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# Development of Reversed Shear and Monotonic q-profiles in NSTX

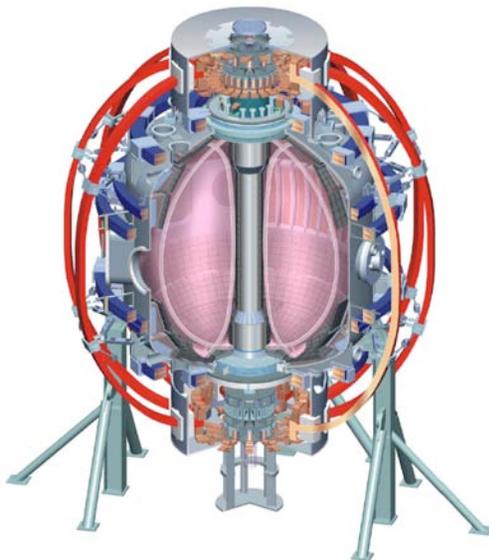
F. M. Levinton, H. Yuh, and the NSTX Team

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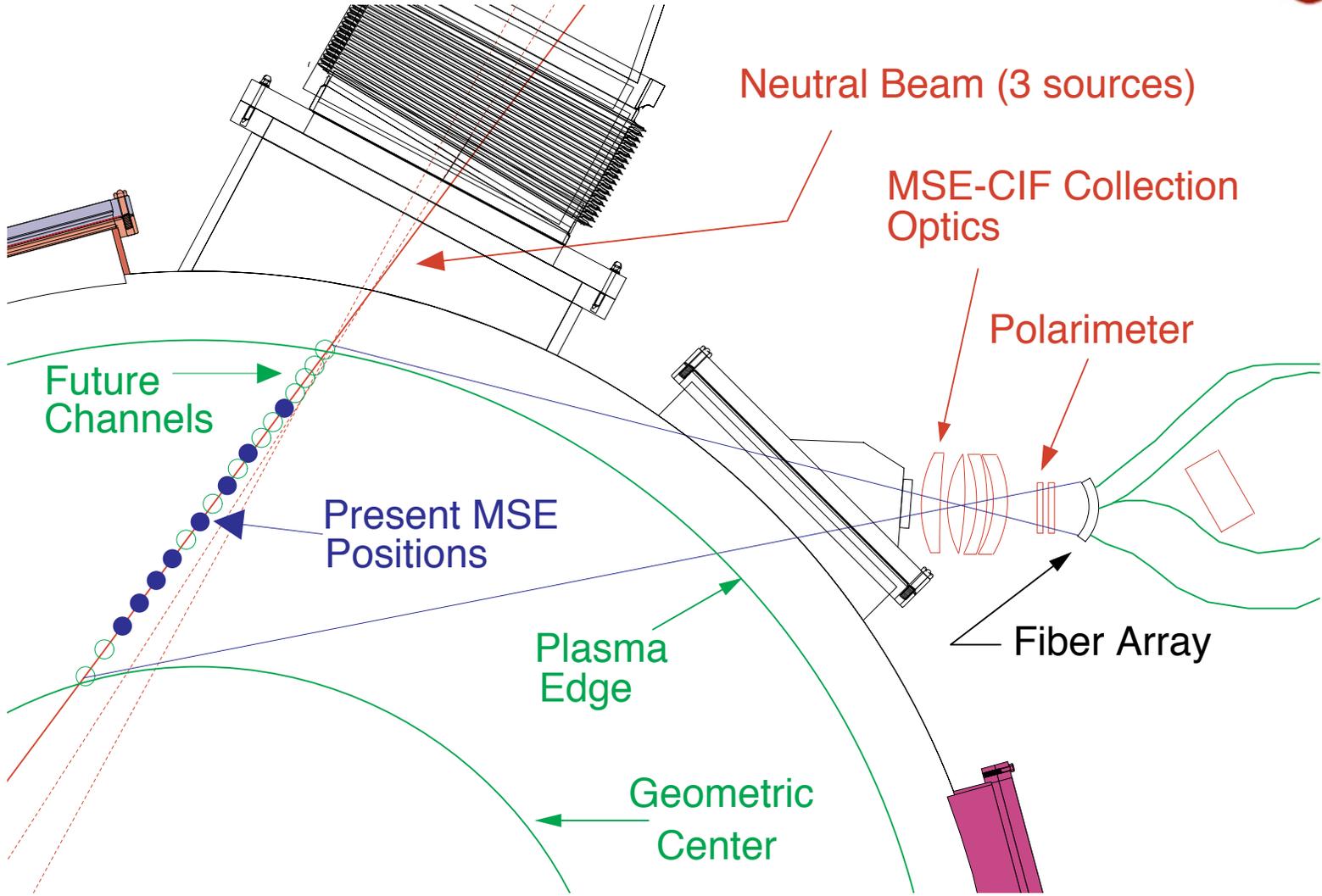
# Outline



