

Status of Tokamak Simulation Code Modeling with Liquid Walls

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Outline

- ◆ Brief Description of Tokamak Simulation Code
- ◆ TSC Simulation of 1 MA NSTX Discharge
- ◆ Plans for Adding Liquid Lithium to TSC Model

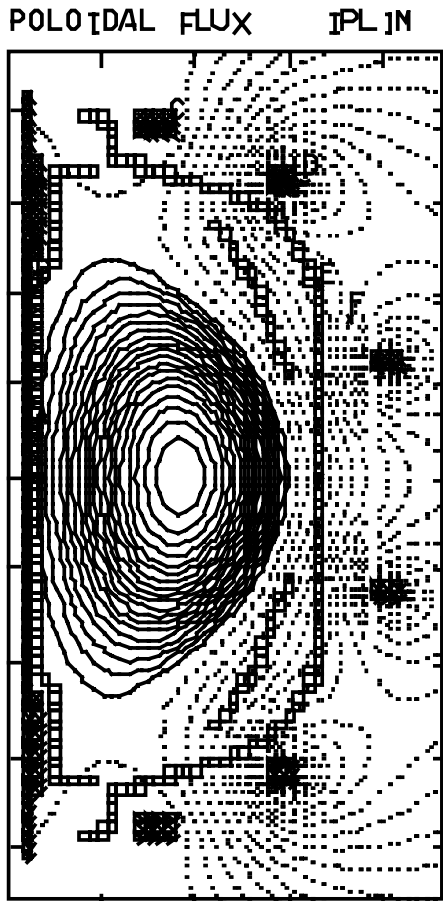
Brief Description of Tokamak Simulation Code (TSC)

- ◆ 2-D, time-dependent, free-boundary simulation code -
 - advances MHD equations for evolution of axisymmetric magnetized toroidal plasma on transport time scale
 - evolves magnetic field in a rectangular computational domain
 - Maxwell MHD equations for plasma
 - couples via boundary conditions to circuit equations for poloidal field coils

Brief Description of TSC (continued)

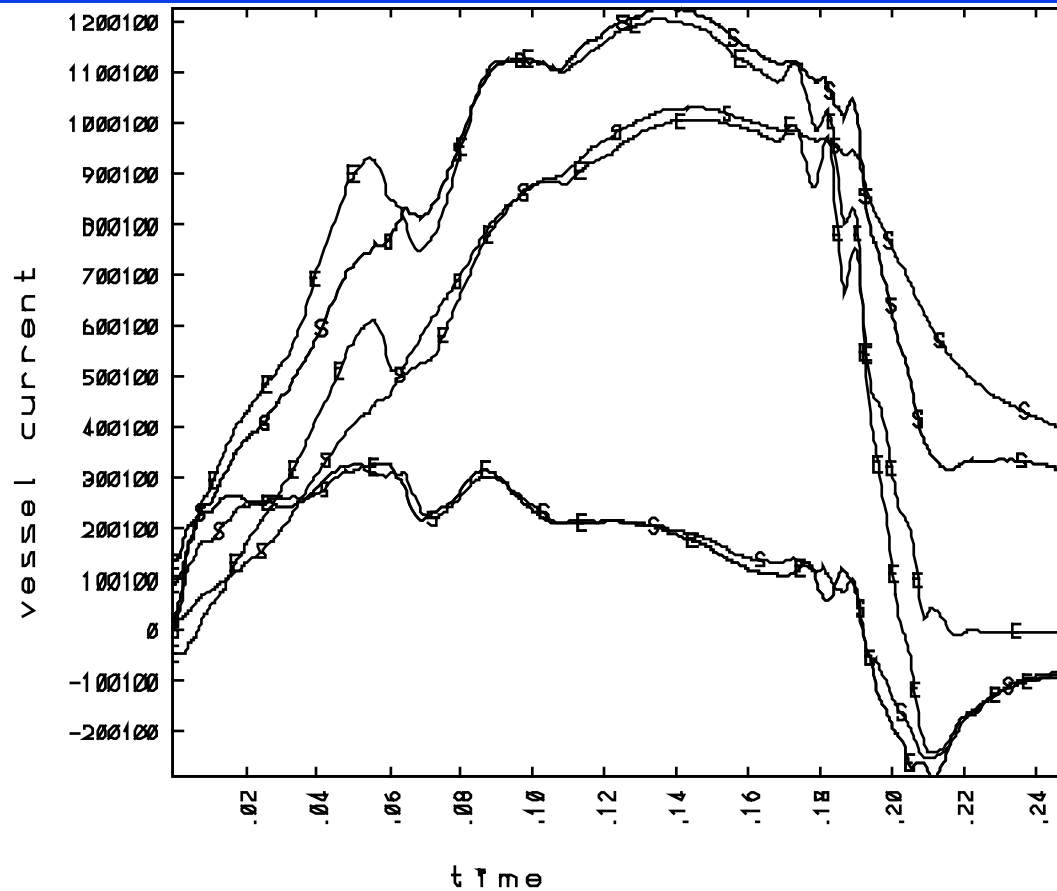
- ◆ Plasma model uses functional forms for:
 - electron and ion thermal conductivities
 - particle diffusion coefficients
 - plasma electrical resistivity
- ◆ Transport model is semi-empirical:
 - adjustable parameters to fit experimental database
- ◆ Reference: S. C. Jardin, N. Pomphrey, and J. L. DeLucia, J. Comput. Phys. 66, 481 (1986).

