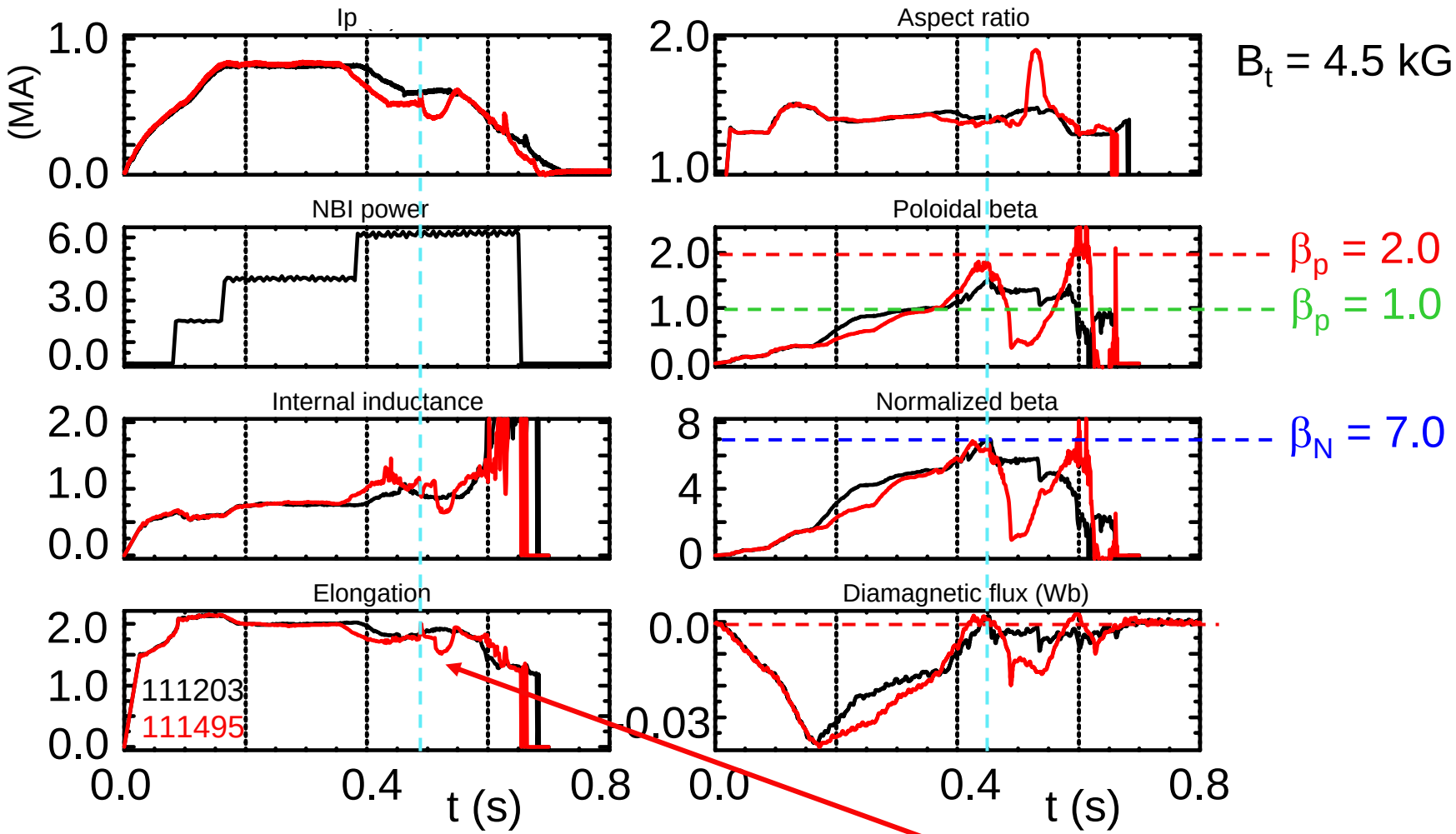
XP528: Rotation and Aspect Ratio Effects near the High β_p Equilibrium Limit

