XP 809: ELM Destabilization by RMP

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NSTX Results Review

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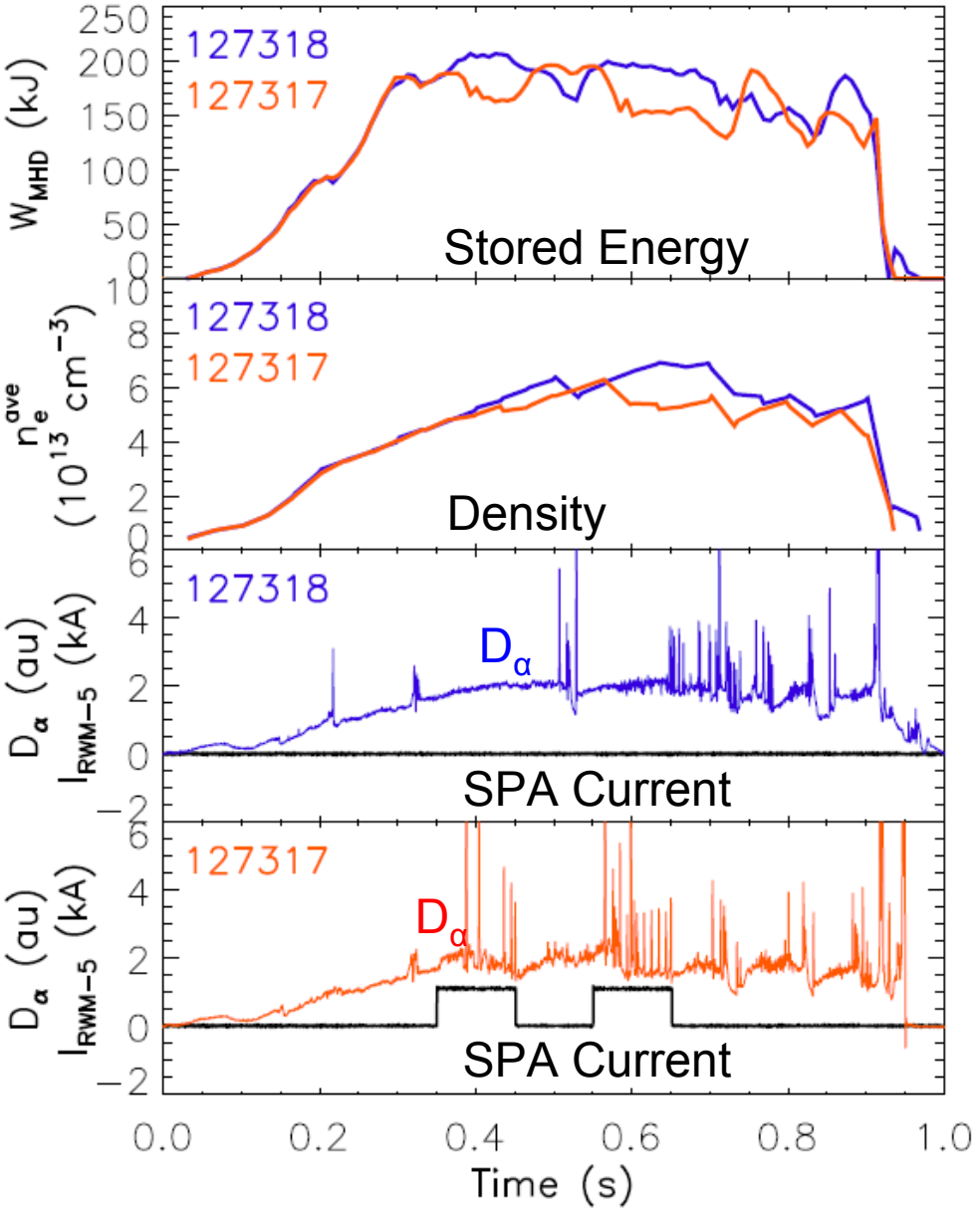
XP 809: ELM Destabilization by RMP

