NSTX

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XP1031: MHD/ELM stability dependence on thermoelectric current, edge J, ν - Update

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NSTX Results / Theory Review

December 1st, 2010

PPPL

V1.0

XP1031 MHD/ELM stability dependence on thermoelectric current, edge J, ν

Goals/Approach

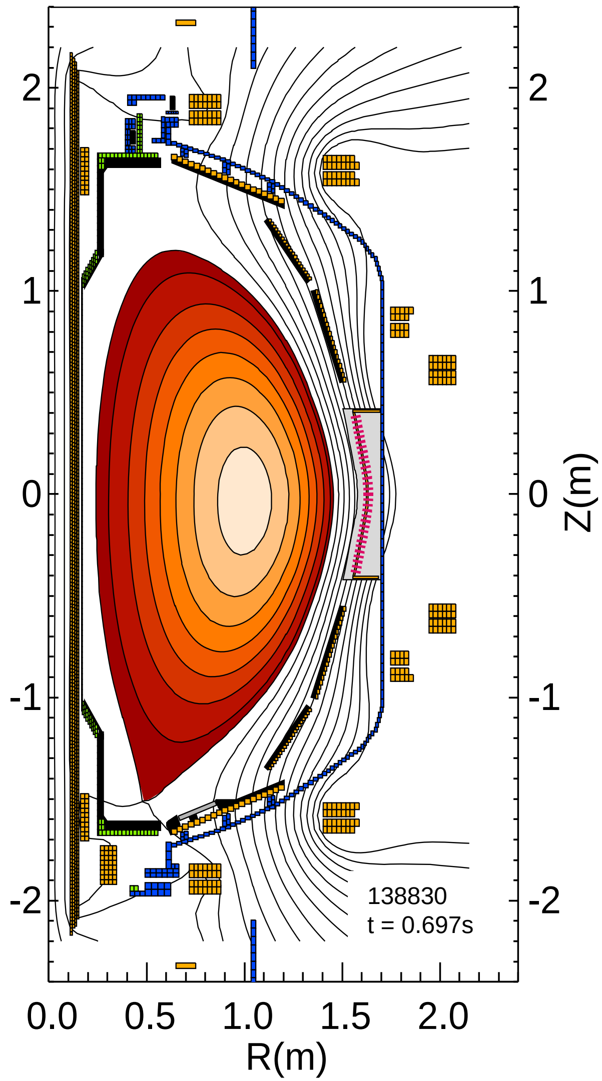
- Test expectations ELM stability theory considering changes to edge toroidal current density, field-aligned thermoelectric current, and collisionality
  - 1) Generate target
  - 2) Vary TE current connection length at fixed 3D field (Vary x-point height; DRSEP)
  - 3) Vary 3D field amplitude
  - 4) Vary toroidal current density near the edge
  - 5) Vary collisionality with LLD

