DOE ELM Milestone 2006

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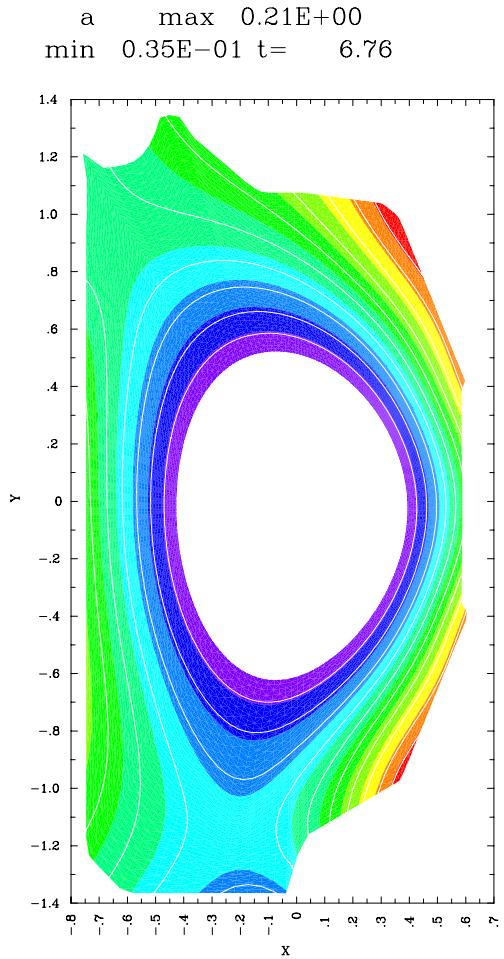
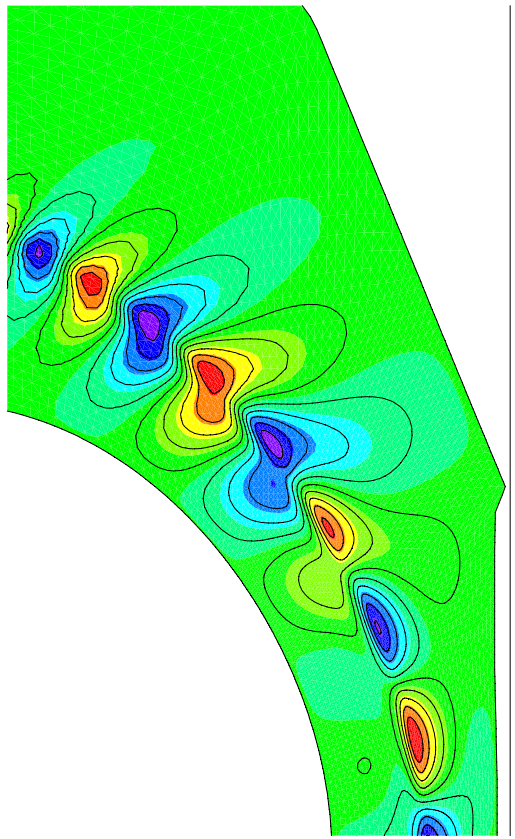
M3D Milestone simulation

- Initialized with Efit eqdsk g113207, DIII-D ELM
- Initialized with unstable n = 12 mode
- Two fluid gyroviscosity included, H = 0.02
  - **H = ion skin depth / R**
- Density evolution: upwind method
- S = 10^6, Prantl number = 10
- Full torus, toroidal modes n = 0, … 40
- Self consistent resistivity
- “vacuum” model: cold, low density plasma
- Realistic boundary shape
- Unstructured mesh of triangular finite elements
- Parallel thermal conduction included
  - **Temperature in ELM relaxes much faster than density**
- Computers –
  - Ram
  - seaborg

