

# M3D MPP ELM simulation improved to follow long time saturation after initial ELM crash

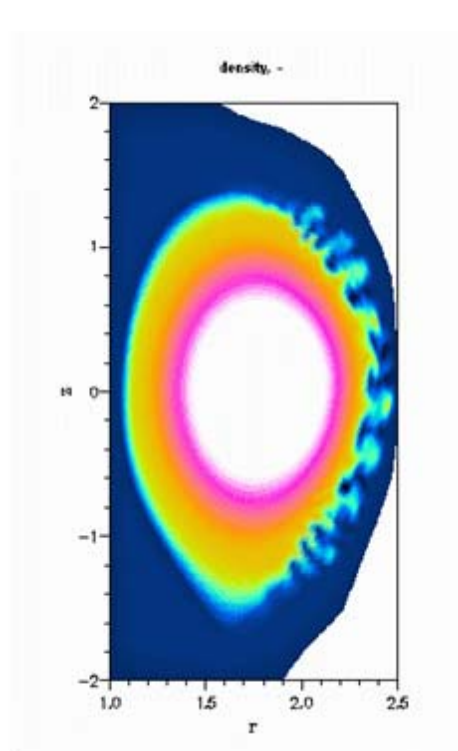
Numerical stabilization and models improved

Nonlinear diffusion part of upwind advection

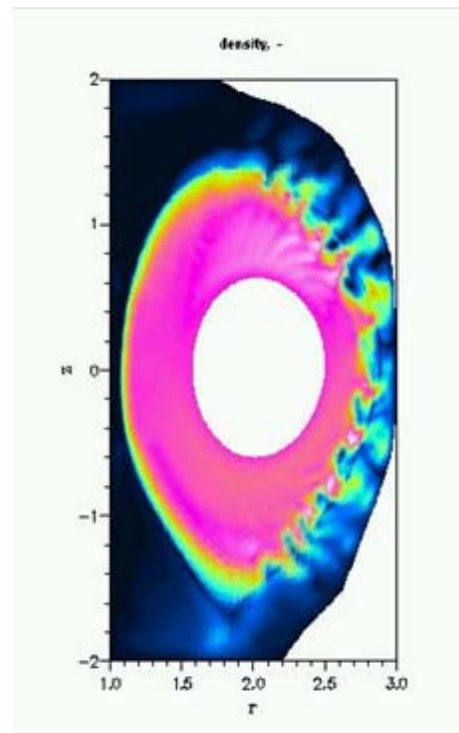
Thicker plasma (plasma absorbs inward part of ELM perturbation)

Example: MHD ELM stages of evolution ( $n=3$  toroidal periodicity)

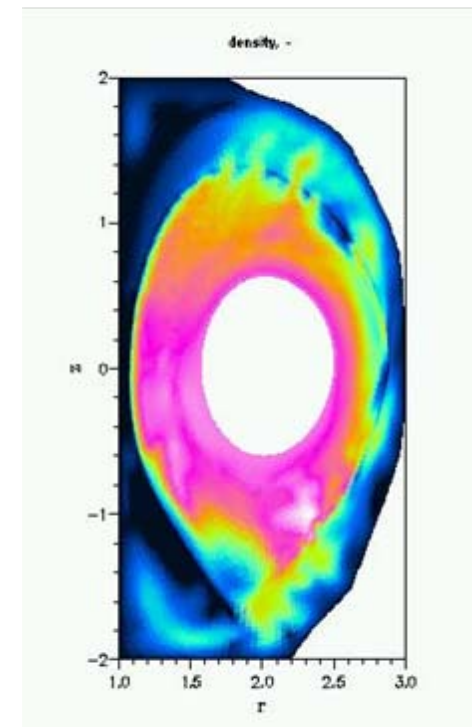
Fast ballooning, Mixing/dispersal, Long-time healing



