XP-1041 **Joint NSTX/DIII-D poloidal rotation experiment**

R. E. Bell, K. Burrell, M. Podestá, W. Solomon

Overview of planned experiment:

The goal of this experiment is to investigate the carbon poloidal rotation in matched NSTX and D III-D plasmas to determine whether the differences between the measured poloidal rotation and the neoclassical predictions are affected by aspect ratio.

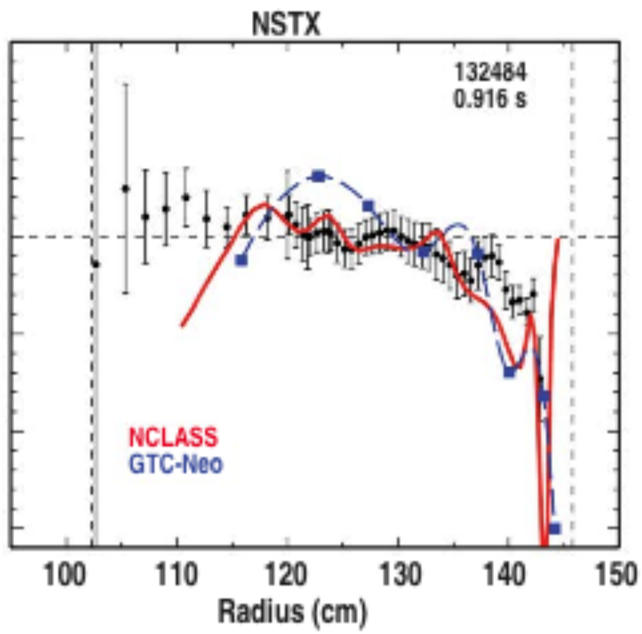
XP-1041 **Joint NSTX/DIII-D poloidal rotation experiment**

Theoretical/ empirical justification

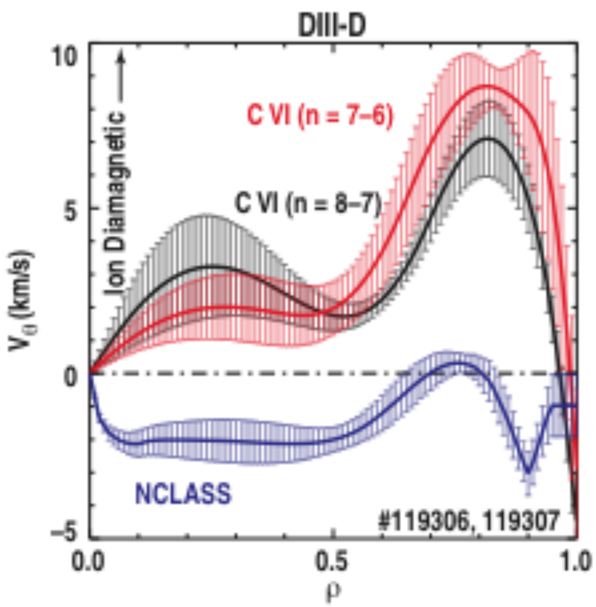
- Measured poloidal velocities on various machines is inconsistent with respect to expectations for poloidal velocity from neoclassical theory.
- DIII-D: QH-mode plasmas had sign and magnitude of measured poloidal velocity differing from neoclassical theory.
- NSTX: H-mode plasmas with measured poloidal velocity at or below neoclassical expectation.
- JET: Measured poloidal velocity in ITB an order of magnitude larger than neoclassical.
- JT-60: Measured poloidal flow is consistent with neoclassical in ITB.
- MAST: Measured poloidal flow is consistent with neoclassical in L and H mode plasmas.
- A comparison between DIII-D and NSTX for similar H-mode at low magnetic field would provide a unique comparison at distinctly different aspect ratios.
- Comparisons with modest ion temperature and low magnetic field would eliminate a potentially serious systematic error due to gyro orbit and finite lifetime effects.

XP-1041 **Joint NSTX/DIII-D poloidal rotation experiment**

- DIII-D: QH-mode plasmas had sign and magnitude of measured poloidal velocity differing from neoclassical theory.
- NSTX: H-mode plasmas with measured poloidal velocity at or below neoclassical expectation.