- MSE-CIF diagnostic
  - Overview
  - Novel features
- Development of q-profiles with varying shear
  - Transport changes with magnetic shear
- Summary



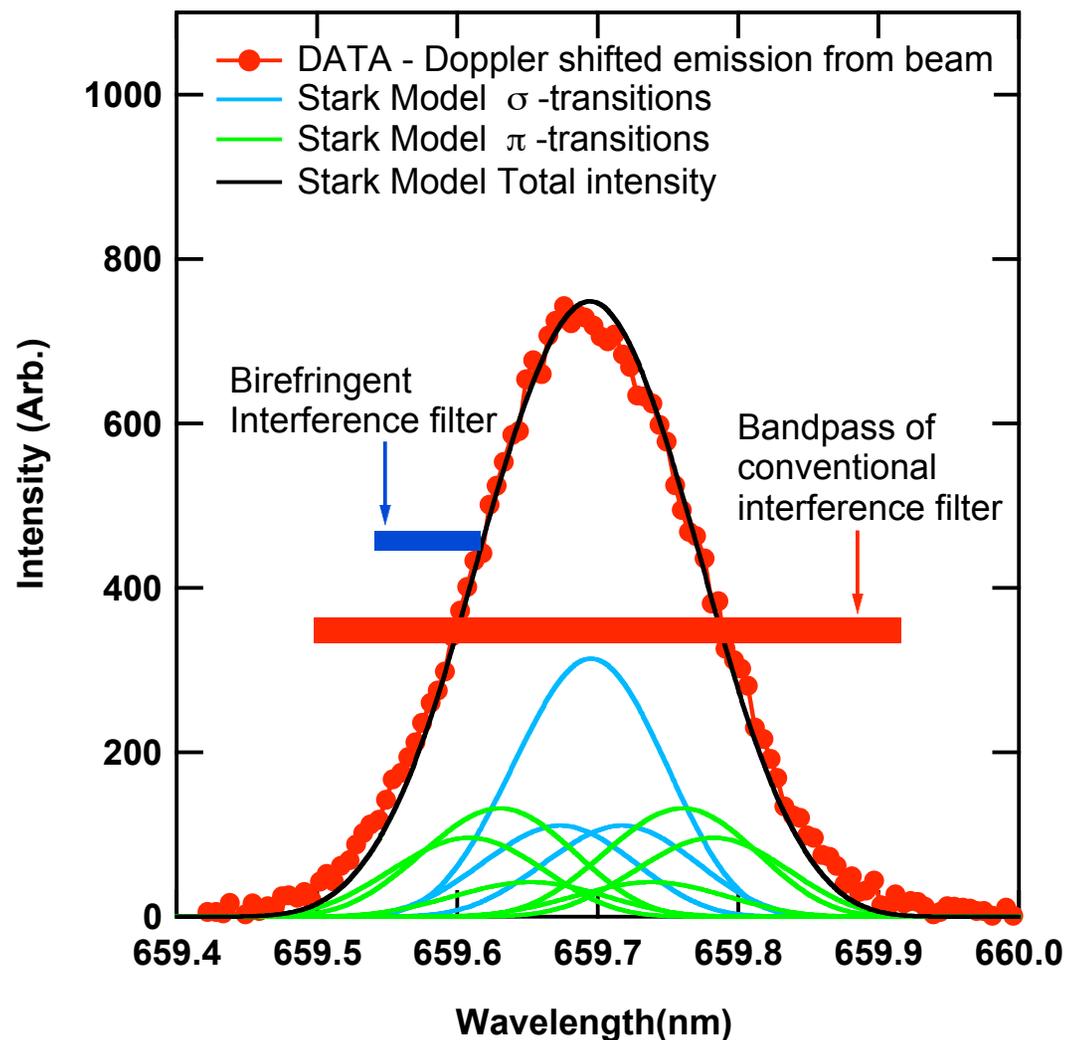
# MSE-CIF Layout on NSTX



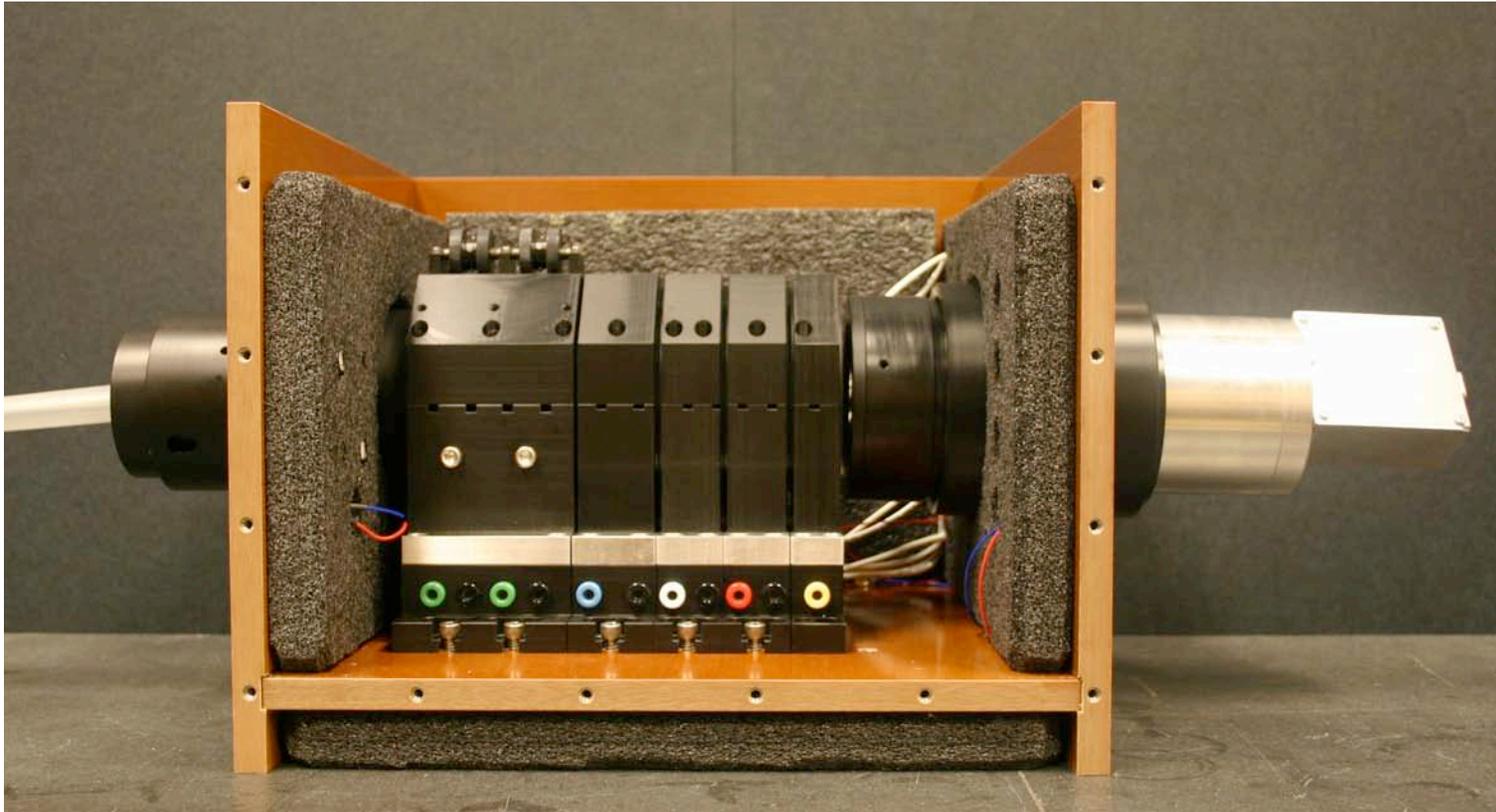
# MSE Issues at Low Magnetic Field



- High resolution spectrum of Doppler shifted beam emission.
- At low magnetic field overlap of Stark multiplet results in low polarization fraction with conventional filter.
- Novel birefringent filter with narrow bandpass can isolate a portion of the spectrum resulting in a much better polarization fraction (~40%).



