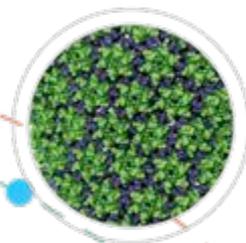
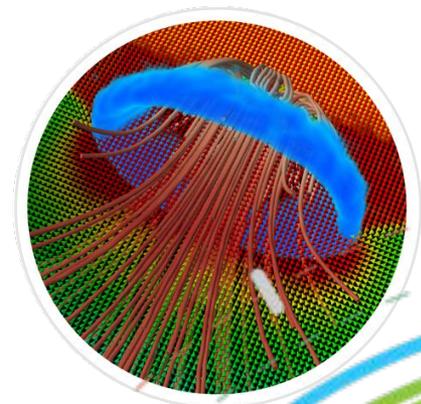


Visualization in Practice



Joseph A. Insley

August 11, 2014

Argonne Leadership
Computing Facility



Arterial Blood Flow

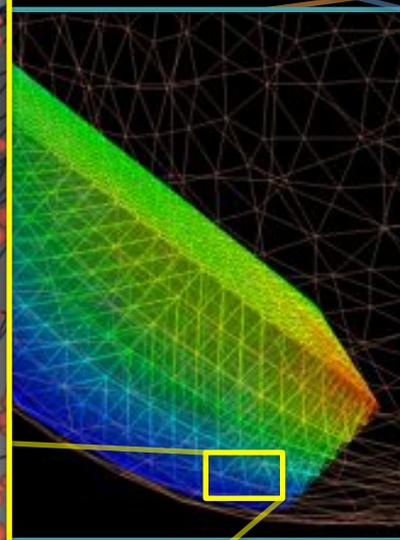
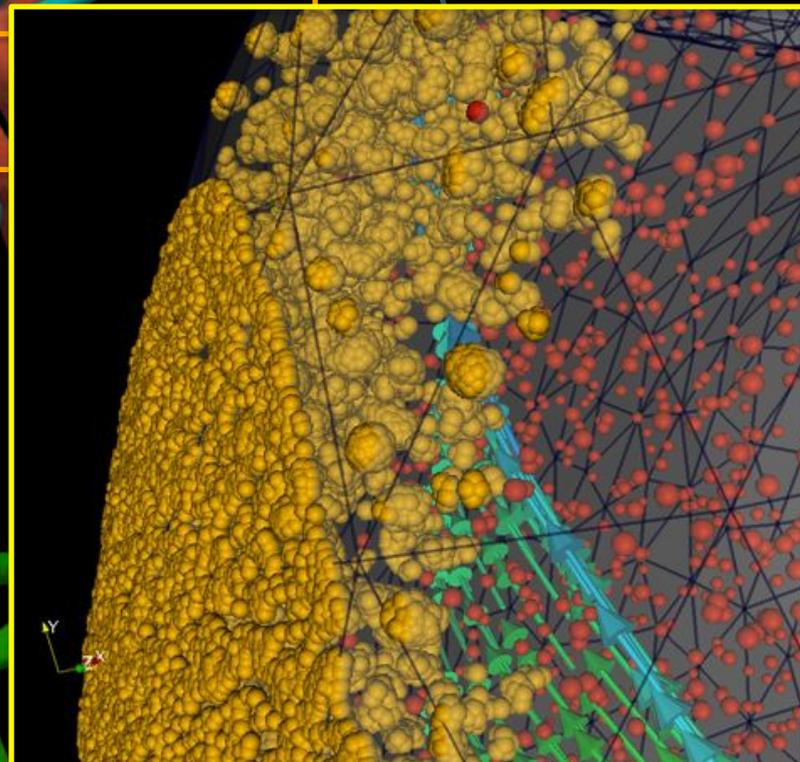
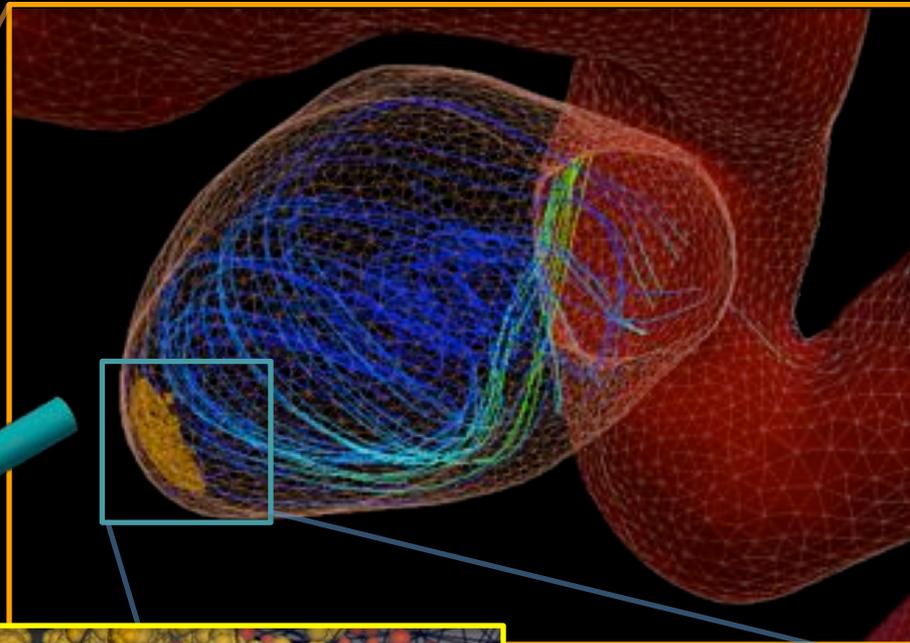
Anterior
Cerebral