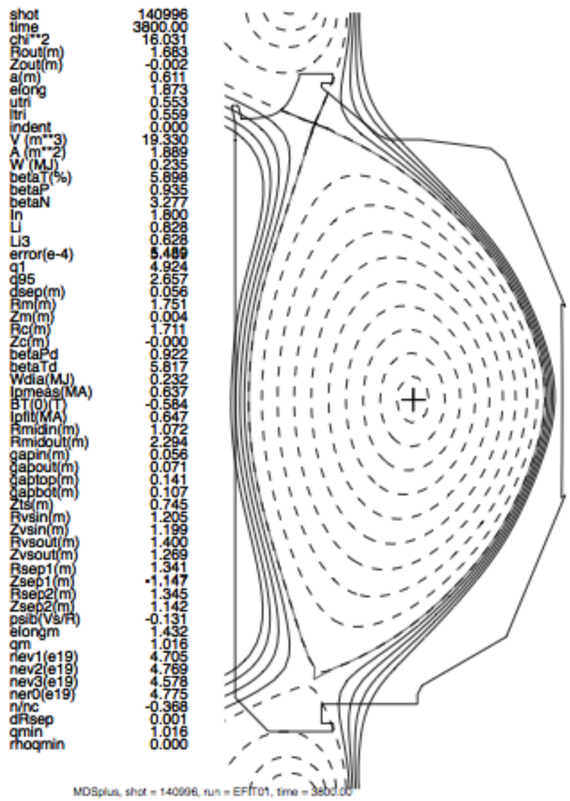


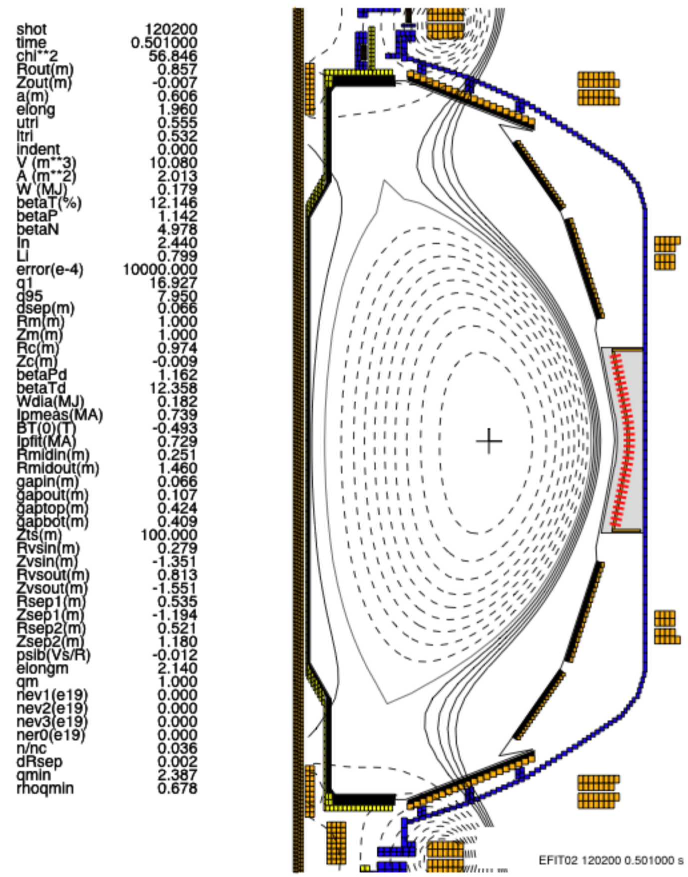
Bell, et al. APS 2009



Solomon et al. APS 2005

Matched discharges from D III-D and NSTX

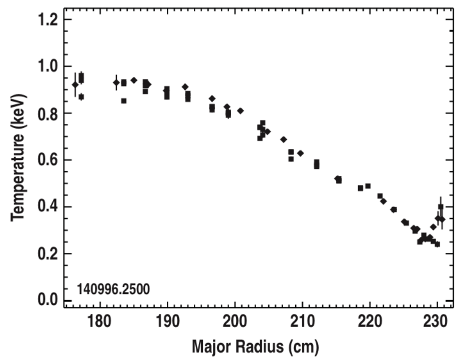


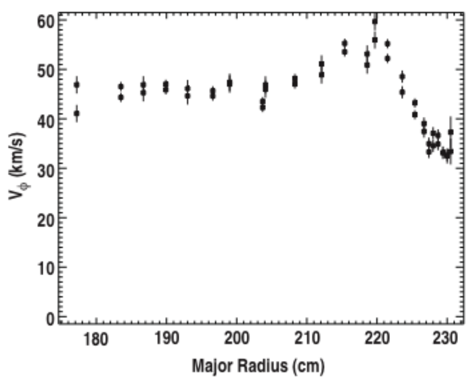


XP-1041 **Joint NSTX/DIII-D poloidal rotation experiment**

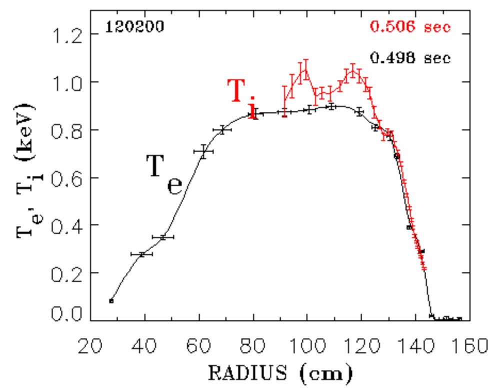
- NSTX V_ϕ larger then DIII-D V_ϕ by factor of 3-4.
- Use magnetic braking with EFC coils to reduce NSTX V_ϕ

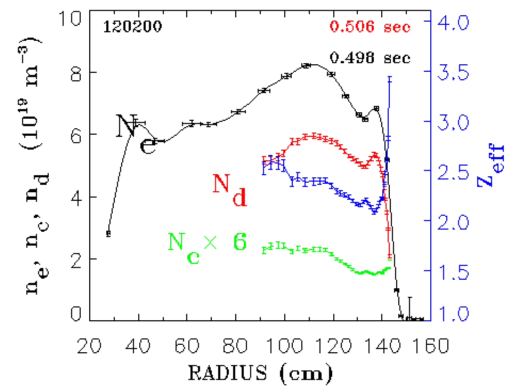
D III-D

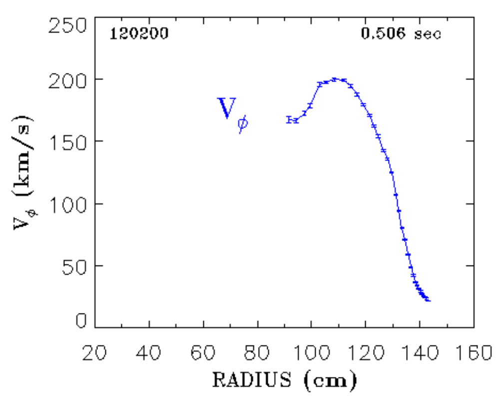


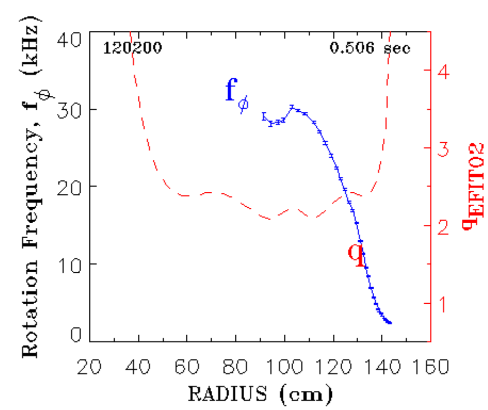


NSTX









XP-1041 **Joint NSTX/DIII-D poloidal rotation experiment**

Experimental run plan

1. Establish the DN target plasma, using reference shot 120200, matching shape, I_p=0.73 MA, B_t=0.495 T.
2. Increase B_t from 0.495 T to 0.55 T to match D III-D discharges.
3. Decrease I_p from 0.73 MA to 0.6-0.64 MA range. (Steps 2 and 3 can be done simultaneously.)
4. Add n=3 error field in steps to reduce toroidal velocity to about 50 - 60 km/s. This should require EFC currents from 0 - 800 kA.

XP-1041 **Joint NSTX/DIII-D poloidal rotation experiment**

Diagnostic Needs

- Poloidal and toroidal CHERS are necessary.
- Turbulence measurements desired, since turbulence is offered as a reason for the disparity between measured and neoclassical values of poloidal velocity.
  - Even with the non-optimal viewing geometry, BES is desired. The pitch angle (I_p/B_t = 1.1 MA/T) for these plasmas is far from optimal for the new BES diagnostic, which is aligned with field lines when I_p/B_t ~ 2 MA/T.
  - High-k scattering is also desired, to be configured with a radial location around 140 cm radius.
  - UCLA reflectometer

Planned Analysis

EFIT, TRANSP, NCLASS, GTC-Neo, NEO