Status of BOUT modeling of NSTX

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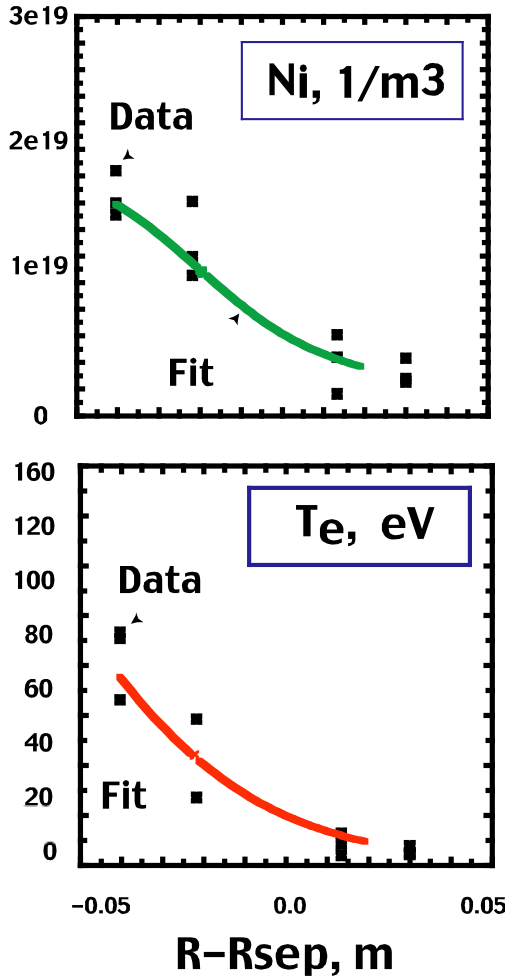
Setting a BOUT case for NSTX

- Using a well-diagnosed NSTX shot 109033
- EFIT-based geometry
- Regression fit to radial profiles of T_e, N_i from Thomson data



NSTX case presents difficulties for BOUT due to relatively weak toroidal field

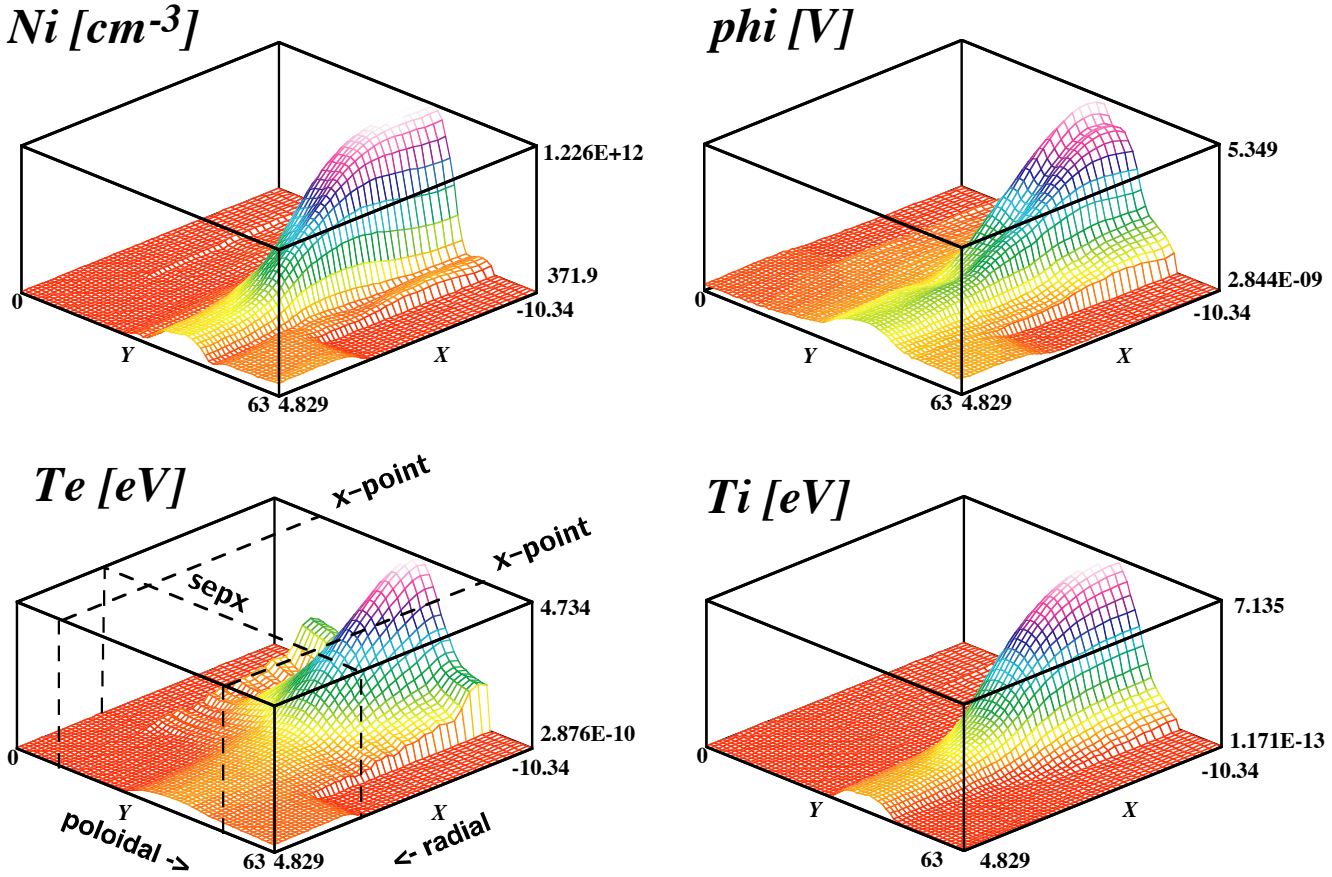
- **Large gyro-radius:** **In BOUT coords (normalized by ρ_{ci}) the radial boundaries appear too close. This leads to numerical problems in inversion of potential vorticity**