# Novel Birefringent Interference Filter Developed for NSTX

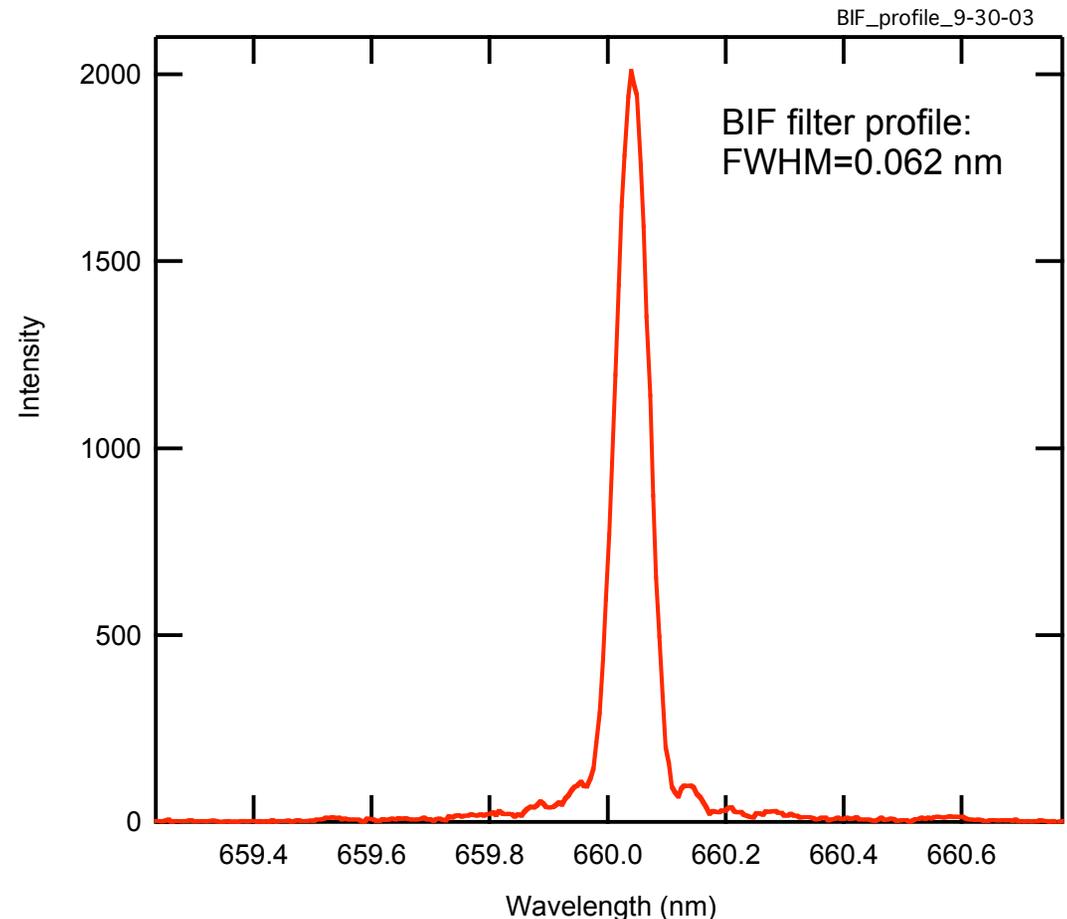


- Modular filter has a 75 mm clear aperture, wide field of view, narrow bandwidth, and is electro-optically tunable.

# Birefringent Filter Development for NSTX



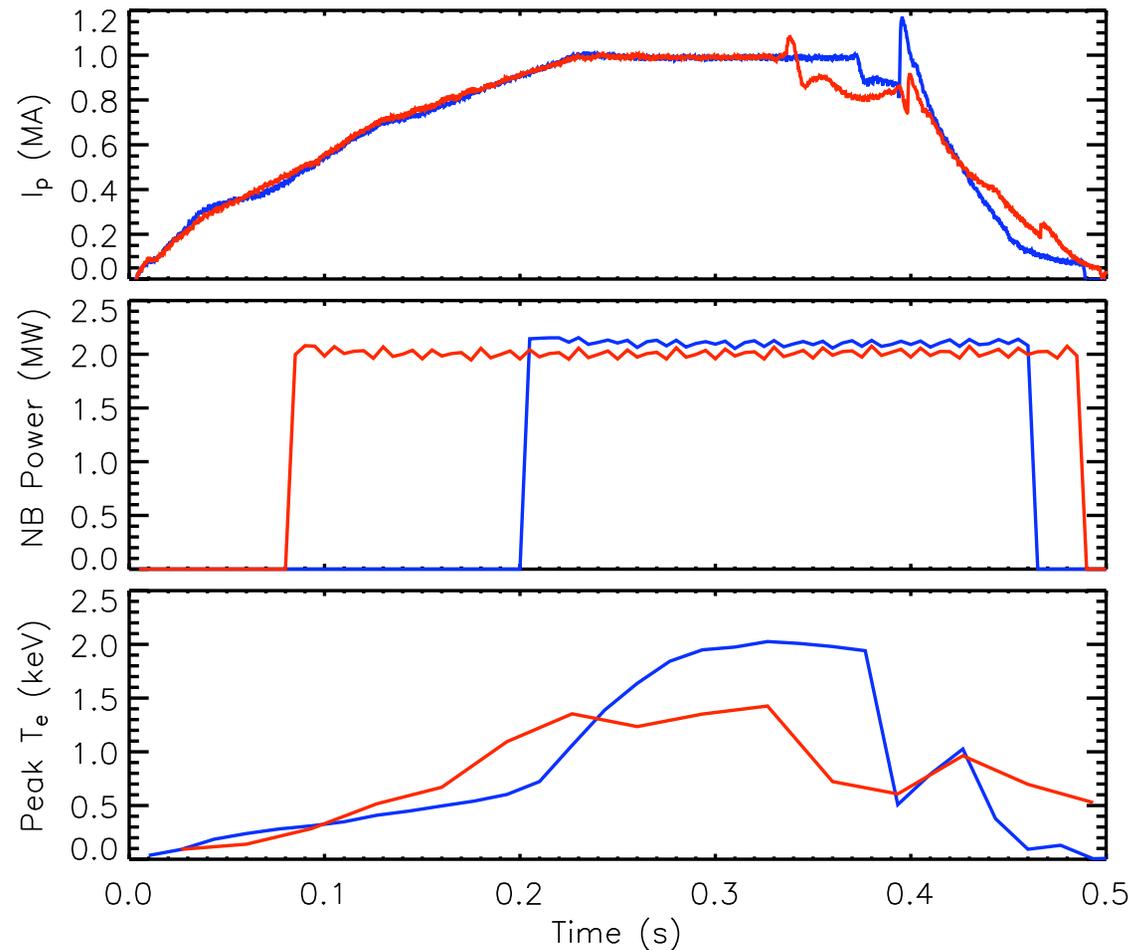
- Novel high throughput, narrow passband filter makes measurements with MSE at low field possible.
- Overall design has resulted in a polarization fraction greater than 40% .
- Achieved good time resolution (~5-10 ms).



