XPs to MSG on n=1 Tearing Progress from Contact with NSTX to Natural q Evolution to Use of Off-axis NBI

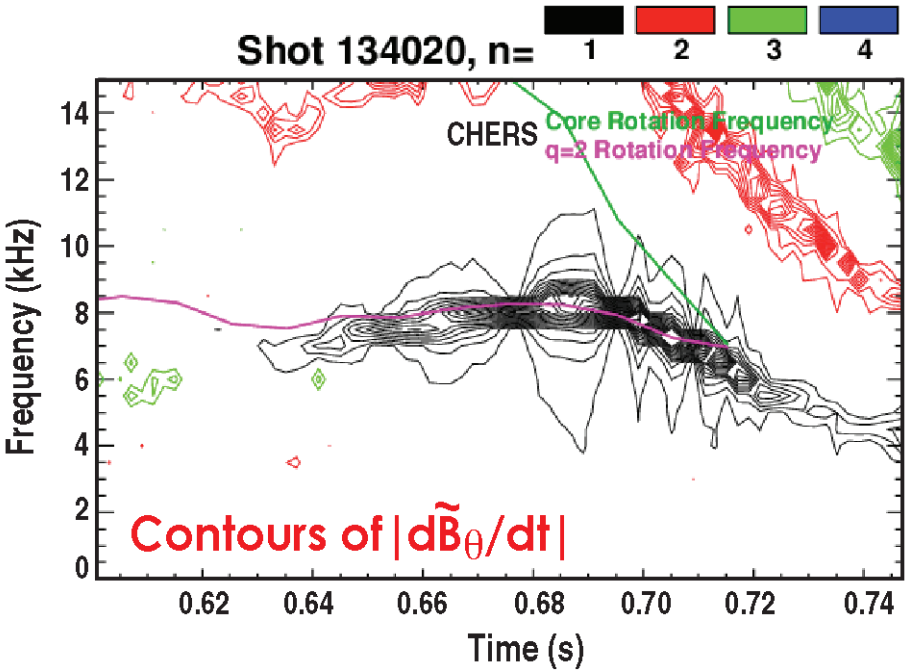
- **XP10: make contact with NSTX for n=1 tearing stability (La Haye)**
- **XP47: assess β_N and qmin n=1 tearing stability limits at the increased aspect ratio of NSTX-U (La Haye)**
- **XP93: compare benefits of off-axis NBI & coordinate with DIII-D (Ferron)**
  - FY 2015 JRT: "Conduct experiments and analysis to quantify the impact of broadened current and pressure profiles on tokamak plasma confinement and stability"

Larger Aspect Ratio in NSTX-U May Reduce Stabilizing Curvature for m/n=2/1 Tearing Stability From That in NSTX (Connection with NSTX Could be Done in Weeks 1–4, More Later)

- **Previous related NSTX XPs include**
  - 739 Marginal island width of NTMs
  - 740 NTM threshold at low rotation
  - 801 Further study of 2/1 NTMs
  - 915 Influence of rotation and error fields on tearing mode beta limits