- Goals
  - Examine aspect ratio dependence of rotation effects at high β_p
    - Maximize $\Delta_{Shafranov}/a = 1/(2A)*(\beta_p(1 + 5/6\ M^2) + 1/4)$; (High A limit)
    - Test 1/A dependence of $(R_{Pmax} - R_{axis})/a$ on aspect ratio
  - Produce maximum β_p and β_N in NSTX
    - Approach (reach?) the equilibrium limit ($\varepsilon\beta_p > 1.8$ based on 110184)
    - Examine bootstrap current at high β_p
    - Reach $\beta_N = 8$ (conceptual design milestone)
      - potential for $\beta_N = 10$ in best case scenario
    - Test equilibrium reconstruction at maximum β_p
  - Complete past XP414
    - Target values of β_N,β_p not reached due to n=1 MHD activity
    - n=1 activity reduced in last 0.5 day run ($B_t = 0.3T$) by keeping $\kappa >= 2$
    - Complete XP with $B_t = 0.45T$, $\kappa >= 2$ targets to reach performance goals
    - Produce reconstructions using MSE data

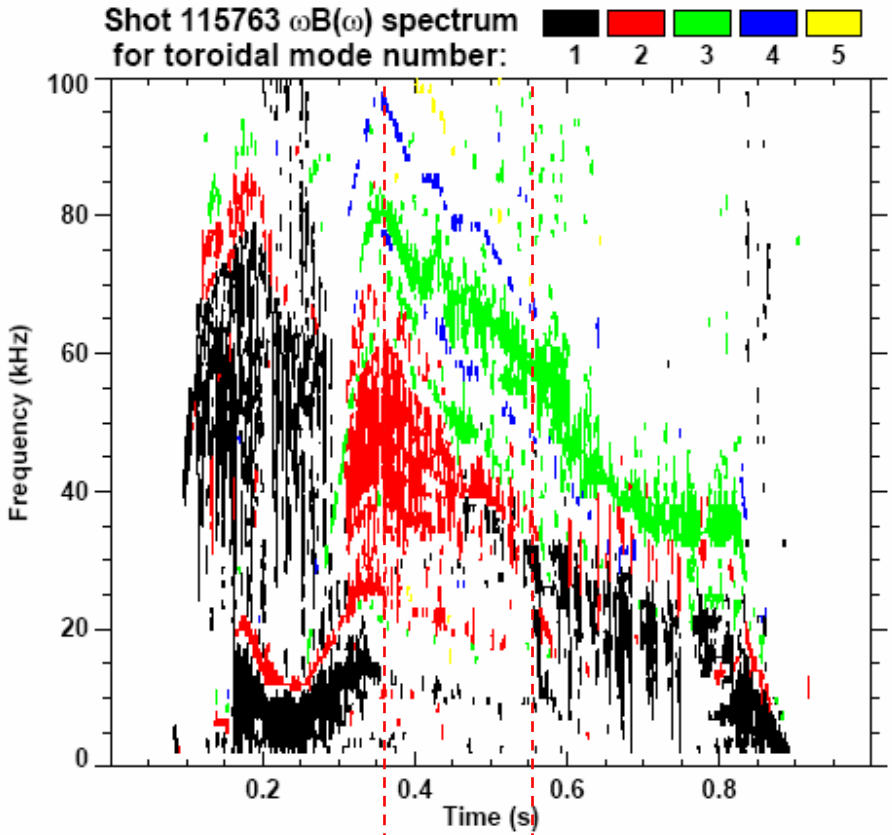
High β_N plasma reached β_p= 1.8; β_p = 2 late



- Highest β_p plasma is slightly diamagnetic (2 mWb)

