

Hybrid Simulations of Beam-driven Alfven Modes in NSTX

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Previous Results from M3D (2004 IAEA)

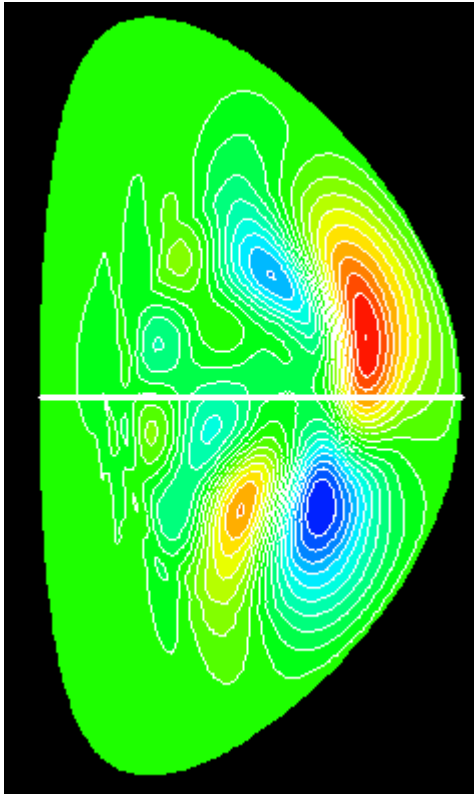
- Linear: calculated mode frequencies agrees well with measurement (TAEs);
- Nonlinear: mostly single mode calculations. Results showed frequency chirps down about 20% with mode moving out radially during nonlinear saturation.

Recent Results from M3D

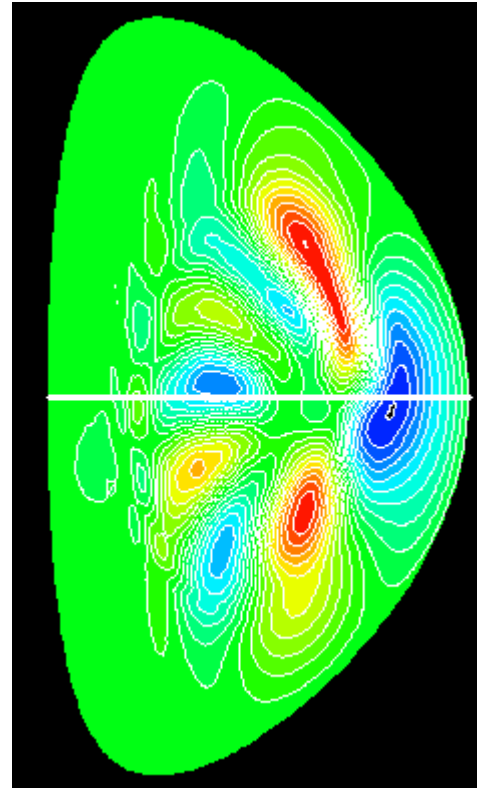
- More NSTX discharges analyzed;
- Parameter scans ($q(0)$, beta, v_b/v_A etc);
- Multiple mode simulations.

