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XP: ELM stability dependence on edge current, q, and collisionality (from XP1031)

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V1.0

Goal: complete scans of XP1031 that varied thermoelectric current, edge J and q, stopped short of ν

- Last year XP1031 Goals/Approach
  - Test expectations ELM stability theory considering changes to edge toroidal current density, field-aligned thermoelectric current, and collisionality
    - 1) Generate target
    - 2) Vary TE current connection length at fixed 3D field (Vary x-point height; DRSEP)
    - 3) Vary 3D field amplitude (not done)
    - 4) Vary toroidal current density near the edge
    - 5) Vary collisionality with LLD (not done)
- Proposal: complete this experiment, pursue interesting findings
  - Ran full shot list except reduced ν – issues/interests
    - 2) Vary TE current connection length at fixed 3D field (Vary x-point height; DRSEP)
      - X-point height / DRSEP scan: X-point height varied during scan: much better control now
      - => RUN a (3 pt / 4 pt) X-point height / DRSEP scan with good x-point height control
      - => Vary 3D field amplitude in two steps during this scan – does ELM character/stability change vs. X-point height and 3D field

R(11-4) milestone support

Request: 0.5 run days in FY11

    - 4) Vary toroidal current density near the edge
      - ELM mitigation found when positive edge current applied (constant B_t)
      - => Pursue this finding: (i) reproduce it, (ii) greater variation of q with I_p (and/or B_t) ramps
    - 5) Vary collisionality: A FY2010 pursuit to determine effect of collisionality on stability – e.g. effect of ν on thermoelectric current