NOTE: κ allowed to drop – led to n=1 MHD activity and β collapse

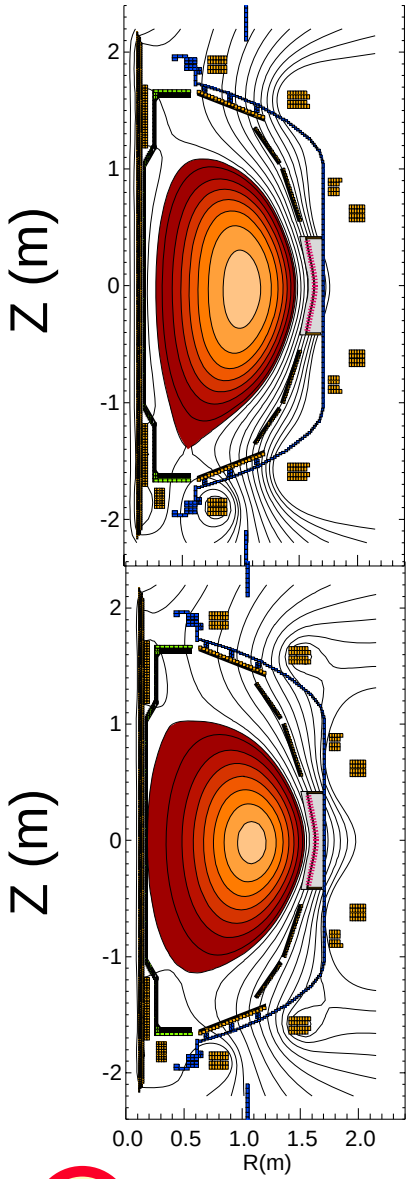
n = 1 MHD reduced in recent target plasmas

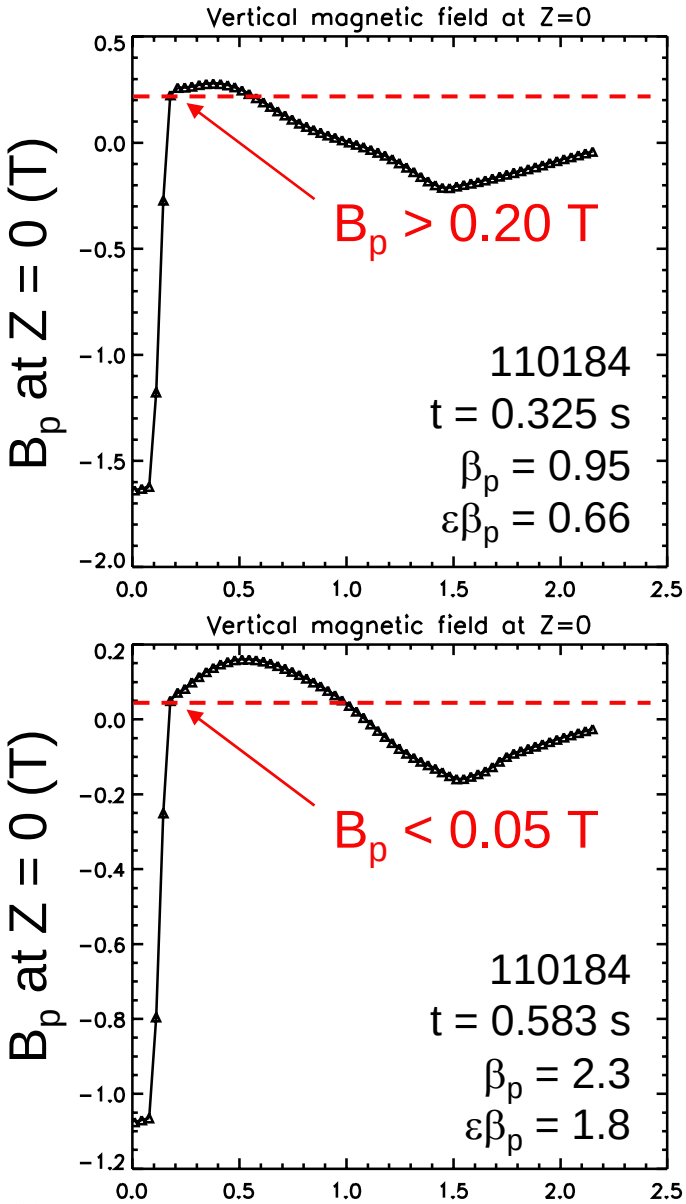


N = 1 activity absent
(reach target β_N in this window)

- Target plasma has B_t = 4.5 kG, reached β_N = 5.7, β_p = 1.2
- Potential for exceeding β_N = 8 with I_p reduction

