# XP818: Exploratory approach to finding ELM mitigation solution with midplane non-axisymmetric coils

- Goal
  - Demonstration of ELM mitigation with NSTX midplane RWM coil set
- Approach
  - Target development
    - (i) low $q_{95} < 6$; (ii) swept $q_{95}$ to insure mitigation not missed due to resonance ; (iii) high $q_{95} > 8$
  - Application of DC fields (broader *n* spectrum, new 2008 capabilities)
    - Past odd parity fields ($n$ = 3, 1+3) operating on low $q_{95}$ target
    - New even parity field ($n$ = 2 (strong $n$ = 4), 6) capability for 2008
    - New combined odd/even parity (present favorite $n$ = 2 + 3)
  - Application of AC fields
    - Using either/both odd and even parity fields; co/ctr propagation
      - ELM mitigation through effects on edge plasma profiles
    - Feedback on $n$ = 1
      - May be useful for giant ELMs, buildup detected by RWM $B_r$ sensors
  - Repeat techniques showing most potential in low recycling (post-LITER)

# XP818 ELM Mitigation run on two days last week

Shots taken (Mon. + Fri.)

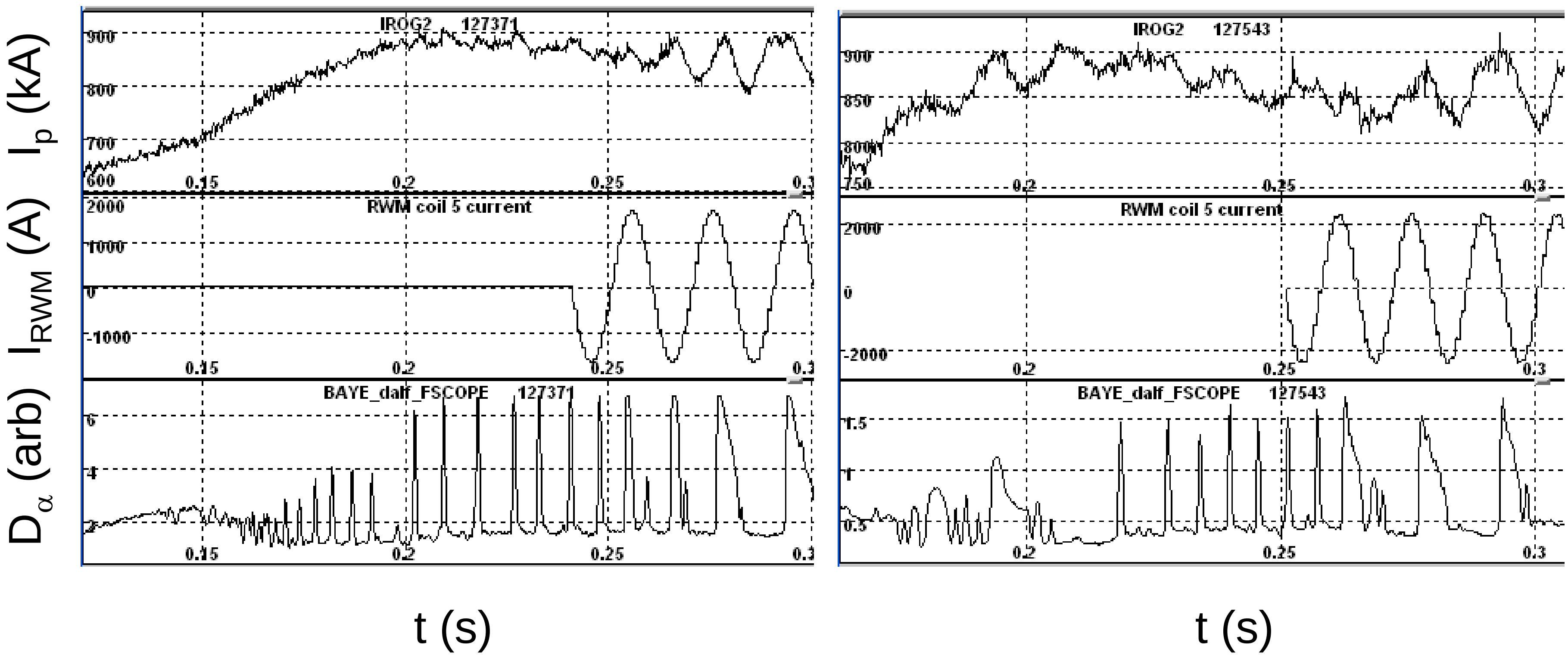
| Task | Number of Shots |
|---|---|
| 1) Create target plasmas | |
| A) Create *q95* < 6 target: (generate at least 10 ELMs with approximately even spacing) (*q95* ~ 5.5 is adequate) | |
| - Use shot 124349 as setup shot, (*Ip* = 0.8 MA, *Bt* = 0.5 T), change NBI source C to 1 MW unmodulated | 2 |
| - Raise *Ip* to 0.9 MA; change *Bt* to 0.45T, then 0.40T | 3 |
| - If *q95* > 6 and insufficient ELMs, perform startup optimizations as per J. Menard to raise *qmin*. | (8) |
| B) Create *q95* ramp target | |
| - Start from low *q95* target created in step (1A), *Ip* flat-top to 0.7 MA, ramping up to 1.0 MA; adjust eventual *Ip* flat-top if needed to create steady ELMs. | 4 |
| - if plasma drops out of H-mode, start *Ip* ramp from 1.0 MA ramping to 0.7 MA | (2) |
| - vary *Bt* to change range of *q* ramp (optional) | (2) |
| C) Create *q95* > 8 target | |
| - Use shot 124349 as setup shot, (*Ip* = 0.8 MA, *Bt* = 0.5 T), change NBI source C to 1 MW unmodulated | |
| - Drop *Ip* to 0.7 MA; tweak to 0.75 MA if desired | 2 |
| 2) Attempt ELM mitigation with non-axisymmetric fields under normal recycling conditions | |
| - DC fields: | |
