JT-60U shot **#46224**: modeling rotational stabilization with MARS-K

This numerical result includes the **precession drift resonance** effect

Scanning rotation from strong to weak, the mode is found stabilized at $\Omega/\omega_A \sim 0.044$

Partial picture shows higher threshold compared to experiment: destabilizing effect from EPs (?), **effect of poloidal rotation** (?) …
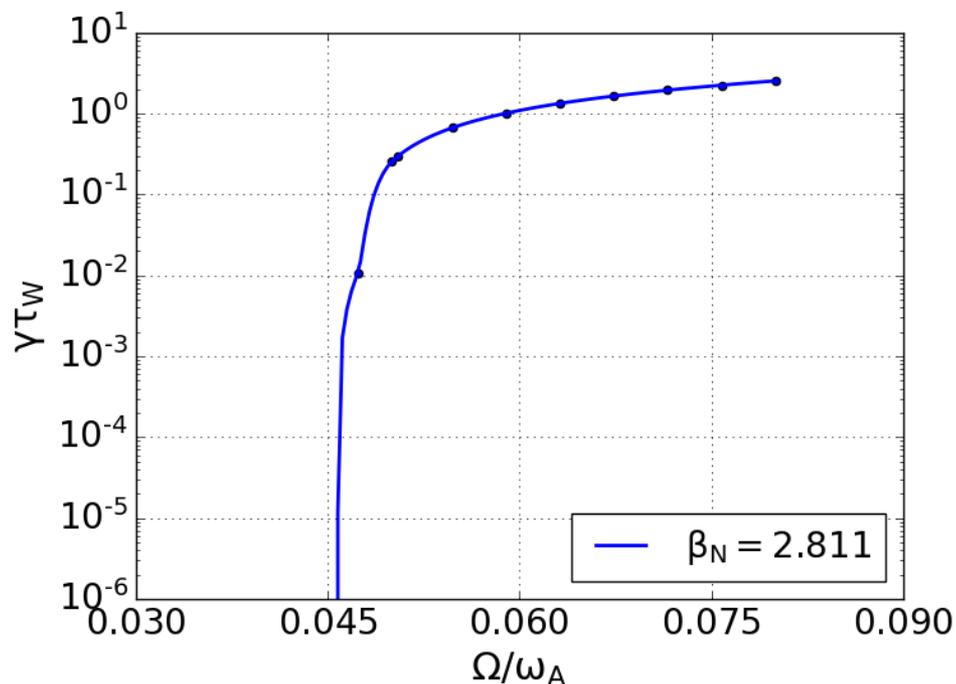
3D plasma response to RMPs

- MARS-F for plasma response computation
- n=1 RMP, plasma scenario #3
- Plasma response to Equivalent Surface Current
- Reconstruction of 3D field with inverse DFT
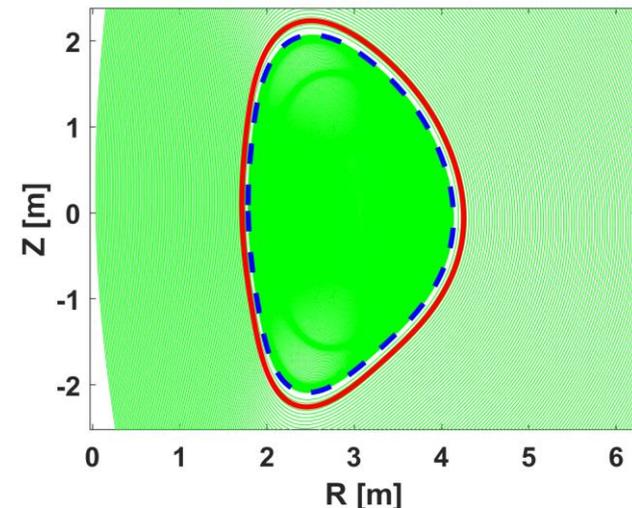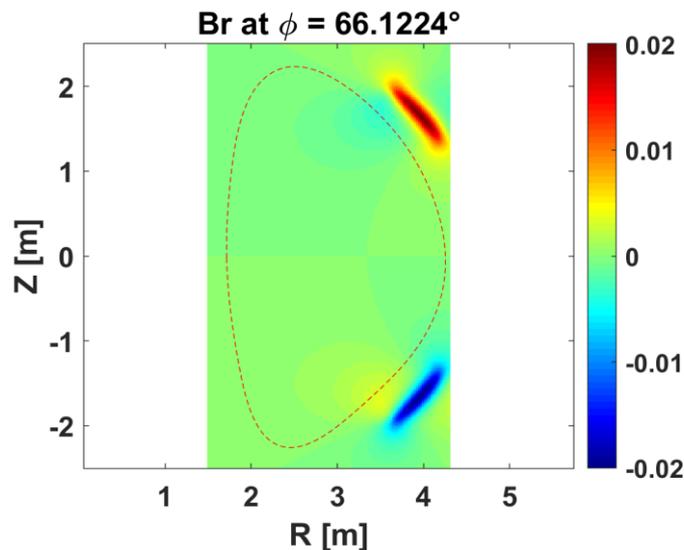
Input vacuum field (biosaw) M.Vallar

