Stability limits at high δ and κ (XP-727) and error field reduction/mode feedback

Presented by D. A. Gates

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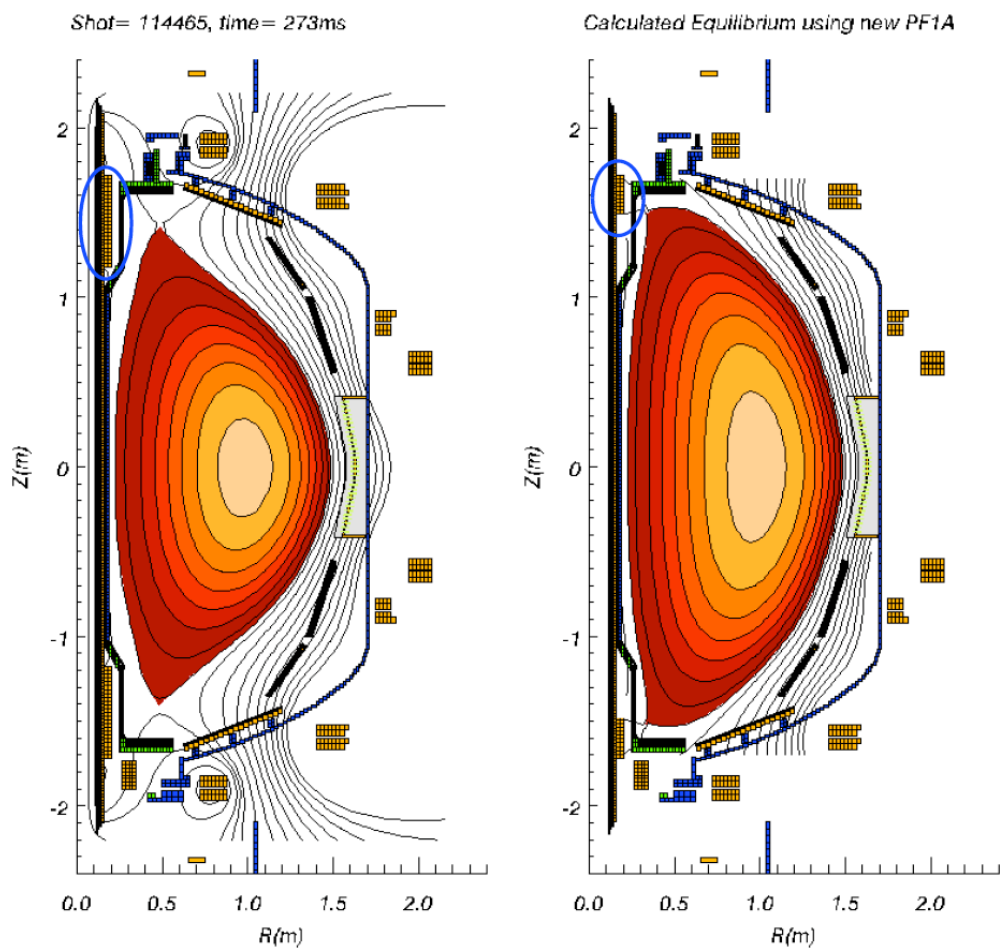
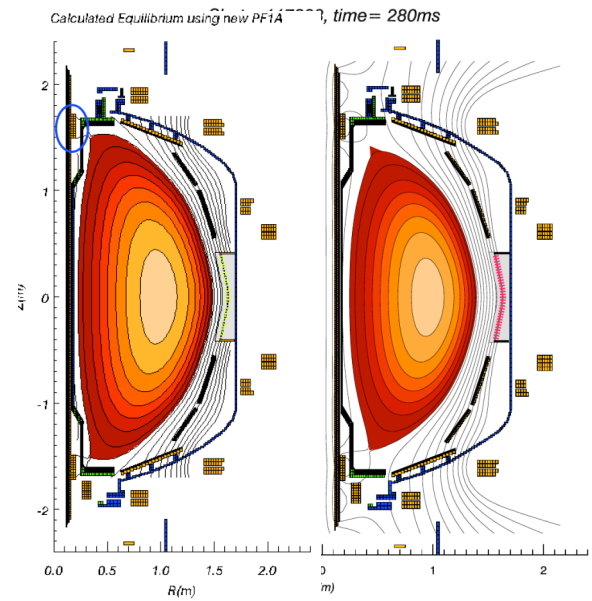
Experimental goals