| A) Apply *n* = 3 field configuration; vary amplitude from 1.5 kA | 4 |
| B) Apply *n* = 3 + 1 field configuration; vary amplitude from 1.0 kA, 0.5 kA | 4 |
| C) Apply *n* = 2 + 3 field configuration (start from RWM (1-4) 0.5kA, RWM (2,6) 0.5kA, RWM (3,5) 1.5 kA) | 4 |
| D) Apply *n* = 2 field configuration; vary amplitude from 1.5 kA | 4 |
| E) Apply *n* = 6 field configuration (primary field is *n* = 0); vary amplitude from 2.5 kA | 3 |
| - AC fields (pre-programmed): | |
| F) Apply *n* = 3; vary *f* above/below ELM frequency; vary amplitude from 2.0 kA | 4 |
| G) Apply *n* = 1 (co-propagating); vary *f* above/below ELM frequency; vary amplitude | 4 |
| H) Apply *n* = 1 (ctr-propagating); vary *f* above/below ELM frequency; vary amplitude | 4 |
| - AC fields (*n* = 1 feedback): | |
| I) *n* = 1 *Br* feedback: giant ELM target (e.g. 125271), vary (i) gain (ii) phase | 6 |
| 3) Attempt ELM mitigation with non-axisymmetric fields under reduced recycling conditions | 16 |
| Total (optional): | 64 (12) |

# XP818 successful so far in changing ELM frequency

- ELM frequency initially reduced with application of AC fields
  - First shown with n = 3 AC standing wave, then n = 2 AC
    - AC fields allow application of greater peak RWM coil current before plasma rotation damping becomes too severe
    - Also shown with DC fields
  - Jokingly named: “Pulsed High Amplitude Transient” – PHAT ELMs
    - Longer duration (multi-filament), lower frequency than Type I
- Key to now understand the effect - aim for mitigation
  - Effect is not restricted to a narrow range of $q_{95}$ – a good thing!
    - Mitigation in DIII-D shown to be sensitive to $q_{95}$
  - Effect is apparently not highly sensitive to applied field
    - Clear dependence on field amplitude
    - Dependence on field configuration (n = odd, even) and application (AC, DC) not yet concluded
  - Frequency ~ 50Hz largely independent of applied field
    - Variation of plasma quantity is affecting ELM

# Reduced ELM frequency observed in several applied field configurations

n = 3 AC field, 70 Hz, 3.8 kA peak-to-peak     n = 2 AC field, 70 Hz, 5.5 kA peak-to-peak




- Timing of PHAT ELMs correlated to timing of applied field in dedicated shots