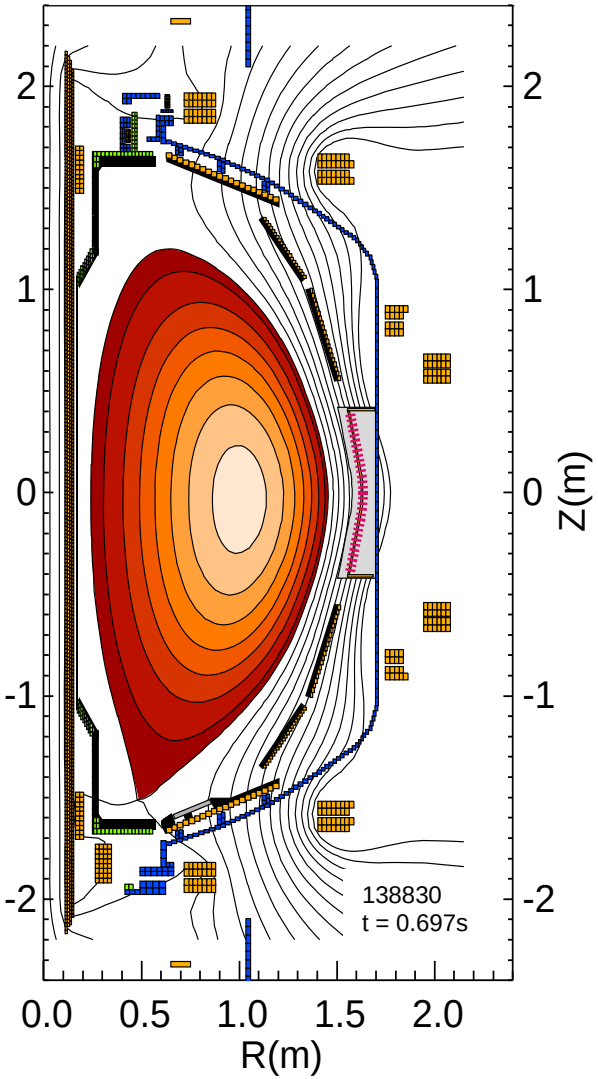
R(12-3) milestone support

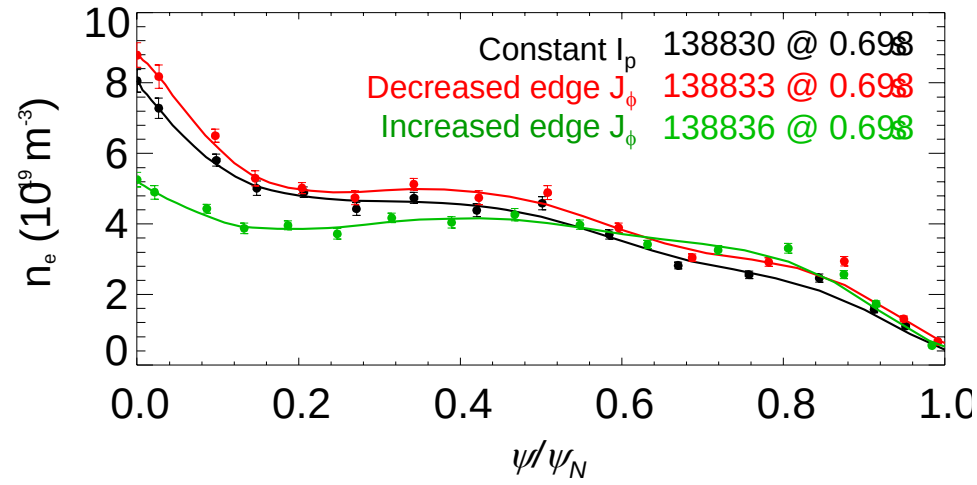
Request: 0.5 run days in FY12

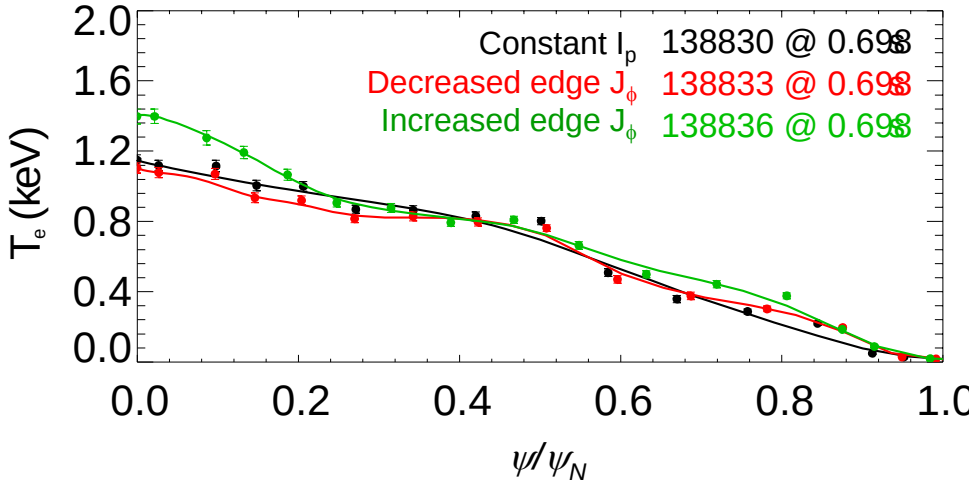
Backup slides – Data from XP1031

XP1031 medium triangularity target and kinetic profiles for toroidal edge current scan

