XP728: RWM active stabilization – used B_r sensors for feedback

ENGINEERING::IP2

124748 high V_ϕ Bru,l fb

120712 low V_ϕ No fb (2006)

120047 low V_ϕ B_{pu} fb (2006)

124708 mid V_ϕ Bpu fb

124707 high V_ϕ Bpu fb

Normalized toroidal beta

RWM coil 5 current per turn

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

RWM sensor amplitude of plasma n=1 BR upper

8 – 9 G "threshold"

t (s)
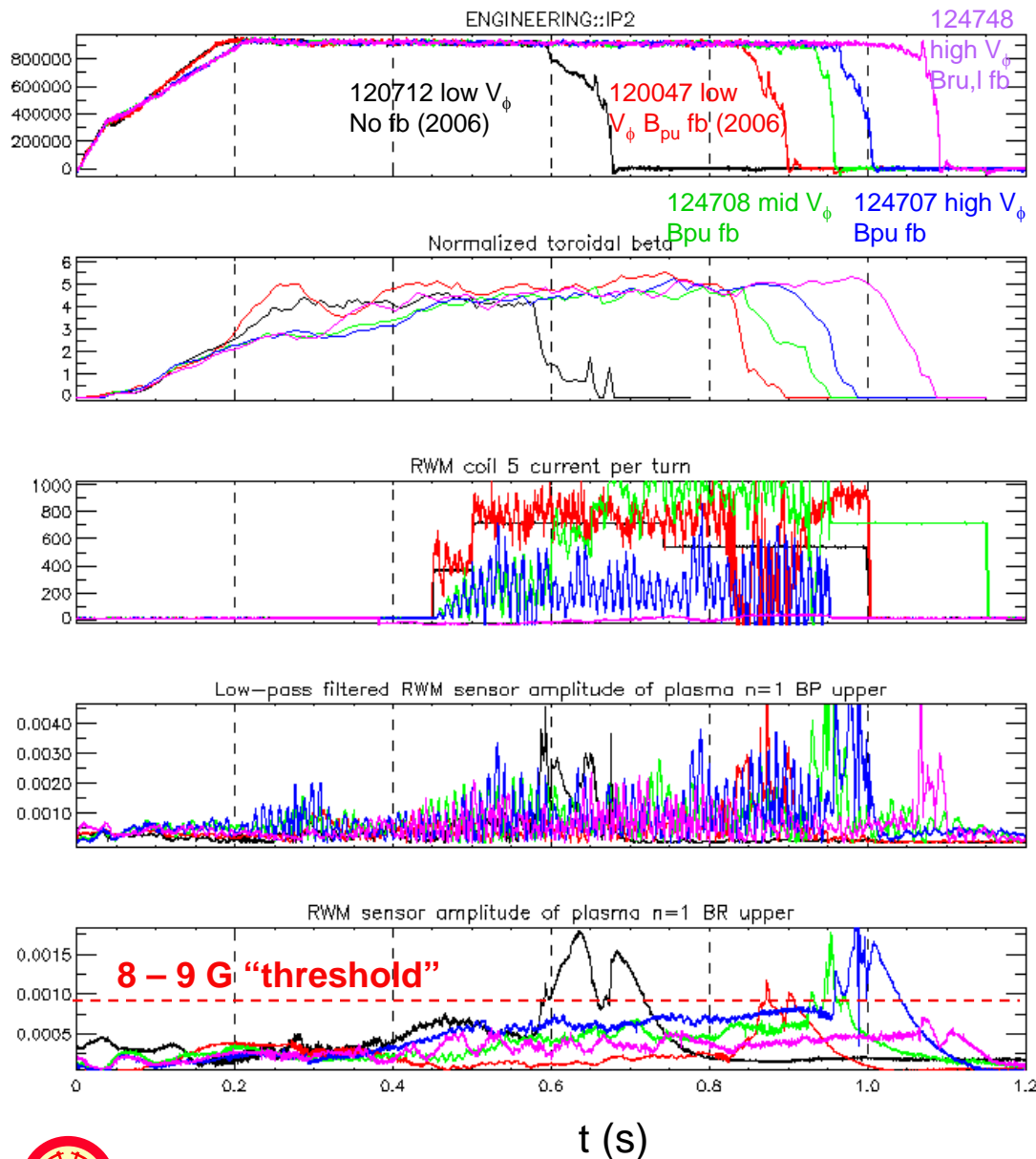
- ❑ **Completed phase scan for feedback with Bp^{lower} + Bp^{upper} sensors**

- ❑ **Determined feedback phase for best response with Br^{upper} + Br^{lower} sensors**
  - ❑ Detailed feedback dynamics, apparent mode deformation

- ❑ **Started second part of XP – dependence on V_ϕ**
  - ❑ Feedback successful at high rotation
    - ● ~ 200A B_r correction
  - ❑ Reduced rotation profile to 2006 "critical rotation profile"