- Goals of XP
  - Determine threshold RMP level for destabilization
  - Explore connection between ELM-triggering and recycling by alternating RMP on/off
  - Measure pedestal profiles for stability analysis
  - Mid-run goal added: use magnetic ELM-triggering to reduce impurity buildup in LITER ELM-free H-modes

- XP Summary
  - Three ½ days allocated (2/29, 6/23, 7/11)
  - ELM-triggering successfully reproduced and documented
  - ELM-pacing results look promising
    - Can trigger ELMs without too much degradation of plasma
    - Reduces ramp-rate of radiated power and density

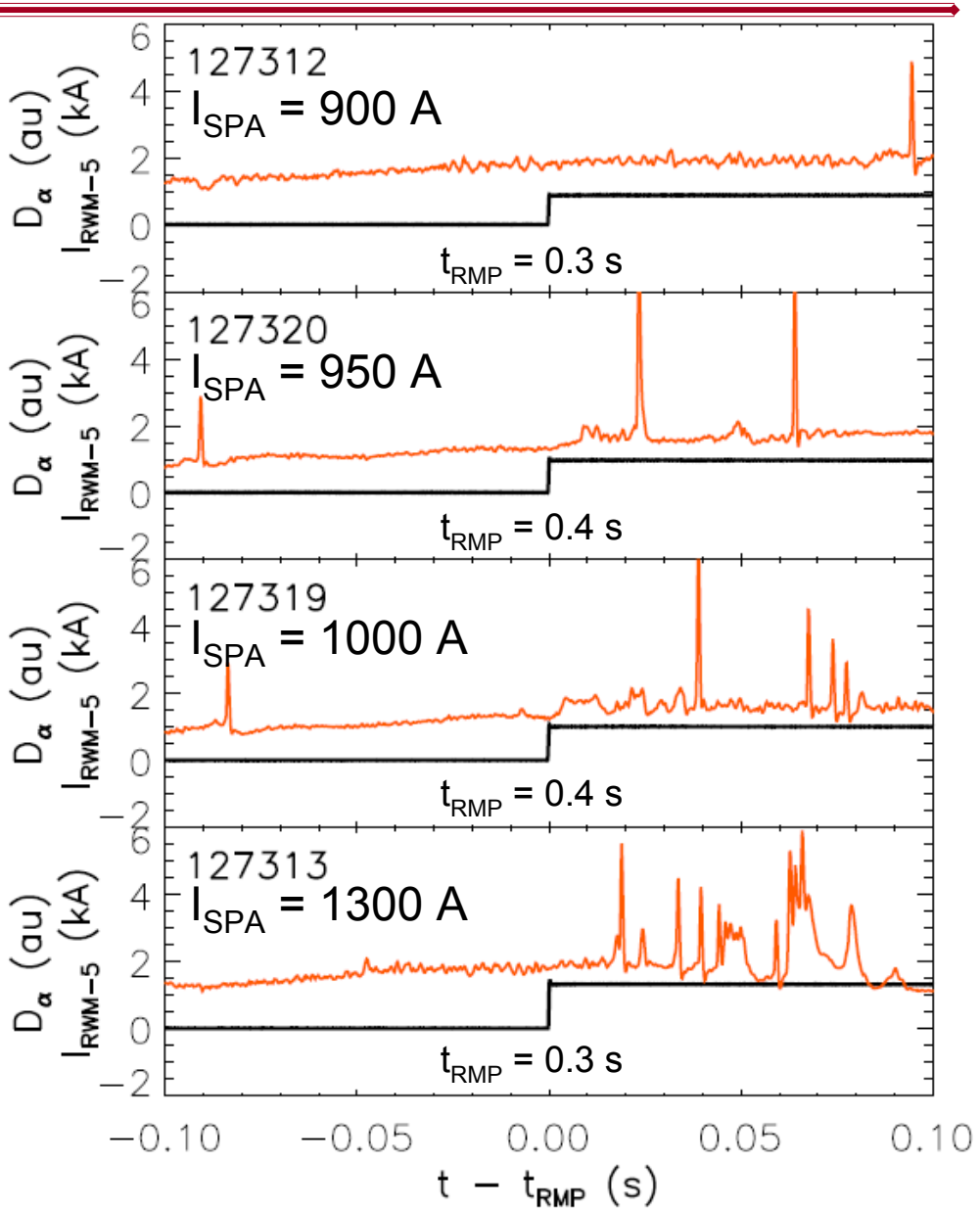
RMP ELM-triggering was demonstrated in δ~0.8 discharges