Middle
Cerebral

Basilar

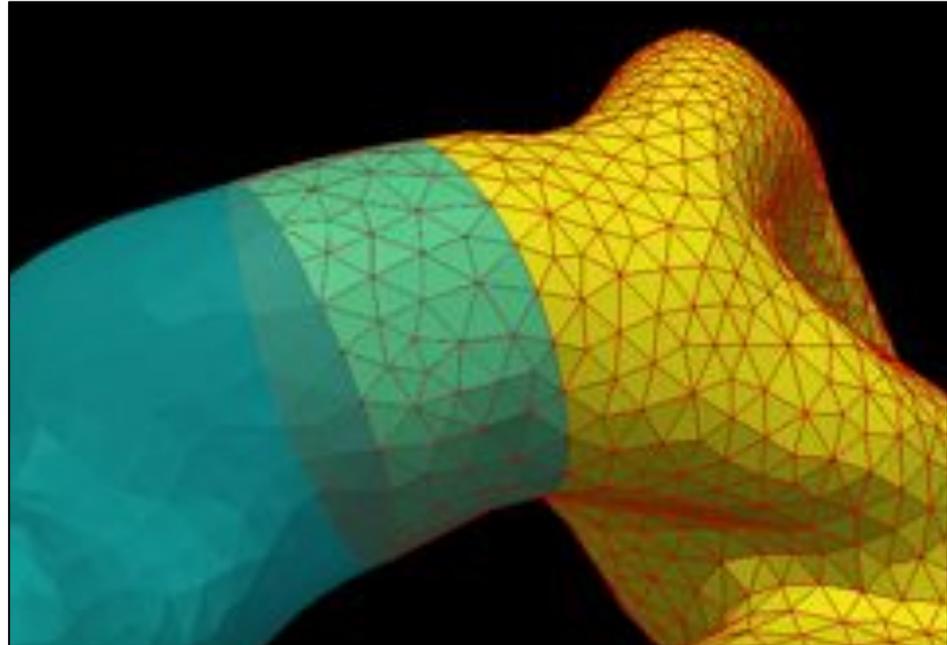
Left Interior
Carotid
Artery

Vertebral

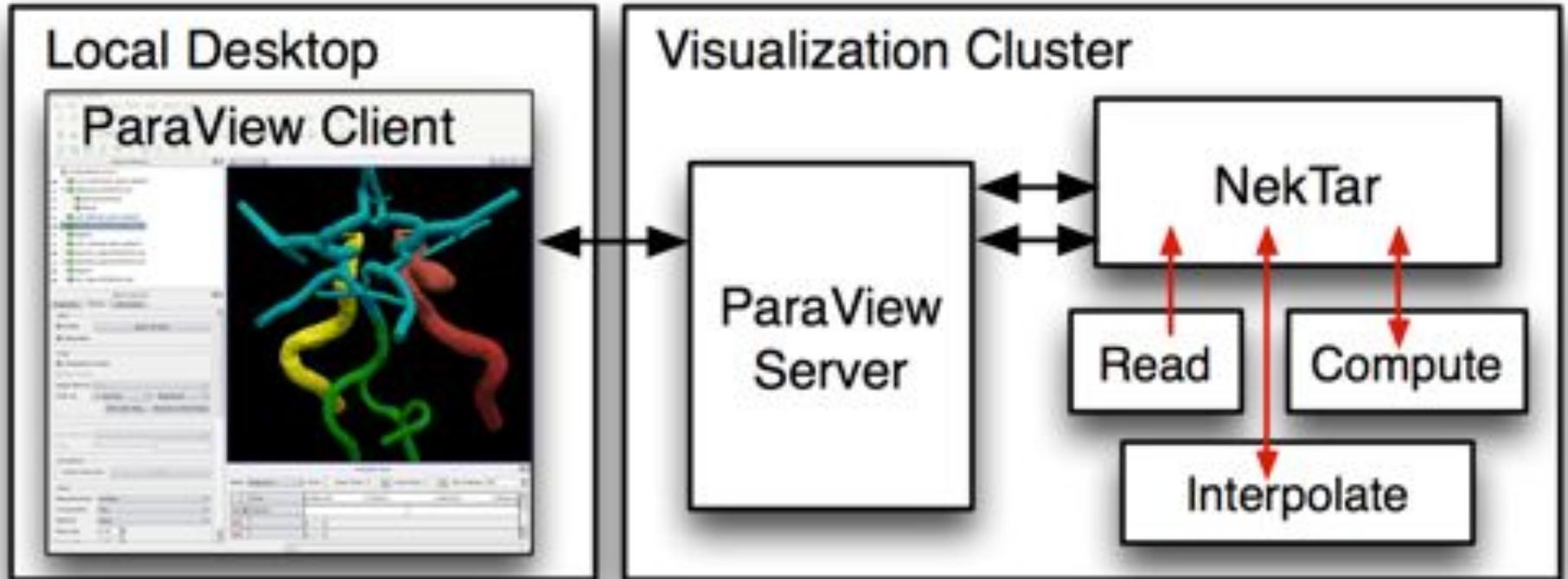


Macroscale Simulation (NekTar)

- ⊙ NekTar: Spectral/hp element method (SEM)
 - ⊙ Non-overlapping elements
 - ⊙ Multi-level approach
 - Domain decomposed into overlapping patches
- ⊙ NekTar Data
 - ⊙ Saved in Modal space
 - ⊙ Mesh (geometry)
 - ⊙ Solution data



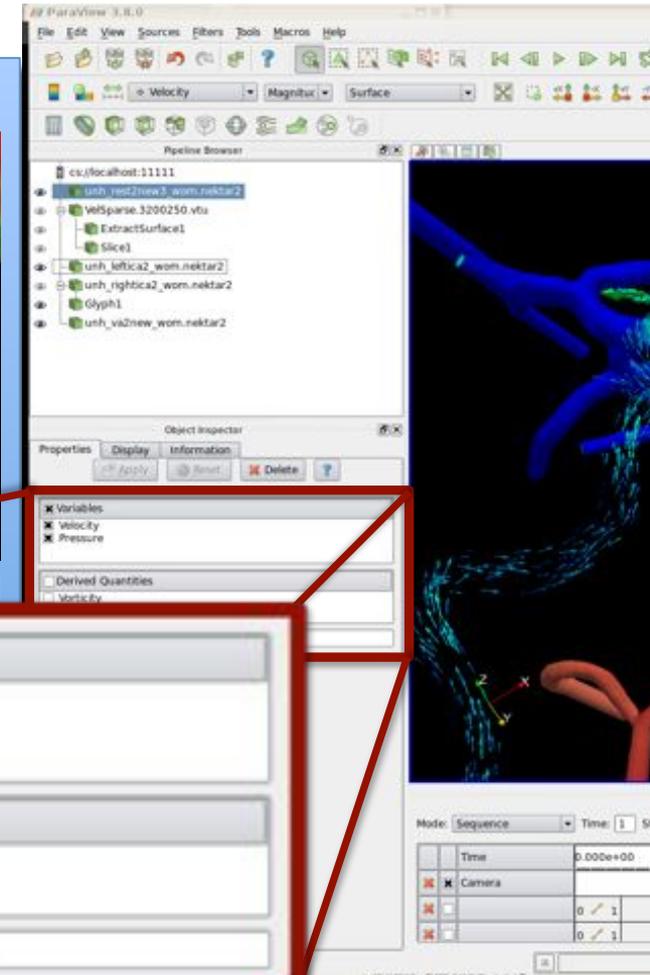
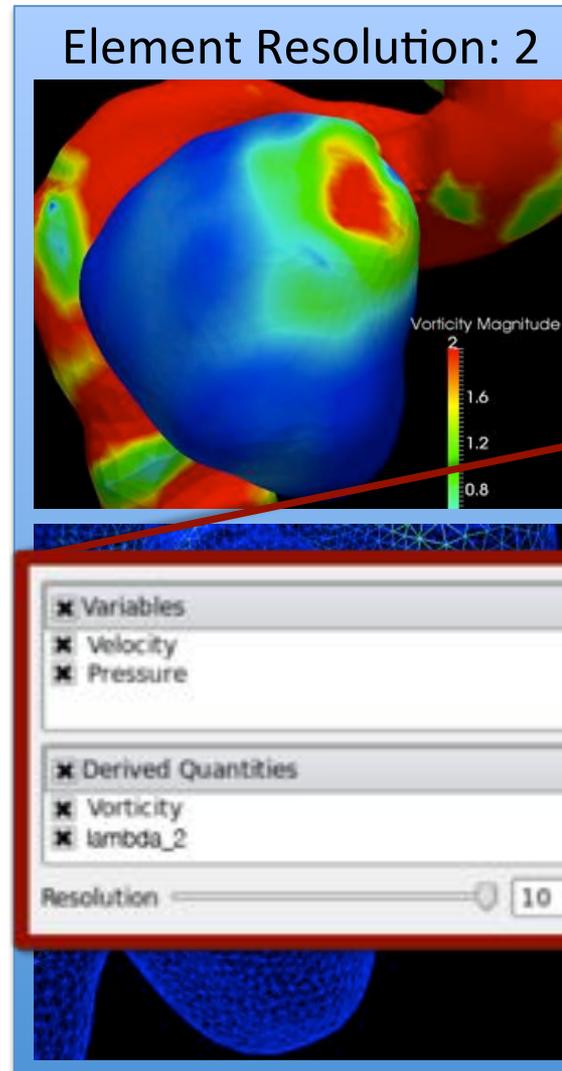
NekTar-ParaView Coupling