Initial poloidal magnetic flux



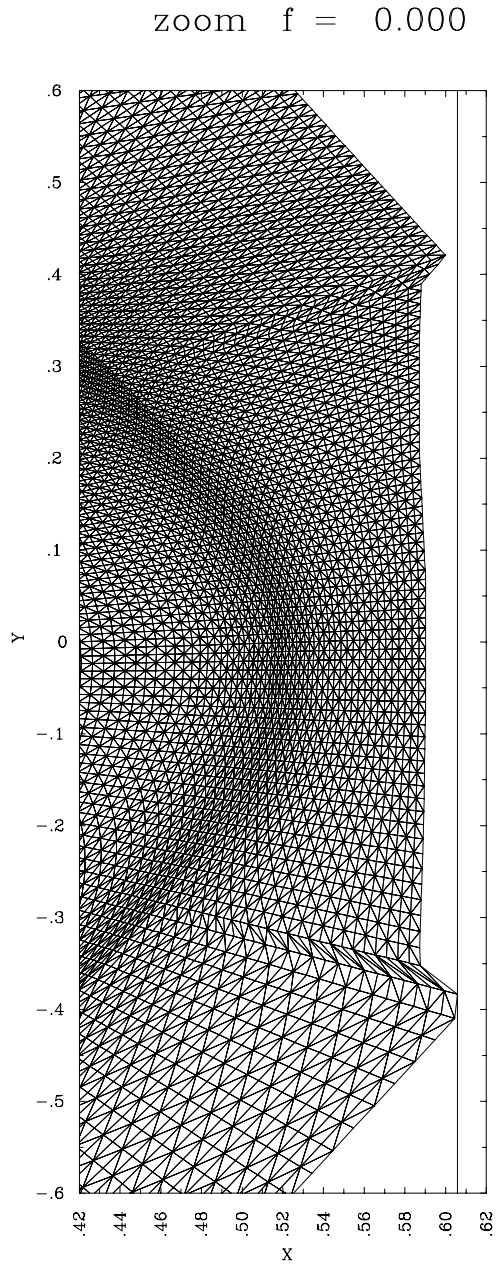


Equilibrium poloidal Magnetic flux

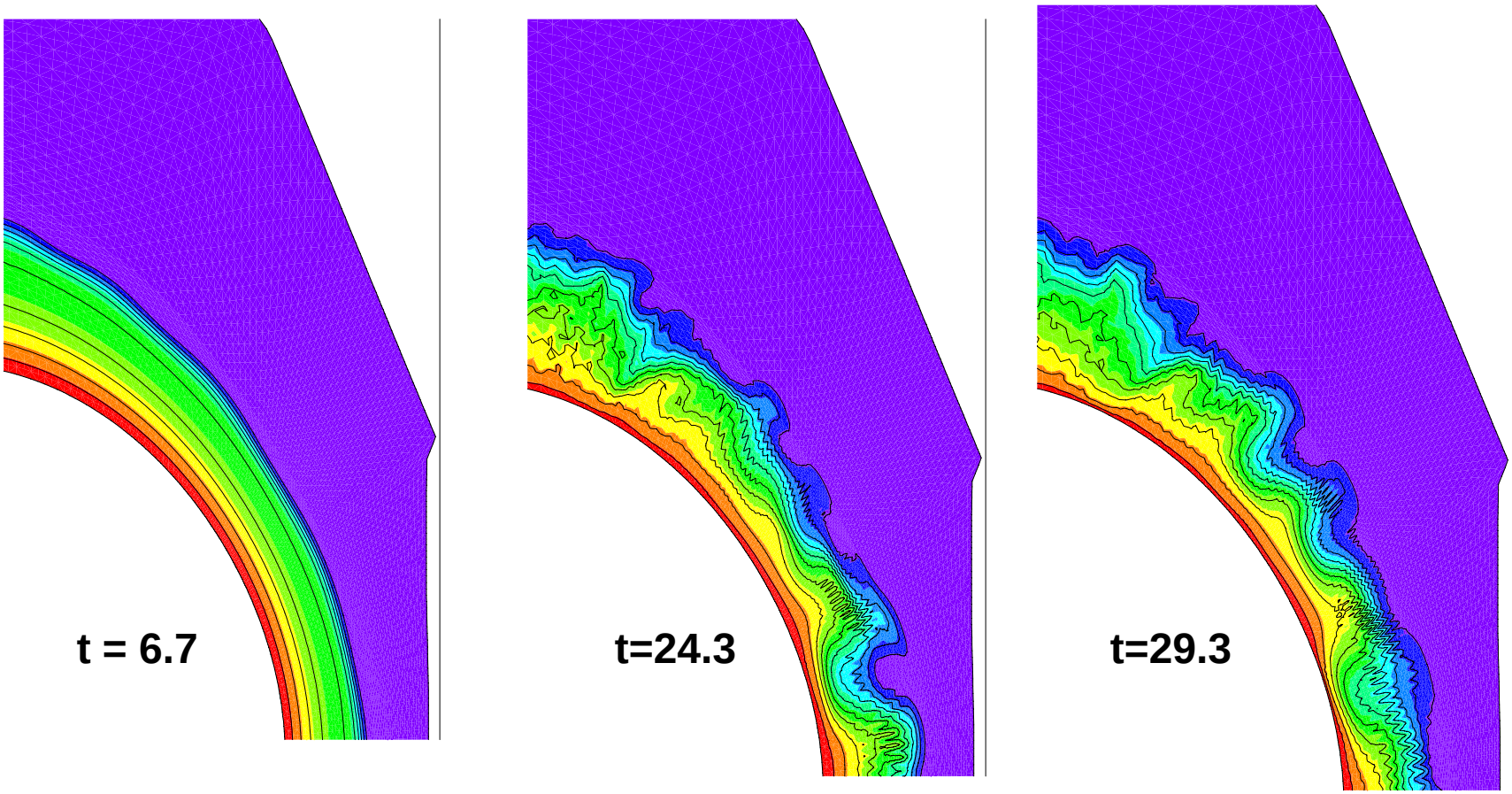
Linear perturbed n=12 Poloidal magnetic flux