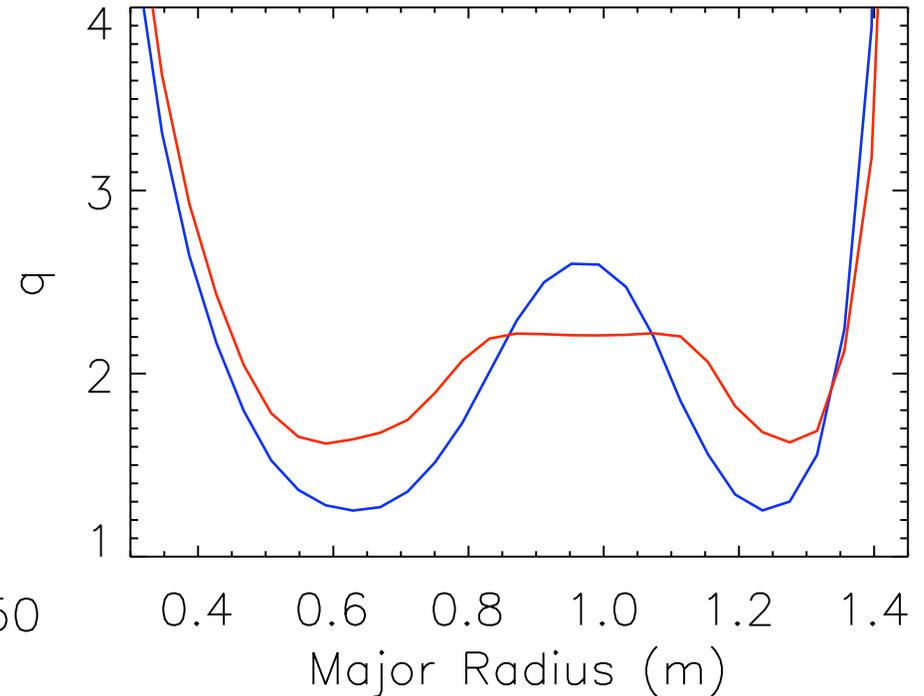
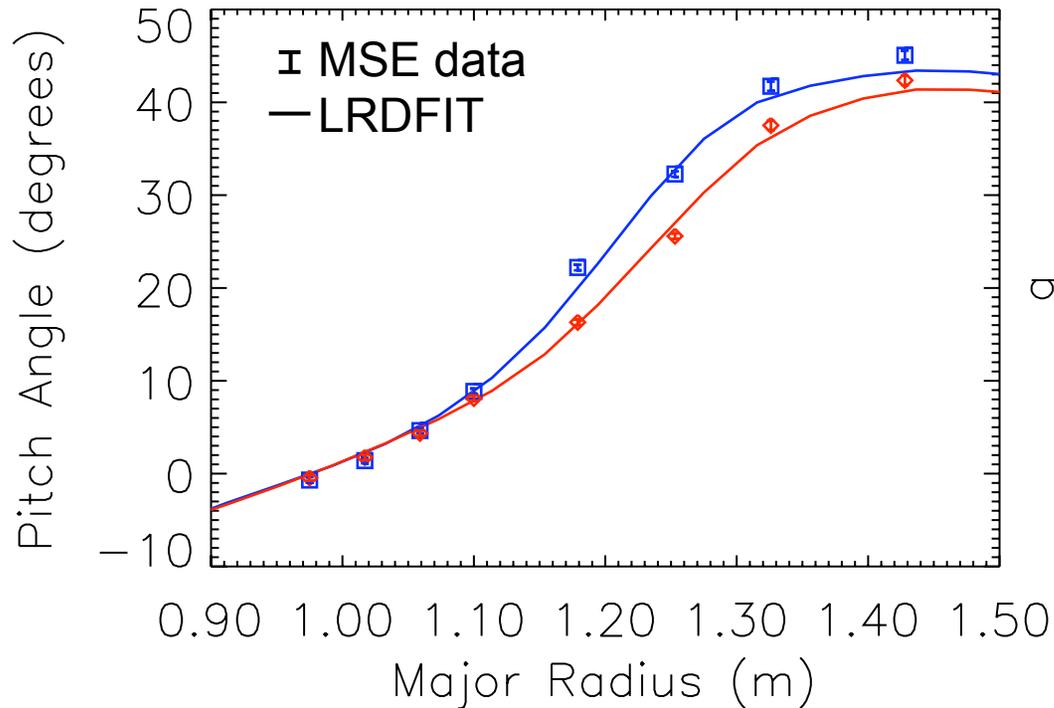
# Transport Dependence on Varying Magnetic Shear



