June 2008 reporting meeting – XP810 and 801 experiment:

801: Marginal island width for the 2/1 NTM

810: Error field and rotation sensitivity of 2/1 NTM onset and decay thresholds

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New experiments in June

- **Take advantage of improved machine conditions:**
  - **Perform ramp-downs and try to keep mode rotating and in H mode**
    - **+ Explore rotation effect with n=3 braking**
    - **Avoid strong n=1 error fields (locked modes)**
  - **Explore mode onset physics**
    - **Measure n=1 impact on beta limit (='penetration' threshold?) at different rotations (by varying n=3 brakings)**

      ➔ aim for four corners, then fill in if possible

Progress on June day on NSTX

- **Morning focussed on ramp-down:**
  - Troubled by evolving conditions as lithium "disappeared"
  - Mode threshold raised through morning
  - Did achieve some ramp-downs
    - H->L transitions prevented clean restabilization.
    - Tricks to drop H->L threshold did not help
- **Afternoon switched to onset variation study:**
  - Had to further optimise to strike mode (reduce centre stack gas)
  - Got to reasonable & reproducible target with no braking
  - Started scan with n=3 ramp (after intervention for GIS problem)
    - Problems with machine operation to get back n=3 shot
  - **Finally got in the zone**
    - **Reliable 2/1 modes with various n=1 & n=3 fields…**

Rampdown Studies had Trouble with H->L transition

- Li changes everything…first shot had a beautiful mode, and then, over the next few shots, it went away.
- Developed a scenario with D_2 glow that allowed the mode to strike fairly reliably.
- Modes were *NOT* always locking, which was the problem in Feb. without EF correction.
- Mode amplitude clearly decreased as β_P was reduced.
- However, plasmas fell out of H-mode before mode was restabilized-> dramatic changes in profiles, followed by locking.
- Tried to make a figure…but couldn't access the data this AM.

NSTX high-k, high-d shape is essentially always metastable to the 2/1 mode

Results

Got reasonable scan with currents at a level that "did something":

Shot	t21	betan	n=1 A	n=3	chers5	chers18
130210	0.66	4.17	0	0	19.5	6.5
130211	0.65	4.19	0	0	19.5	6.49
130212	0.675	4.02	0	890	12.2	4.5
130216	0.64	3.67	0	800	16.98	4.11
130218	0.697	4.03	1100	0	9.85	2.69
130219	0.692	3.93	740	0	10.8	4.67
130217	0.645	3.23	mix	mix	16.5	2.56
130220	0.525	3.32	500	800	27.87	2.39
130221	0.618	3.86	370	800	18.5	1.59