- **Small Btor/Bpol:**
  Time step is limited by electrostatic shear Alfven modes

$$\omega = \sqrt{\frac{M}{m}}\,\omega_{ci}\,\frac{k_{\parallel}}{k_{\perp}} \qquad 1/q$$

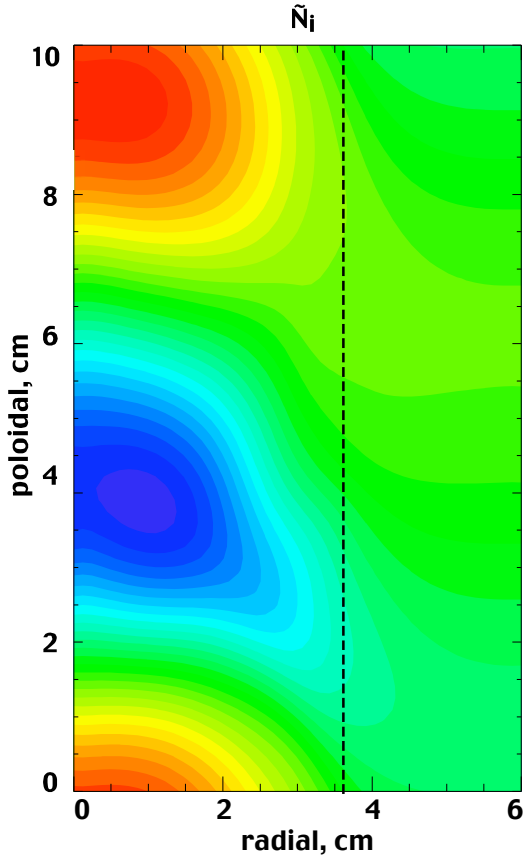
- **Leads to extremely small time step!** $\Delta t \sim O(1e\text{-}3/\omega_{ci})$

Turbulent activity peaks near the core boundary. An artifact of vorticity inversion?



BOUT fluctuations from NSTX case appear to have reasonable spatial and temporal scales

- $\tilde{N}_i$ at the level ~10%
- $\tilde{T}_{ei}$ at the level a few eV
- $\tilde{\phi}$ at the level ~10 V
- Spatial scale ~ 2 cm
- Frequency f ~ 1e5 s^{-1}



Summary/Conclusions

- Modeling of NSTX presents a challenge for BOUT, due to the relatively weak B-field
- The time step is extremely small, limited by high-frequency electrostatic shear-Alfven modes
- Small ρ^* leads to difficulties in the potential solver through the radial boundary conditions
- Nevertheless, we have obtained some preliminary results with BOUT for NSTX
- With collecting a longer time history we will attempt quantitative comparison with the experiment