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Joint Experiment on ELM Mitigation with Midplane Control Coils

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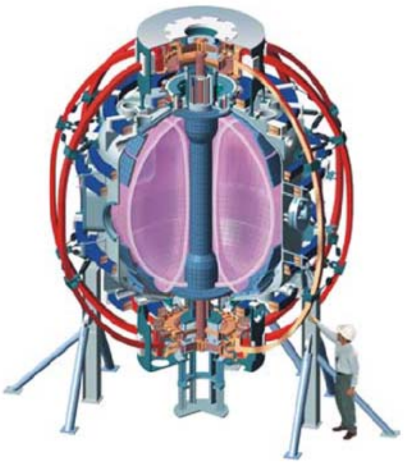


Joint ELM Mitigation XP Meeting
February 4, 2008
Princeton Plasma Physics Laboratory

Considerations for Joint ELM Mitigation XP Run Plan

- Target Plasmas and General Approaches
  - What target(s) should be used?
    - Giant ELMs, or smaller ELMs?
    - What variation of q95?
    - What plasma shape, DRSEP, etc. ?
  - DC applied fields
    - Decide on "most favorable" approaches (see strawman run plan)
  - AC applied fields
    - Still examining effect ELMs, connection to toroidal rotation (SAS)
  - n = 1 feedback – use B_r feedback on ELMs with frequency < 1kHz
- Technical Logistics of the Run Plan
  - Application of non-standard DC fields will require overnight buswork change
    - Group similar needs on same day, put special needs on 0.5 day with another XP not needing RWM coil current
  - Iterate run plan, review XP by 2/11/08