- To continue to investigate the β limit in high triangularity double null discharges at high elongation using the recently modified PF1A coil
- To further optimize shape to more closely approach the shape target
- To attempt to minimize the impact of any intrinsic error fields that exist on NSTX, in particular the recently identified error proportional to $I_{tf}*I_{oh}$

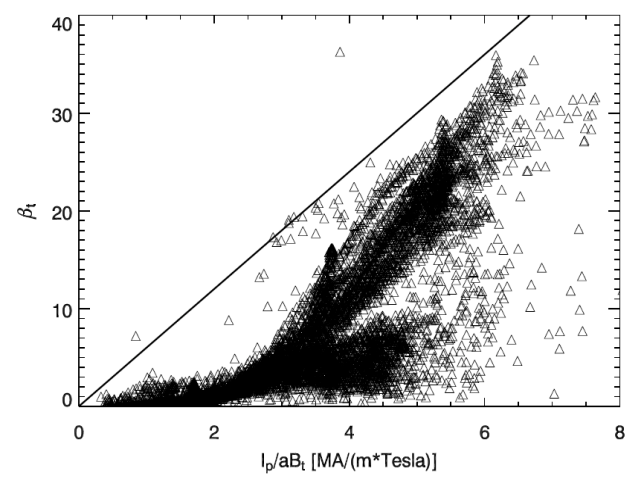


Highest β shot requires more shape optimization

- Triangularity not optimized $\delta \sim 0.6$
- δ control complicated by the eddy currents during strong current ramp (as expected, but requires run time)
- Elongation ~ 2.5, but
- High κ due to large gap (small minor radius) raising aspect ratio
  - Better to make plasma taller



Troyon plot for shots from XP 502

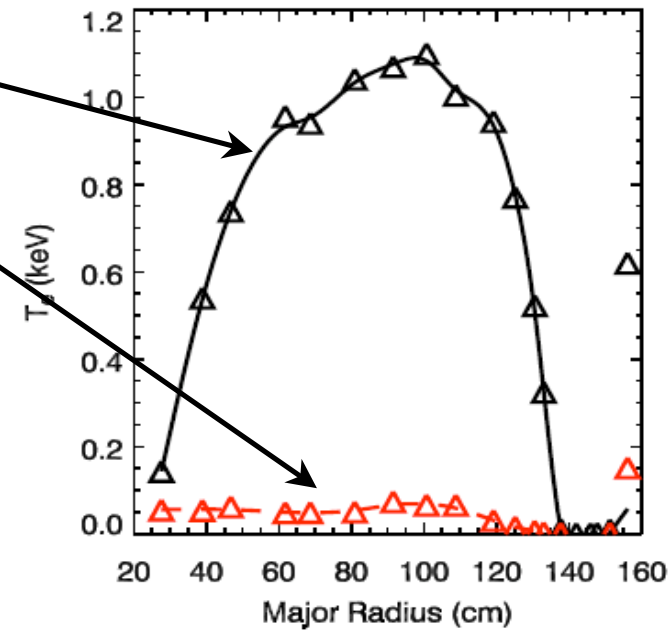


Evidence indicates non-rotating low-n mode terminates discharge

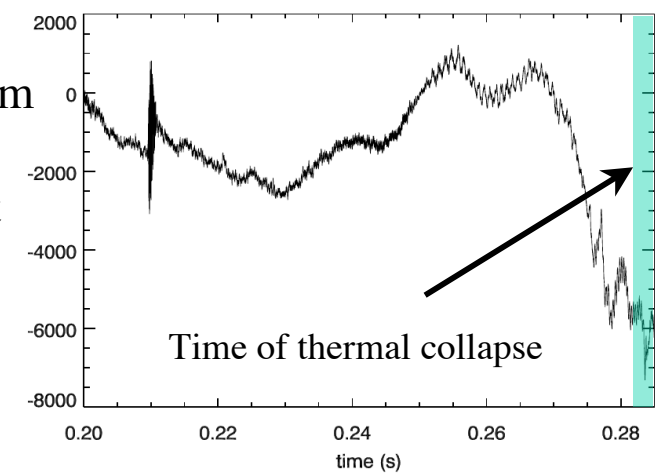
- Plasma terminates with rapid thermal collapse
- Evidence of large non-rotating mode which grows
  - Locked mode?
  - RWM?
- Need MSE during these plasmas to facilitate stability analysis
- Should also analyze lower β counterparts for comparison

