NSTX

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Determination of Heating Efficiency of HHFW in NBI target plasmas

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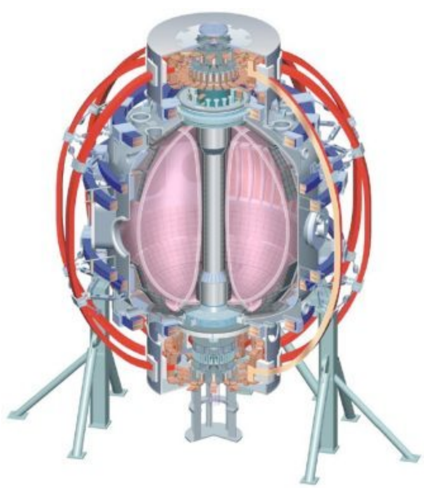
B.P. LeBlanc
PPPL

NSTX Research Forum 2010
1-3 December 2009, Princeton, NJ



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Determine HHFW Efficiency via Neutron Rate

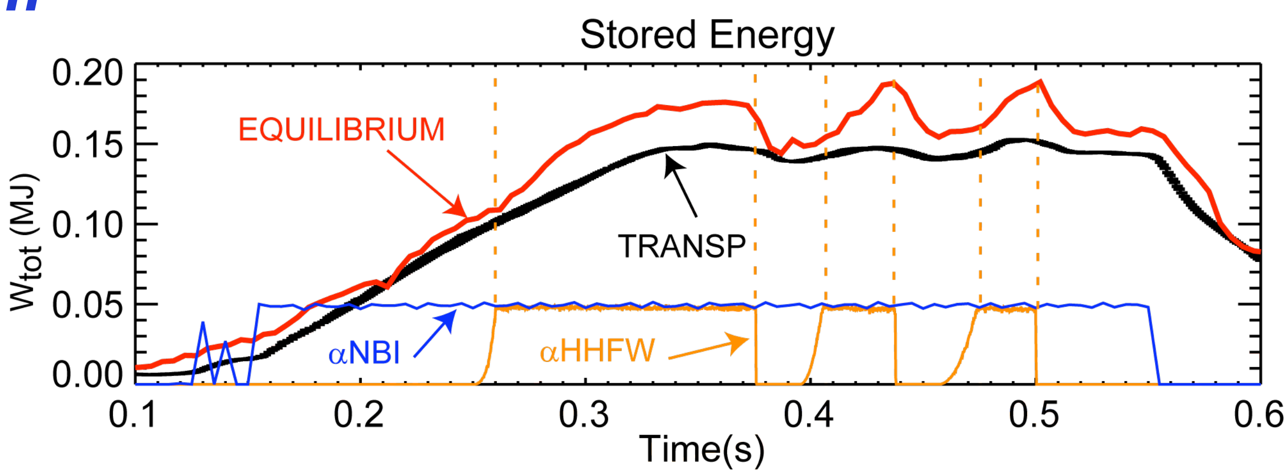
- Obtain a map of the HHFW coupling efficiency of NBI target plasmas against operation conditions
- Experimental determination of the fraction of the rf power coupled to the plasma core based on the measured neutron production rate enhancement during HHFW heating.
  - This rugged effect is routinely observed and pertains only to the core plasma
  - Subject of APS-DDP talk in 2009
    - LeBlanc et al. JO4.00011
- Apply this analysis for NBI induced H-mode (high priority) and L-mode target plasmas

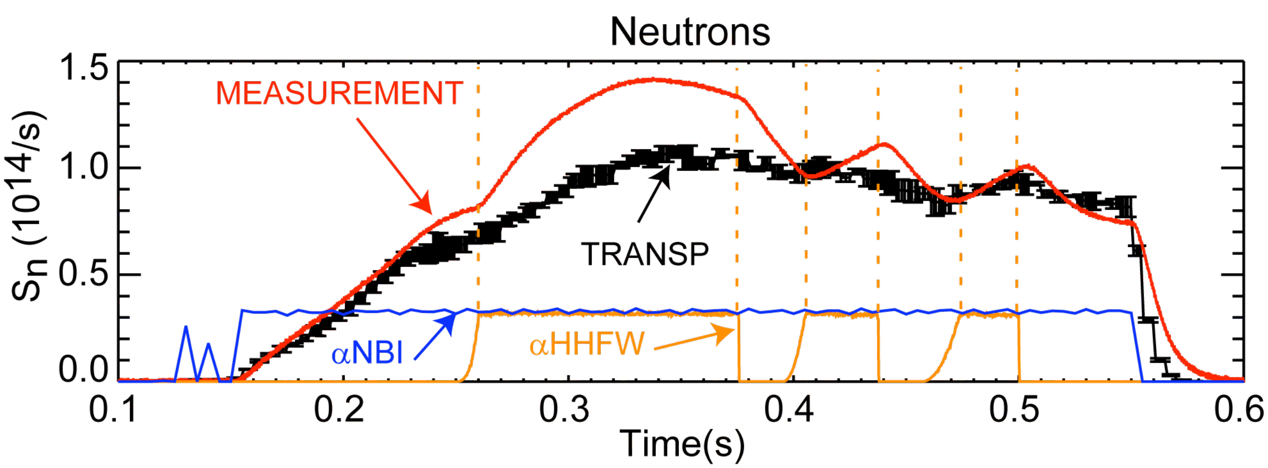
Newer TORIC in TRANSP Provides Improved Analysis Tool
Supplement analysis with CQL3D