Mode structure is sensitive to q profile

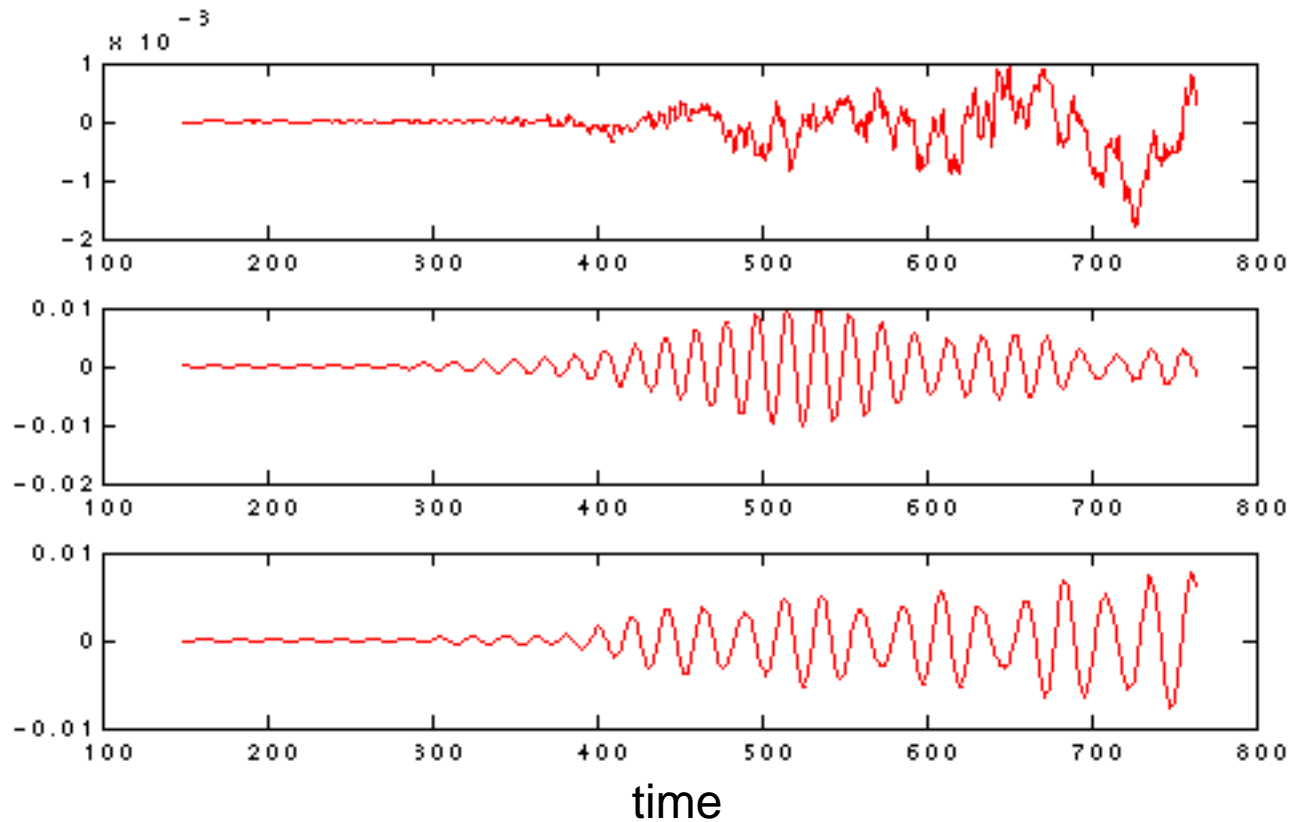
$q(0)=1.7, n=2$



$q(0)=1.9, n=2$



Nonlinear evolution with multiple modes ($n=1, 2$ & 3)