Reference shots

Pure n=3

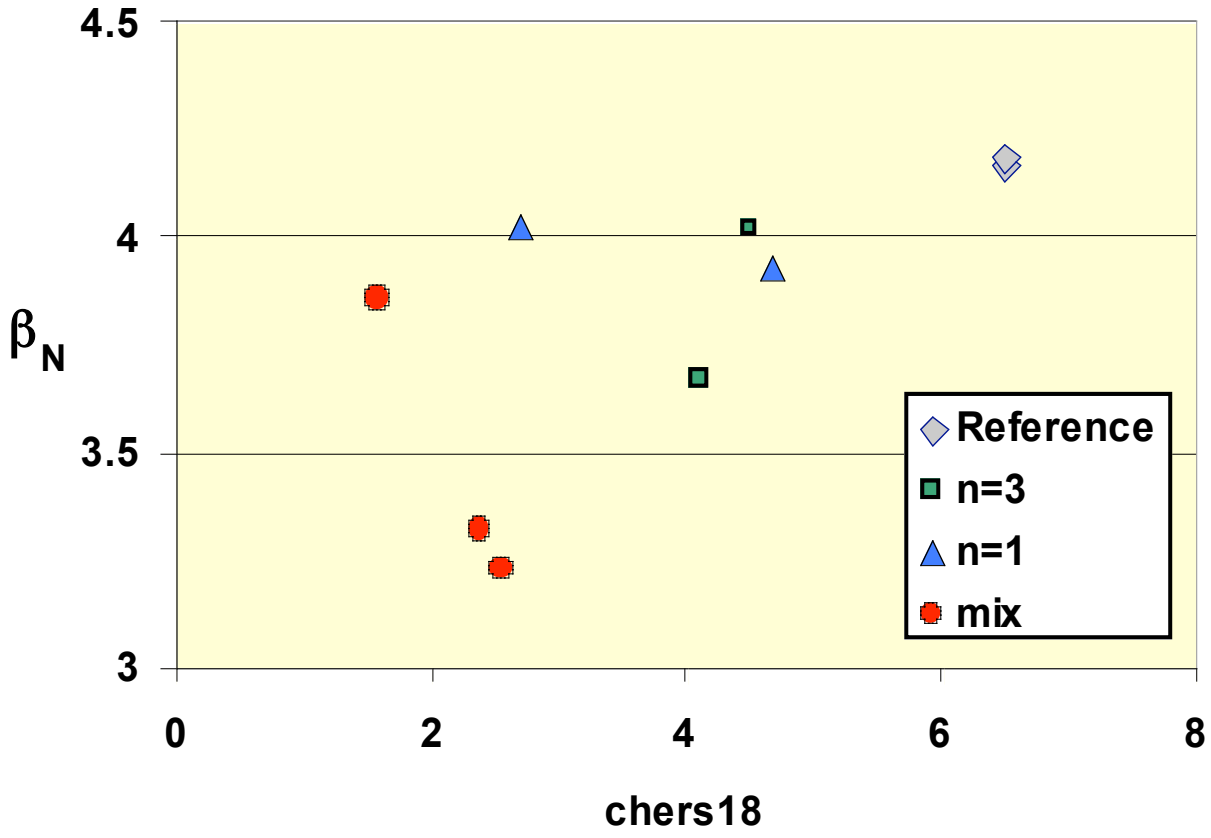
Pure n=1

Mixed n=3 and n=1

- n=1 and n=3 may brake plasma differently
- Work now to deconvolve effects…
  - *The above are 'good shots' for data analysis, please*

Clear effects in raw data

- Key to deconvolve is rotation and rotation shear effects



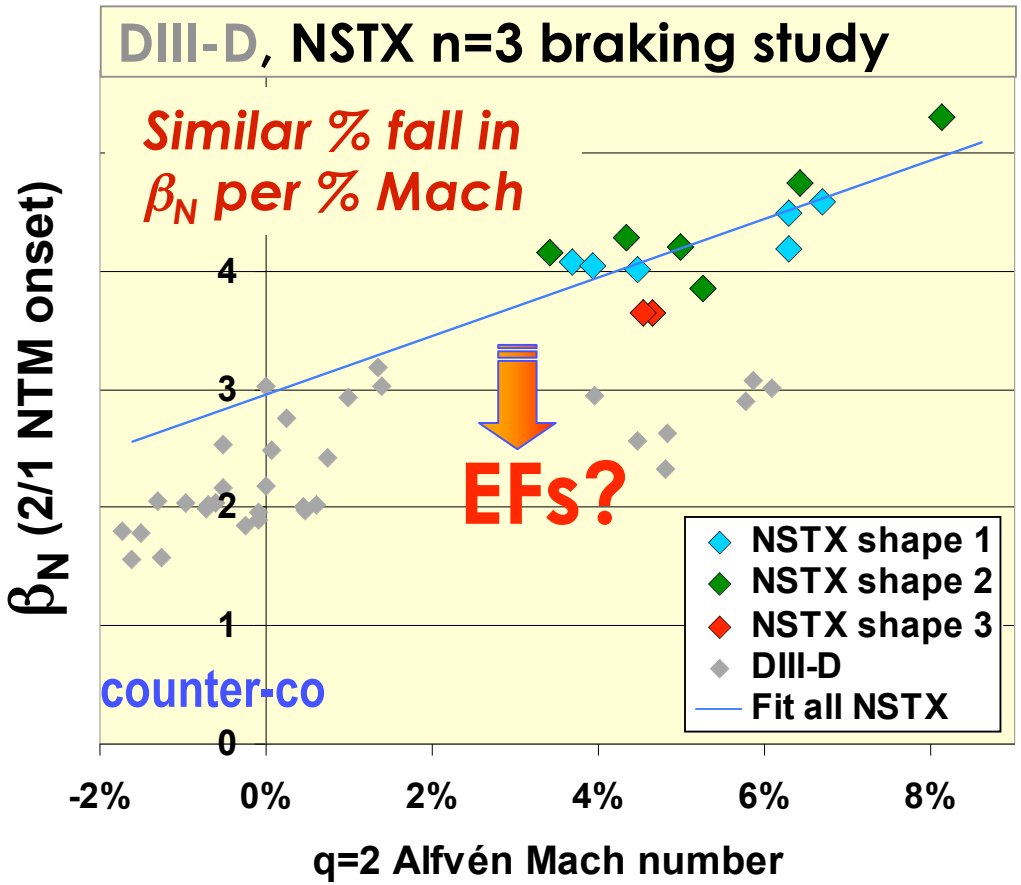
- Also, a simple 'error field threshold' measurement should be possible, and its scaling with plasma braking…