Reconstructed 3D response

Response to each n harmonic of input field and re-combined with DFT^{-1} on plasma boundary (ongoing work)

Vacuum
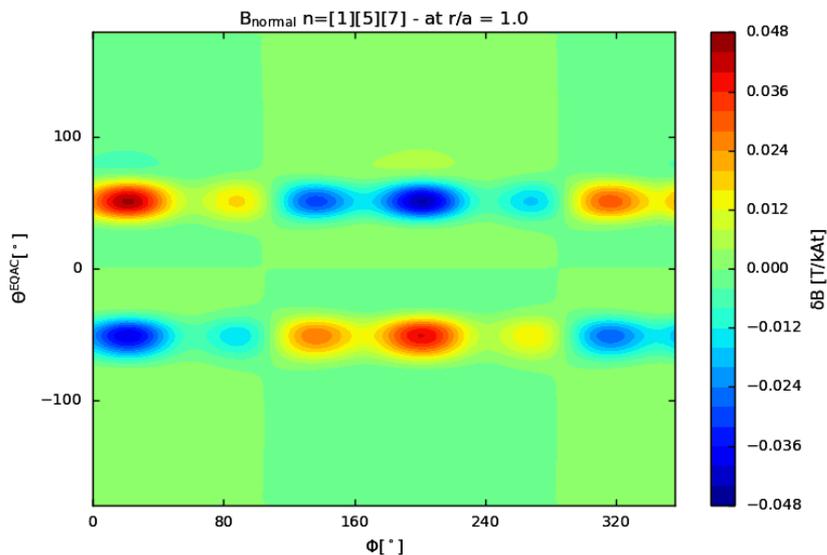
Response
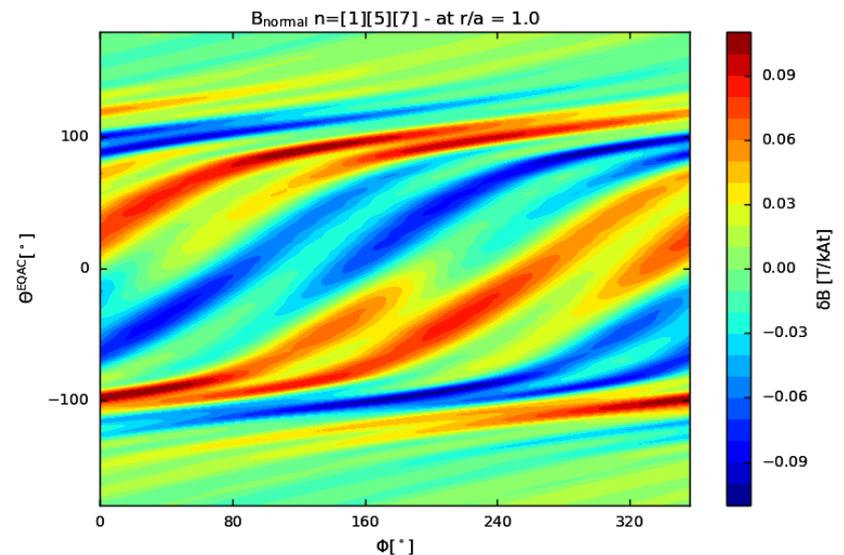
Work in 2021 and onward

- Integrated commissioning (magnetics & MHD)
  - Data access, documentation
  - Validation of EM models using mag data

- Discussion started with QST team for disruption database: right time now to revamp?

- MHD stability modeling for high β

- Plasma response in fast ion distribution