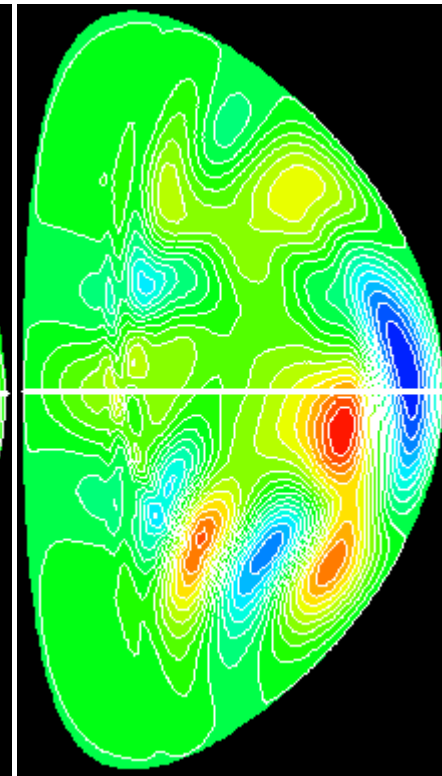
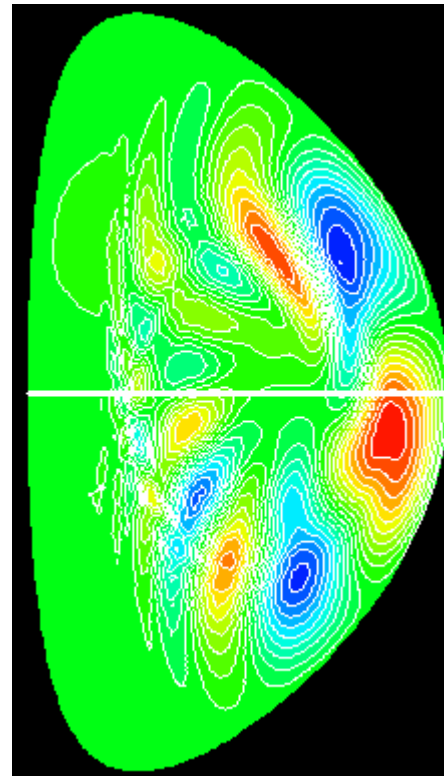
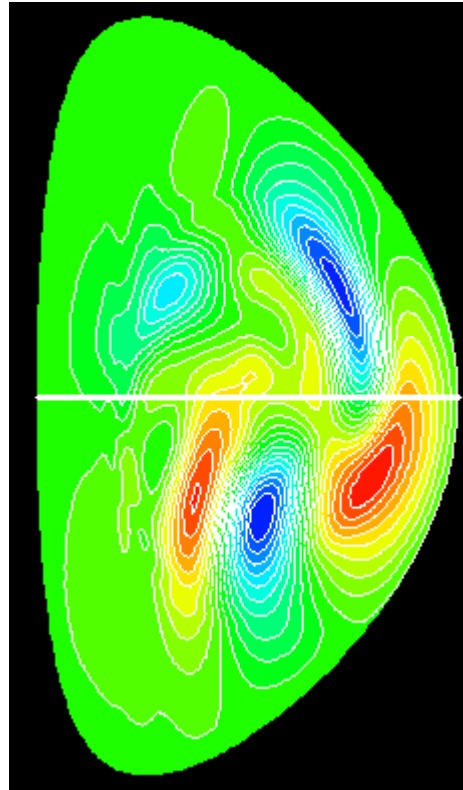
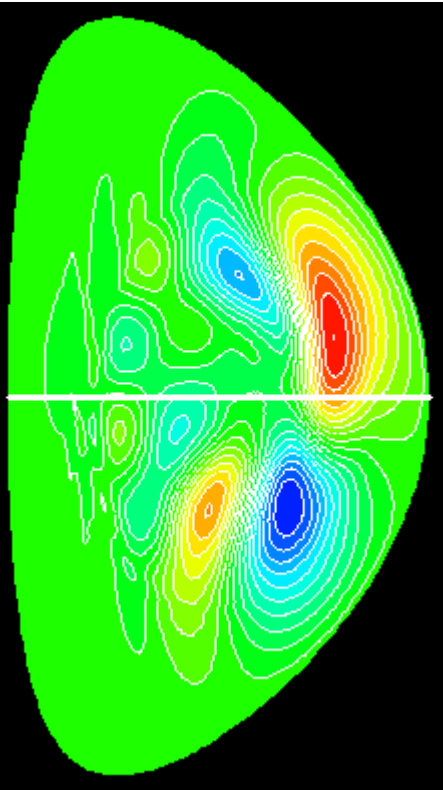
Mode structure changes significantly due to nonlinear evolution