- TRANSP makes use of recent version of TORIC, which can compute HHFW propagation and absorption in NSTX
  - M. Brambilla, Plasma Phys. Control. Fusion 44 (2002) 2423-2443
- TORIC calculates power deposition into all species including fast ions
  - But TRANSP RF Monte Carlo Fokker-Planck operator is not ready
  - Self-consistent calculation of fast ions not available for NBI + HHFW plasmas
- Use CQL3D to estimate neutron rate generated by fast ions
- Analyze two cases
  - HHFW generated high-T_e plasmas
  - HHFW heating of NBI-induced H-mode plasmas

Measured Stored Energy and Neutron Rate Exceed TRANSP Calculations during HHFW Pulses

$K_\phi = -13m^{-1}$

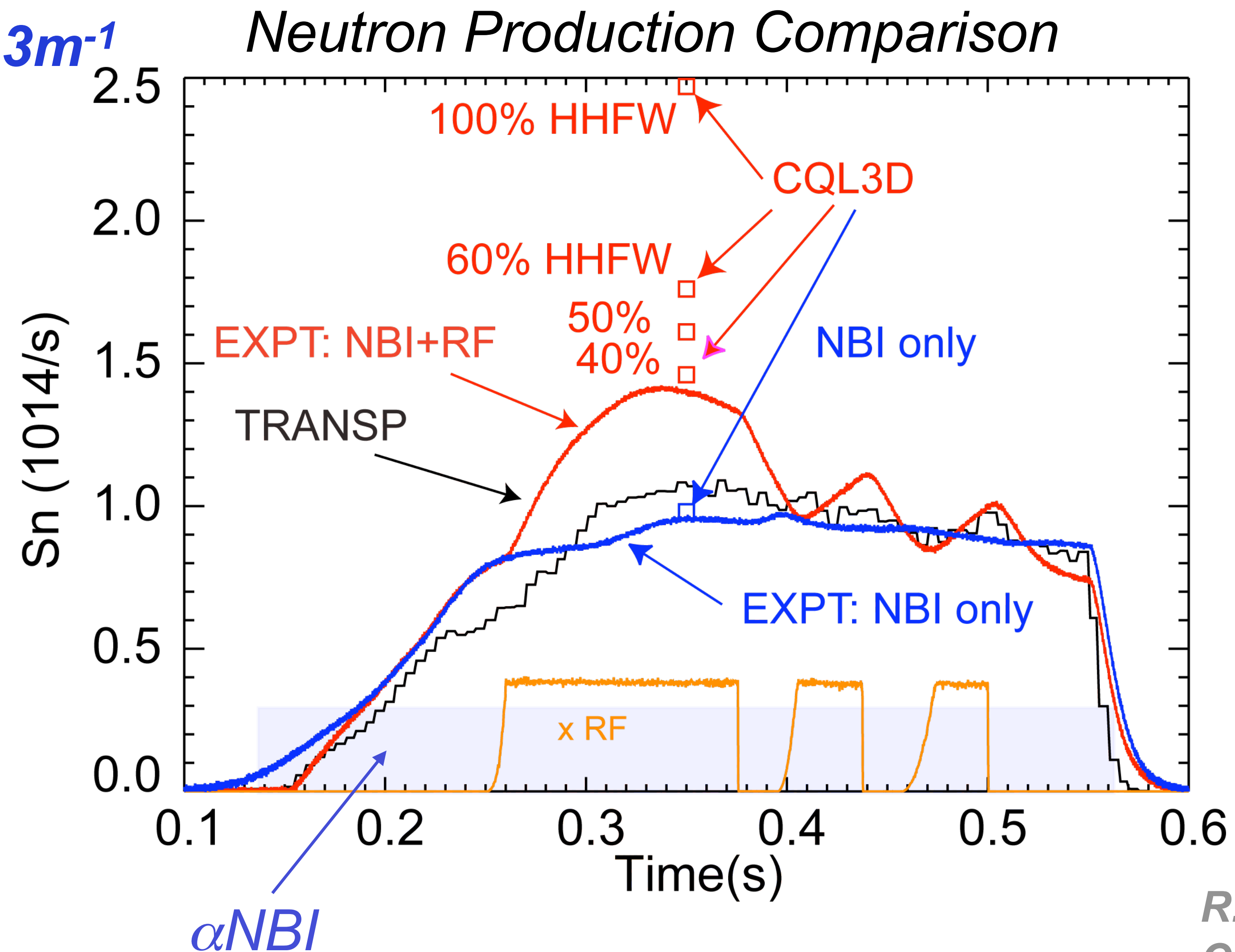