- Control discharge (127318) had ELM-free period to 0.5 s
- When n=3 RMP is applied (127317) ELMs start within ~50 ms
- ELMs disappear when RMP is removed at 0.45 s, reappear with second SPA pulse
  - Doesn't appear to be linked to recycling
  - Shot-to-shot SPA timing scan confirms that ELMs are connected to application of RMPs



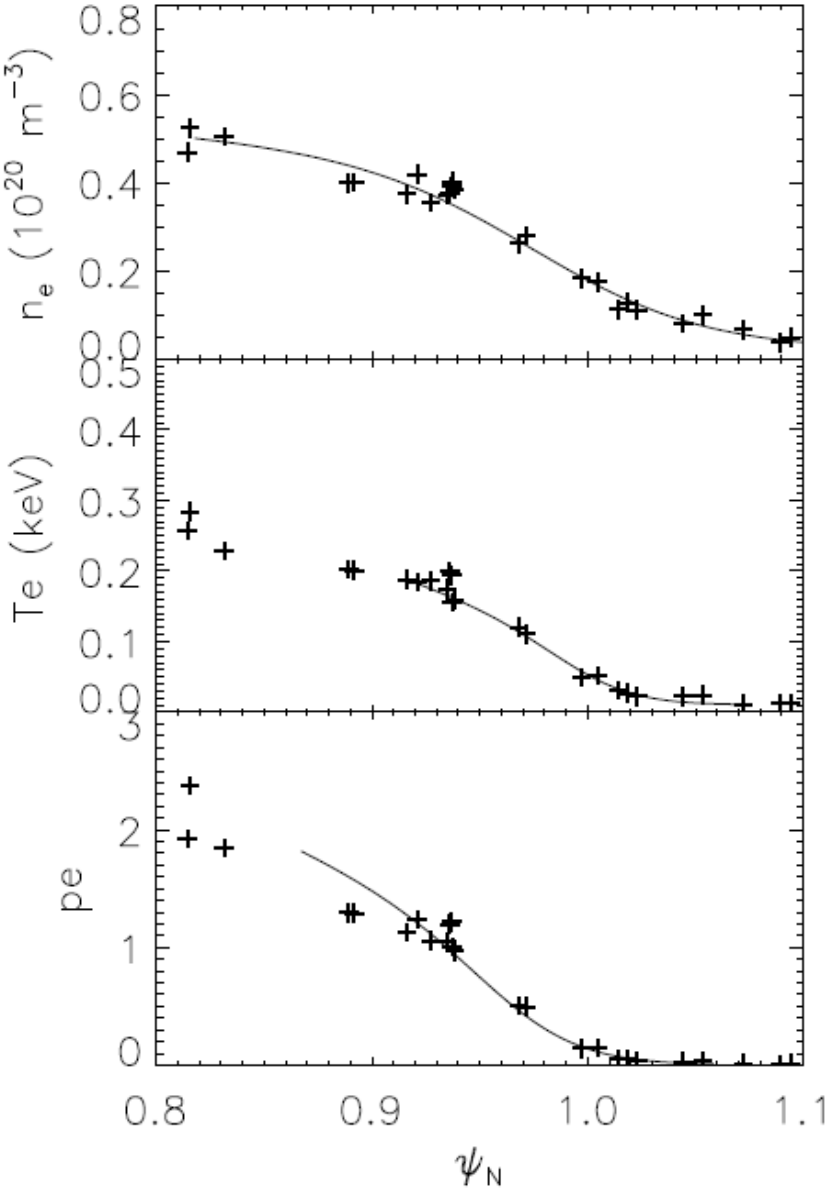
SPA current scan revealed destabilization threshold