Medium triangularity target



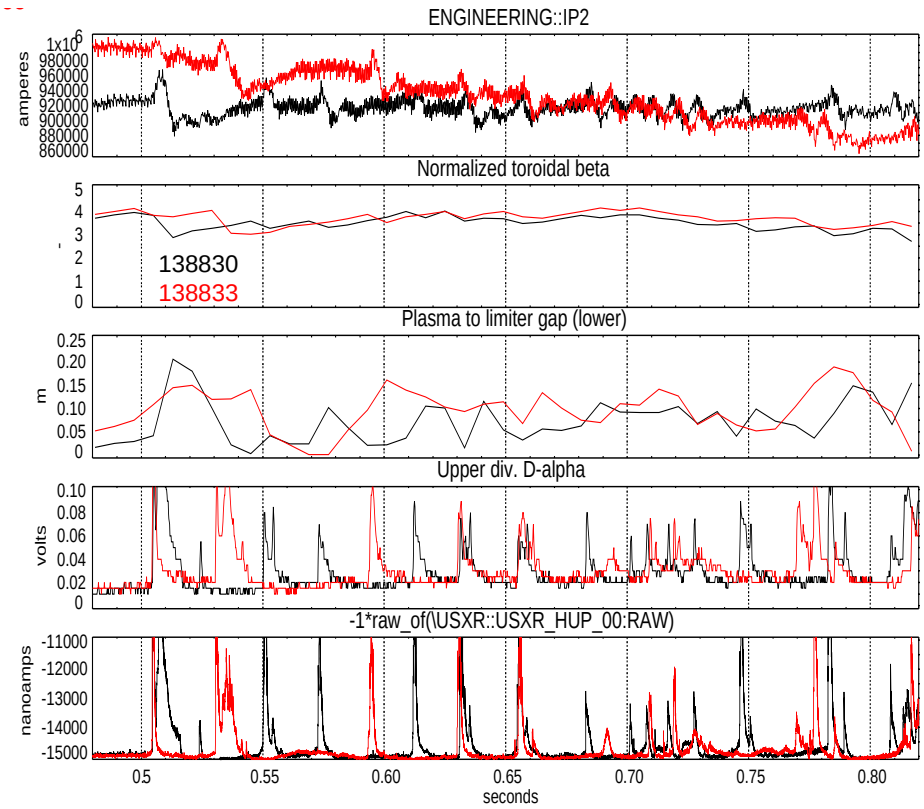




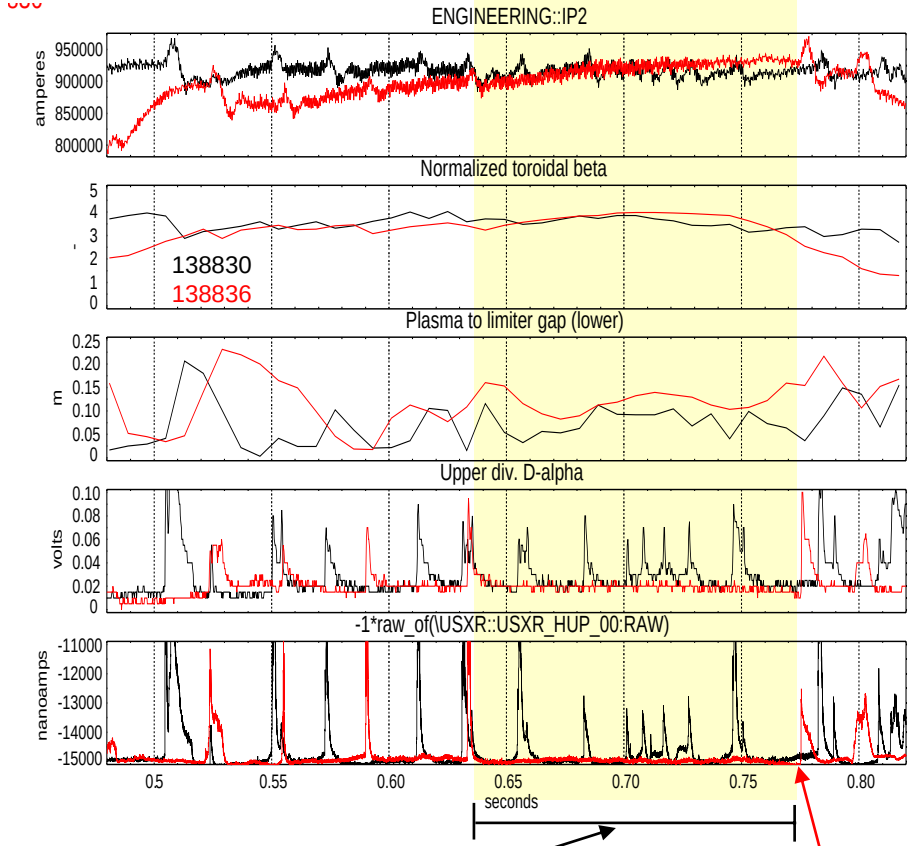
- Profile comparison (n_e, T_e vs. ψ_N) for shots with edge current changed

XP1031: ELM stabilization with positive current ramp + 3D field during ELMing phase in medium triangularity plasma