Section of poloidal mesh

Mesh is unstructured triangles
18000 points in an annulus from normalized radius r = .8 to wall

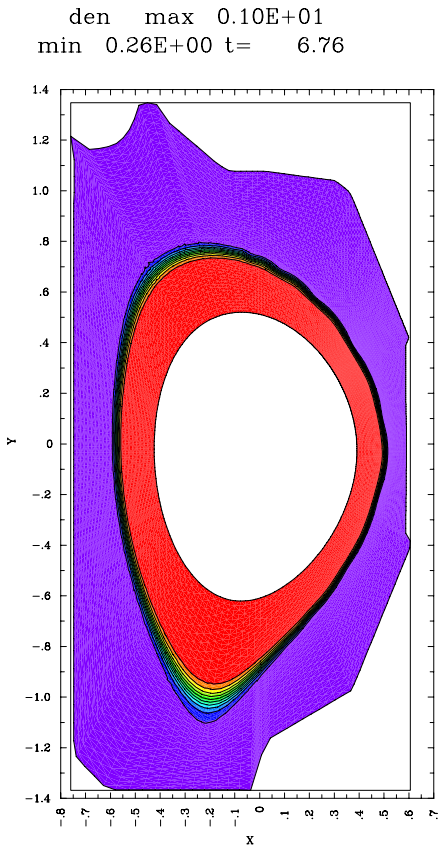


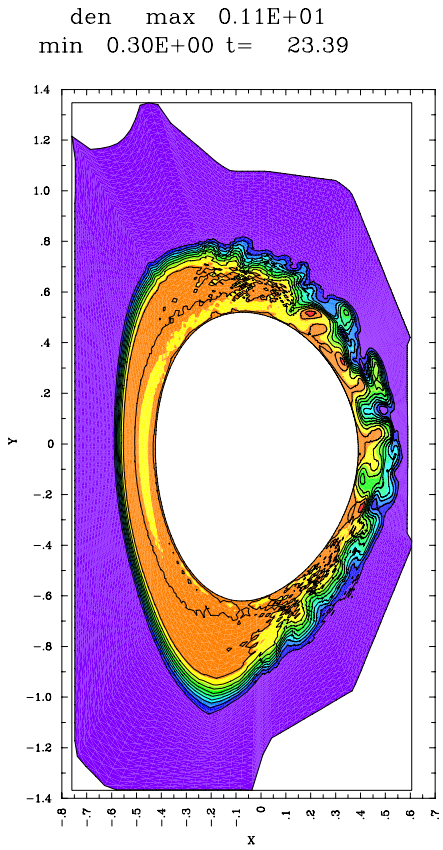
Nonlinear pressure

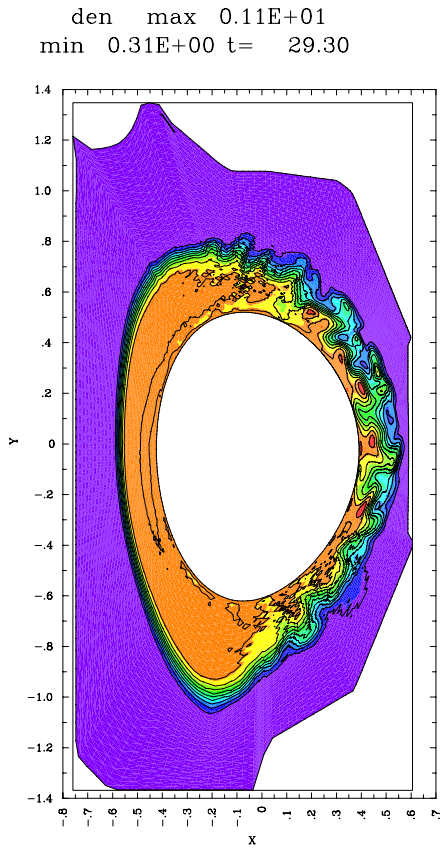


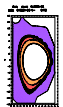
At t = 24, amplitude is nearly maximum
At t = 29, pertubations are decreasing