- Threshold SPA current for ELM-triggering is ~950 A
  - No triggering at 900 (natural ELMs start at ~0.5s in control)
  - Intermittent ELMs at 950 and 1000 A
- ELM frequency appears to increase with RMP magnitude
  - ELMs become more regular
  - Tendency clouded by tendency of plasma to lock and disrupt at high currents- too much braking



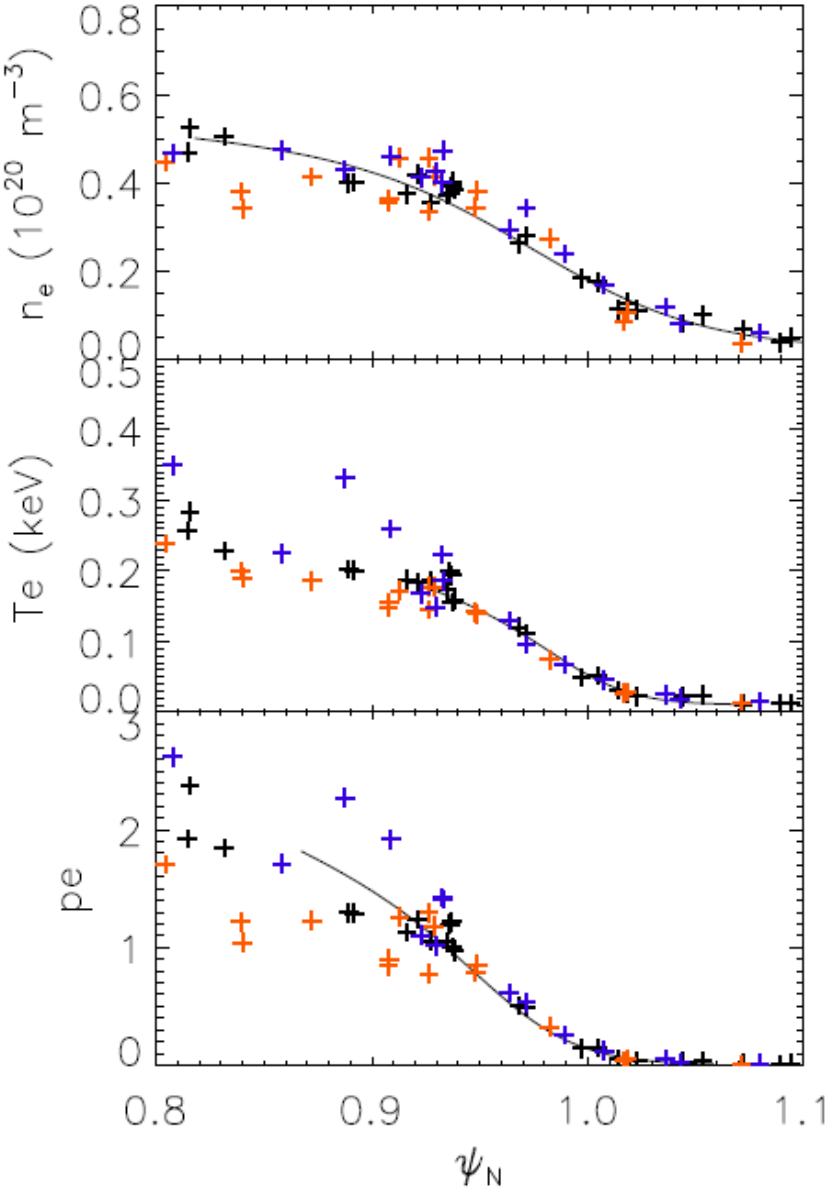
RMP doesn't have an obvious effect on pedestal profiles of n_e, T_e

