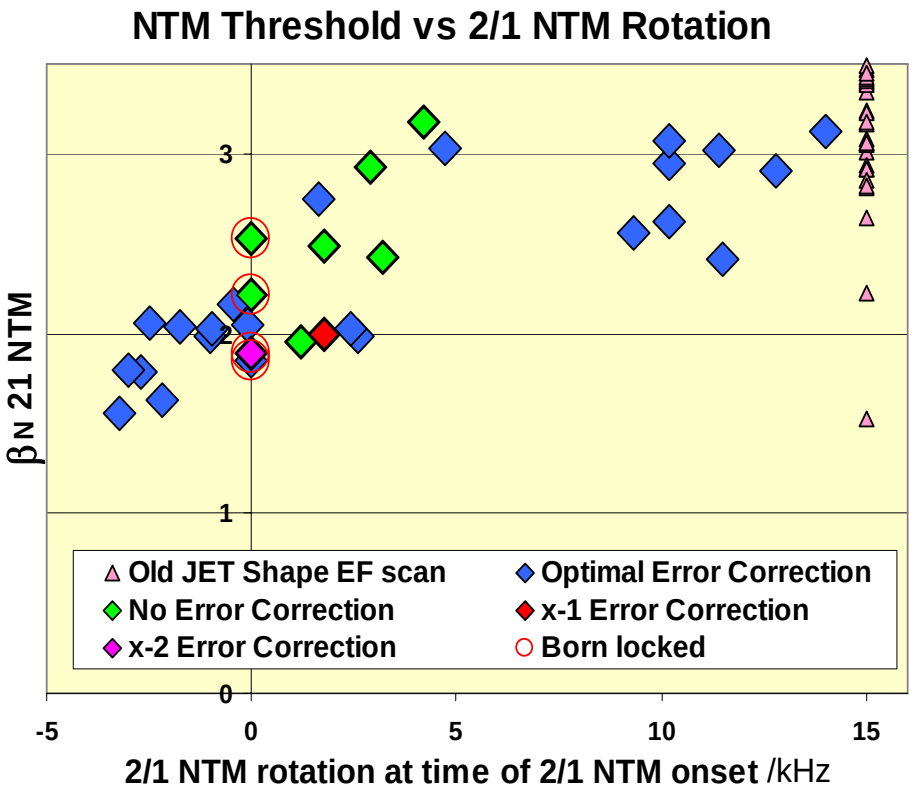
NTM threshold at low plasma rotation

(R. Buttery, R. La Haye, E. Strait)

DIII-D experiment with varying NBI torque

- **2/1 NTM threshold falls as rotation is reduced**
- **n=1 error field leads to further decrease of β_N**
- **Qualitatively similar results with 3/2 mode in JET**

➢ ***Implications for ITER or CTF at low plasma rotation?***



Possible influence of rotation on NTM stability

- **NTM seeding**
  - Decreased rotational shear between resonant surfaces may enhance coupling of sawteeth, ELMs, etc.

- **NTM threshold terms**
  - Ion polarisation introduces rotation dependence:

$$a_{pol} \propto \rho_{i\theta}^2 \; g(\nu,\varepsilon) \; \omega \; (\omega_{i*} - \omega) / \omega_{e*}^2$$

    - *Depends on rotation in ExB frame of reference*
    - *Sets size of seed required or rise in* $\Delta'(\beta_N)$ *to trigger NTM*

- **"Classical" tearing mode stability**
  - Wall stabilization of rotating islands
  - Or enable error field to help drive the island

Proposed NSTX experiment

- **Ramp beta up until the 3/2 onset is reached**
  - If feasible, continue to increase beta to the 2/1 onset
  - Then use beta ramp-down evolution to test NTM physics terms
- **Repeat the beta ramp with a shot-by-shot scan of n=3 magnetic braking to reduce plasma rotation**
- **Repeat the rotation scan, or high and low rotation cases, with the addition of a modest n=1 error field (2-5 Gauss?)**
- **Requires 1/2 day of experimental operation**
  - Standard shape, constant Ip and Bt
- **Input to ITPA joint experiments:**
  - MDC-3: NTMs (including error field effects)
  - MDC-4: NTM physics - aspect ratio comparison