Nonlinear density

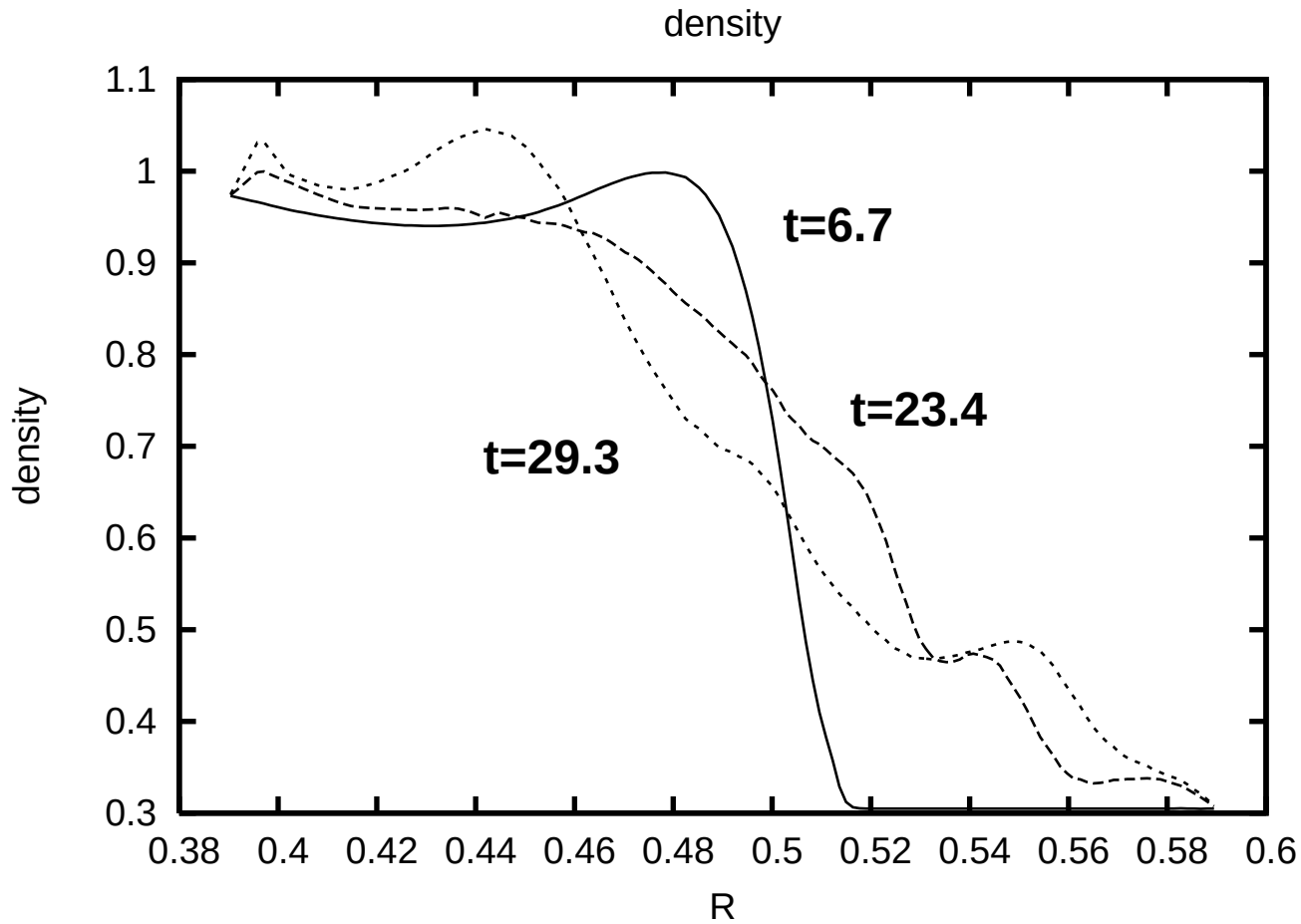






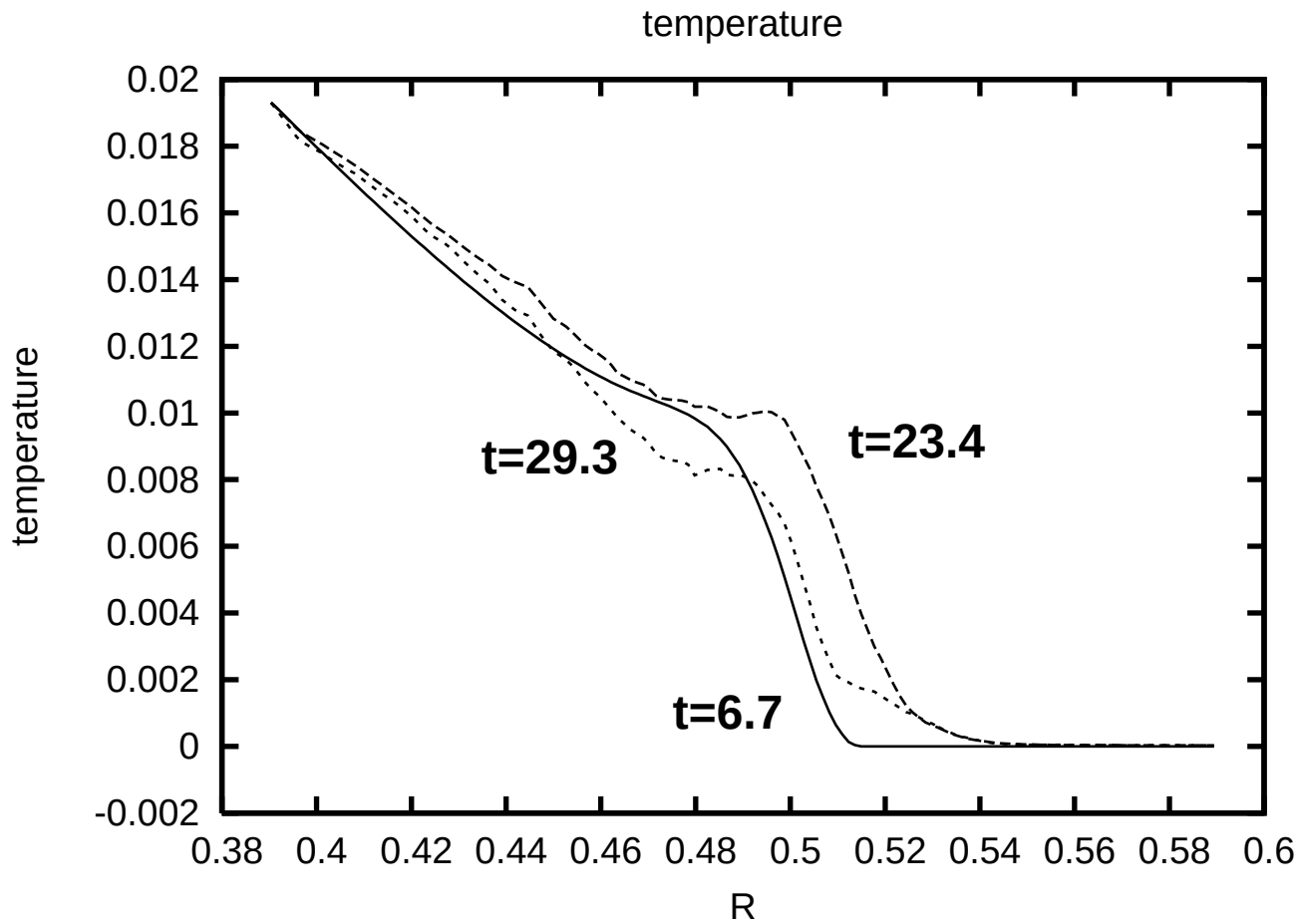