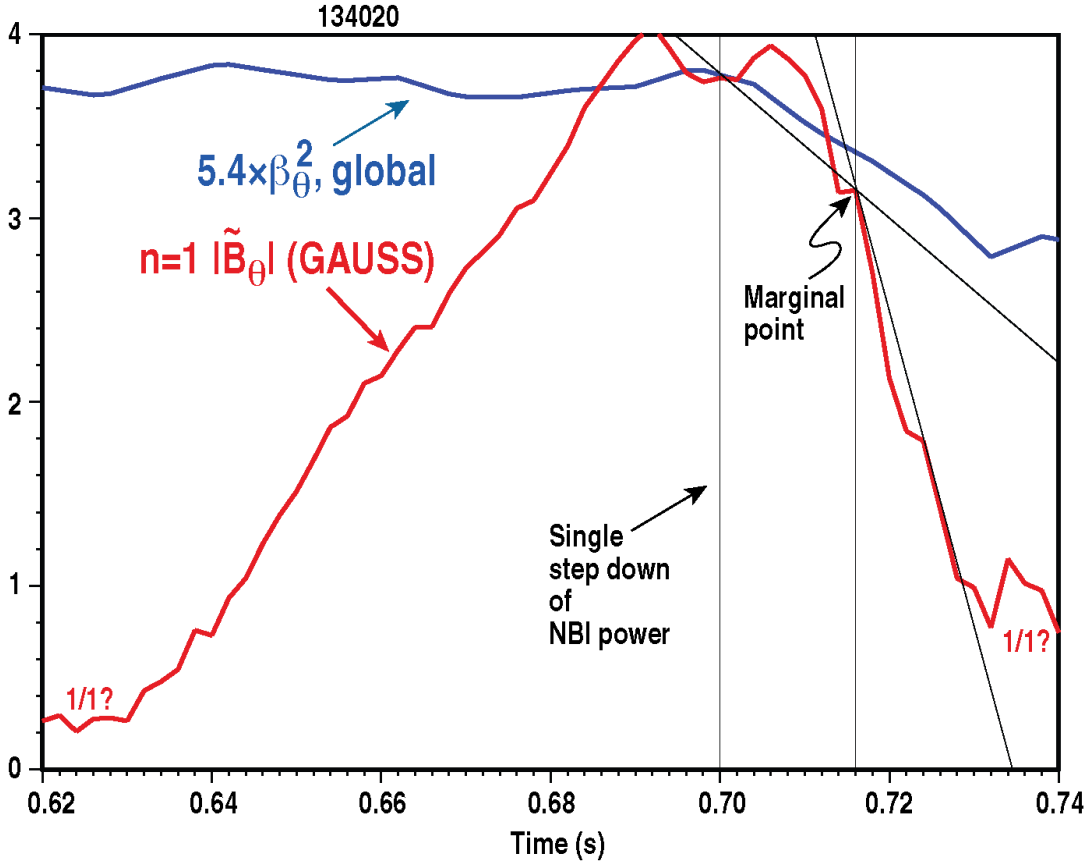
- **Publications include**
  - S.P. Gerhardt et al, NF 49, 032003 (2005)
  - R.J. Buttery et al, NF 51, 073016 (2011)
  - R.J. La Haye et al, PoP 19, 062506 (2012)

NSTX: Reproducible onset condition using modest L_i evaporation, and mode locking avoided by n=1 and n=3 error field correction (IP = 0.9 MA, BT = 0.44 T, "fixed" q_{95})



NSTX Exhibits Little Hysteresis in Beta Between n=1 NTM Excitation and Self-Stabilization ("Marginal Point")

- **NBI power stepped down after m=2, n=1 mode saturates**
  - mode wanes, then stabilizes