TSC Simulation of 1 MA NSTX Discharge



Poloidal flux near peak of plasma current

TSC Simulation of 1 MA NSTX Discharge (continued)

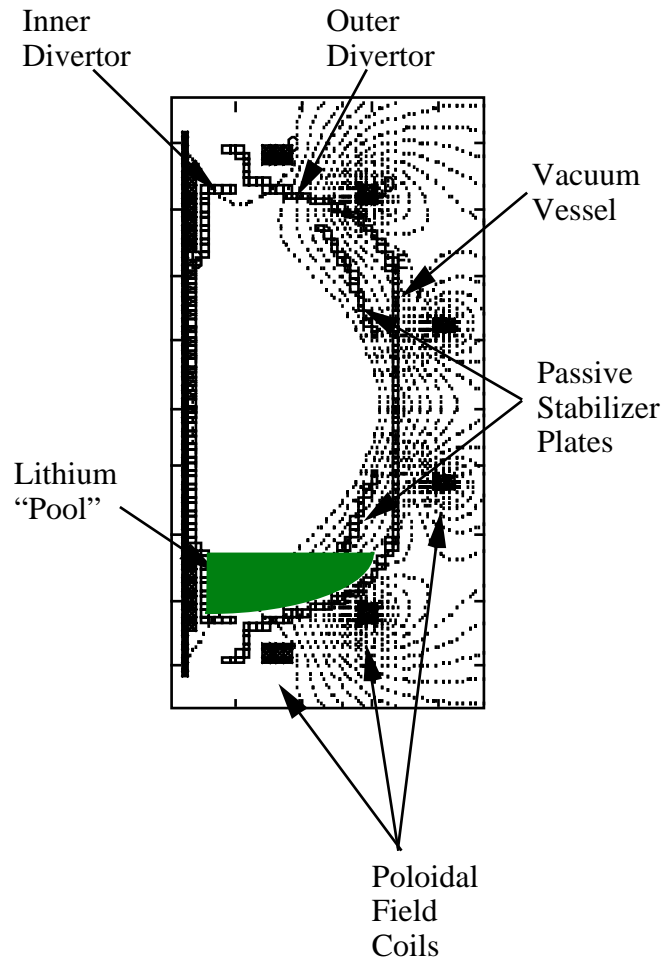


Comparison of TSC results (S) with experiment (E) for NSTX plasma + vacuum vessel current (upper), vacuum vessel current (lower), & plasma current (middle).

Plans for Adding Liquid Lithium to TSC Model

- ◆ Add toroidal “pool” of liquid lithium to bottom of NSTX vacuum vessel.
 - Include resistivity, conductivity, and density of lithium.
- ◆ Determine effect of time-evolving NSTX coil currents used in 1 MA simulation on liquid lithium in absence of plasma.
- ◆ Perform simulation with plasma if behavior of lithium appears to be reasonable.

Plans for Adding Liquid Lithium to TSC Model (continued)



- TSC already treats boundary between regions of different density and resistivity.
- Goal is to simulate “poloidally-local” region that is occupied by the lithium.