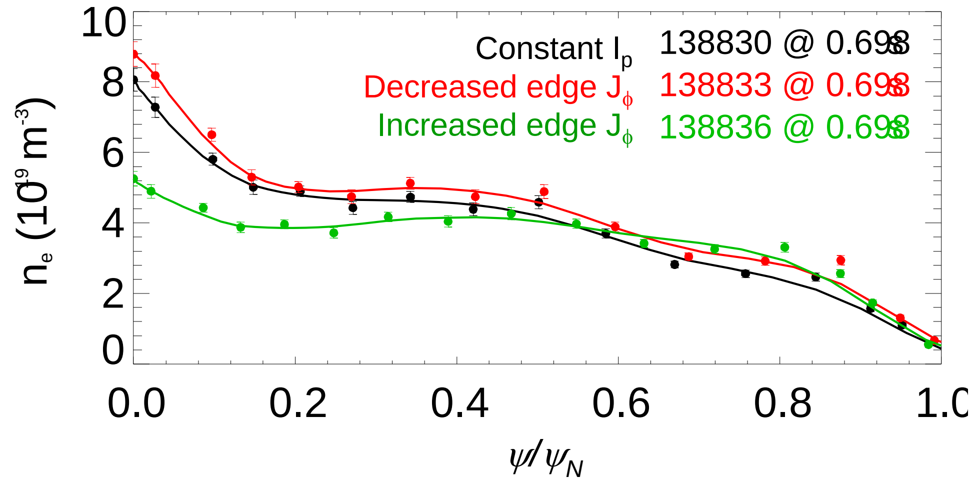
Present data

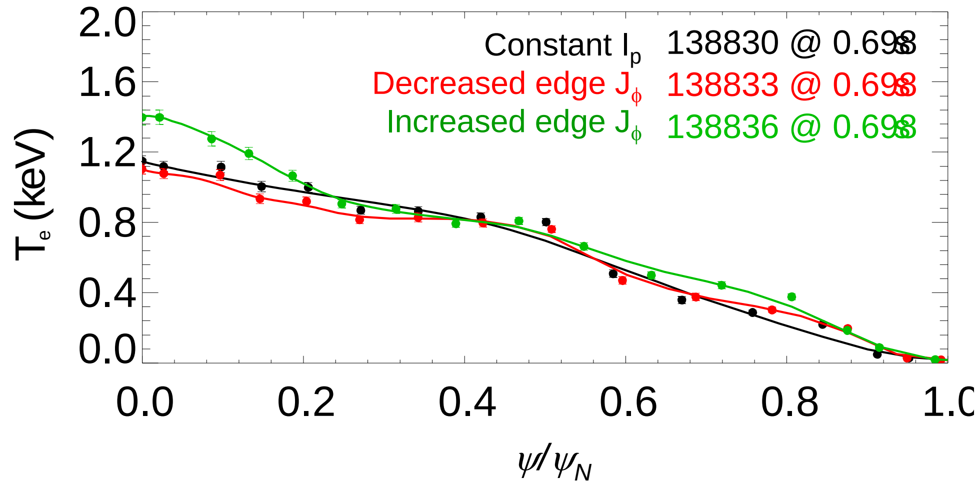
- Ran full shot list except reduced ν
  - X-point height and DRSEP varied separately (tricky for operators early on)
    - ELMs change with variation – to be analyzed
  - Target reproduced with ELMs induced by 3D field
  - 50 Hz n = 3 field mostly used in med. δ target, DC field used more in fiducial target
  - Scrape-off layer current detail measured by LLD shunt tiles / Langmuir probe arrays
    - e.g. n = 1 clearly seen during initial part of ELM, changing to n = even
  - ELM stabilization when positive edge current applied (constant B_t)

One XP1031 scan examined the effect of toroidal edge current change on ELM stability