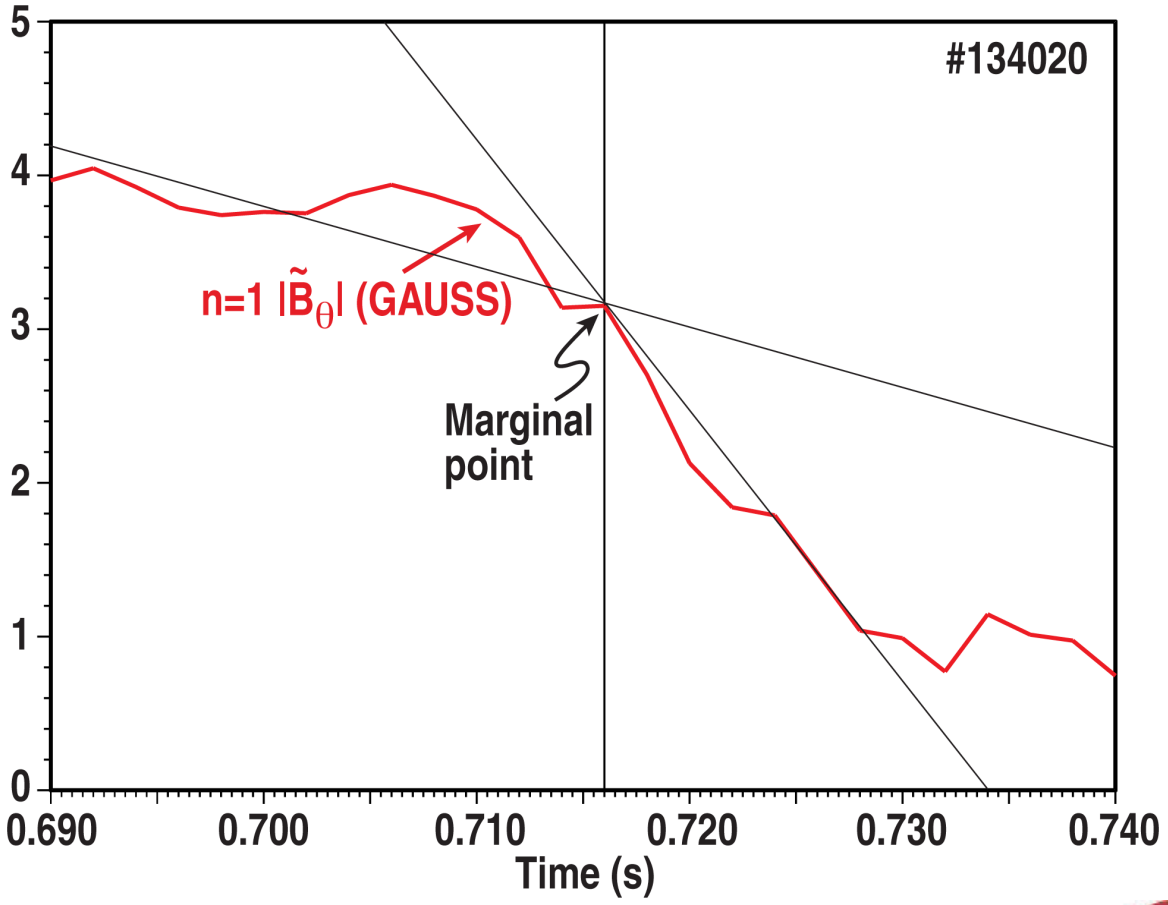


- **Classical tearing stability index $\Delta' \approx 0$ inferred**
  - curvature D_R balanced by neoclassical bootstrap drive D_{nc}
    - thus little hysteresis
  - advantage for low aspect ratio

- **$D_R/D_{nc} \approx -1.2\,(a/R)^2$**
  - NSTX → NSTX-U
    - $(a/R)^2$ x 2/3
      - less stable?

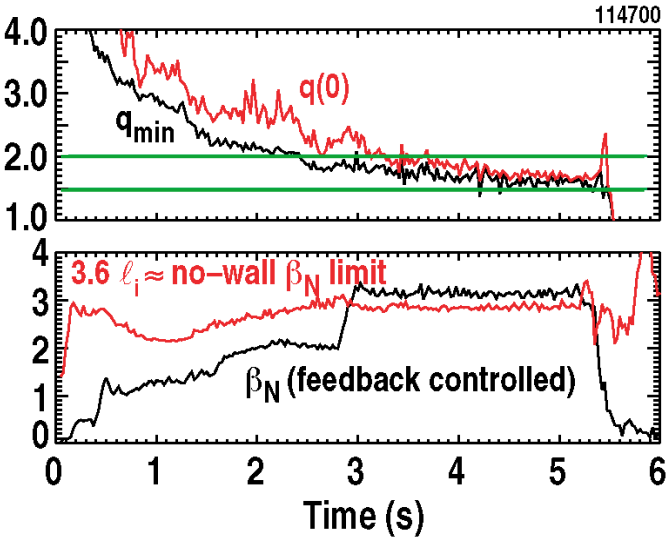
Marginal Point is Determined from Change in Slope of Mode Amplitude with Time (NSTX Example Shown)