- Profile fit from T. Osborne's python routines
- 127318, 375 ms
  - No RMP



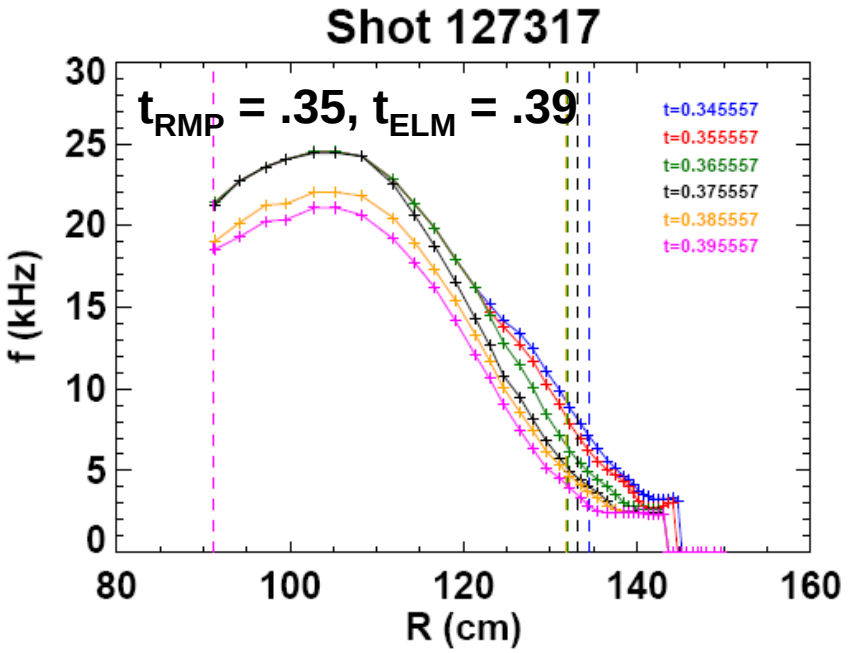
RMP doesn't have an obvious effect on pedestal profiles of n_e, T_e

- Profile fit from T. Osborne's python routines
- 127318, 375 ms
  - No RMP
- 127319, 375 ms
  - RMP on
  - 60-99% of ELM cycle
- 127317, 400 ms
  - RMP on
  - 50-99% of ELM cycle

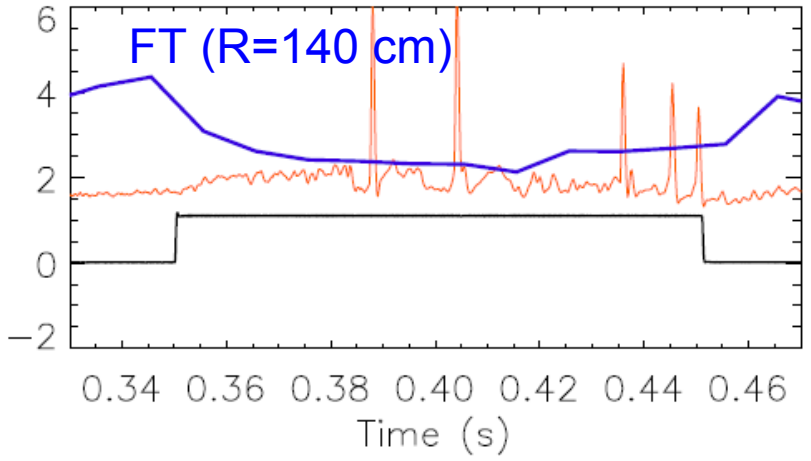


Toroidal rotation drops with RMP

- Lots of braking with n=3 field
- Edge rotation drops in ~20 ms when RMP is applied
- But profile around R=140 cm looks nearly stationary before ELMs start (only purple curve is after the 1st ELM)

