Motivation

- Many physically interesting phenomena have been observed as a result of Neutral Beam Injection (NBI) on MST:
  - Heating
  - Tearing mode suppression
  - Energetic particle modes (EPM)
- Electron density fluctuations correlated with the tearing modes and the EPM have been observed with FID (see N62,0001) on Wednesday.
- Electron temperature fluctuation measurements could give additional insight into tearing mode suppression and help to characterize the energetic particle modes

Correlating Temperature Fluctuations With Tearing Modes

- Modes rotate toroidally and poloidally around MST (~10 kHz)
- Temperature is modeled as an equilibrium temperature plus a single-fluctuating mode
- Temperature and fluctuation amplitudes are determined through Rayleigh statistical analysis over many shots

Core Tearing Mode Suppression in Non-reversed Plasmas With Neutral Beam Injection

- NBI parameter specification:
  - Beam Energy: 25 keV
  - Pulse Length: 20 ms
  - n 95-97% H,
- Neutral Beam Injection (NBI) on MST:
  - B⊥ < 0.6 T
- MST Thomson Scattering Diagnostic is Capable of Localized Electron Temperature Measurements with High Temporal Resolution
- Lasers are aligned vertically through the geometrical center of MST. Collection optics image 21 radial locations with < 2 cm resolution
- Summary and Future Work
- Measurements of electron temperature fluctuations correlated with tearing modes are consistent with previous results:
  - Core-localized fast-ion populations stabilize the inner-most tearing mode
  - Tearing mode amplitude reduction up to 60%
- First observation of electron temperature fluctuations with fast ion induced mode
- Bumpy mode at 35 kHz replaces n = 5 tearing mode
- n = 6 temperature fluctuations correlated with mode
- Future work:
  - Explore n = 6 tearing mode in reversed plasmas

Energetic particle modes with n = 5 structure appear ~2 ms after sawtooth crash at ~90 kHz
- Enhanced n = 5 mode activity at ~35 kHz observed with edge magnetic coils
- Energic particle modes with n = 5 structure appear ~2 ms after sawtooth crash at ~90 kHz

E. Parke, D. J. Den Hartog, L. Lin

Neutral Beam Injection Produces a Core-localized Fast Ion Population

- Toroidal injection to maximize beam deposition
- Co-current or counter-current injection by reversing plasma current
- Fast-ion diagnostics include a scintillator-based neutron detector and advanced neutral particle analyzer
- Fast-ion density profile is peaked in the core
- Safety Factor q = 1, depending on plasma conditions, the (n = 1) tearing mode may be resonant in core
- Safety Factor q(0) = 1.0 ± 0.07

Temperature Fluctuations Consistent With Magnetic Signals

- Mode reduction in n = 5 correlated temperature fluctuations from 1 - 3 ms after a sawtooth event consistent with observed suppression
- n = 6 tearing mode amplitude increases by ~50%, but rational surface and island width appear largely unchanged
- Core-localized fast-ion population stabilizes only the inner-most tearing mode
- Correlations exist between time scale of the tearing mode and the time scale of one of the fast-ion induced temperature fluctuations of the core

MST Thomson Scattering Diagnostic is Capable of Localized Electron Temperature Measurements with High Temporal Resolution

- Multiple modes of operation allow measurement of fast electron dynamics:
  - Bursty-mode at 35 kHz replaces n = 5 tearing mode

This work supported by the U.S. Department of Energy.