Will look at data in bottom panel

CQL3D Suggests ≈40% of HHFW Power Ultimately Coupled to Plasma Core

$K_\phi = -13 m^{-1}$

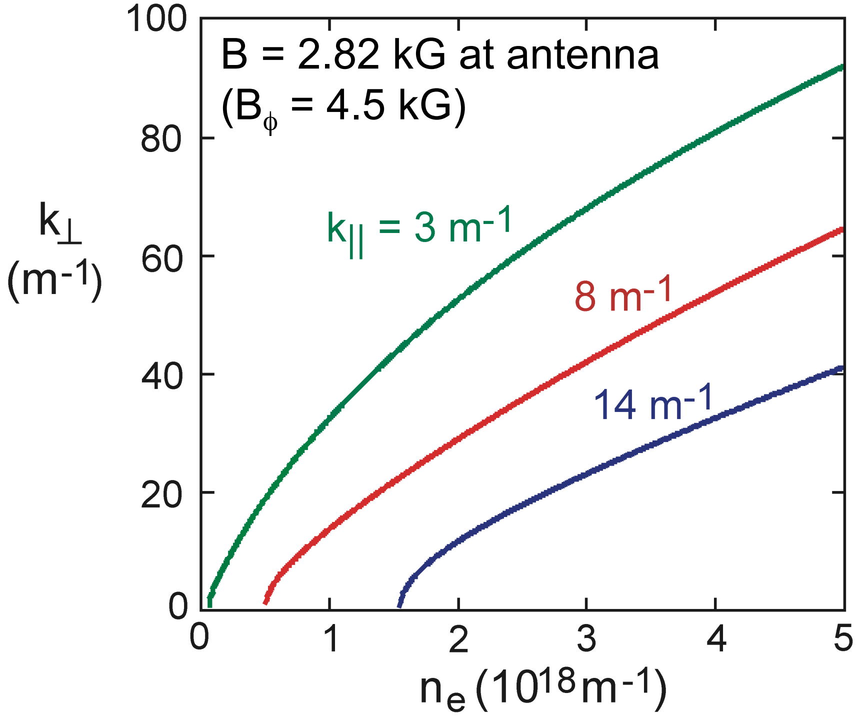


R. Harvey
CompX

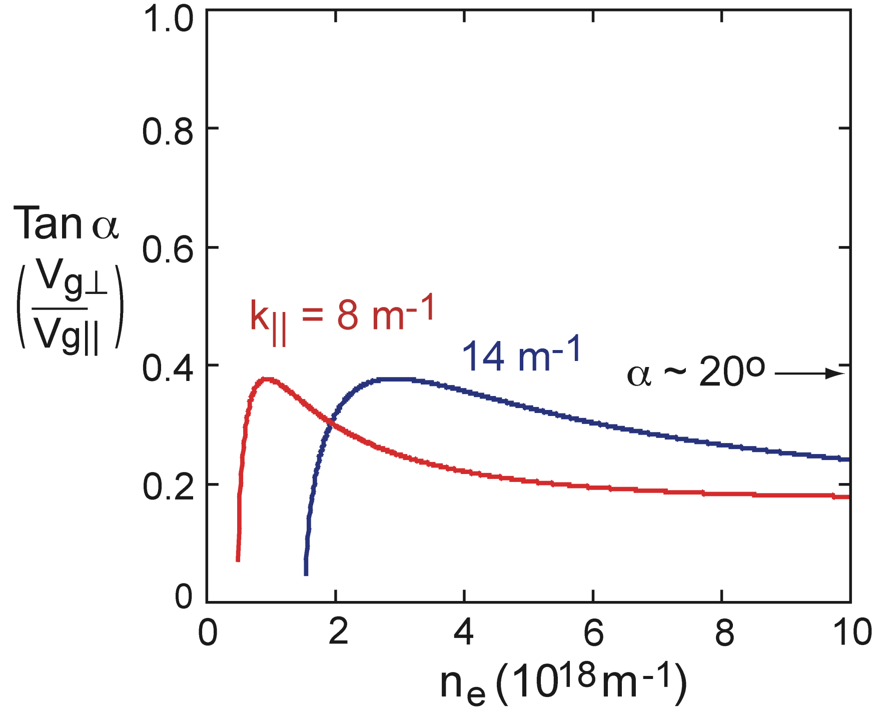
EXTRA SLIDES

Surface FW Propagation Supports Surface Loss at Lower $k_{||}$

Propagating $k_{\perp}$ vs. density at antenna B



Angle of ray to B vs. density



Onset density is $\propto B^*k_{||}^2/\omega$

- Propagation is very close to wall at $k_{||} = 8\ m^{-1}$, on wall at $k_{||} = 3\ m^{-1}$
- Losses in surface should be higher for lower $k_{||}$
- Propagation angle relative to B much less than for lower harmonic case
- Increasing B should move onset farther from antenna, increasing heating

J.C.Hosea