- ◉ NekTar for parallel I/O and computation
- ◉ ParaView for parallel visualization and rendering

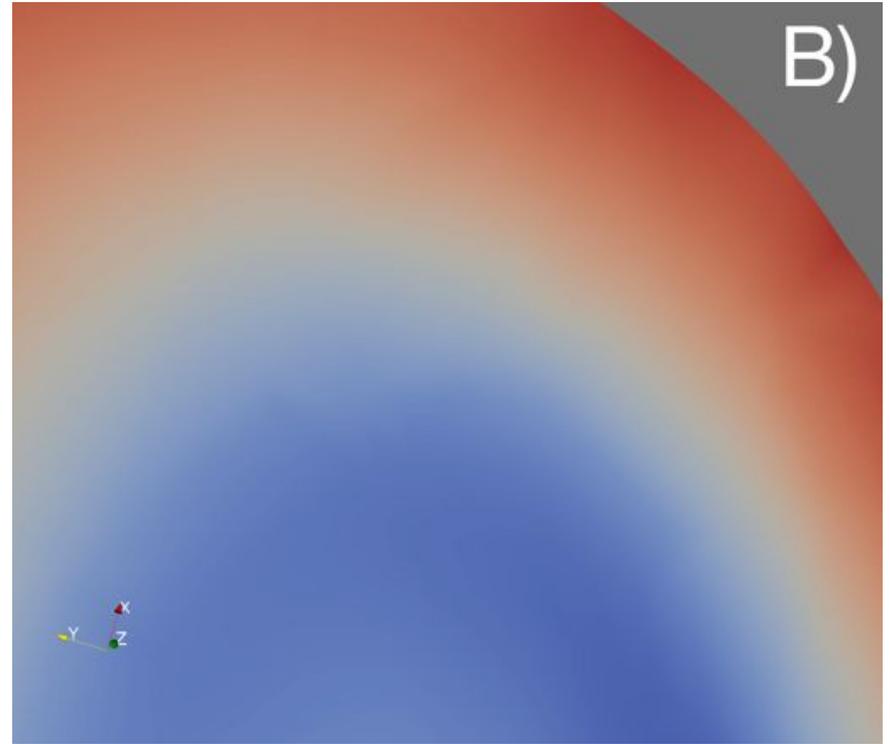
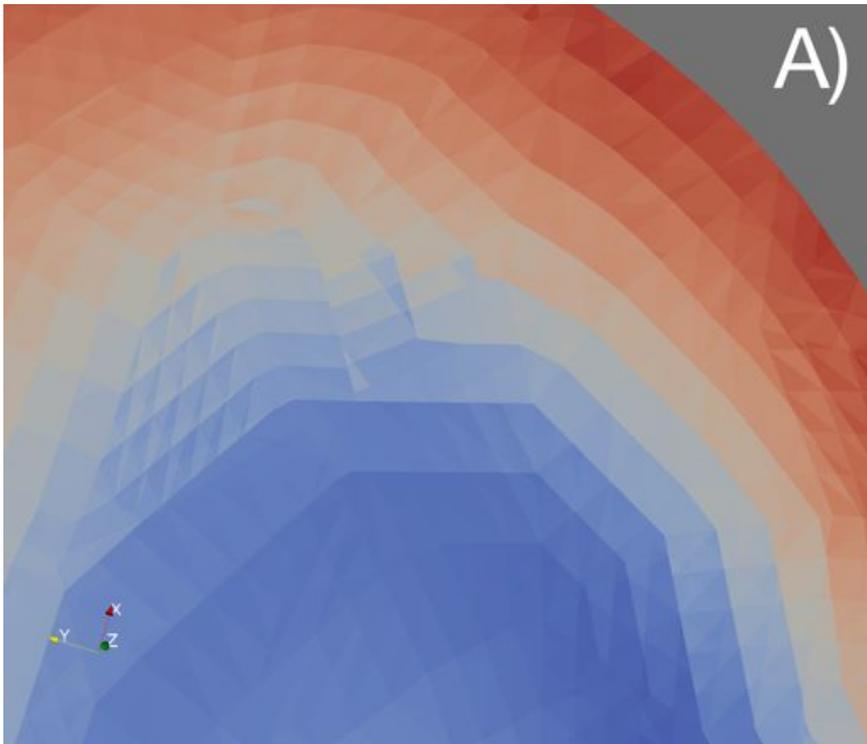
Plug-in Controls

- ◉ Select variables
- ◉ Interactively set data resolution
 - ◉ No need to re-read data from disk
- ◉ Time varying data
 - ◉ Only new data read from disk, not geometry
- ◉ Data caching