- Development of robust reversed shear startup.
- Varied  $I_p$  ramp rate, NBI timing, plasma shaping, and gas fueling.
- Plasma is L-Mode and MHD quiescent.

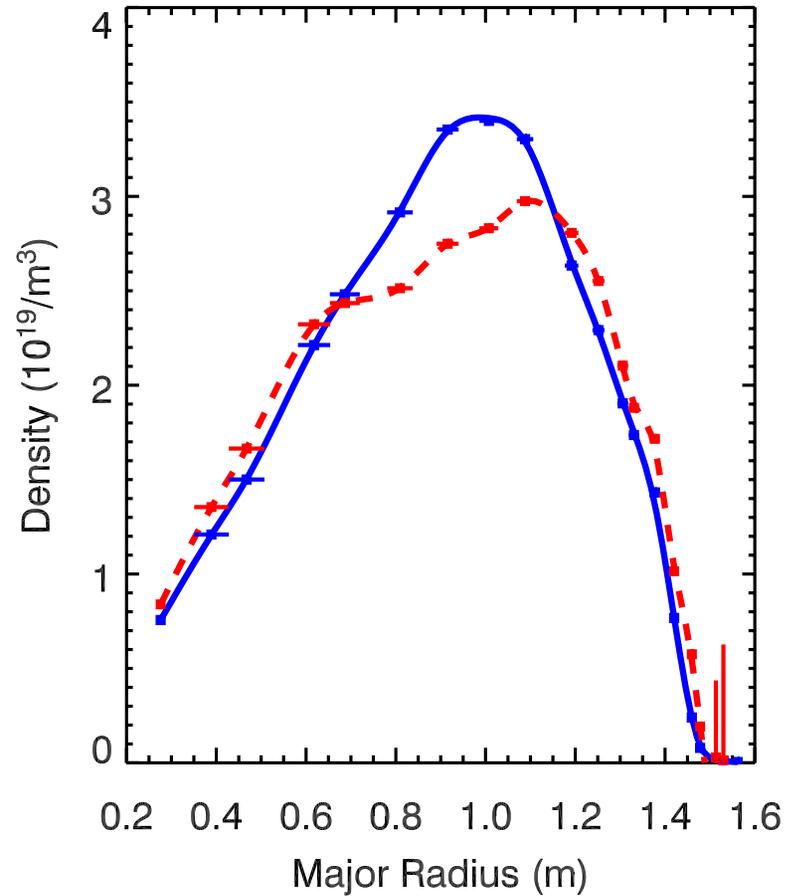
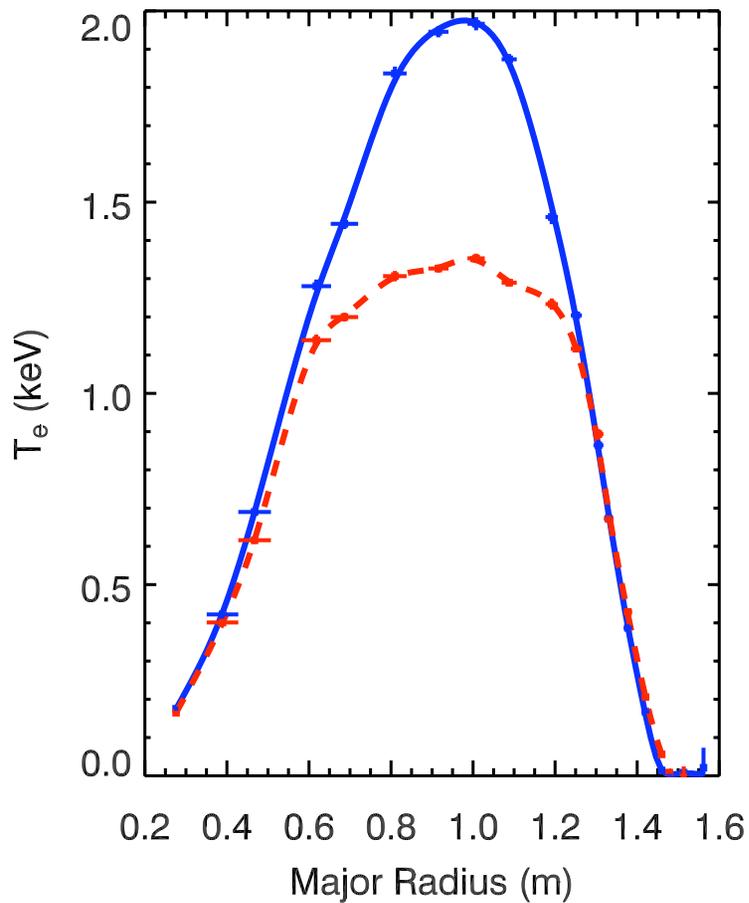