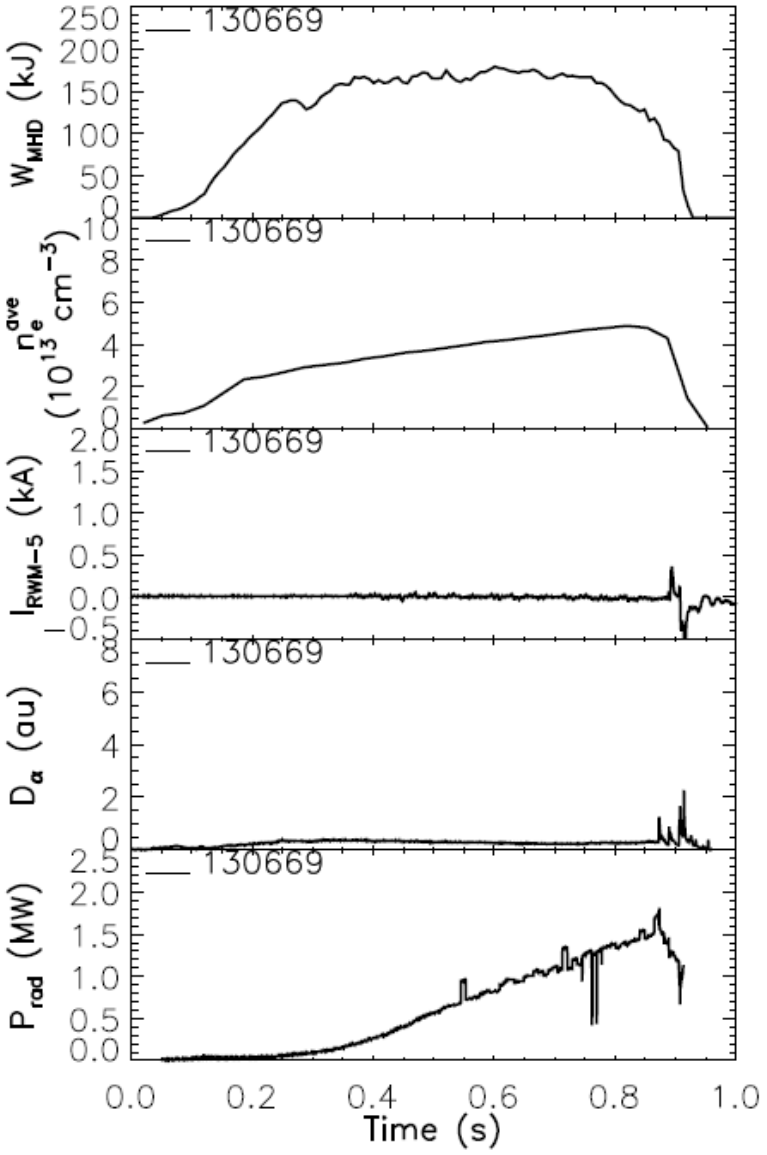


- Connection between ELMs and v_{tor} (R=140 cm) not obvious
- Similar trends seen in other RMP shots