Linear $n=2$

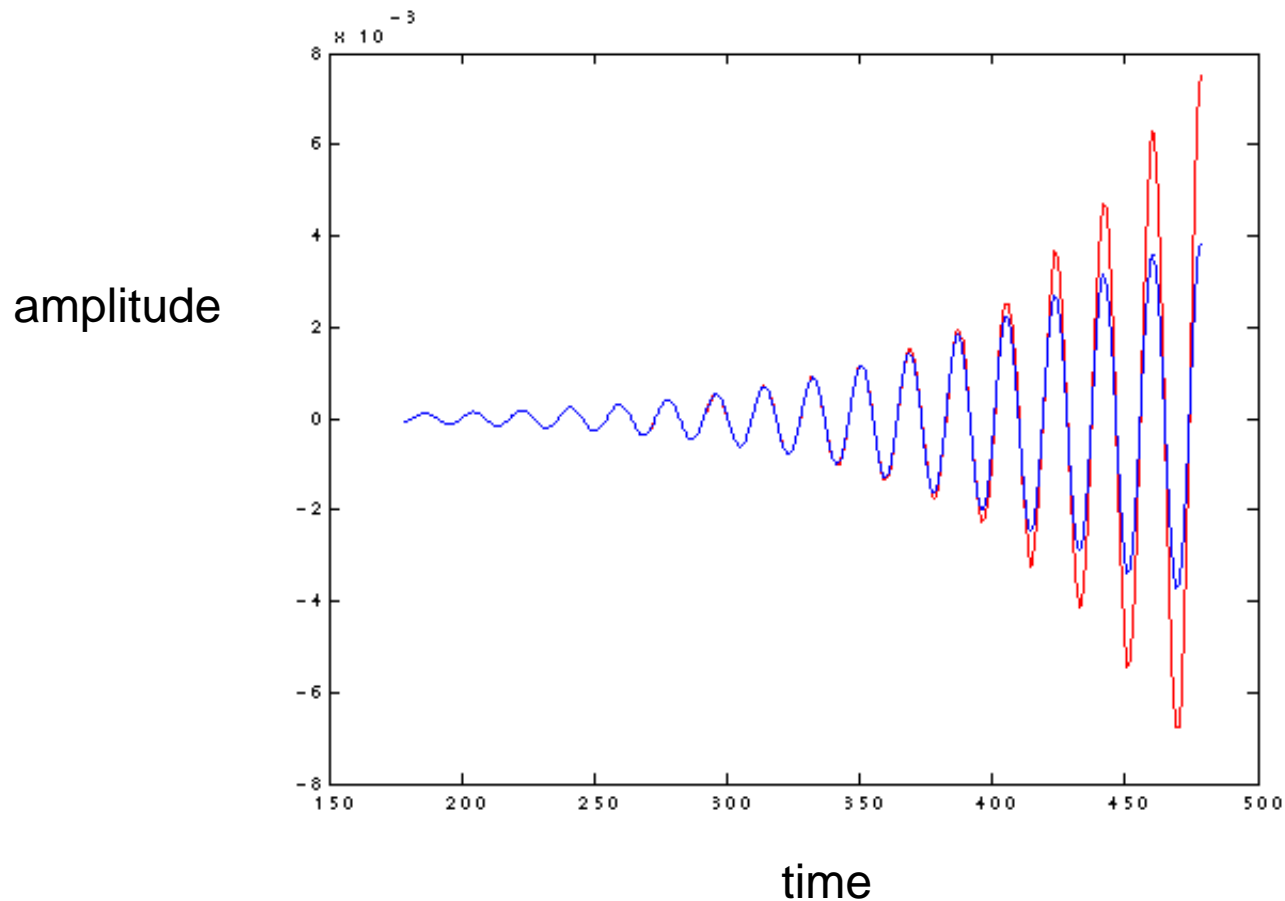
Nonlinear $n=2$

Linear $n=3$

Nonlinear $n=3$

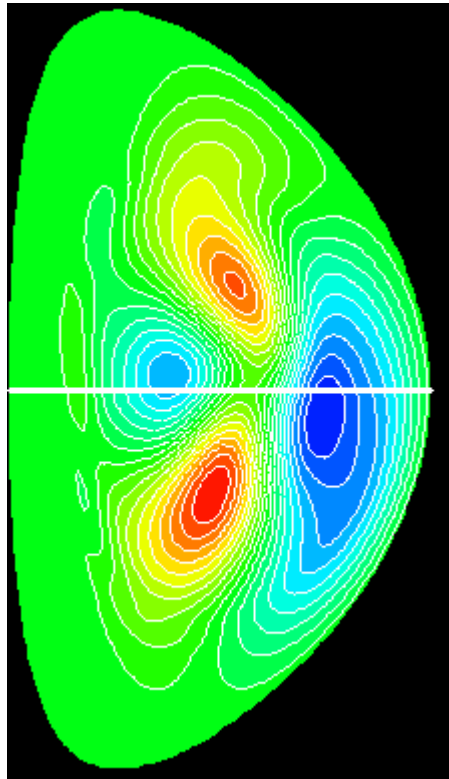


N=2 mode amplitude is larger with multiple modes (red) as compared to single mode case (blue).