$t=77 \tau_A$



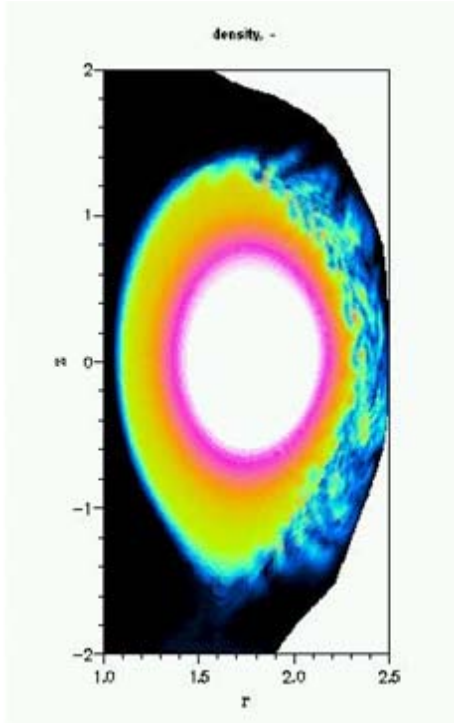
$t=99 \tau_A$



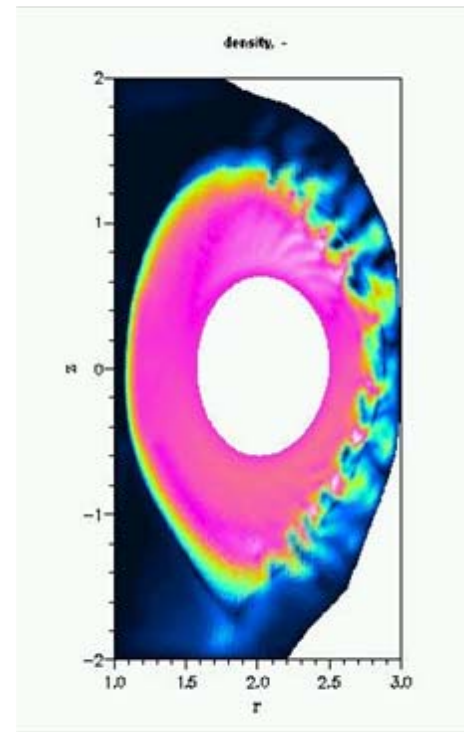
$t=492 \tau_A$

# Two-fluid ELMs (electron and ion temperatures)

Two-fluid has weaker linear growth rate, due to ion diamagnetic rotation  
Nonlinear two-fluid ballooning mixes faster in vacuum region, reducing the edge pressure gradient that drives MHD instability  
Numerically less stable than MHD model --  
secondary long time instabilities at plasma edge can blow up