Density profiles



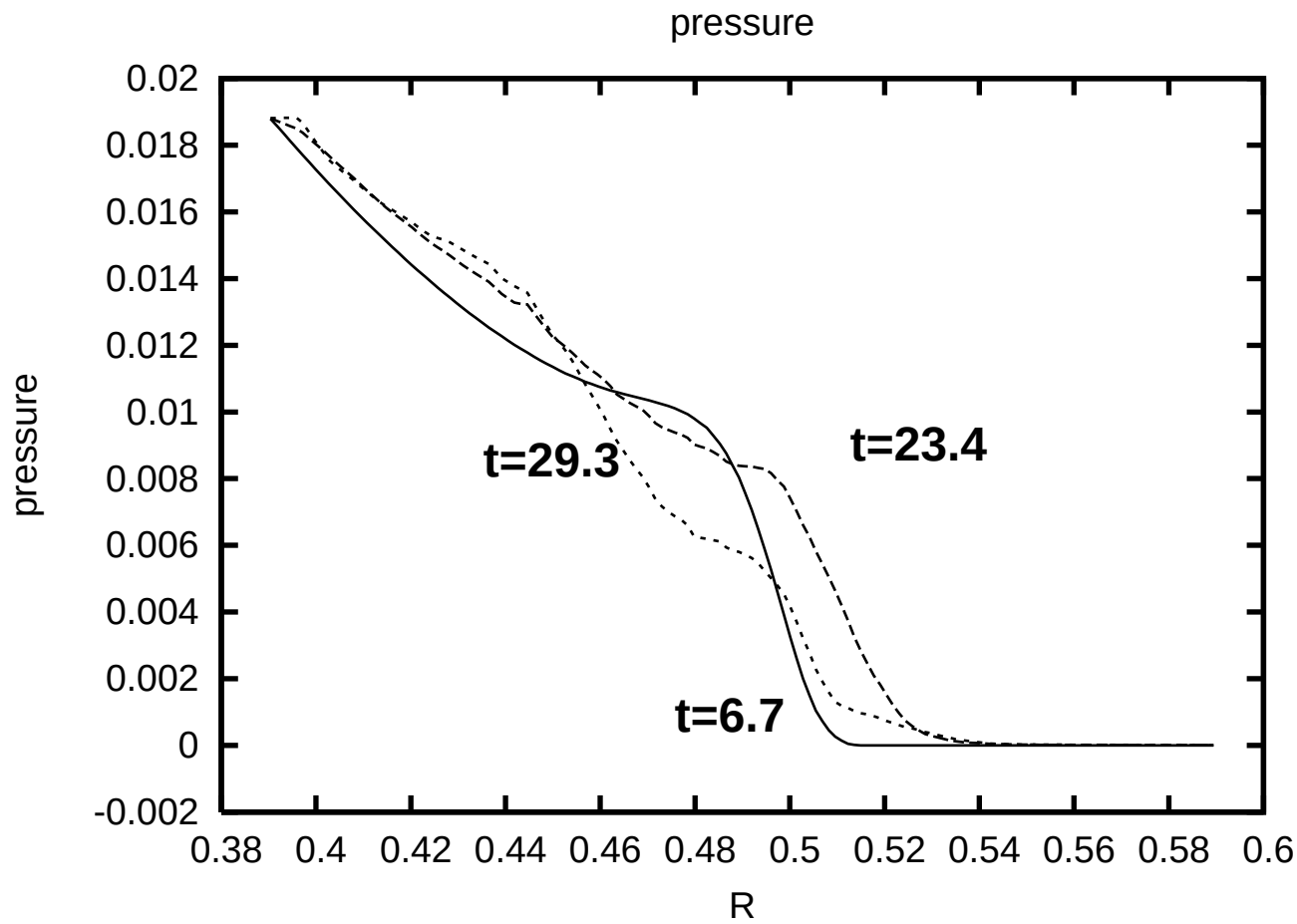
At t=23.4, substantial density is outside the initial pedestal
At t=29.3, density profile is relaxing to lower gradient