t = 282ms

t = 298ms

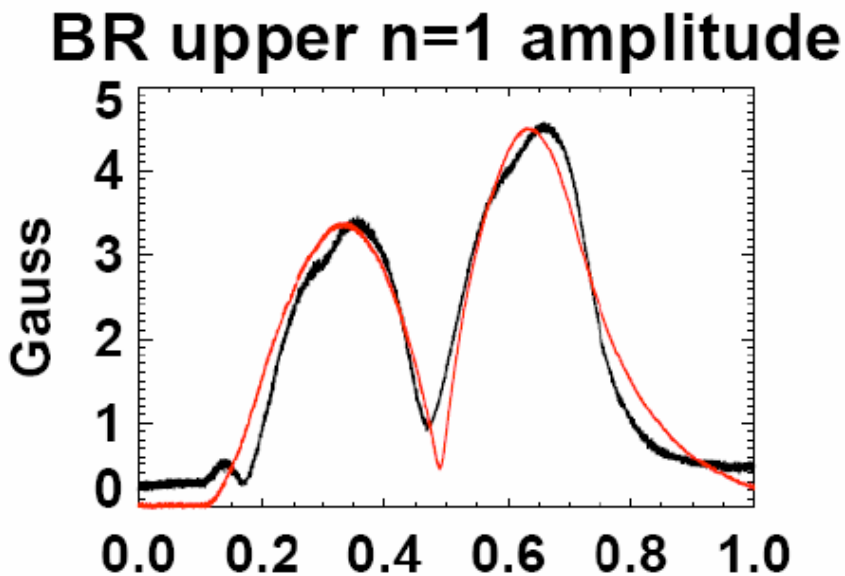


n=1 signal from toroidally opposed fast Mirnovs



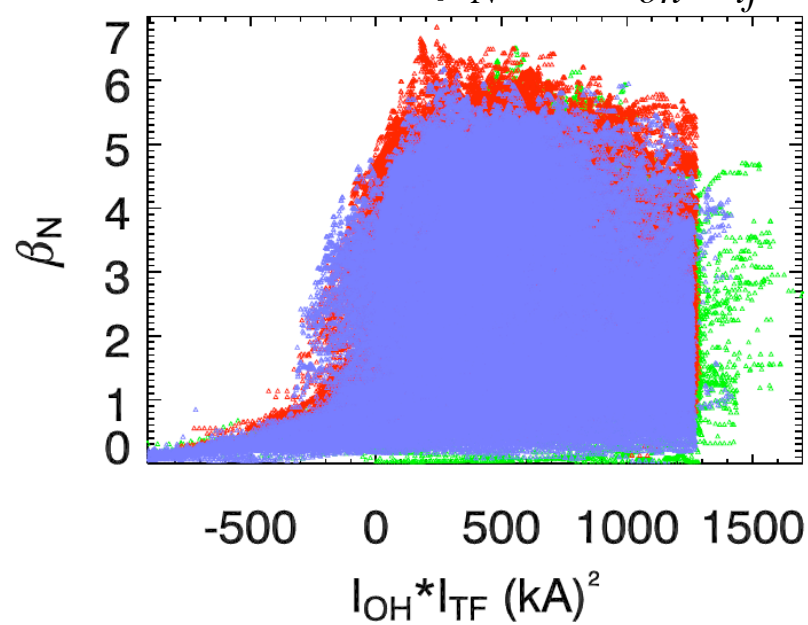
Error field driving RWM (RFA?)

- Error field observed to scale with $I_{oh}*I_{tf}$
- Maximum achievable β_N decreases with increasing $I_{oh}*I_{tf}$
- Motivates investigation of error field mitigation proportional to $I_{oh}*I_{tf}$



Measured and simulated error field due to TF motion within the OH bundle

Measured β_N vs. $I_{oh}*I_{tf}$



Required run time

- Shape development
  - Increase κ,δ in high β target plasmas use 122625 with reduced TF (3kG) as target
  - Vary current ramp rate over range of 3-6MA/s (5-6 shots)
    - Vary HFS gas between 1000-1400 Torr
  - Correct shape control for varying eddy current history (if necessary, 3 shots)
  - Raise Ip in 100kA steps (3-4shots)
  - Perform beam timing scan (3 shots)
  - Raise kappa to ~2.4 (1 shot). Repeat Ip rate scan (5 shots)
  - Repeat best shot at 3.5kGauss.
- Attempt error field minimization/feedback (another day)
  - This effort will benefit greatly from knowledge obtained in other XPs investigating the appropriate phasing and amplitudes for error field reduction (Menard, Sabbagh)
  - Error field feedback + Mode feedback