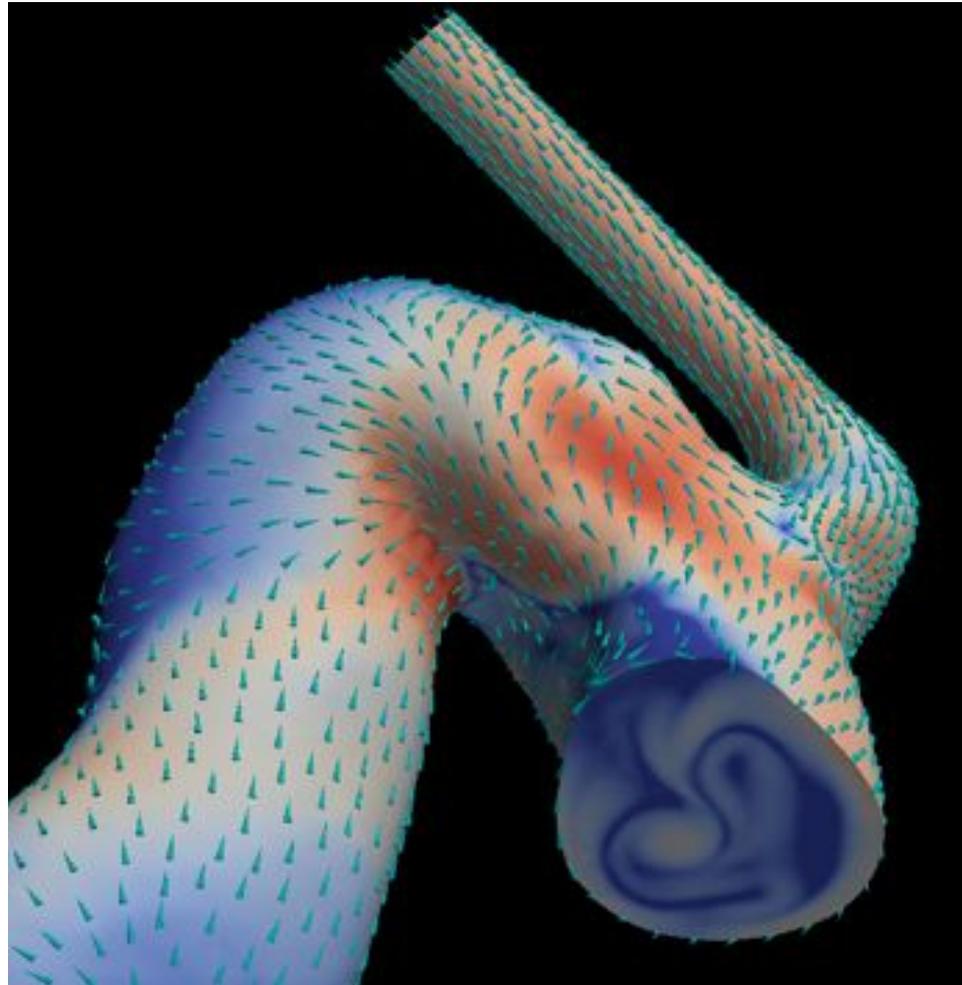
Derived Quantities: Vorticity

- ⦿ Data computed with high-order spectral accuracy
- ⦿ Grid consistent with simulation resolution



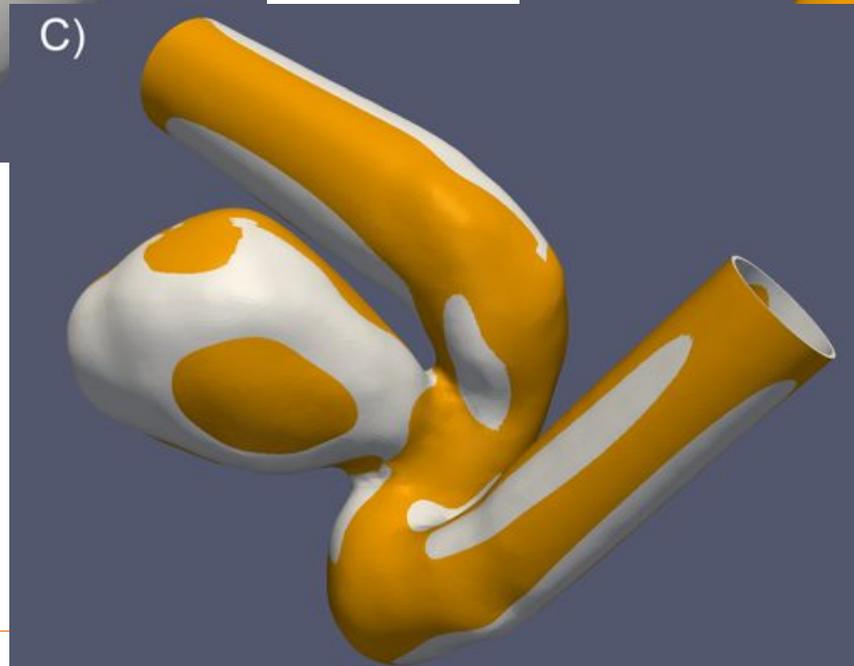
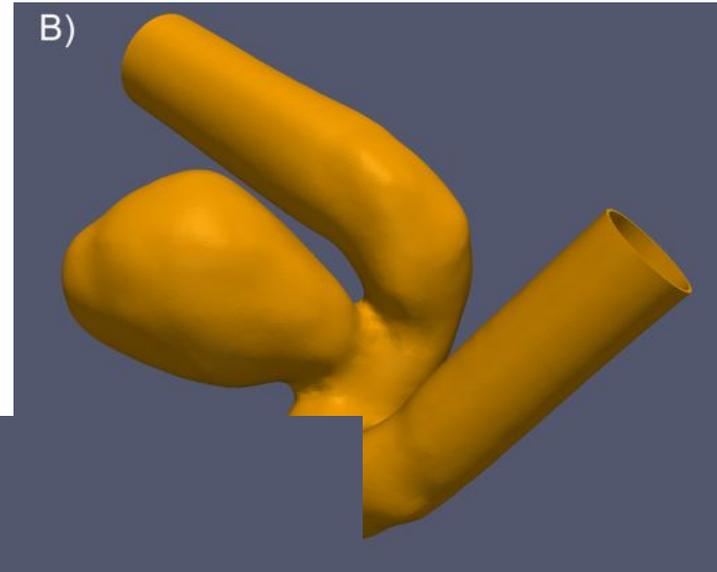
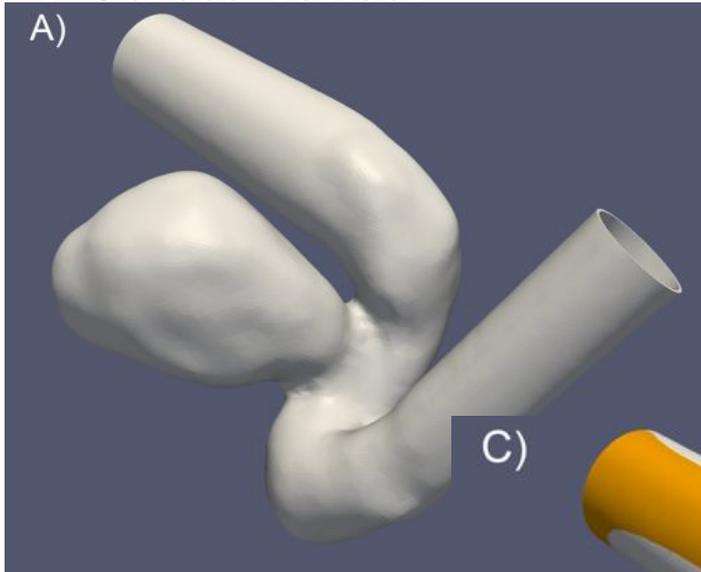
Derived Quantities: Wall Shear Stress