Medium triangularity target



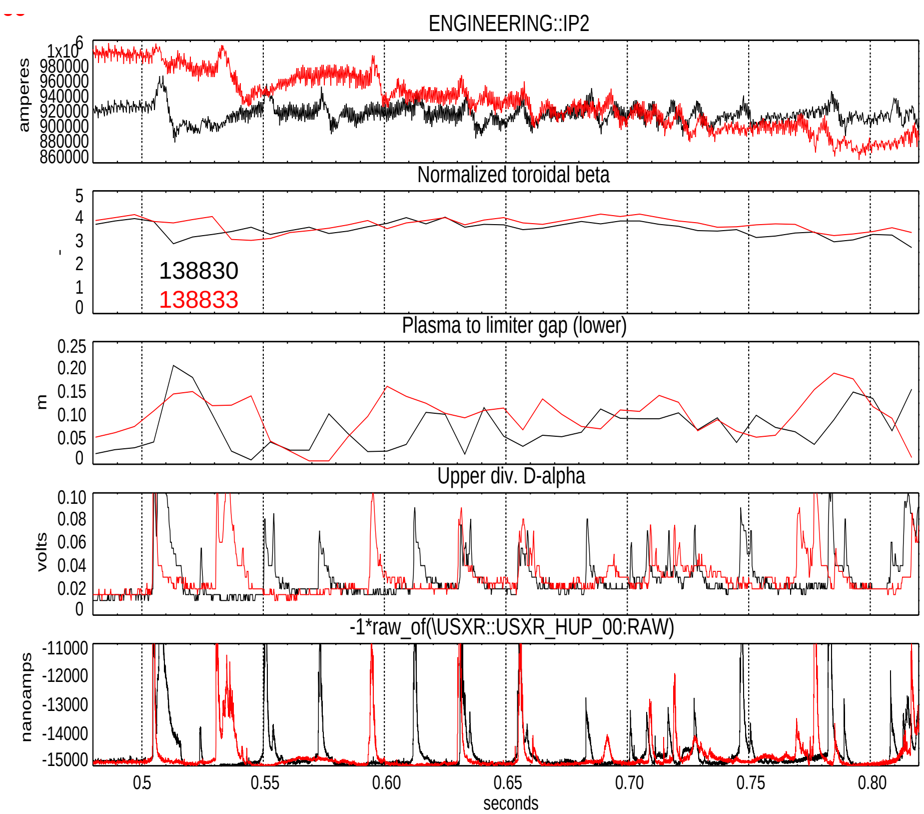




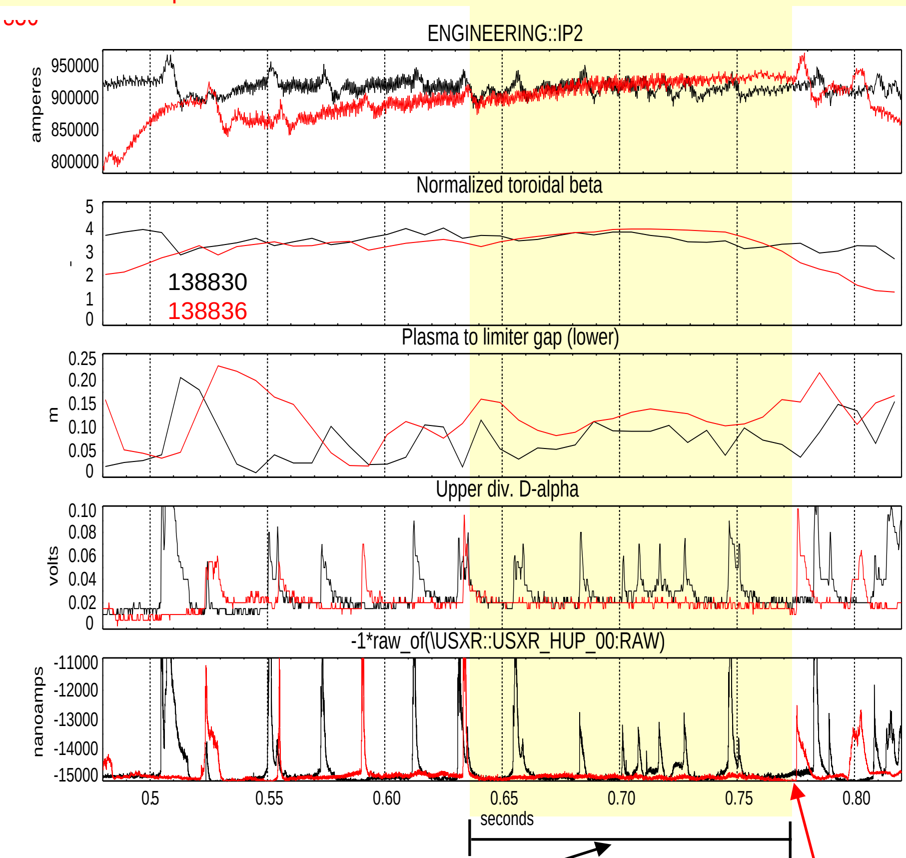
- Profile comparison (n_e, T_e vs. ψ_N) for shots with edge current changed