Summary

- **A tricky day technically – especially to tune conditions for below experiments and get lithium out**
- **NTM ramp-down studies could not avoid H-L**
  - **Look for the 2/1 mode in low-d, high-b plasmas (database).**
  - **These may provide a lower H->L threshold, and allow rampdown.**
- **But n=1 and n=3 fields observed to have clear effects on plasmas and induce/lower thresholds for modes**
  - **'Four corners' of scan obtained**
  - **Work now planned to deconvolve effects of n=1, n=3, β_N , rotation and rotation shear**
  - ***Part B still bid*** *– NTM trends with rotation sign...*

Basis of NSTX NTM rotation experiments…

DIII-D & NSTX show strong rotation dependence in NTM physics:



To explore:

- **Do error fields drop thresholds more at low rotation?**
- **How does rotation impact thresholds?**
  - Rotation or rotation shear?
  - Triggering physics or underlying stability?
- ***Explore with mode onset and decay experiments on NSTX***
  - ***n=1 and n=3 brake plasma differently***

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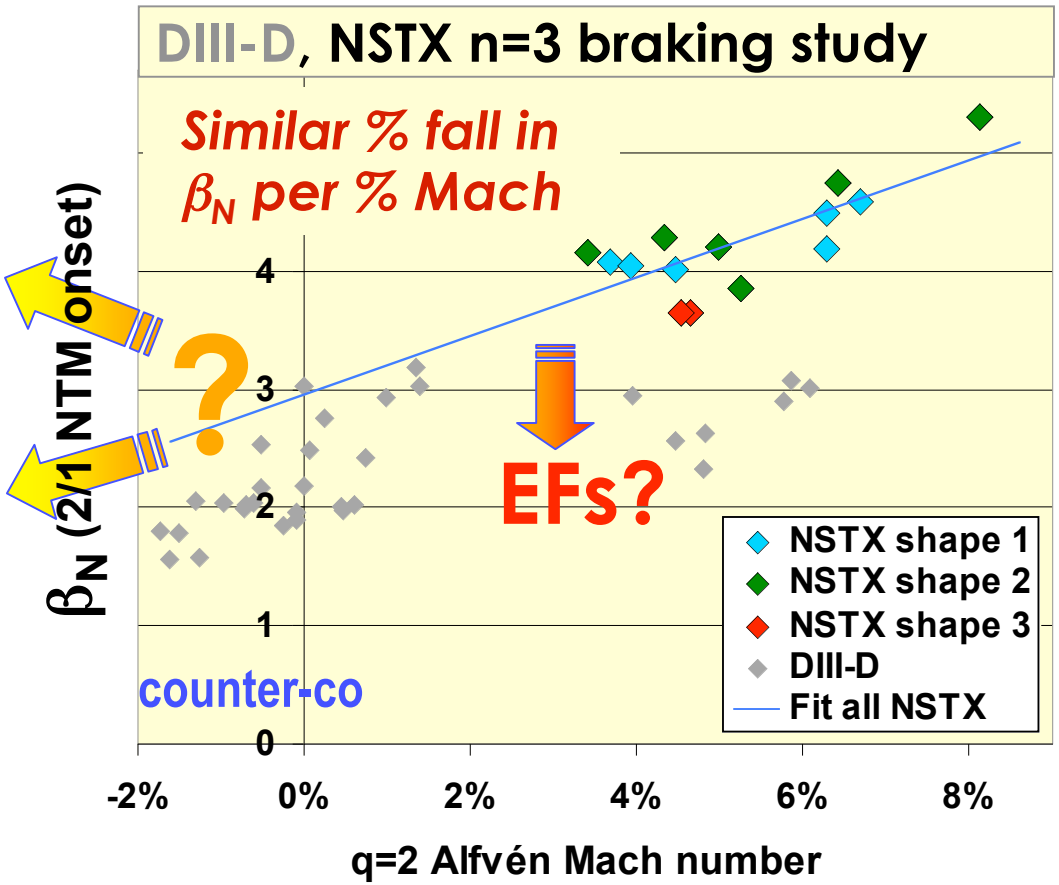

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Later (if reverse Ip operation possible):

- Does counter rotation stabilise mode or not?