- ⦿ Extract boundary mesh



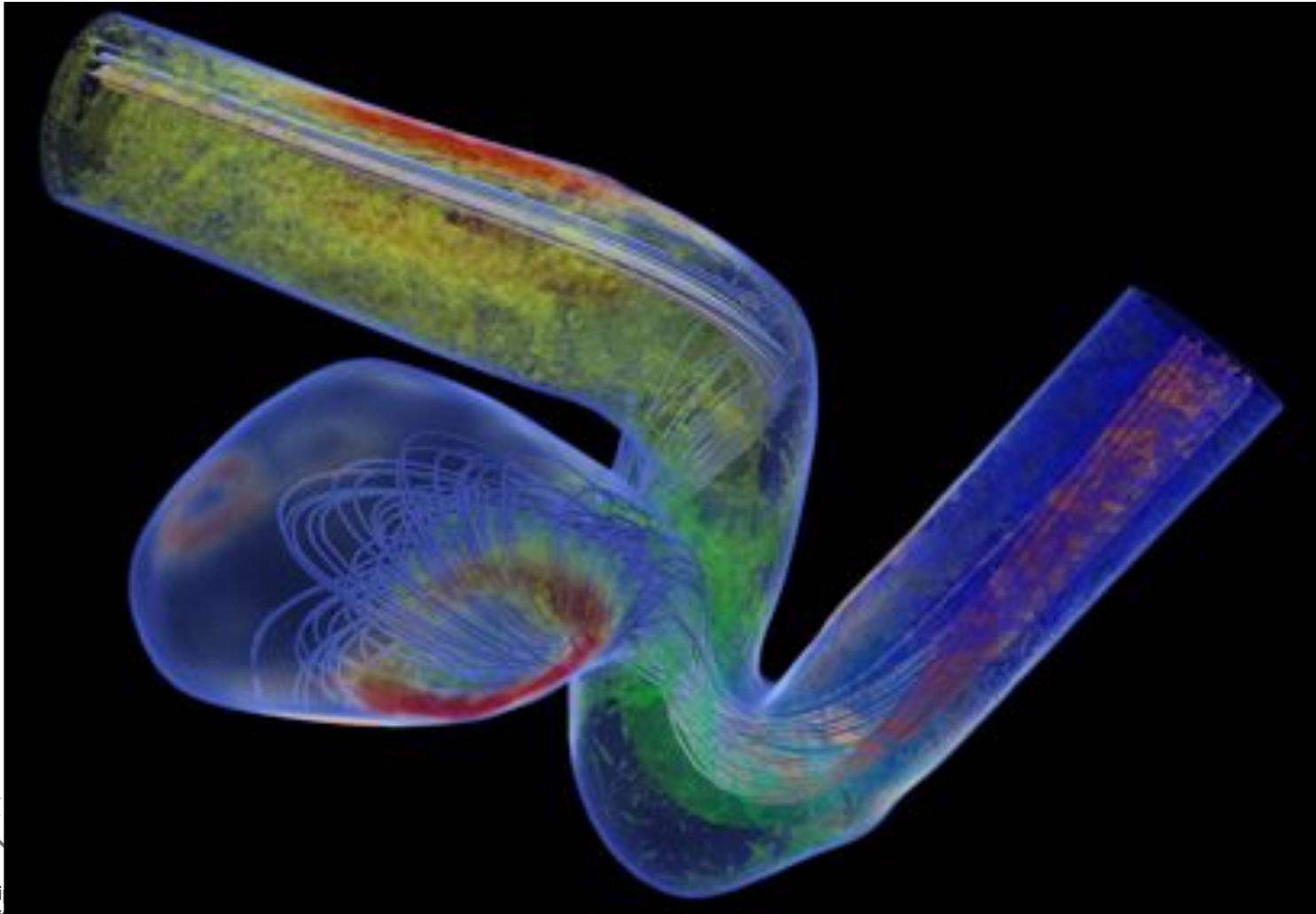
Fluid-Structure Interaction

- ⊙ Dynamic mesh
- ⊙ Stress Tensor

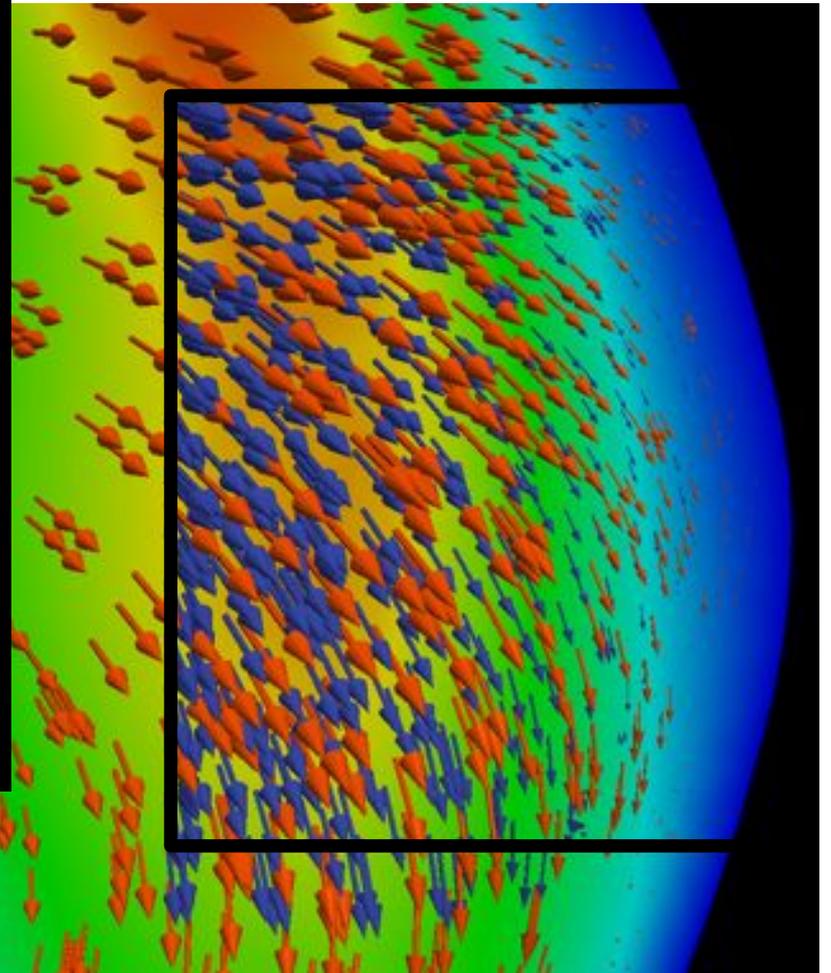
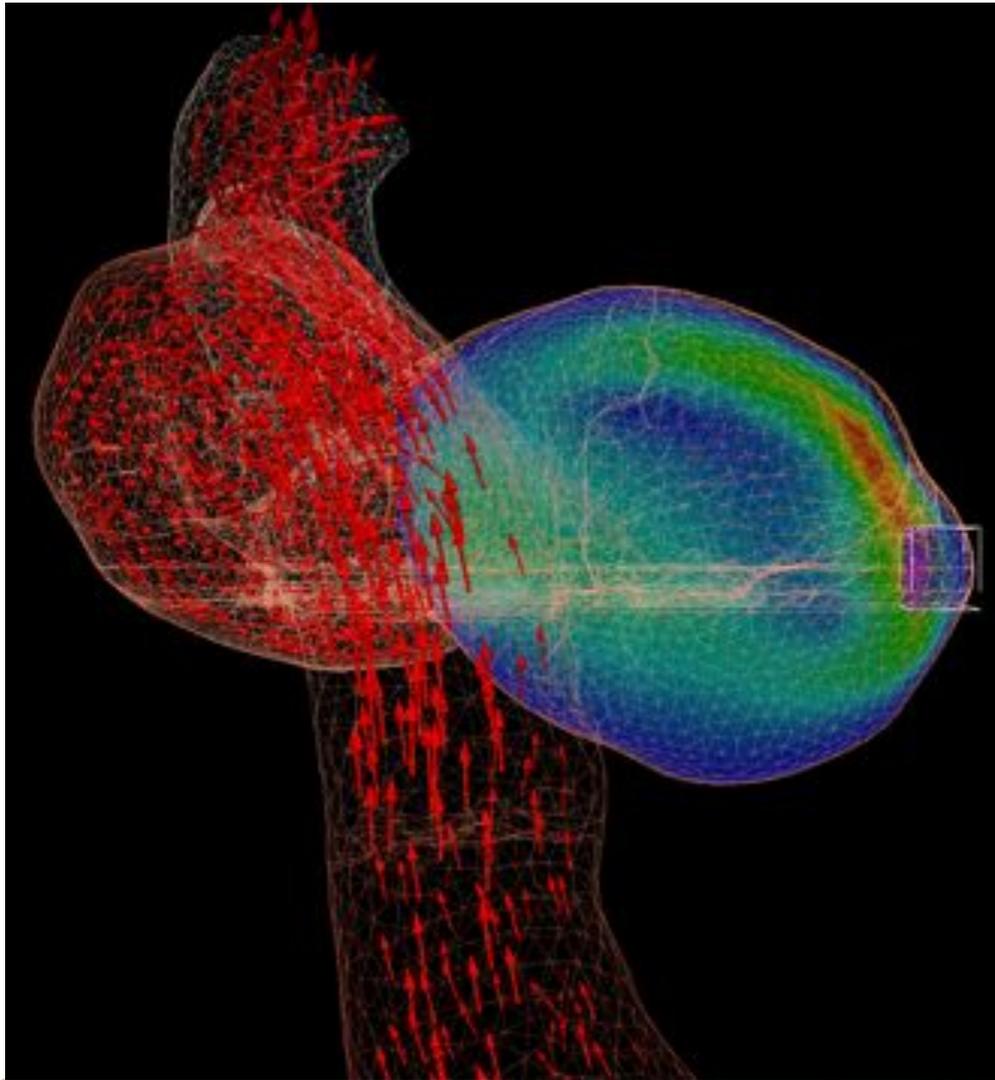