High β_p plasma is approaching the equilibrium limit

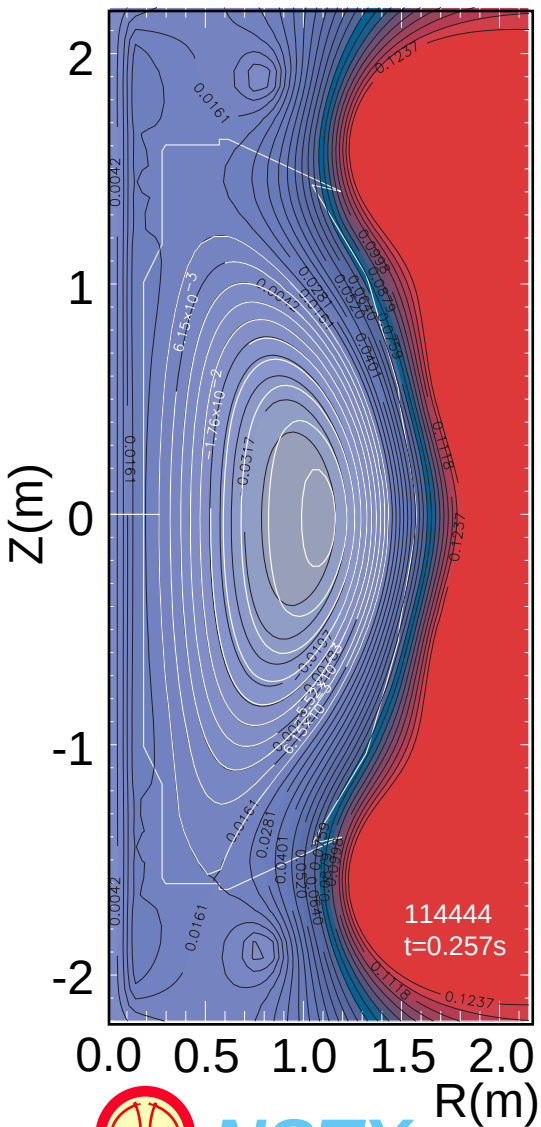


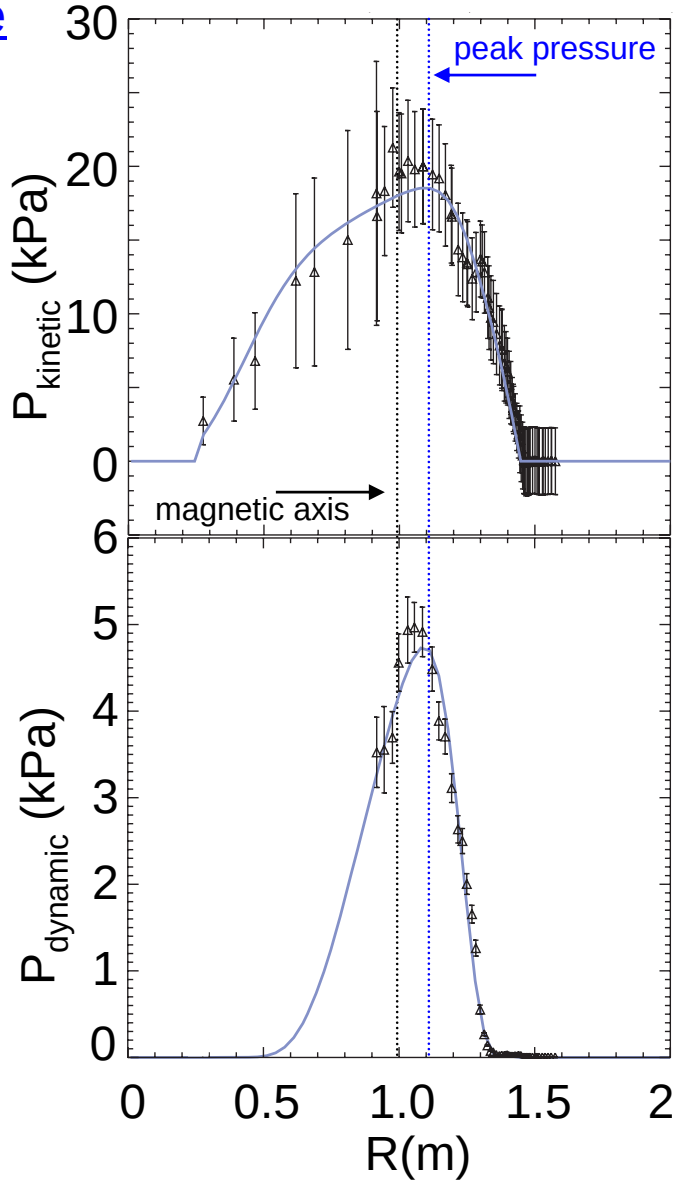


- Vertical field at inboard midplane reduced by more than a factor of 4 at highest β_p