Key issues NSTX can shed light on

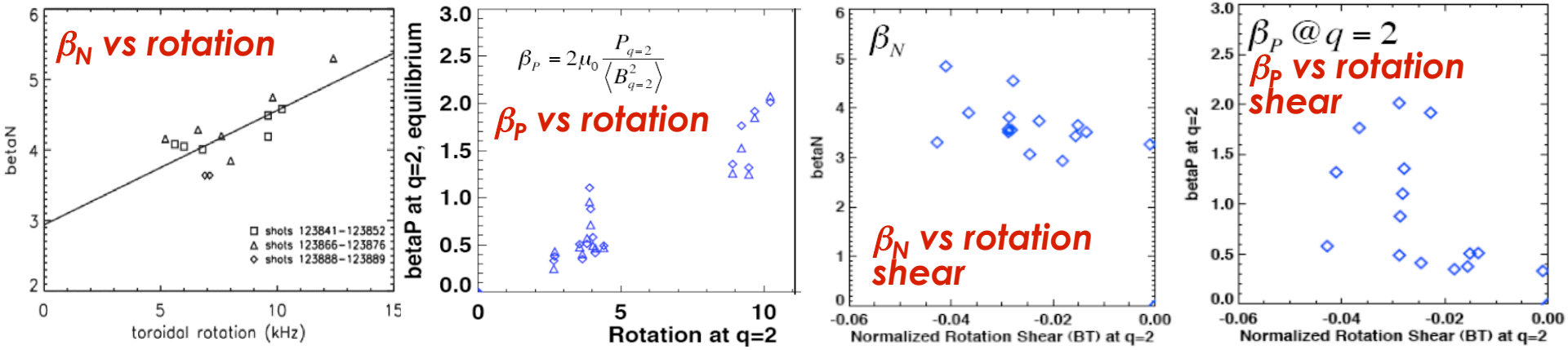
- **NSTX can probe error field effects**
  - To see if increased sensitivity at low rotation
- **NSTX can explore rotation profile effects**
  - Distinguish between rotation and rotation shear models?
  - Assisted by varying mix of n=1 & n=3 braking

Part A

- **NSTX can readily address the counter rotation question**
  - Does trend go up or down in counter direction?
  - *Just reverse Bt and Ip… (later, but covered by this XP)*

Part B

Stefan Gerhardt analysis… :



Lots of problems in February "restart"

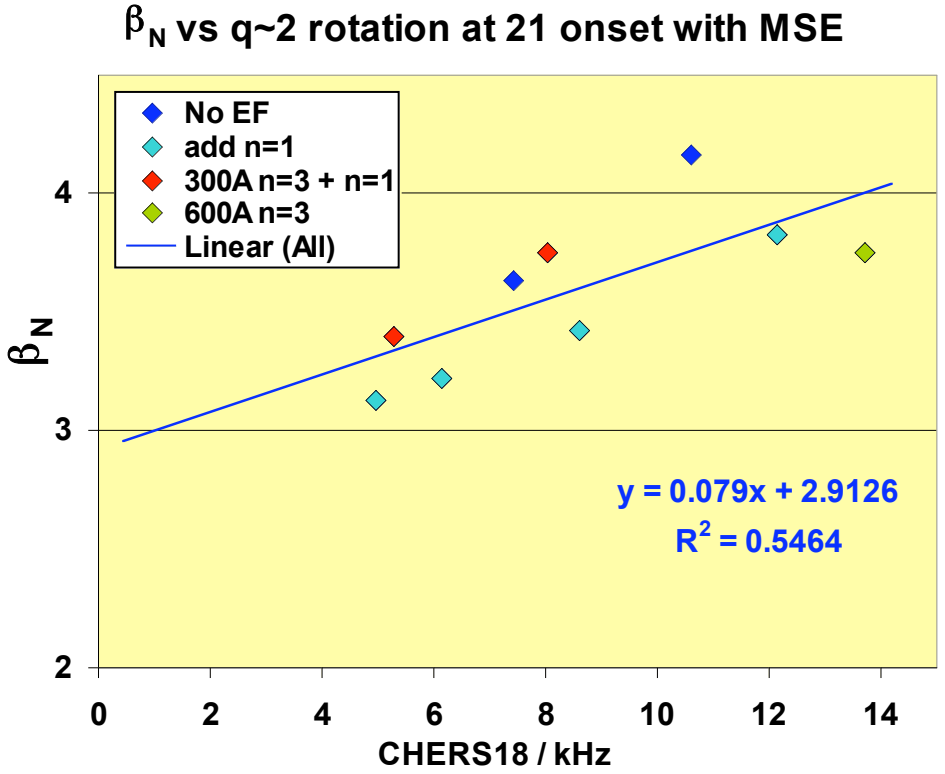
- Poor machine conditions → considerable scatter in results
- Beam C and then A failures
- Central stack problem
- Earth fault
- Error field correction not functioning → modes locked