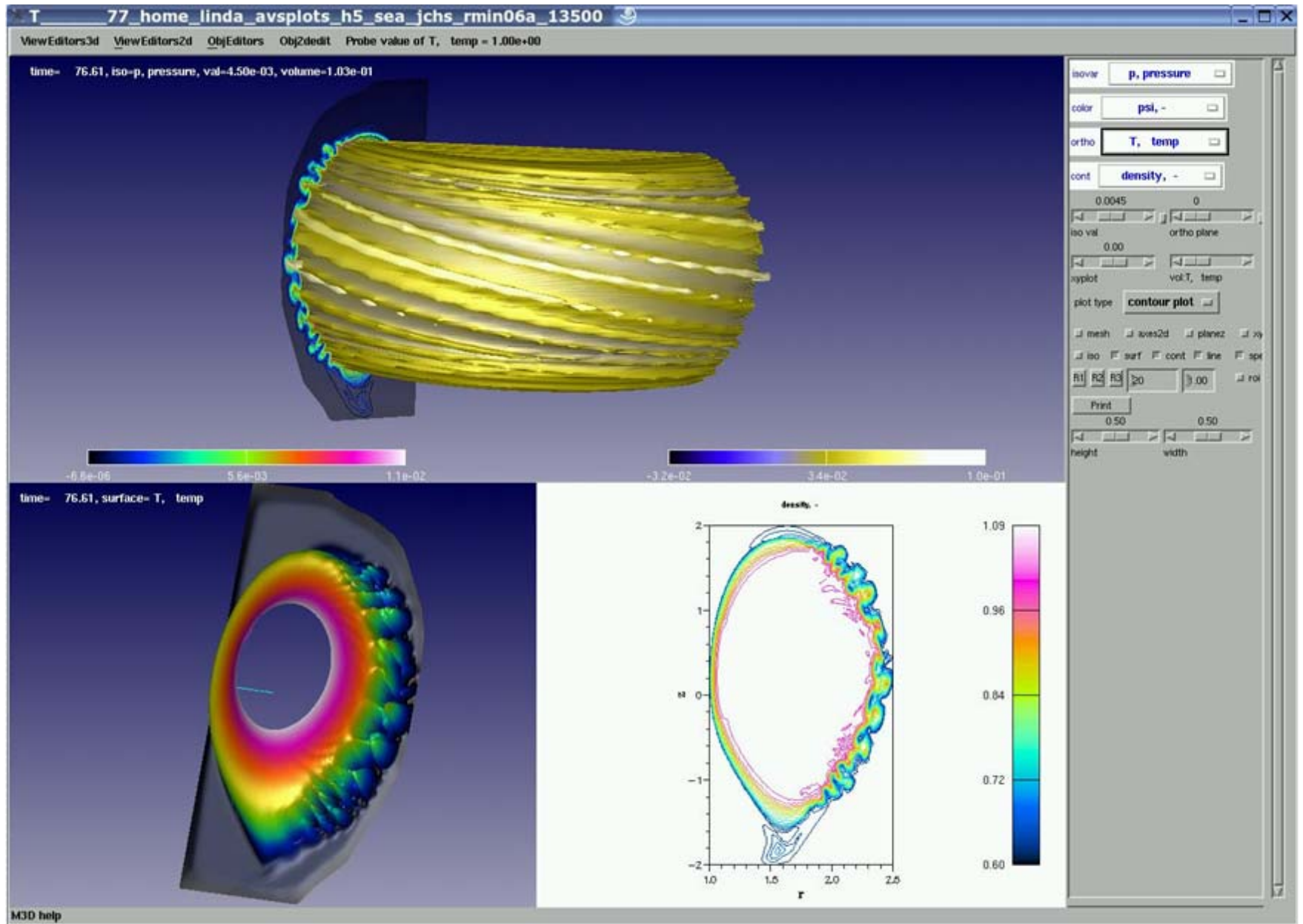


2F  
 $t=90 \tau_A$

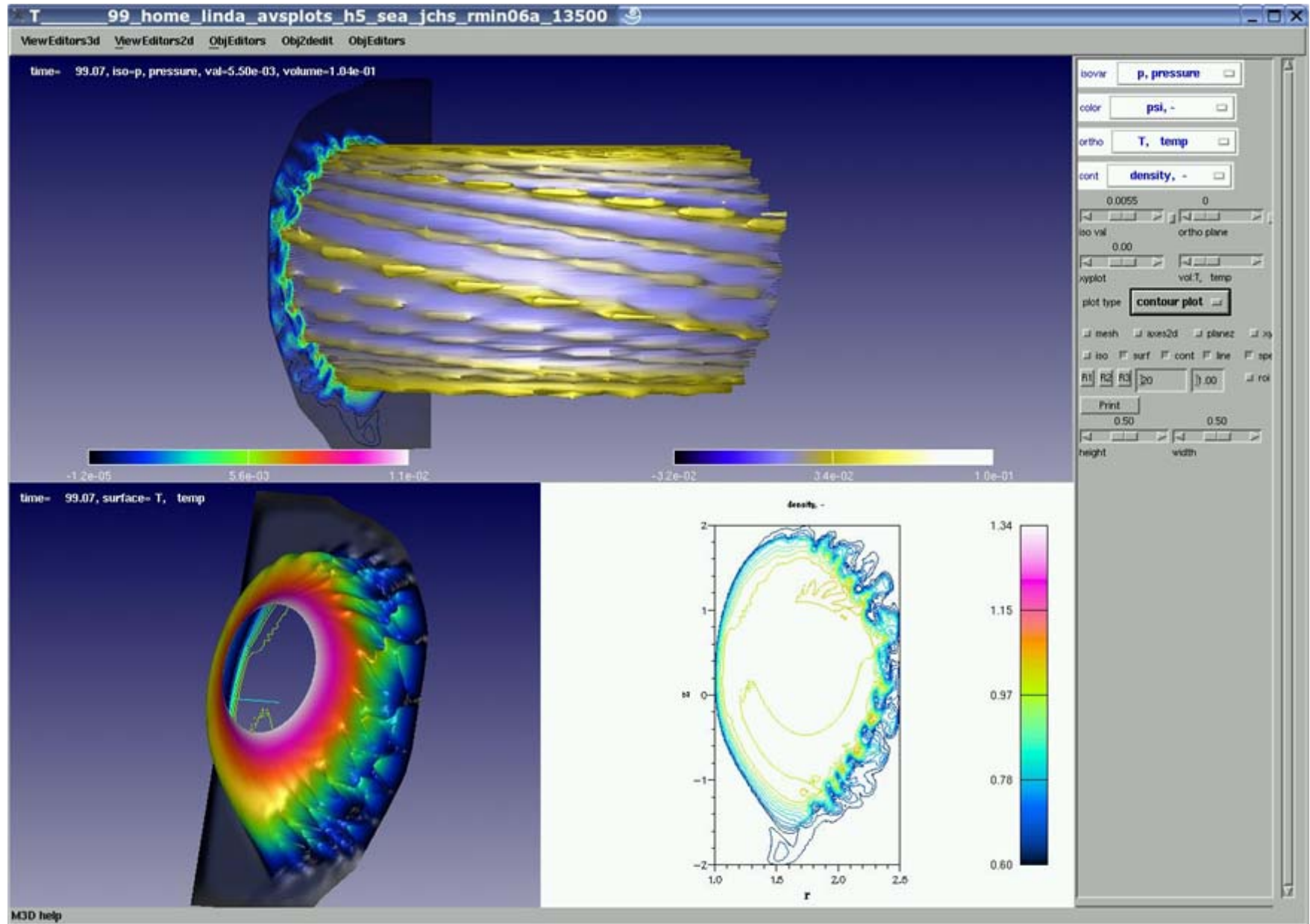


MHD  
 $t=99 \tau_A$

t=77. Ballooning perturbation follows magnetic field lines of plasma (p,T,n)

