Stabilization of the Resistive Wall Mode and Error Field Reduction by a Rotating Conducting Wall


### Theory predicts rotating wall can stabilize RWi

- Linear: For high plasma pressure and MHD results presented.
- Rotating wall:
  - Safety Factor: $q_a r/a = 0.3$
  - Round wall:
    - $\omega = 2 \alpha r/a$
    - $\Gamma [\text{arb}]$
  - Elliptical plasma.

### Steady-state error field shielded and advected by rotating wall

- Error fields ($E_{ax}, E_{az}$):
- Equilibrium plasma currents ($B_{eq}$).
- Error field excluded and advected by wall.

### Vertical field penetration time decreases as wall rotation increases

- Can be understood by examining how wall-epsilon modes: fast static, slow static, and then introduce rotation.
- Band wall creates single wall
- Error fields into slow and fast root.
- Fast root: course-flowing weakly currents.
- Slow root: course-flowing weakly currents.

### Plasma has intrinsic ExB rotation due to electrostatic current drive

- Baseline plasma: H-mode, equilibrium wall and angle require radial electric fields.
- Rotating radial flow profile has radial and slow axial. MHD modes are naturally kink-like in the device.
- Flow must be linked to observe MHD stabilization.

### Rotating wall stabilizes locking RWi

- Wall stabilization most clearly seen when error field field constant.
- Growth rate induced by wall rotation.
- Growth rate is non-linear: cannot compare to theory. Lock mode rotation forcing couple to wall.

### Mode-locking observed and fit to canonical model

- Restoring torque to ExB rotation.
- Wall Electromagnetic torque calculated Error field torque included.

### Rotating model extended to differential treatment wall rotation

- Differential rotation effects electromagnetic torque.
- Wall rotation is modulated to lock.
- Wall rotation has modulated effect on locking threshold.
- Very strong effect on unlocking threshold seen.
- For fast counter-rotation the bifurcation disappears and no locking possible.

### Wall rotation has modulated effect on locking threshold.

### Experimental eigenfunctions are Anode Localized in Device

- Experimental eigenfunctions are: equilibrium, adiabatic localized.
- Those predictions are symmetrical.
-Axis boss facility achieving ExB mode downstream.

### Observed Eigenfunctions are Anode Localized in Device

- Experimental eigenfunctions are: equilibrium, adiabatic localized.
- Those predictions are symmetrical.
- Axis boss facility achieving ExB mode downstream.