→ Got about 0.5 days machine time

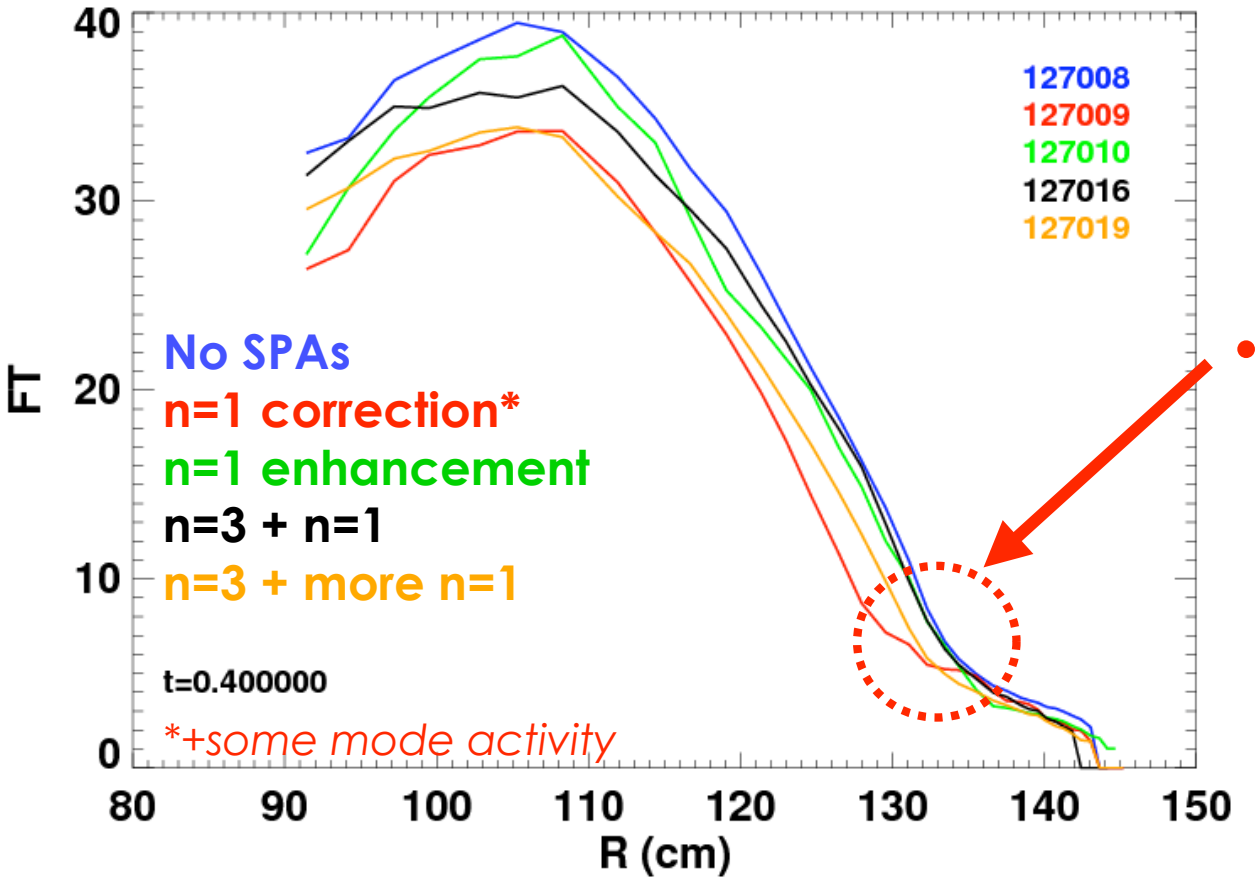
- Ramp down element unsuccessful
- Mode onset study 'made a start'
  - 4 point n=1 study
  - 2 points with n=3 but at low level

Preliminary results – mode onset

- **Preliminary onset scan obtained with n=1 fields & 2 beam recipe…**
- **…but very limited data with n=1 applied when lowering rotation from n=3 braking…**
  - *(this was main objective)*
- ***Nevertheless, useful extension of NSTX database to get at rotation vs. rotation shear issue…***



Nevertheless, considerable variation in target rotation profiles before mode…



- **Particularly in q~2 region of interest**

Although variations in machine conditions and reconstruction proving problematic… (W.I.P.)