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



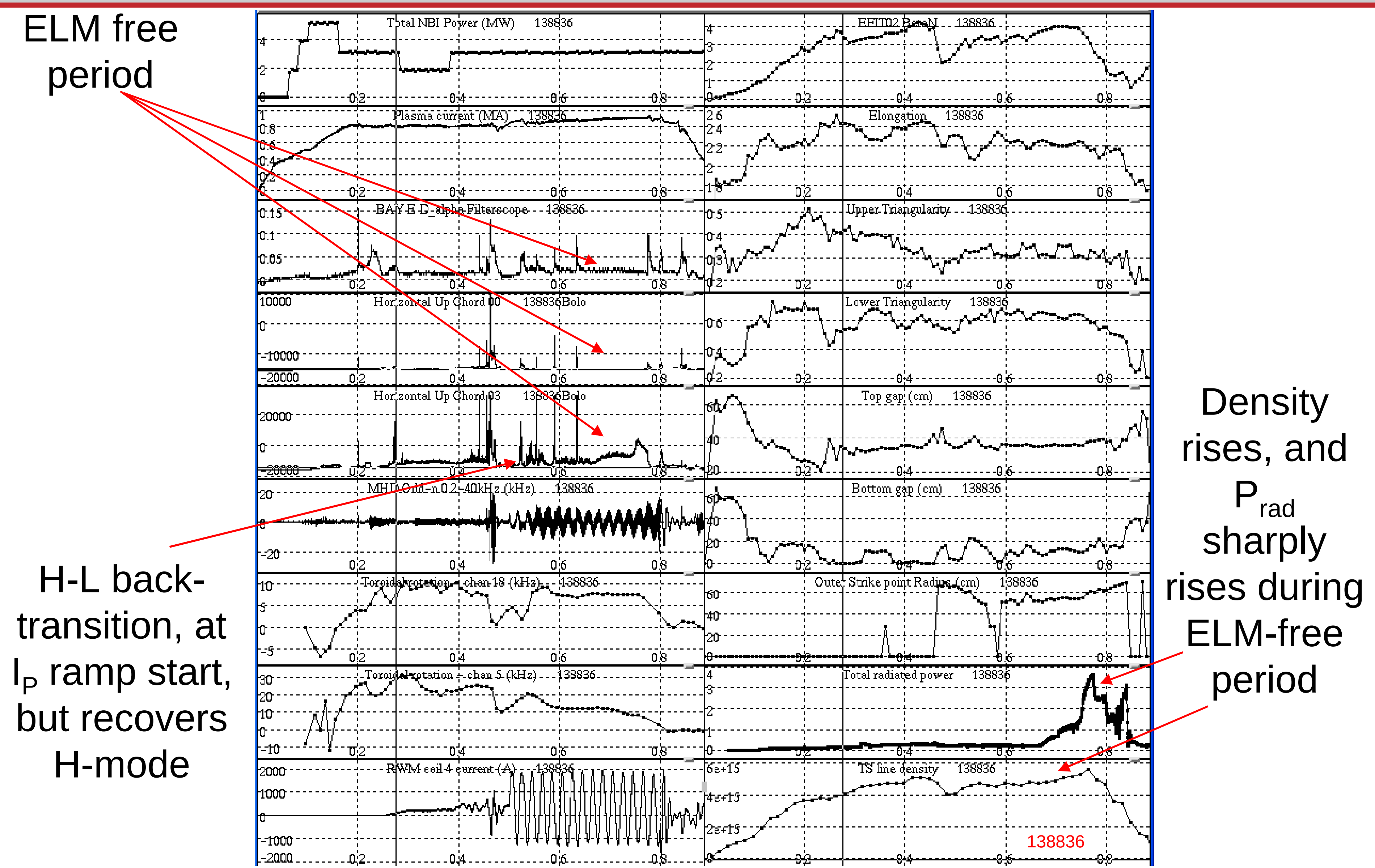
Constant I_p and increase edge J: ELM-free period found



ELM-free period (plasma in H-mode)

H-L back-transition

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



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 negative 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)

- Future Analysis
  - Examine key differences between target plasmas run
  - Examine
    - Variations of stability of baseline target configurations
    - Variations due to change of TE current (X-point height, DRSEP)
    - Variations due to change of edge toroidal current density