Fluid-Structure Interaction

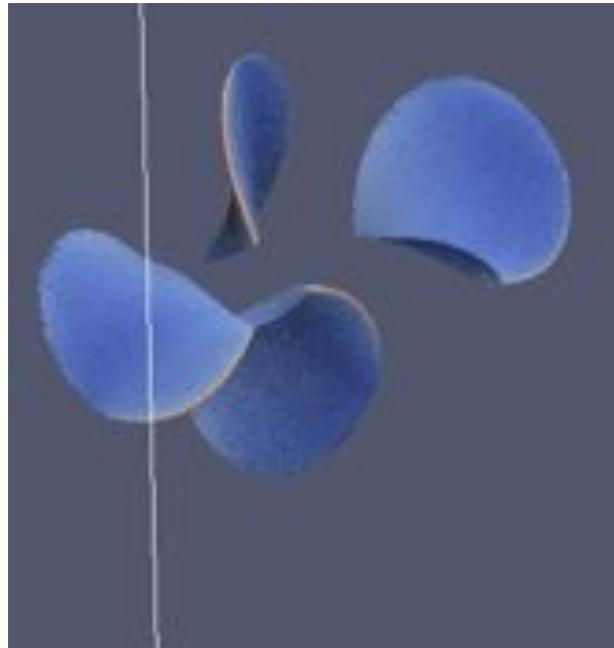
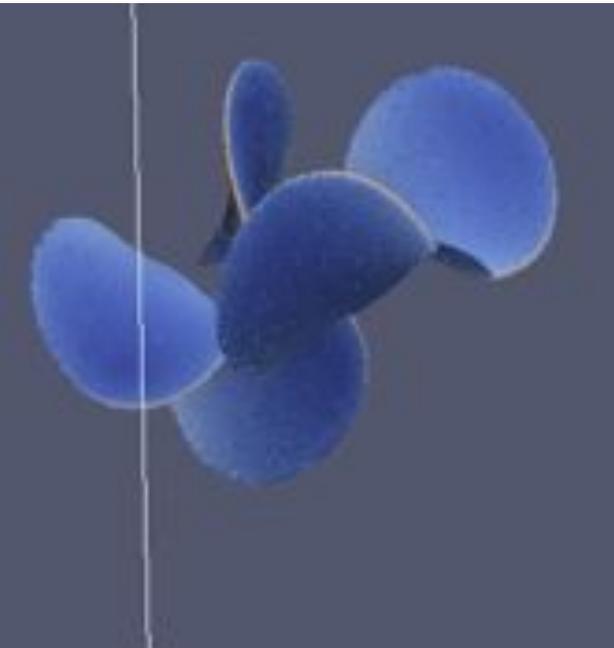
- ⊙ Dynamic mesh
- ⊙ Stress Tensor