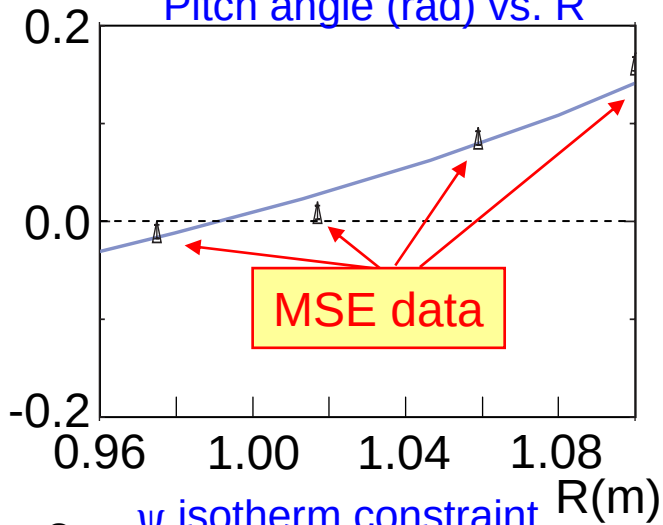
Maximum β_p configurations will test EFIT rotation reconstructions

Poloidal flux and pressure

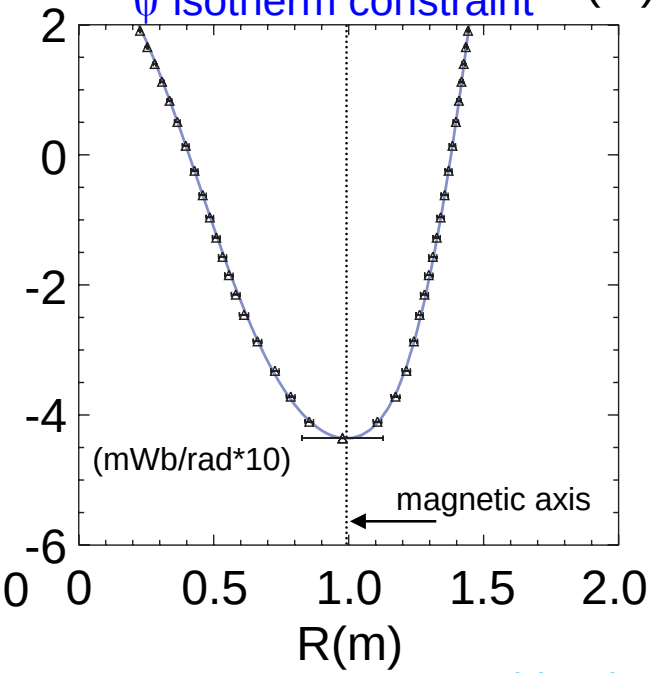




Pitch angle (rad) vs. R



ψ isotherm constraint



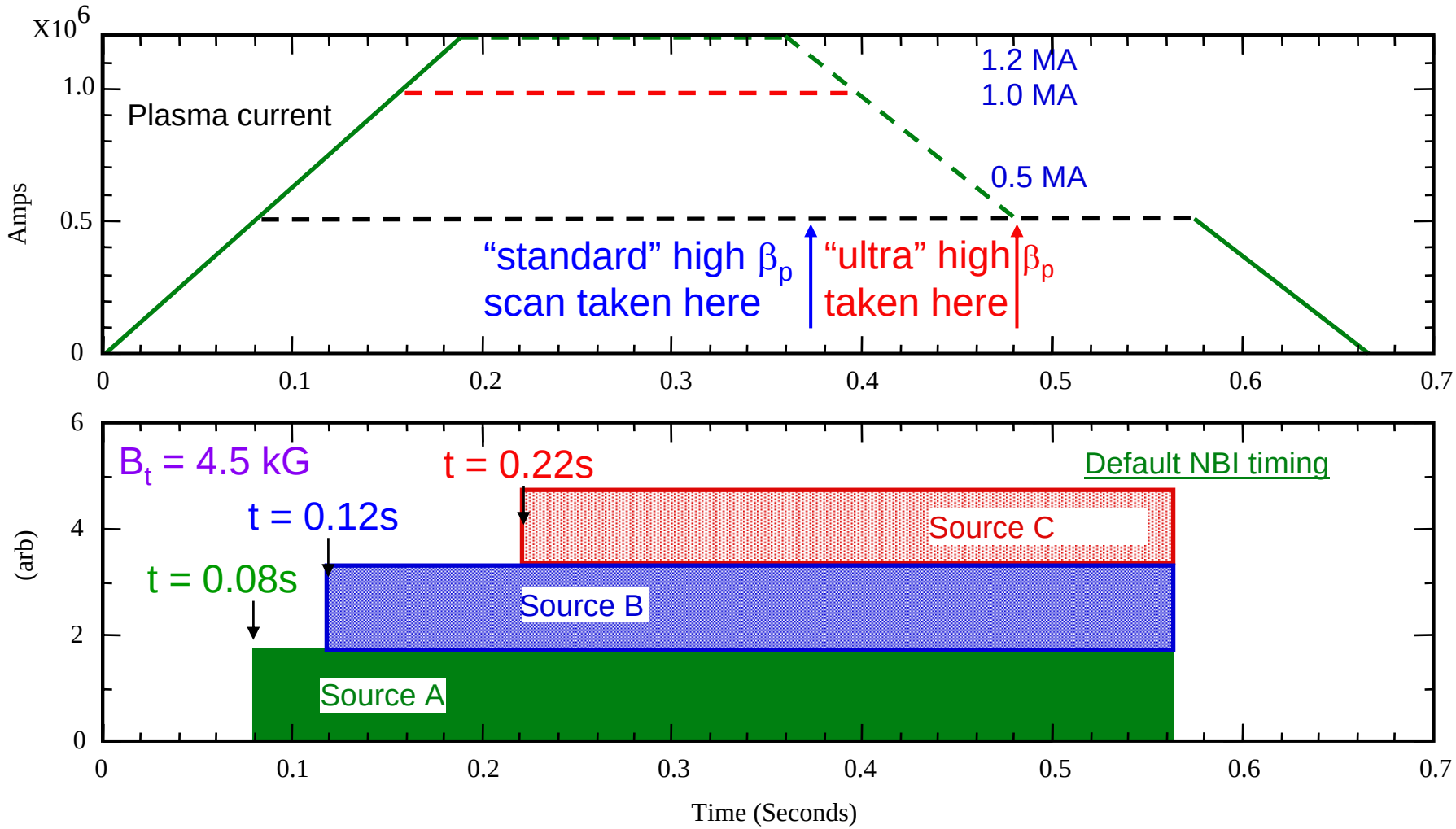
XP528: Aspect Ratio Effects at High β_p – Run Plan

- **Scan aspect ratio and poloidal beta (36 shots)**

start here

Task	Number of Shots
A) **Use shot 115763 as setup, B_t = 4.5 kG**, maintain fixed, low aspect ratio < 1.35; I_p ramp-down to 0.5 MA, full NBI power standard control system (*** don't use rtEFIT for this XP ***)	
(i) Rerun 115763 (β_N = 5.7 pre I_p ramp target); attain early H-mode)	1
(ii) Initial I_p = 1.0 MA	4
(iii) Initial I_p = 0.5 MA (2 NBI sources first, 3 if required to raise β)	2
(iv) Attempt initial I_p = 1.2 MA	4
(v) (optional) B_t = 4.5kG ramp-down to 3.0kG at time of I_p ramp	(2)
B) Repeat with A increasing to 1.6 by increasing inner gap	6
C) Repeat with A increasing to maximum by increasing inner gap	6
Total shots:	23 (25)

High β_p equilibria can be investigated at several points



- Attempt to keep elongation >=2 during I_p reduction

Duration and Required / Desired Diagnostics

- XP could be completed in 1.0 - 1.5 run days
- Required
  - Magnetics for equilibrium reconstruction
  - CHERS
  - MSE
  - Thomson scattering
  - Diamagnetic loop
- Desired
  - Internal RWM sensors
  - USXR diagnostics
  - Toroidal Mirnov array
  - Fast camera