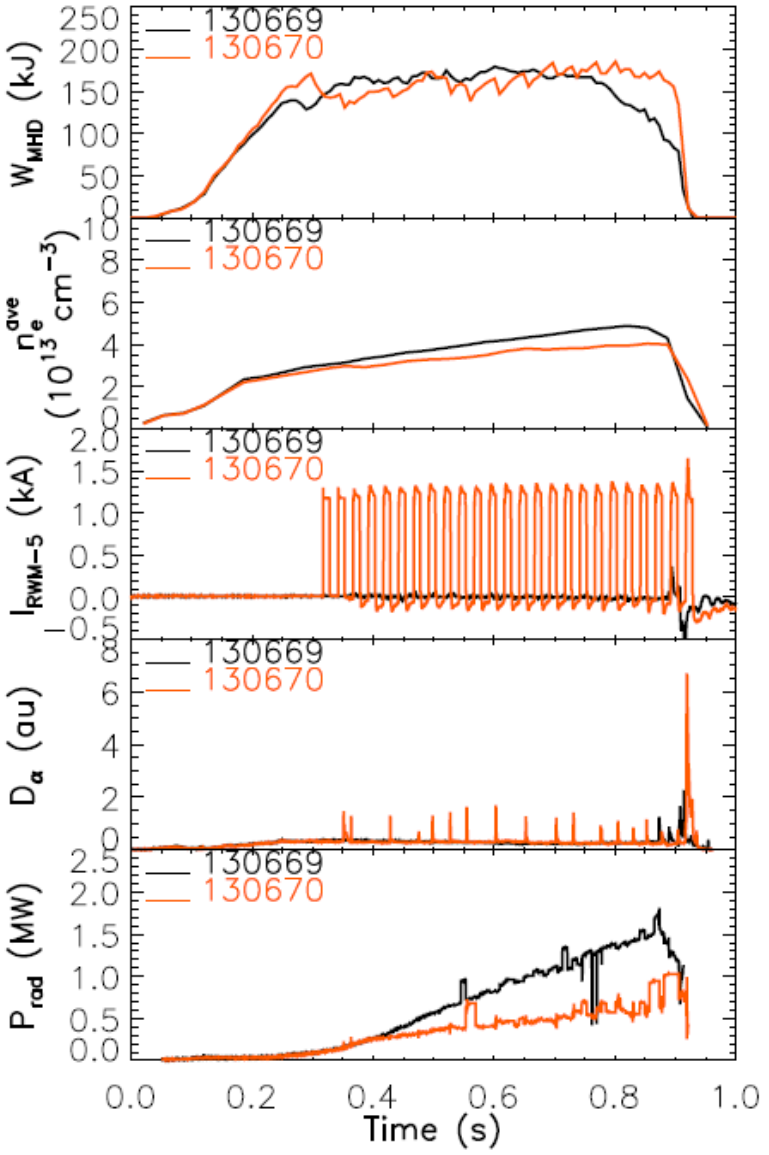
Magnetic triggering has been applied to LITER ELM-free H-modes

- Typical behavior with Li conditioning
  - No ELMs
  - Impurity accumulation (Prad ramps to 1.5 MW in this case)



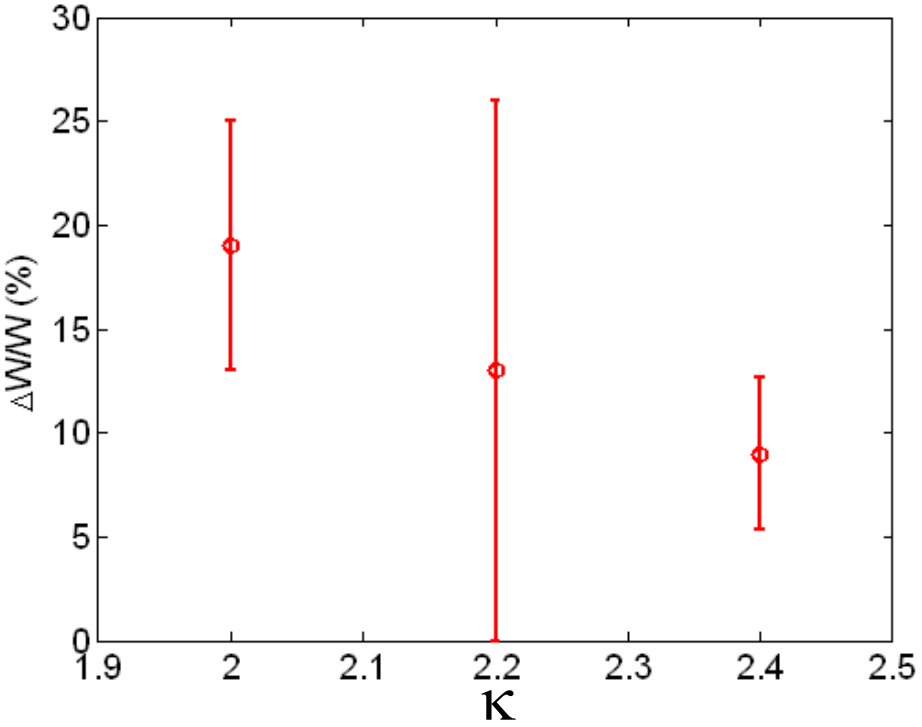
Magnetic triggering has been applied to LITER ELM-free H-modes