# q-profiles Developed with Varying Magnetic Shear



- Variation of pitch angle and q-profile with NBI timing.
- q-profiles from equilibrium reconstruction with LRDFIT.

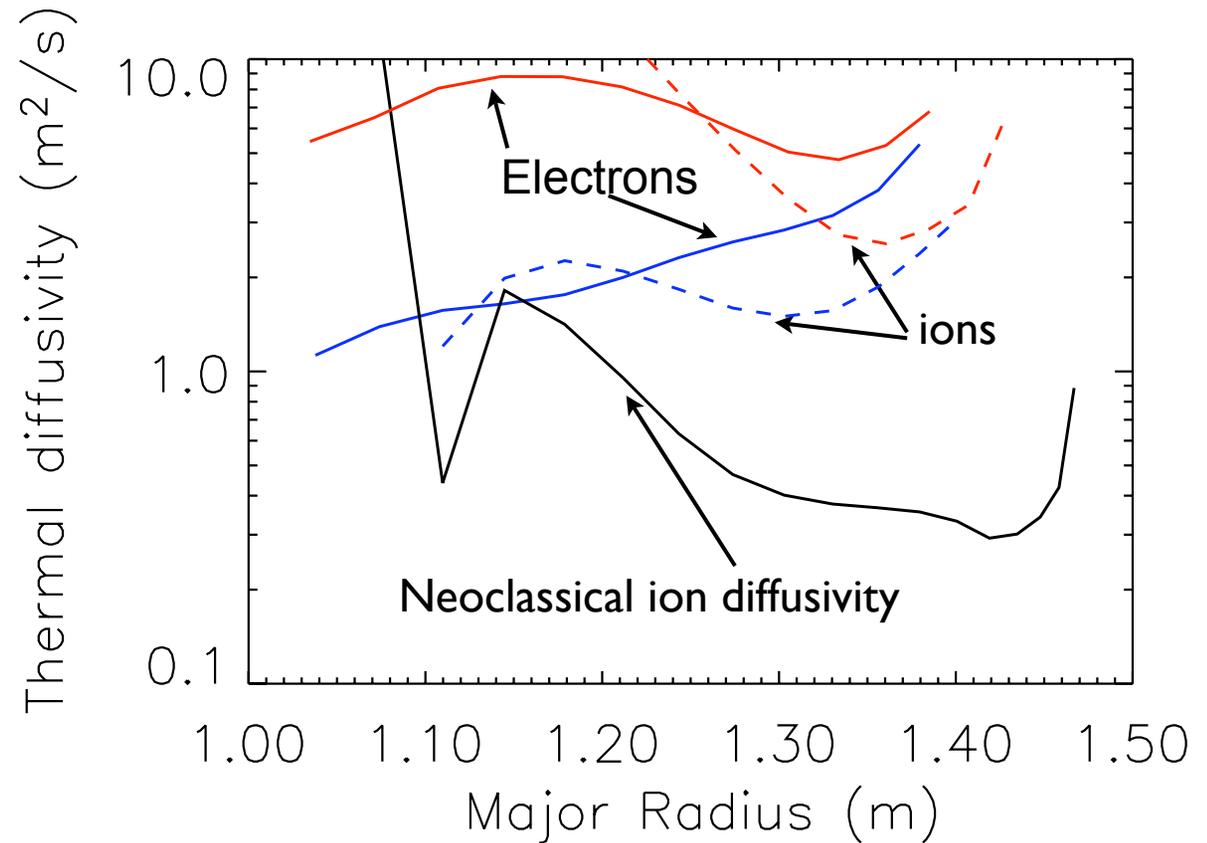
# Discharge with Larger Reversed Shear has Higher Electron Temperature