Joint ELM Mitigation XP - Run plan (STRAWMAN)

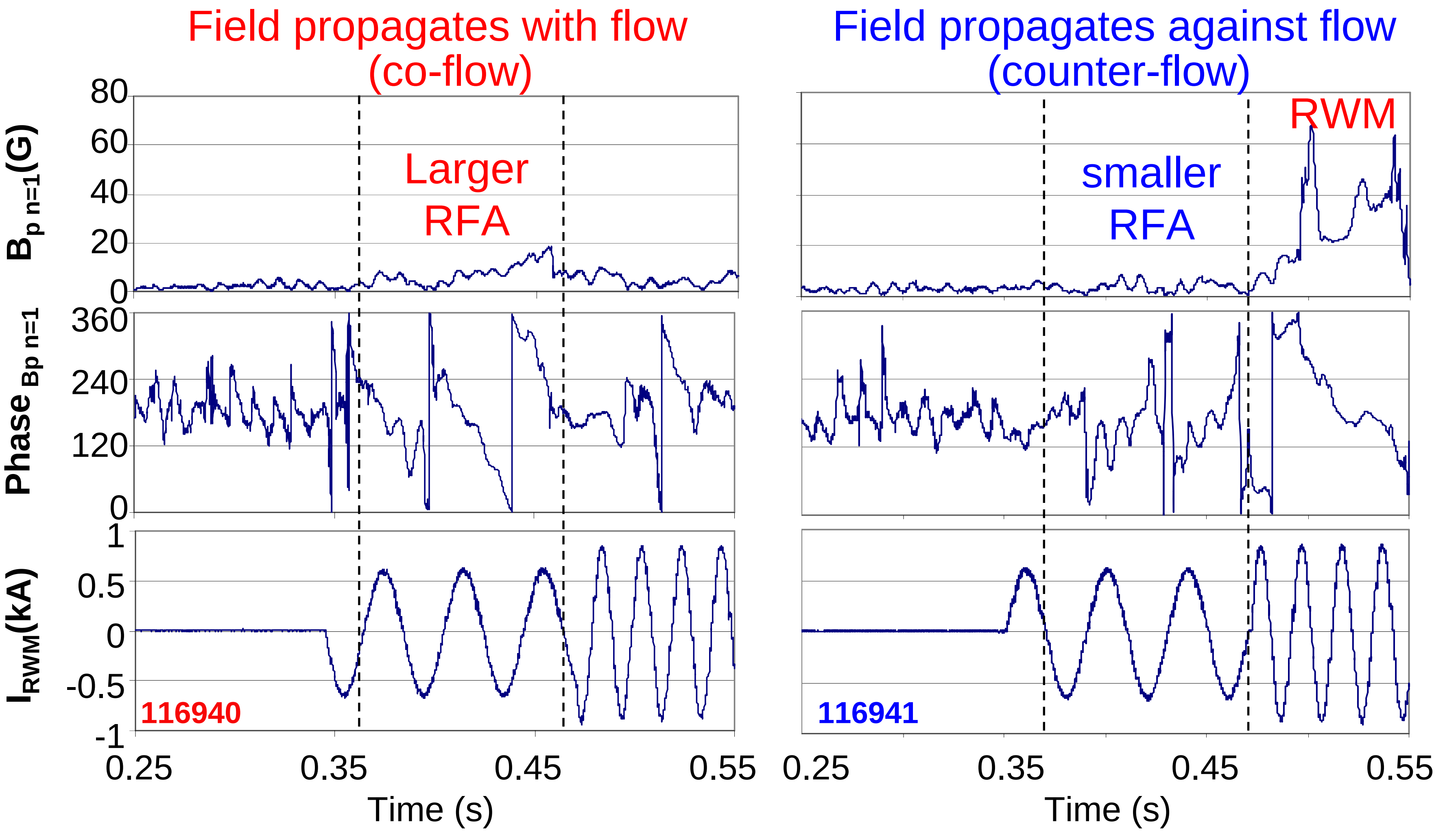
Task	Number of Shots
1) Create targets (i) below, but near and (ii) above ideal no-wall beta limit (control shots)	
(use 125271 (large ELMs) as setup shot, 2 or 3 NBI sources, relatively high κ ~ 2.0 or above to avoid strong rotating modes)	
A) No non-axisymmetric field, 2-3 NBI sources, q95 ~ 8	2
B) Reduce q95 ~ 6 (NOTE: attempt lower q95 than this?)	2
2) Attempt ELM mitigation with DC fields	
A) n = 2 + 3 fields	6
B) n = 2 fields, change phasing, amplitude	4
C) n = 3 fields, change amplitude (change NBI torque???)	4
D) n = 6 fields by producing primary n = 0 field	2
E) Try n = 1 (???); change NBI torque (???)	4
3) Attempt ELM mitigation with AC fields	
A) pre-programmed, match ELM frequency, not-propagating (20 < f(Hz) < 800)	2
B) pre-programmed, match ELM frequency, co-propagating (20 < f(Hz) < 800)	2
B) pre-programmed, match ELM frequency, counter-propagating (20 < f(Hz) < 800)	2
C) n = 1 B_r feedback, vary (i) gain (ii) phase	8
4) Additional scans	
Total	38