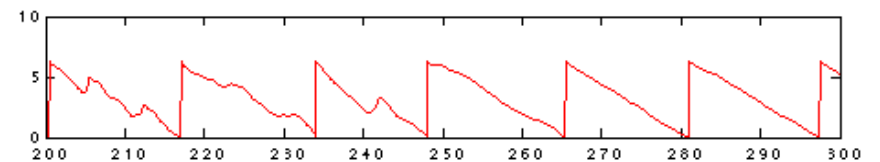
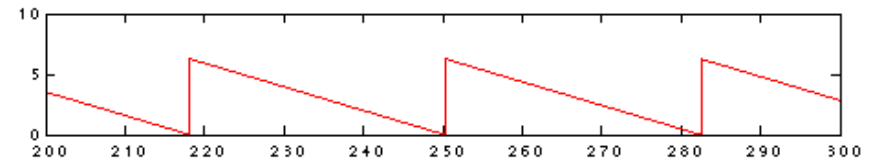
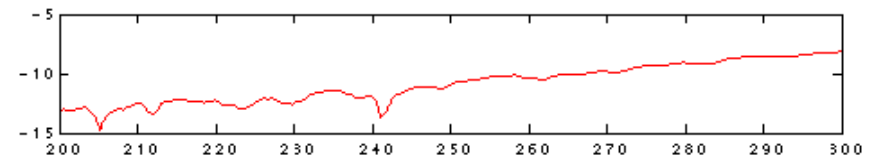
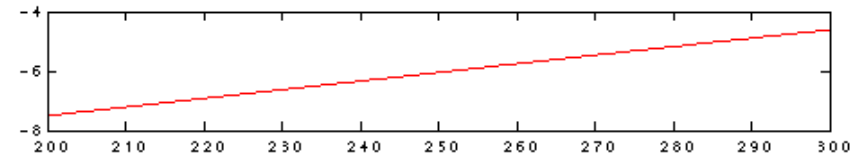
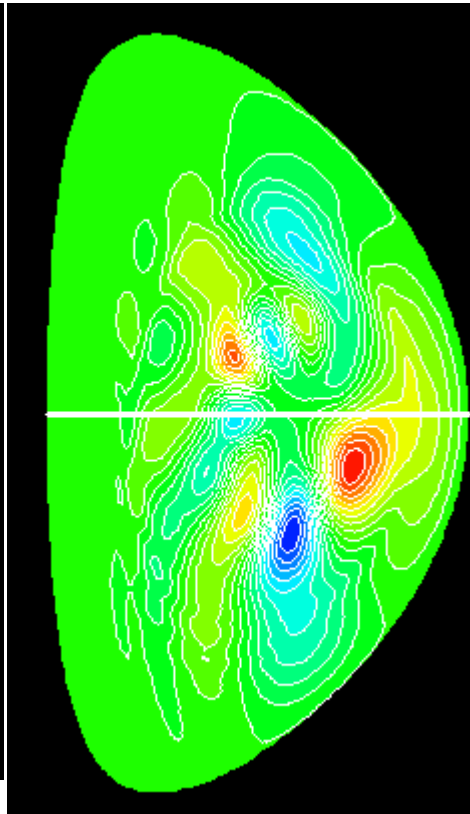


Evidence of a nonlinearly driven $n=2$ mode

$n=1$



$n=2$



Summary

- Mode structure is sensitive to q profile;
- Multiple mode simulations show significant nonlinear interaction between unstable modes;
- Evidence of a nonlinearly driven $n=2$ mode (also $n=1$ mode in other cases).