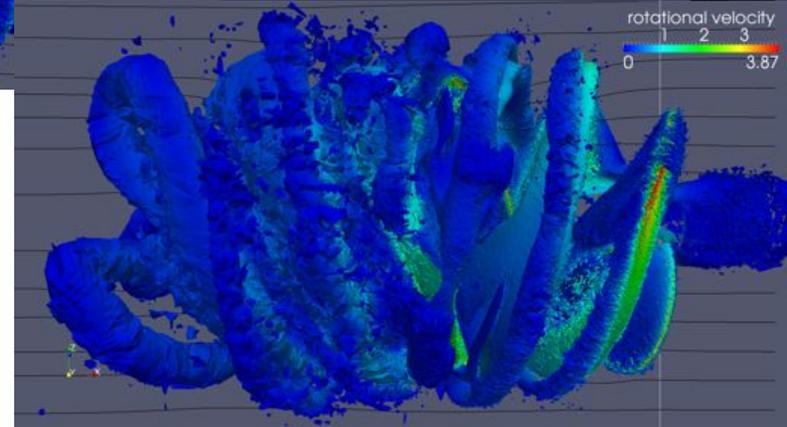
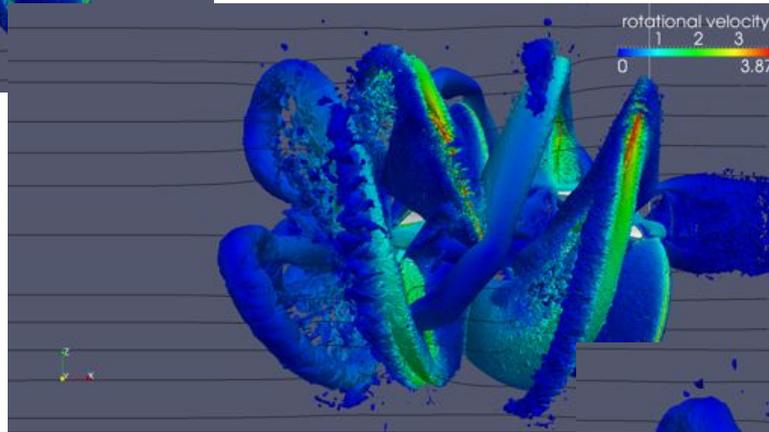
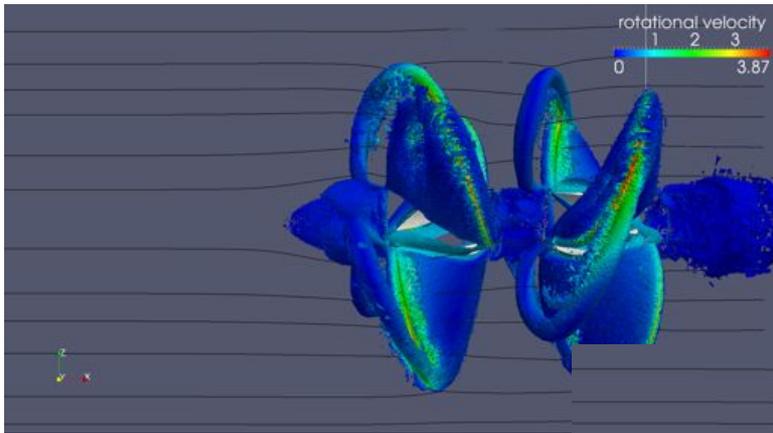
Visualization for Verification