Constant I_p and decrease edge J: similar ELMing

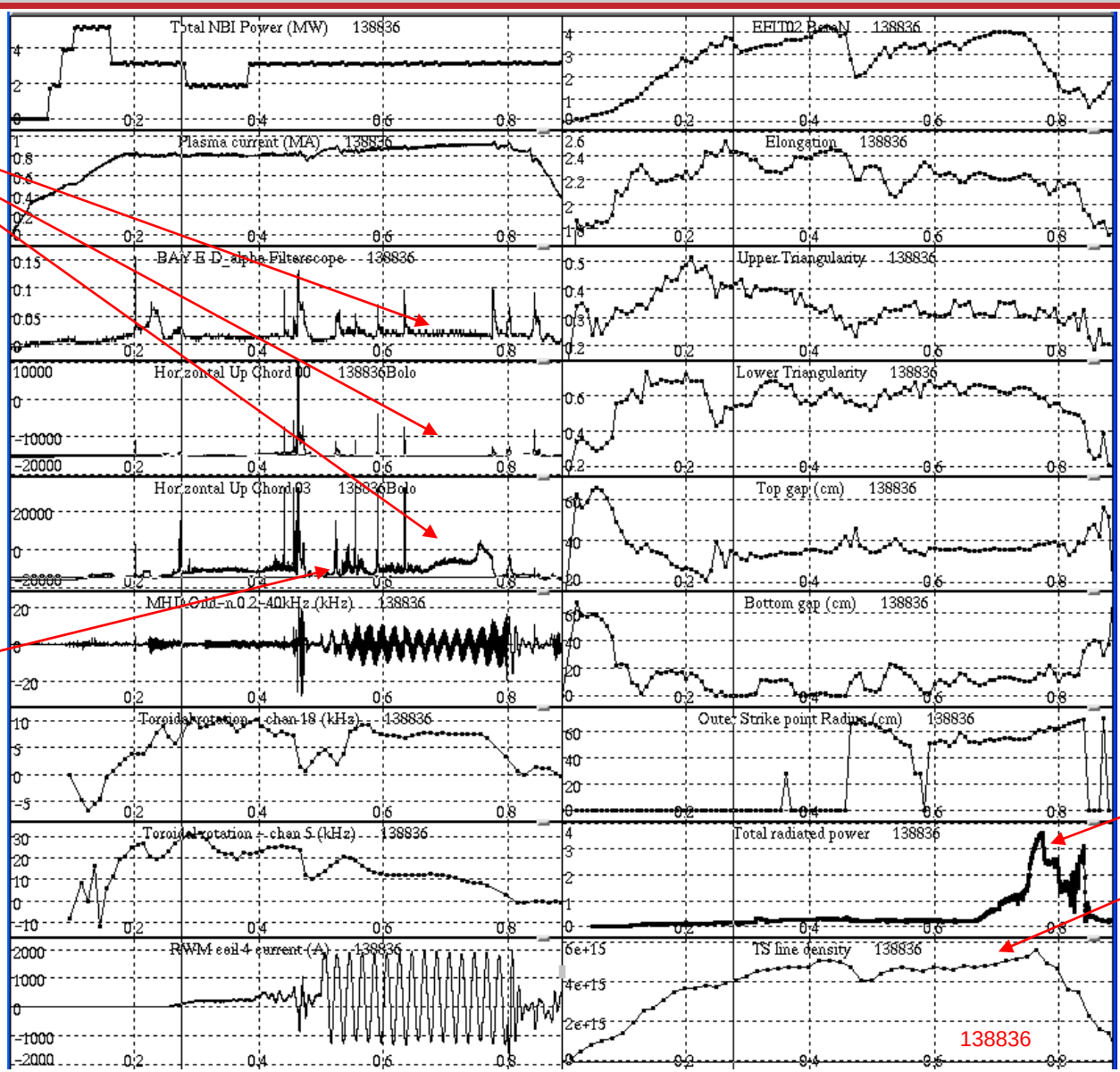


Constant I_p and increase edge J: ELM-free period found



H-mode terminates in ELM-free discharge from P_{rad} increase

ELM free period



H-L back-transition, at I_P ramp start, but recovers H-mode

Density rises, and P_{rad} sharply rises during ELM-free period

Latest XP1031 run yielded different ELM stabilization results – analysis continues to determine key physics differences...

- Initial run: **medium triangularity target** with 3D fields applied (κ = 2.2, q_{95} = 8.4)
  - Did not stabilize ELMs with negative current ramp
  - Stabilized ELMs with positive current ramp
- Recent run: **fiducial target** with 3D fields applied (κ = 2.35, q_{95} = 9.6)
  - Needed to switch target plasma
    - Medium triangularity target was further developed with better control (FAR BETTER X-point height control); was not controlled on the run day (issue w/outer strike point crossing CHI gap)
  - Did not stabilize ELMs with negative OR positive current ramp
    - Due to higher triangularity target, different q profile (resonance effect)?
    - Due to stronger n=3 field compared to ELM stabilized shot from initial run?
- Recent run: **lower kappa target** without 3D fields applied (R. Maingi)
  - Did not stabilize ELMs with negative OR positive current ramp (κ = 1.9, q_{95} = 8.2)