Progress in M3D Hybrid Simulations with Unstructured Mesh

G. Y. Fu

PPPL, Princeton, N.J., U.S.A.

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Introduction

- Hybrid Model:

$$\rho_b \frac{d\mathbf{v}_b}{dt} = -\nabla P_b - \nabla \cdot \mathbf{P}_h + \mathbf{J} \times \mathbf{B}$$

- Three options for mode representations in M3D:

  Double Fourier: Fourier decomposition in poloidal and toroidal angles and finite difference in radial direction.

  Single Fourier: Fourier decomposition in toroial angle and unstructured mesh in poloidal planes.

  Real version: unstructured mesh in poloidal plane and finite difference in toroial angle.

- Previously we have benchmarked the M3D (Double Fourier) against NOVA-K code for stabilization of internal kink mode.

Recent Results

- Benchmarked the Single Fourier version against the Double Fourier version for both internal kink mode and TAE mode.

- First simulations of fast ion driven $n = 1$ mode in a spherical tokamak (NSTX geometry).

Future Plan

- develop an MPP version of the M3D hybrid code (real version);
- simulate fast ion driven MHD modes in tokamaks and STs;
- simulate fast ion driven MHD modes in stellarators.

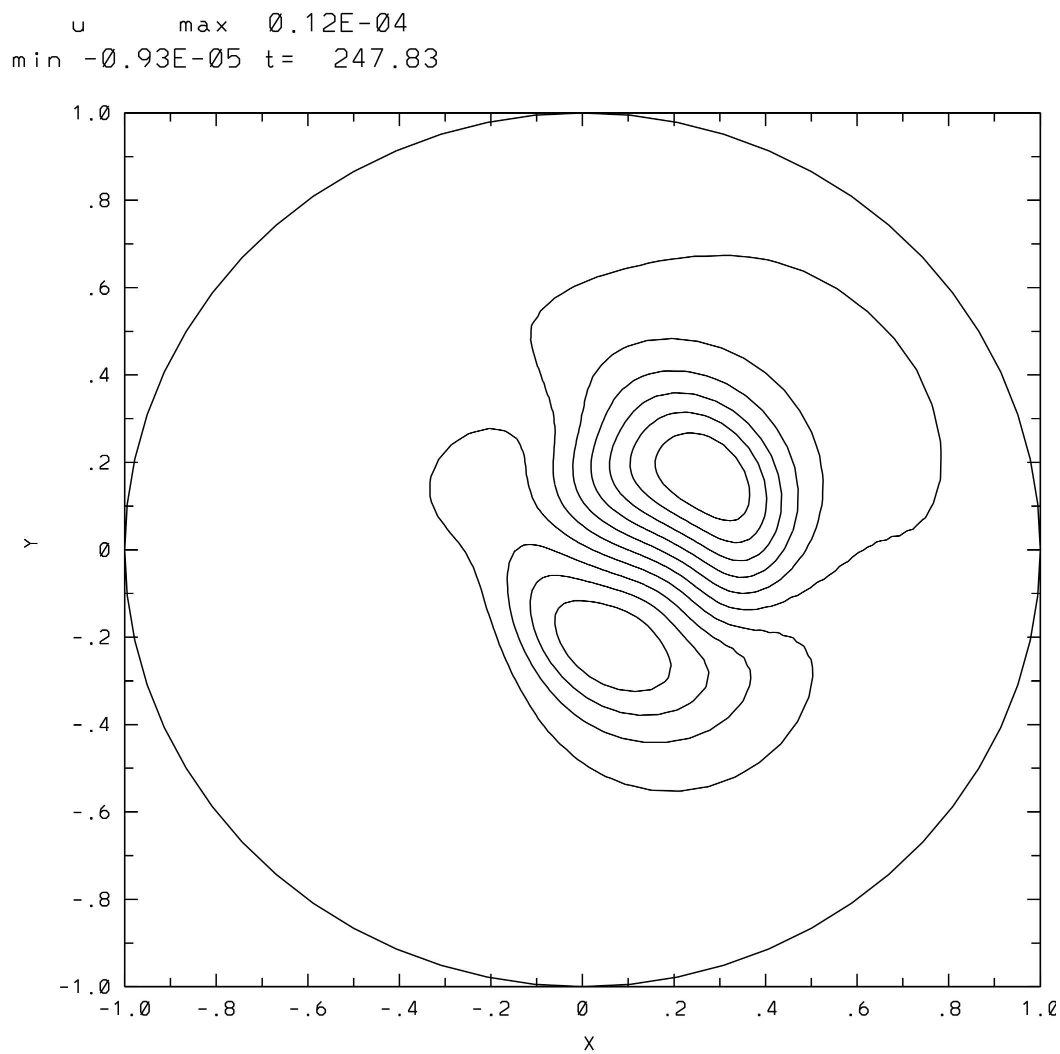

Figure 1: *Simulations of fast ion driven TAE with unstructured mesh*

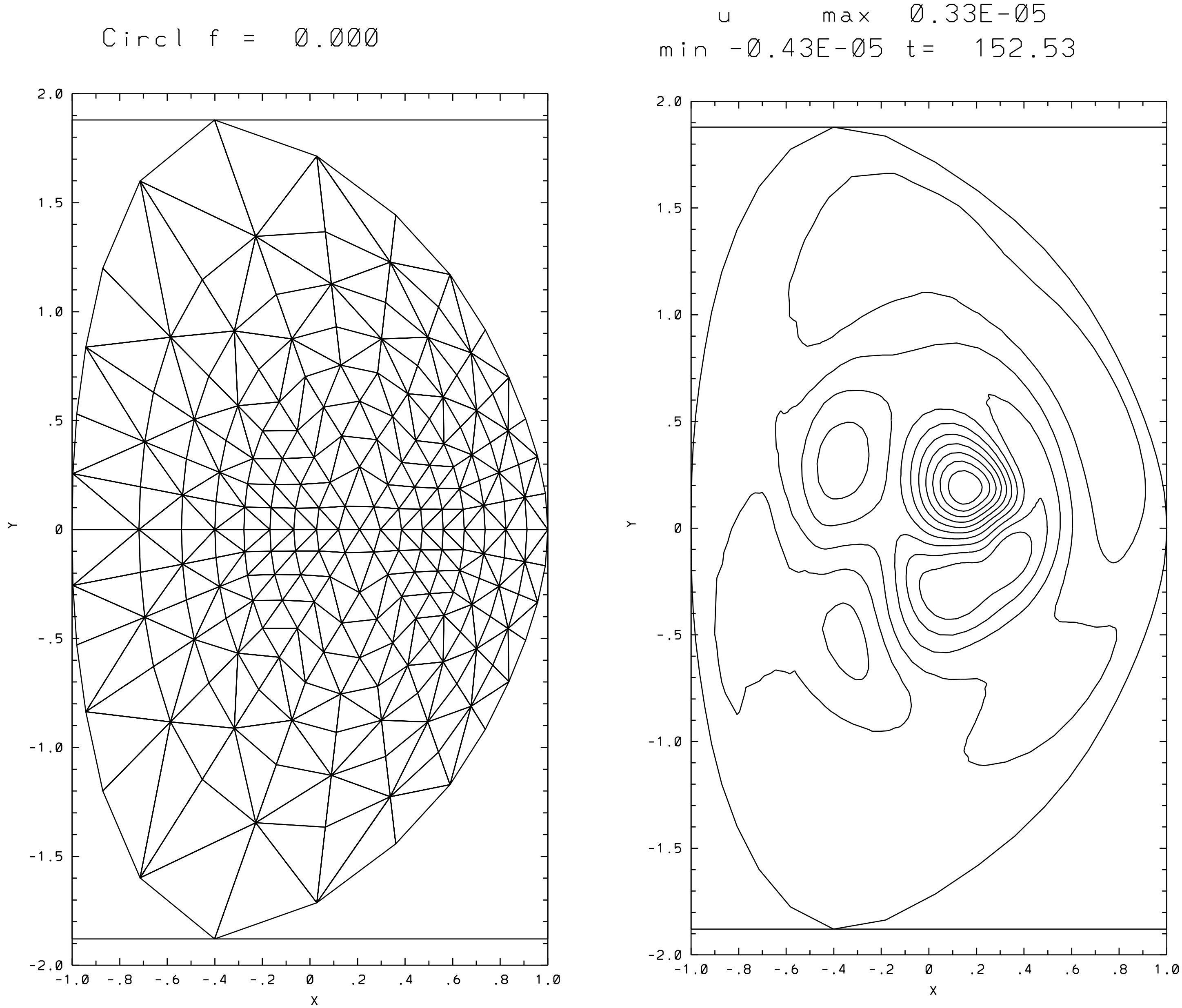

Figure 2: *Simulations of fast ion driven $n = 1$ mode in NSTX geometry with unstructured mesh.*