- ❑ **Feedback using Br^{upper} + Br^{lower} sensors at high rotation available as tool for other XPs**

NSTX

Rotation profiles produced during RWM feedback – XP728

passively stabilized by rotation

(120038, t = 0.535s)

TODAY
(124707 t = 0.805s)

Ω_{crit}/ω_A

(124708
t = 0.805s)

n = 3
braking

(axis)

(q=2)

(120047 t = 0.825s)

(120717, t = 0.915s)

ω_ϕ/ω_A

0.4
0.3
0.2
0.1
0.0

0.9 1.0 1.1 1.2 1.3 1.4 1.5

R (m)

experimental critical rotation profile
(120712, t = 0.575s)
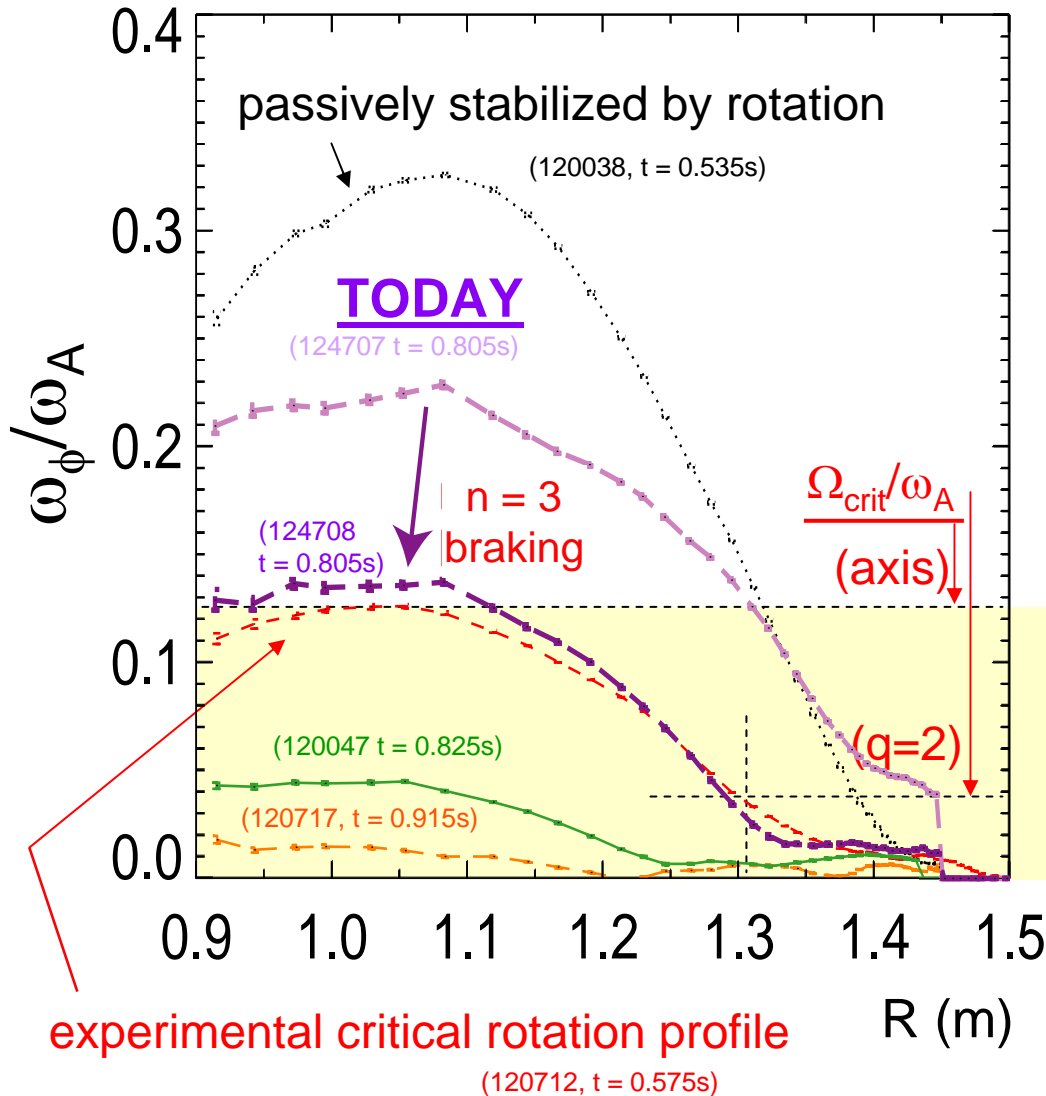
- ❑ Produced broad, high rotation profiles with feedback
  - ❑ B_p, B_r feedback