# Larger Reversed Shear Case has Better Transport



- Blue curves, with larger reversed shear region, have lower electron and ion thermal diffusivities.

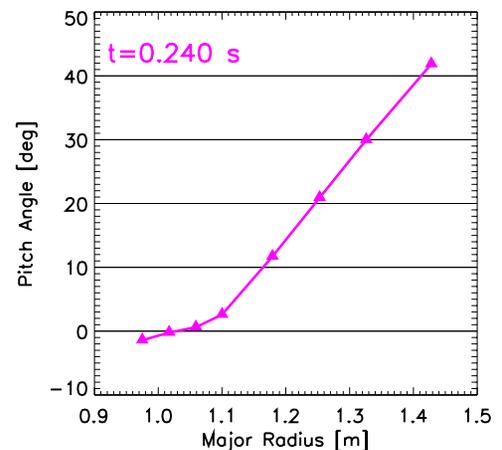
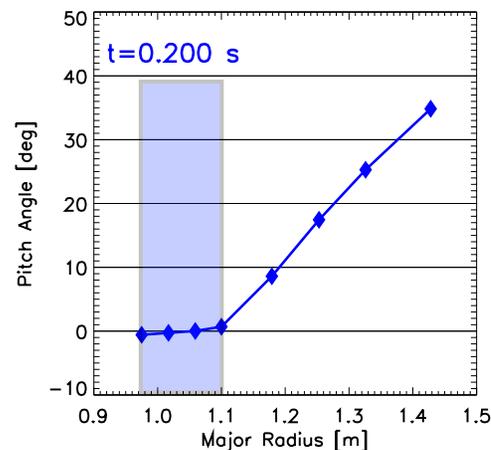
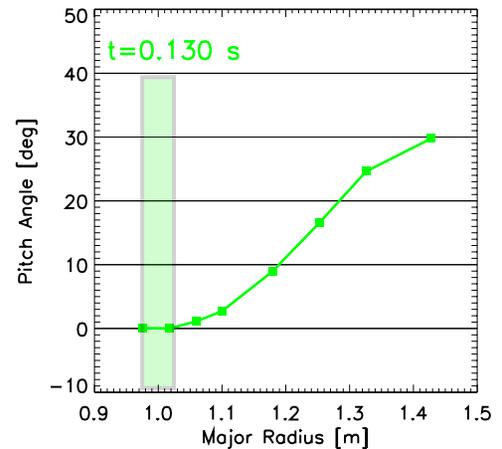
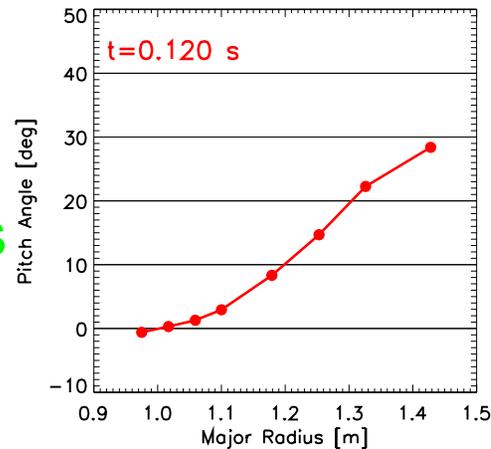


# MSE Shows Formation of Region with Very Low Current Density



- At 0.12 s central current profile is hollow but finite.
- Small region of almost zero current density forms at 0.13 s.
- Expands to about 15 cm diameter by 0.2 s.
- Central current density becomes positive again by 0.24 s, but still very low.

MSE Pitch Angle Profiles,  $E_r(v_\phi)$  Corrected



# Summary

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- The MSE-CIF diagnostic on NSTX presently has 8 channels operational with 19 available for future upgrade.
- Novel tunable birefringent interference filter design working well. Makes MSE measurements possible at low magnetic field.
- Good progress made toward development of q-profiles with a wide range of magnetic shear for transport studies.
- Further details @Poster by H. Yuh (RP1.00011).