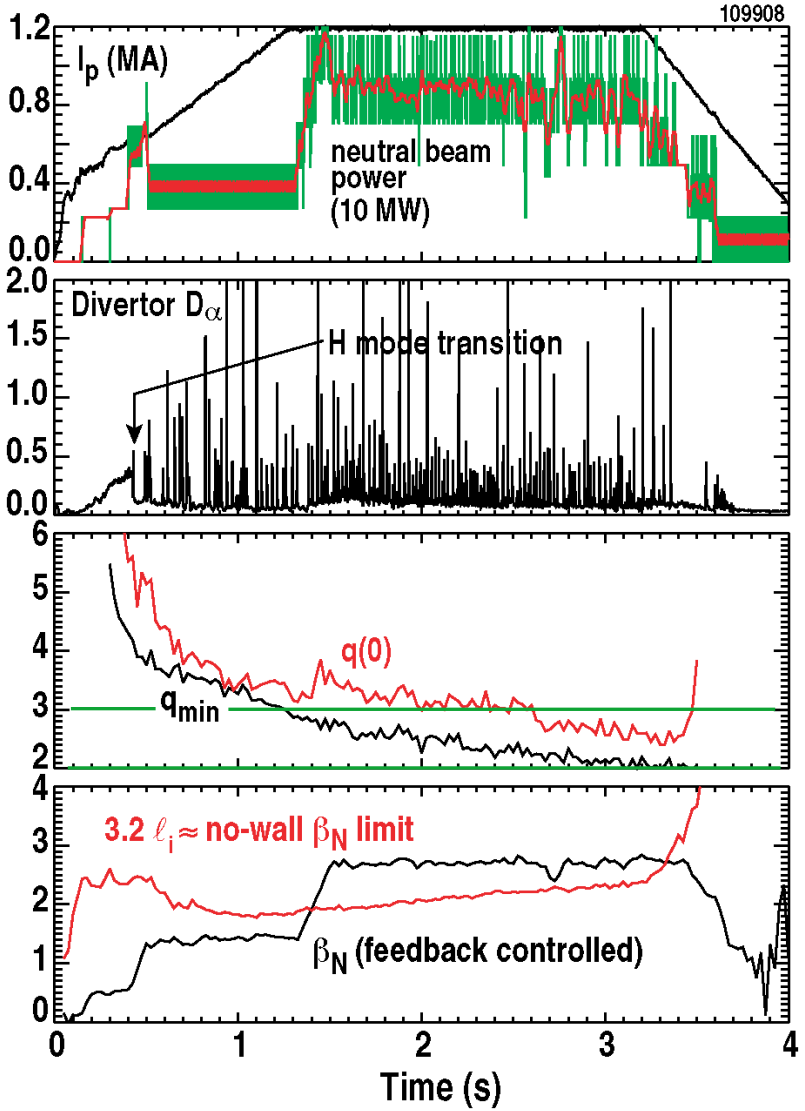
- **Slow decrease in beta (not shown) causes mode to get smaller**
  - mode wanes, then stabilizes



The q Profile Timing is Varied in DIII-D by Modifying the Discharge Formation or Delaying the High Beta Phase

- Increased T_e in H-mode slows rate of current penetration
- $1.5 < q_{min} < 3$, $q_{95} \approx 5$
- Two examples, $q_{min} \approx 2.5$, $\beta_N = 2.7$ and $q_{min} \approx 1.7$, $\beta_N = 3.2$ run without significant MHD for discharge duration
  - sweetspots for n=1 stability





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J. Ferron, etal., PoP 12, 056126120051

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