- ❑ On last shot reduced rotation profile with n = 3 braking to "critical rotation profile"
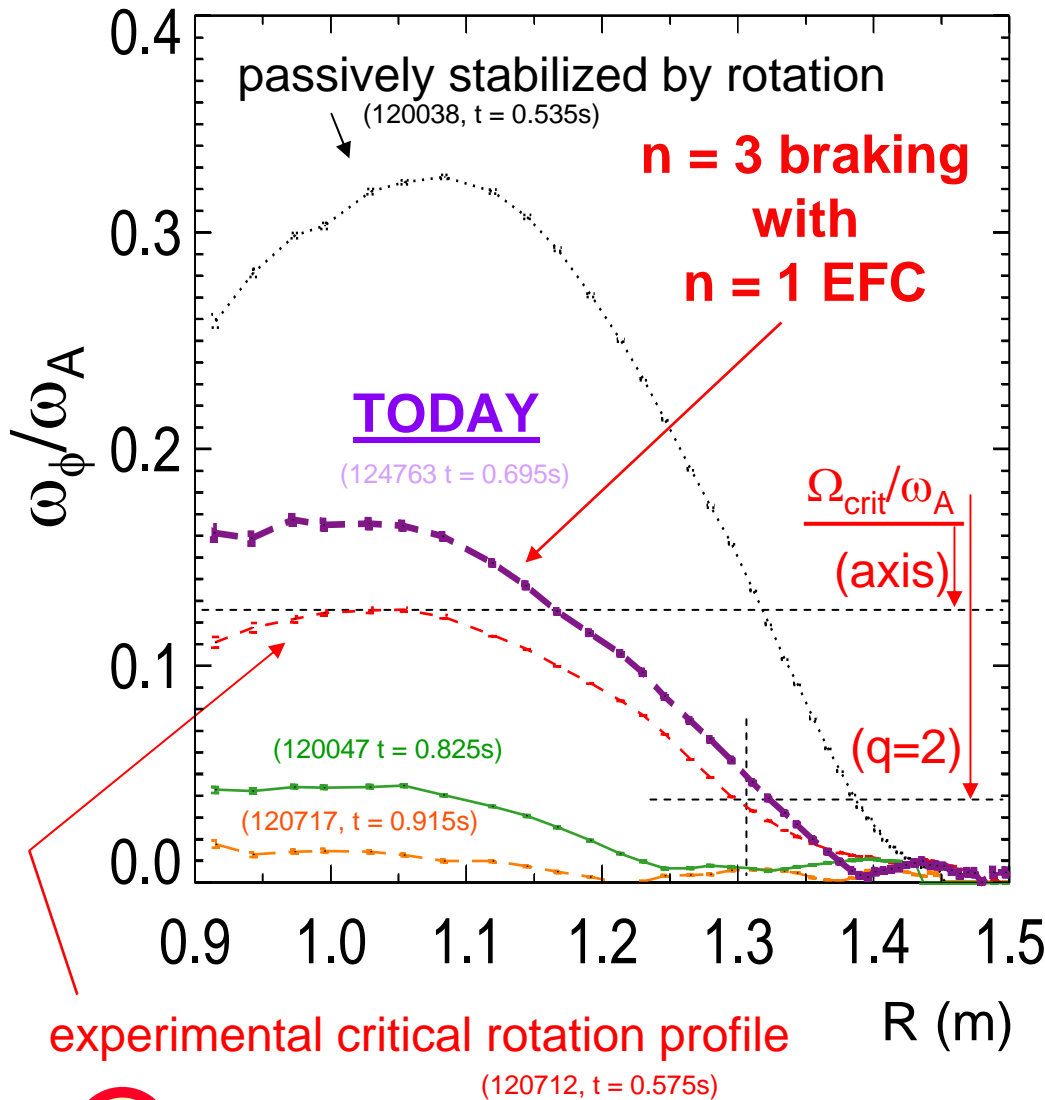
- ❑ To complete XP:
  - ❑ Need to increase n = 3 braking to get KEY data at low rotation; vary phase

  - ❑ Need to gate on/off feedback at low rotation < "critical profile"

NSTX

n = 1 error field correction applied to n = 3 braking – XP729

(A. Garofalo, et al.)

passively stabilized by rotation
(120038, t = 0.535s)

n = 3 braking with n = 1 EFC

TODAY
(124763 t = 0.695s)

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)

- ❑ **n = 1 "optimal" error field correction currents found**
  - ❑ Using Bpu sensors (iteration converged)
  - ❑ Using Bru + Brl sensors (diverged)

- ❑ **Started n = 3 braking on last few shots**
  - ❑ Reduced rotation to near "critical" rotation profile

- ❑ **To complete XP:**
  - ❑ Several shots with stronger n = 3 current
    - ● Will braking effect saturate?
    - ● Will $\Omega_{crit}(\psi)$ change?