Stabilization of the Line-Tied Resistive Wall Mode by a Rotating Conducting Wall


---

Device Overview

- **Diagnostics:**
  - 80 Radial Field Magnetic Coils
  - 30 Azimuthal Field Coils
  - 10 Axial Field Coils
  - Assorted Probes
  - Segmented Anode

- **Plasma Source:**
  - 19 Electrostatic Guns
  - Arc & Bias to 1kA

- **Pulse Width Modulation scheme** allows control of plasma current in each gun

- **Axially Inserted Probes Determine Plasma Parameters:**
  - Langmuir: tri-$B$ dot
  - Mach: Optical

---

The Resistive Wall Mode Has Been Found in the Device

- Magnetic Diagnostics used to analyze the coherent MHD fluctuations seen in the experiment
- The RWM growth rate has a characteristic dependence on the boundary material wall time
- Spatial Fourier decomposition enables specific MHD modes to be tracked in time

---

Theory Predicts Rotating Wall Can Stabilize RWM

- Linear, force free, incompressible, ideal MHD results presented
- The dispersion relation plotted as a function of the q-value shows the crossover to stability

---

High Speed Rotating Wall Has Been Built

- Max speed = 280 km/h
- Radius = 10 cm, Length = 1m
- Shaft: 1mm Cu + 3/8" 304SS Drive: 15HP Motor
- Bearings: SKF Angular contact Control: VFD & NI Fieldpoint
- Lubrication: SKF Oil-Spot Diagnostics: Temp, Speed, Vibration

---

Preliminary Results Suggest RWM Stabilization

- Rotating wall discharges can show dramatically reduced m=1 amplitudes
- Effect observed in the mid-plane, anode end of the experiment, away from flux rope merger region
- Rotating wall appears to drag mode in its direction of motion

---

Asymmetry Seen in Rotation Direction

- Wall rotation can be either stabilizing or destabilizing
- Consistent with Doppler shifted wall rotation as seen from a rotating plasma
- However, RWM magnetic structure is locked to the wall
- Time history shows strong destabilizing or stabilizing effect of the rotating wall
- Dynamic error fields still seen in stabilized case
- Work remains to quantify this asymmetry - flows likely the cause

See M. Brookhart

---

Reprints:
email: pazsoldan@wisc.edu
web: https://mywebspace.wisc.edu/pazsoldan/web/APS2010.pdf