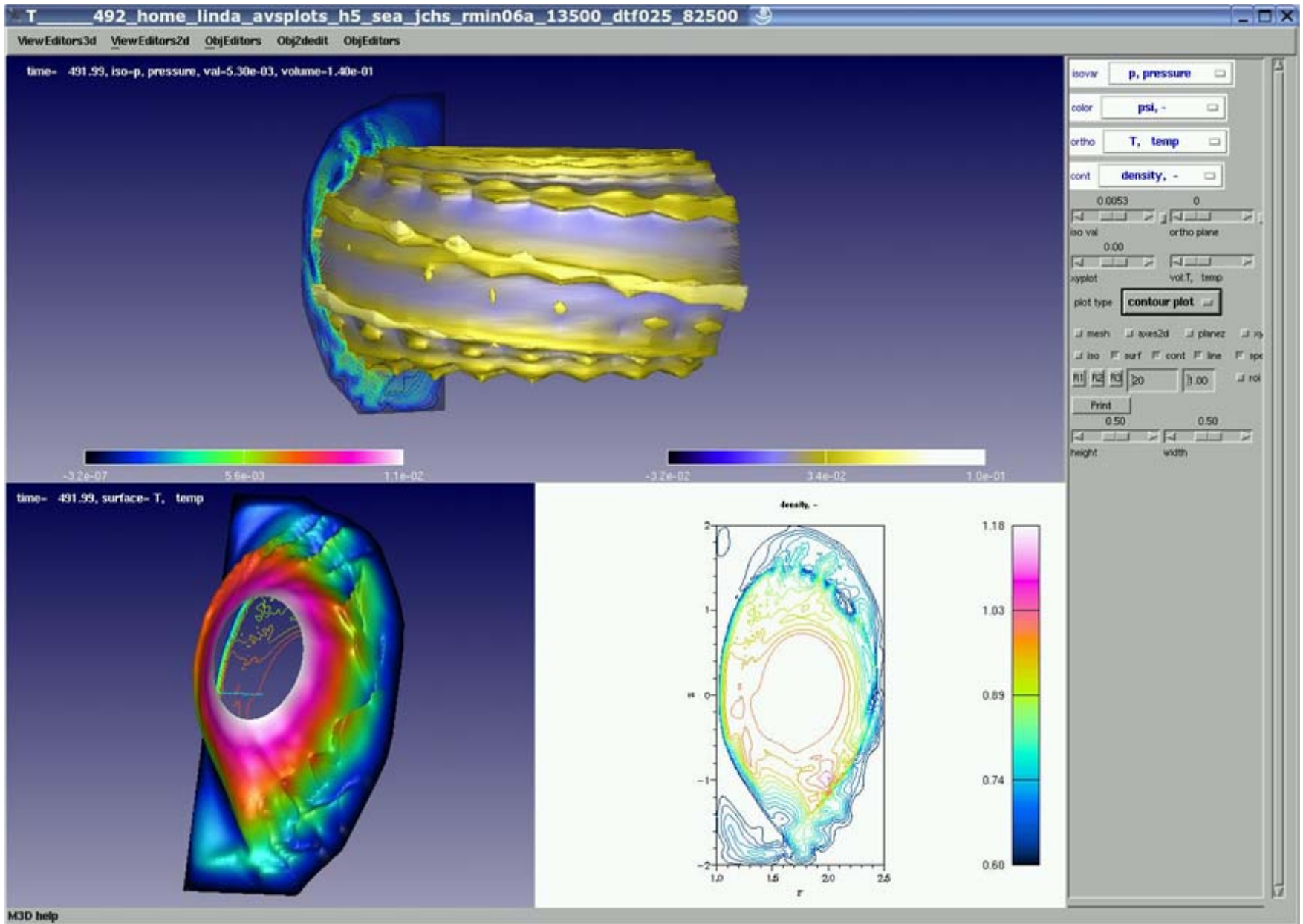


t=99. Plasma hits bounding wall. Pert strong on certain magnetic field lines.





t=492. Long time - healing to near original configuration.



## Jaguar CNL

PETSc has problems with Compute Node Linux on new Jaguar computer  
Random MPI errors crash code, particularly on continuation runs  
Cannot run M3D ELMs for long times

NERSC Franklin also uses Compute Node Linux  
Similar random MPI errors

Cray will support PETSc, but little experience

At present time, hard to scale up M3D ELM runs to the next stage without these two computers.