XP728: RWM active stabilization – $B_{pu,l}$ sensors in feedback

ENGINEERING::IP2

125257
ϕ_{fb} = 90 deg

125259
ϕ_{fb} = 225 deg

125256
ϕ_{fb} = 270 deg

Normalized toroidal beta

RWM coil 5 current per turn

Low-pass filtered RWM sensor amplitude of plasma n=1 BP upper

Amplitude modulation frequency decrease

RWM sensor amplitude of plasma n=1 BR upper

8 – 9 G "threshold"

t (s)
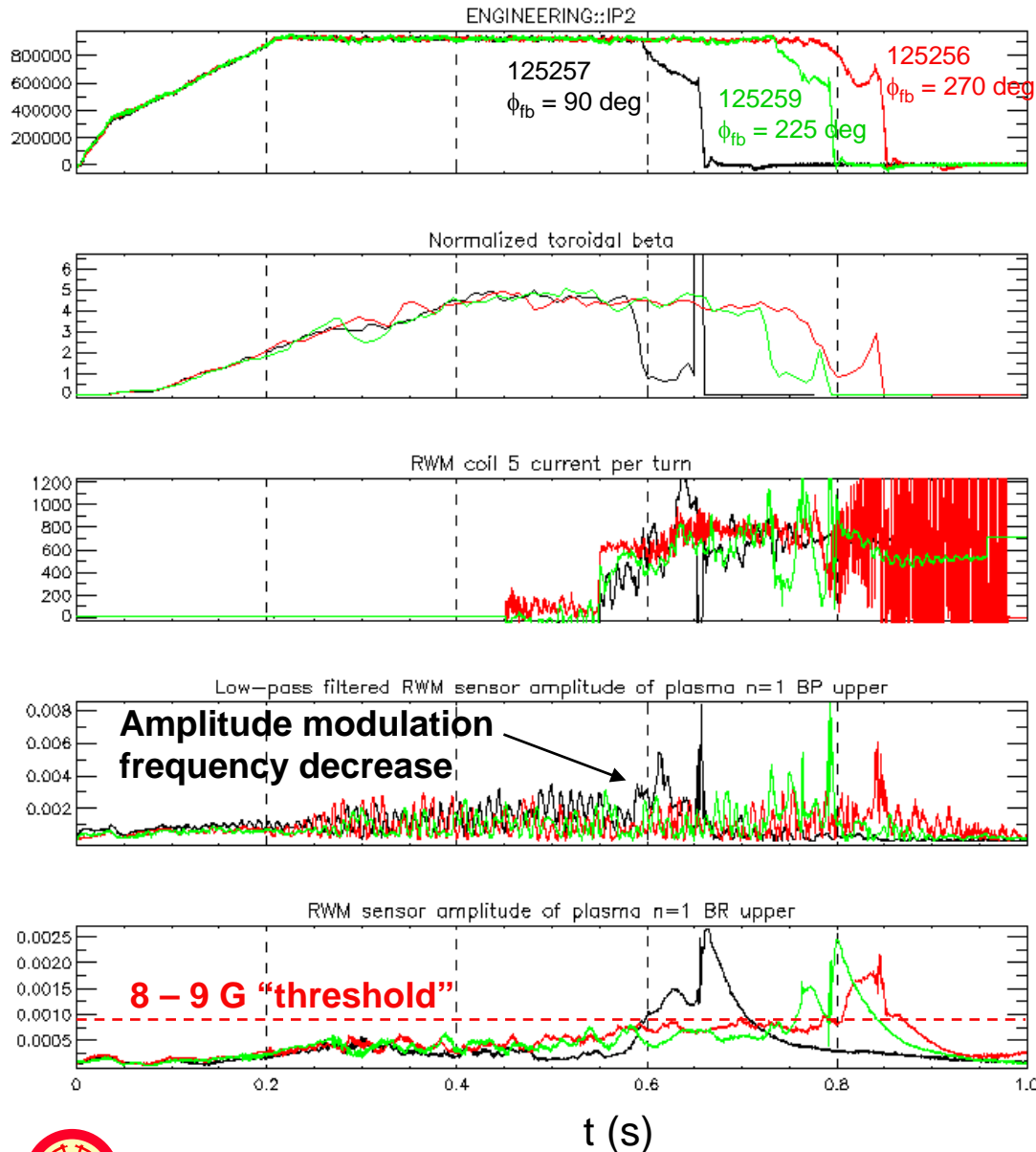
- ❑ **Feedback phase scan for B_p^{lower} + B_p^{upper} sensor average, 180 degree spatial offset**
  - ❑ favorable 270 degree feedback phase expected by simple theory
  - ❑ B_p sensor amplitude modulation decreases in frequency during mode onset
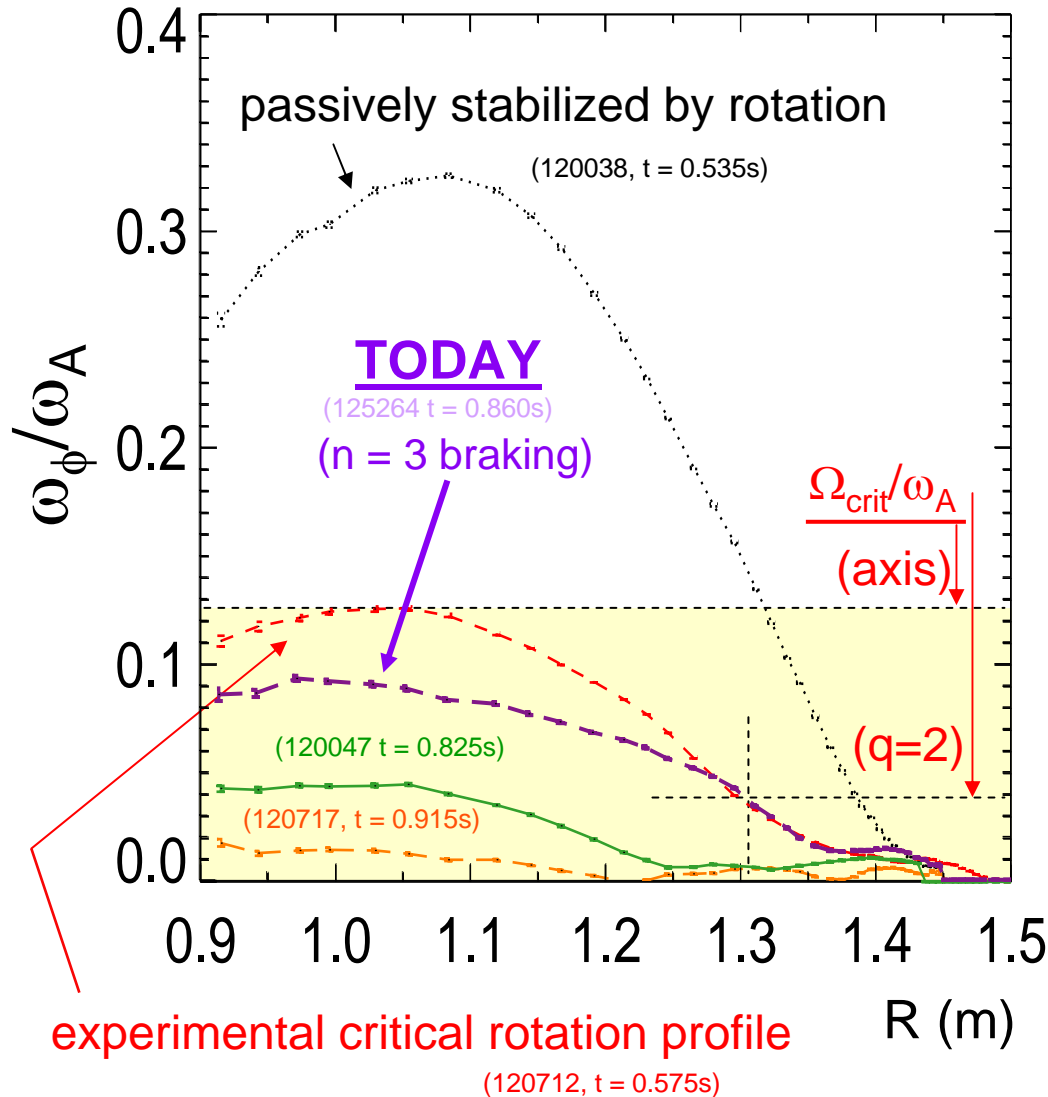
- ❑ **Feedback with full B_r, B_p sensor set**
  - ❑ XP702 – plasma stable at high V_ϕ to 1.3s with fdbk
  - ❑ Similar plasma showed instability – again showing mode amplitude modulation decrease in frequency

- ❑ **Filled in V_ϕ profile variation**
  - ❑ Variety of profile shapes produced (some profiles broader than usual)

NSTX

XP728 filled in rotation profiles produced during RWM feedback

passively stabilized by rotation

(120038, t = 0.535s)

TODAY
(125264 t = 0.860s)
(n = 3 braking)

Ω_{crit}/ω_A

(axis)

(q=2)

(120047 t = 0.825s)

(120717, t = 0.915s)

experimental critical rotation profile
(120712, t = 0.575s)

ω_ϕ/ω_A

R (m)

- ❑ Rotation below "critical rotation profile", but not by much
  - ❑ Might have produced lower rotation with additional shots

- ❑ No indication, so far, of stable, low rotation state with feedback off
  - ❑ Rotation may not have been slowed enough
  - ❑ Stability analysis with trapped particle precession included will tell

- ❑ XP728 has produced wide range of rotation profiles for RWM stability analysis
  - ❑ Key detail in mode dynamics during feedback
  - ❑ May need to go beyond simple model to understand how stabilization works