Temperature profiles



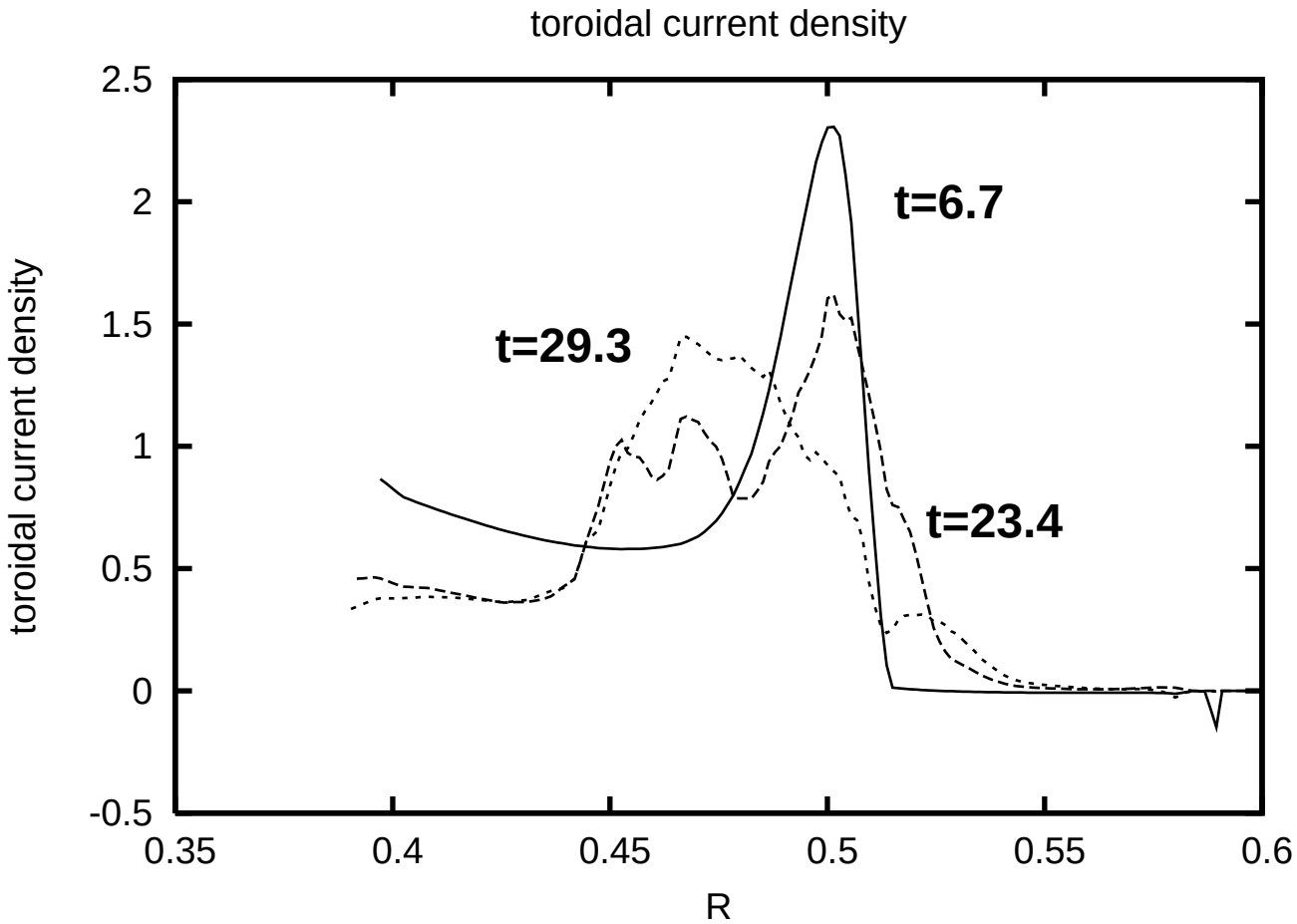
At t=23.4, significant temperature is outside the initial pedestal
At t=29.3, temperature profile is relaxing to almost initial profile

Pressure profiles



At t=23.4, significant pressure is outside the initial pedestal
At t=29.3, pressure profile is relaxing to lower gradient

Toroidal current density profiles



At t=6.7, initial bootstrap current
At t=23.4, significant current is outside the initial pedestal
At t=29.3, current is lower and broader

Summary

- Achieved DOE ELM milestone
  - 40 modes
  - Nonlinear (saturation)
  - 2 fluid (gyroviscosity)
- Computers
  - Problems using seaborg
  - Ram
    - Months of real time
    - 12 hour limit = 200 time steps / run
    - 2 – 3 days in queue to restart
- Physics
  - Density perturbations larger than temperature perturbations
  - Temperature stays close to initial profile while density relaxes