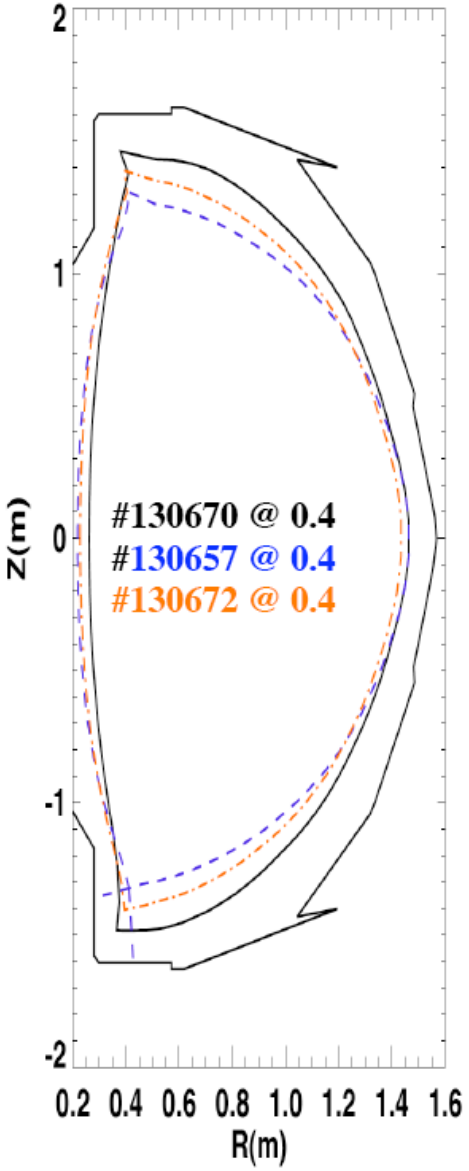
- Typical behavior with Li conditioning
  - No ELMs
  - Impurity accumulation (Prad ramps to 1.5 MW in this case)
- RMP square wave applied to LITER dicharge
  - 11 ms pulses, f=40 Hz, amp. = 1.2 kA
  - ELMs triggered on ~80% of pulses
  - Total radiated power reduced by a factor of ~2
  - Density ramp rate also decreased
  - Stored energy relatively unaffected



Smaller, more frequent ELMs are triggered at high elongation

- ELM-triggering in LITER discharges was done for κ=2.0,2.2 and 2.4
- ELMs always large (~10%), but decrease ir size as κ as increased
- RMP pulse frequency can be increased (maintaining reliable triggering) at high κ





Pulse width of 8-12 ms required for reliable triggering

- Triggered ELMs happen ~10 ms after start of RMP pulse (pulses shown are 11 ms wide)
- With 8 ms pulses, triggering rate drops to ~50%
- Pulse width might be limited by field penetration time