Extra Slides

Exploratory approach to finding ELM mitigation solution with midplane non-axisymmetric coils

- Goal
  - Demonstration of ELM mitigation with NSTX midplane RWM coil set
- Approach (complementary to other proposed plans)
  - Application of broader n spectrum of DC fields
    - Non-standard coil configs: (i) turn off one coil, (ii) turn off 5 coils, (iii) turn off every other coil, (iv) slow pre-programmed toroidal propagation of setup (iii)
    - New "n = 2" applied field capability for 2008, vary phase
    - Perturbations away from "n = 1" control currents (which have n = 1,5 dominant), superposition of n = 1 – 3, higher n
    - Bonus: Can get NTV rotation braking data piggyback!
  - Application of AC fields
    - Pre-programmed toroidal propagation of several DC setups mentioned above
      - Might stimulate ELM to allow to transform large ELMs into smaller (acceptable) ELMs
      - Now examining existing ELM mitigation evidence from past RWM, NTV experiments
    - N = 1 feedback
      - Can best feedback configuration from 2007 alter ELM dynamics?
  - Take best approach above and run in closest ITER shape w/ELMS

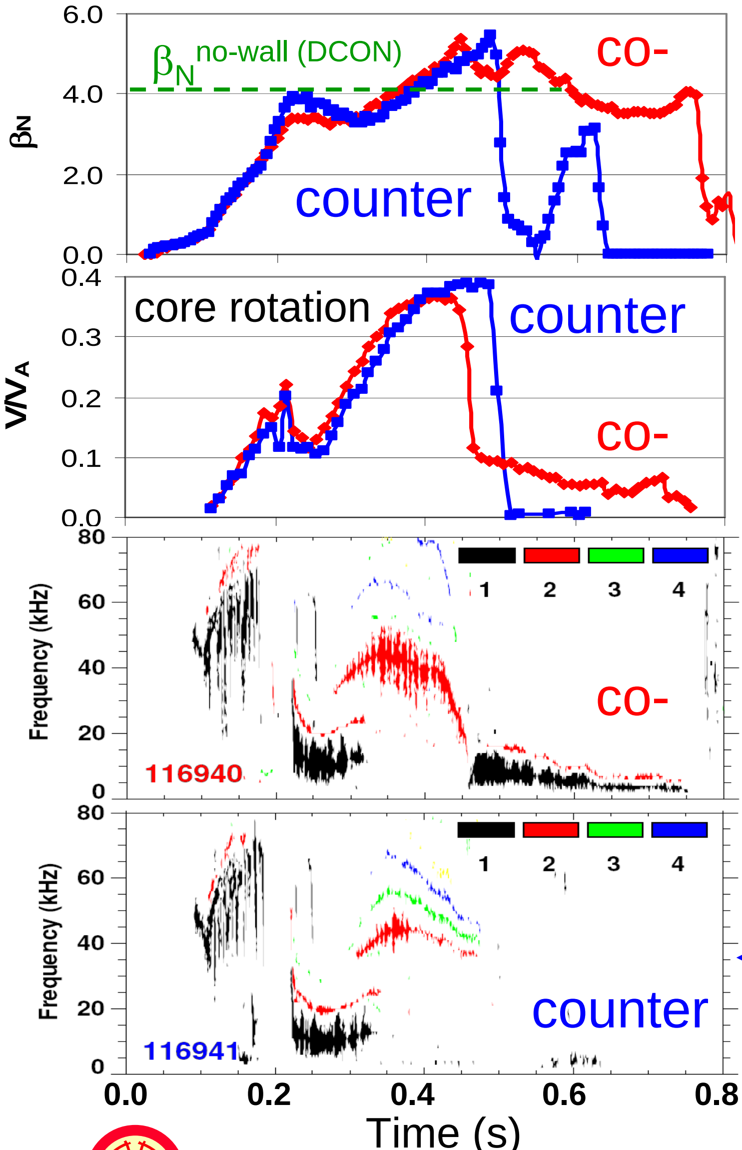
Direction of applied n=1 traveling wave alters RWM stability

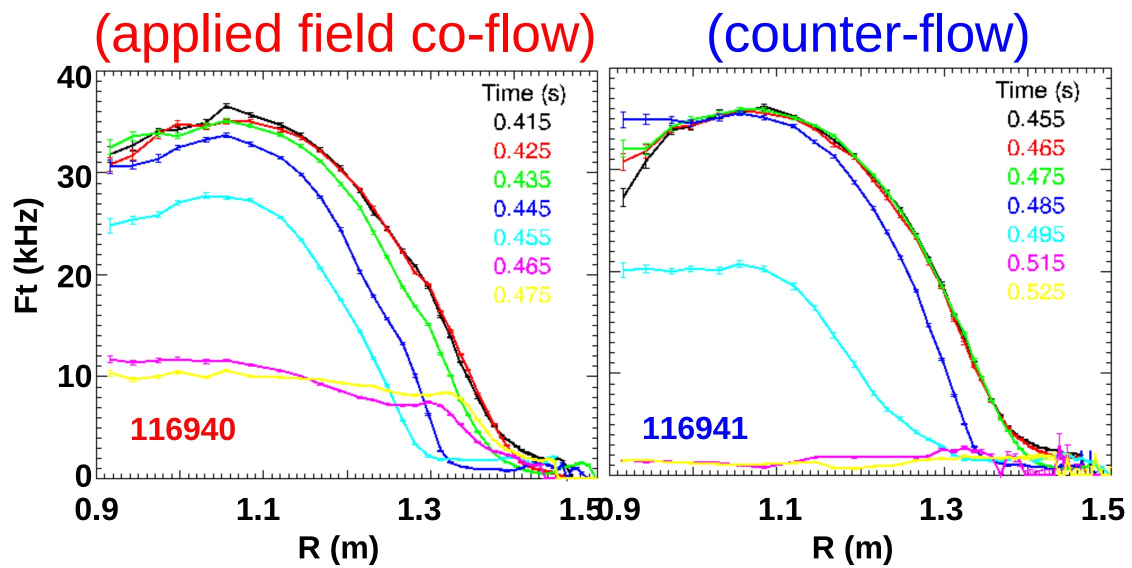


- Stronger RFA with co-flow field
- RWM not destabilized

- Weaker RFA with counter-flow field
- Unstable RWM

Unstable RWM avoided with rapidly rotating n = 1





- Applied field in the direction of plasma flow:
  - RFA increases and rotation damps
  - n=1 internal mode triggered
  - Rigid rotor rotation profile; beta recovers
- Applied field against the plasma flow:
  - RWM grows
  - Rapid, complete rotation and beta collapse