Visualization for Debugging

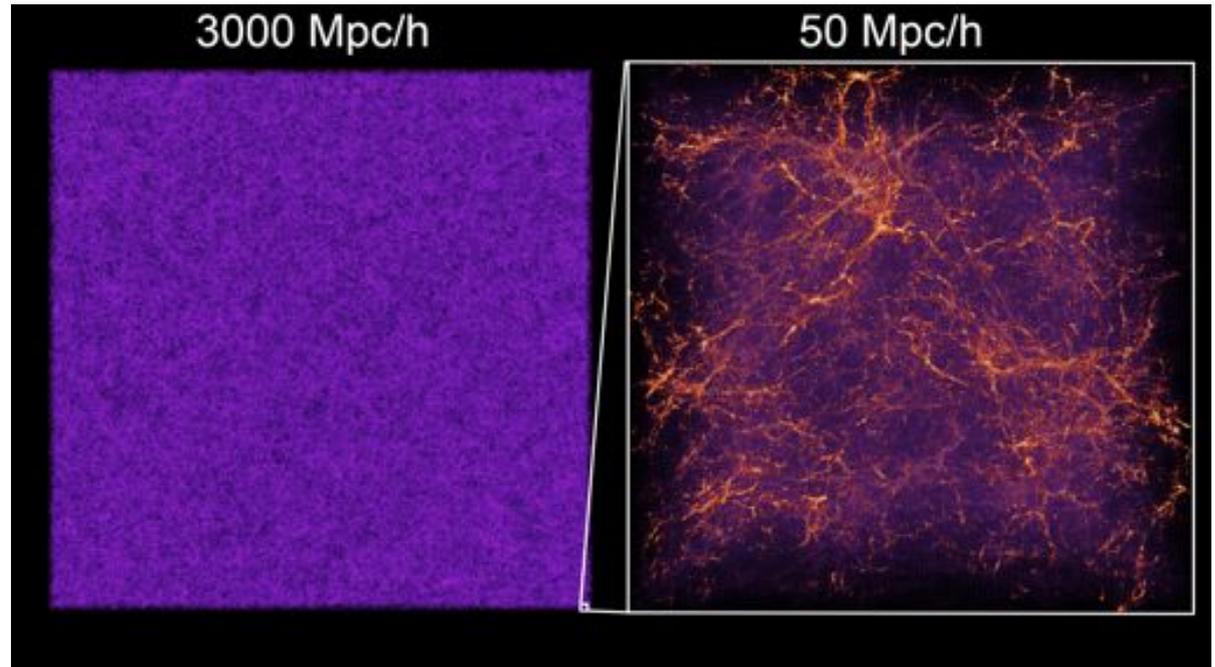


Visualization for Debugging



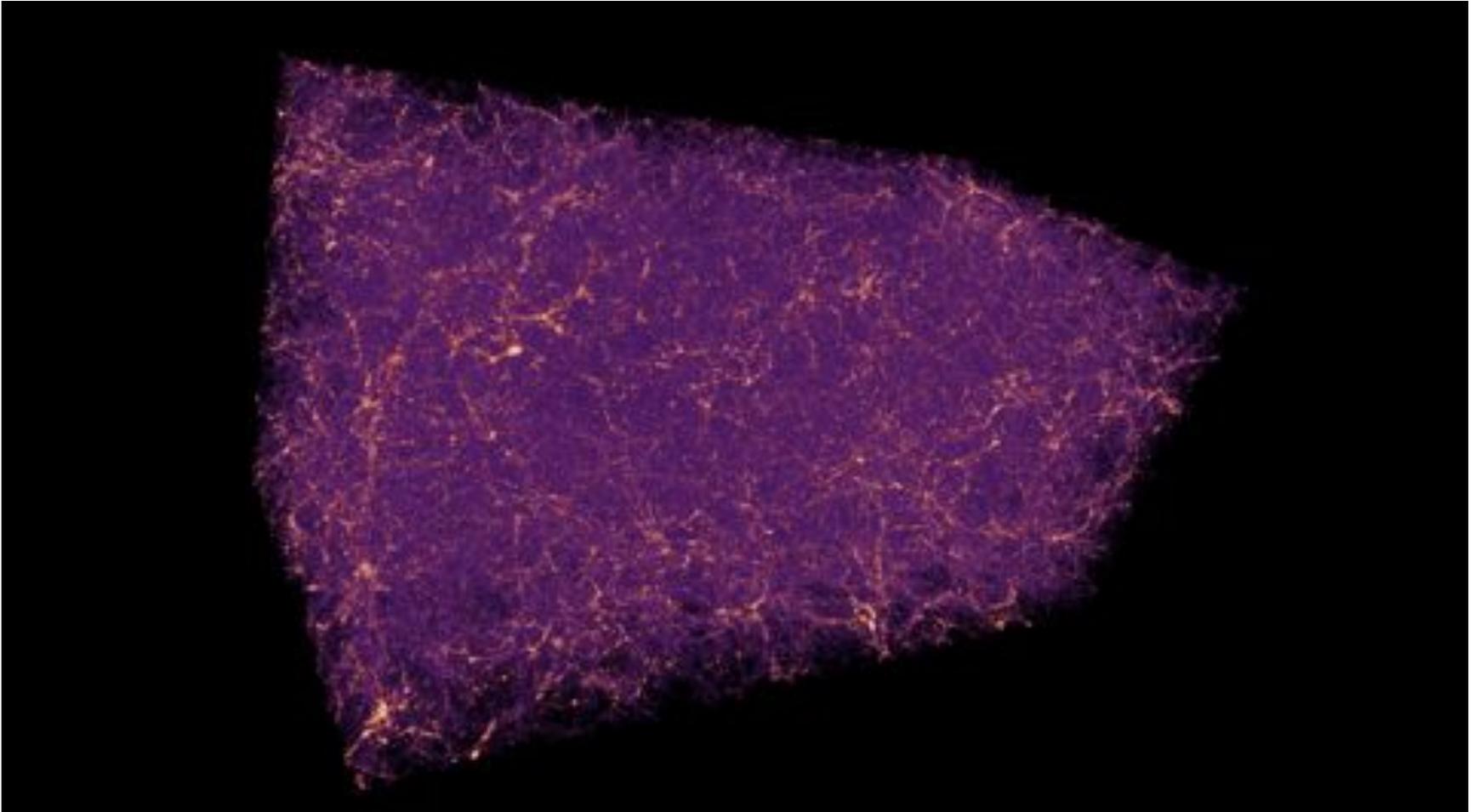
HACC: Cosmology Simulation

- ⊙ 1.1 trillion particles
- ⊙ Projected onto a regular grid currently ($10K^3$), post-processed ($\sim 4TB$ per time step)

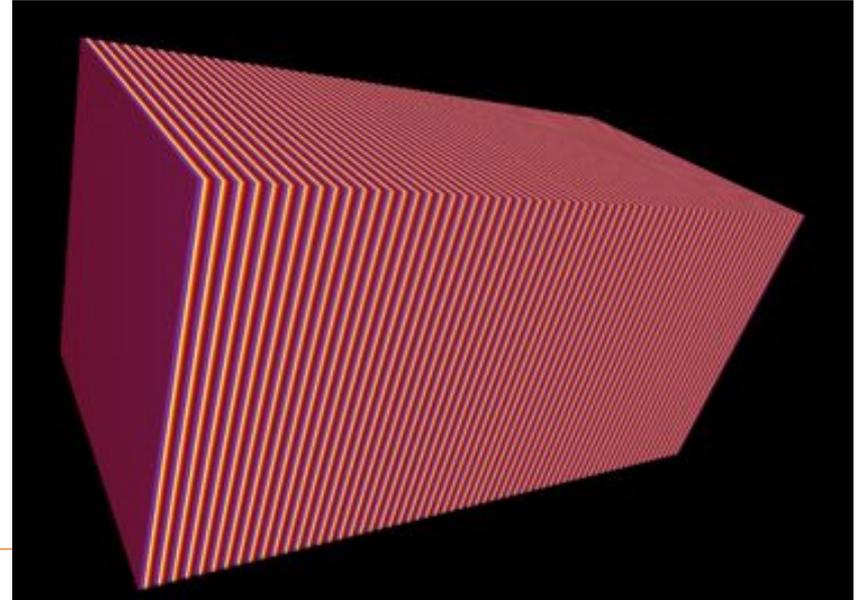
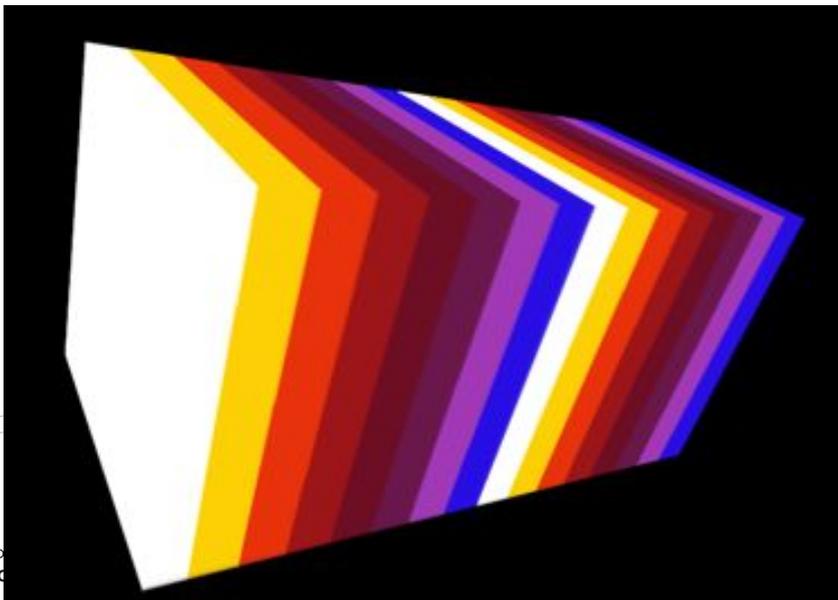
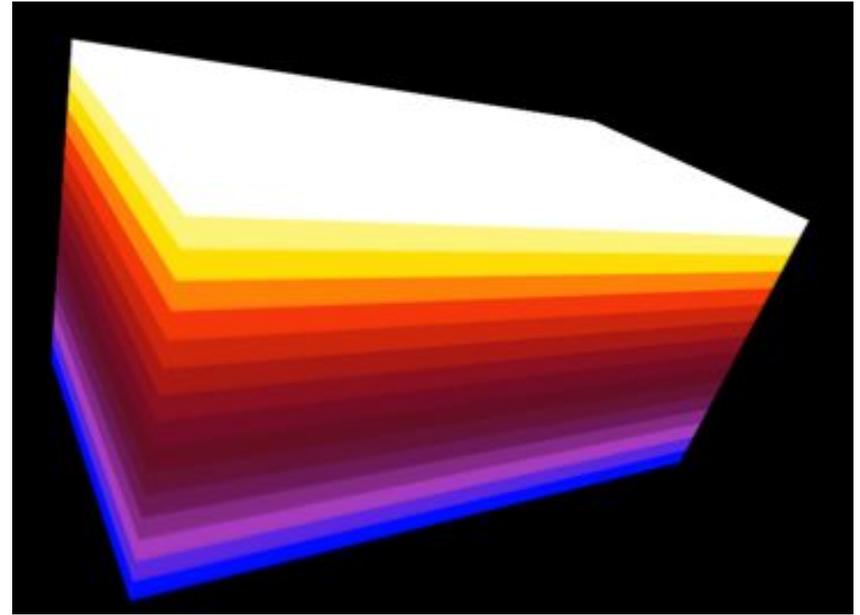
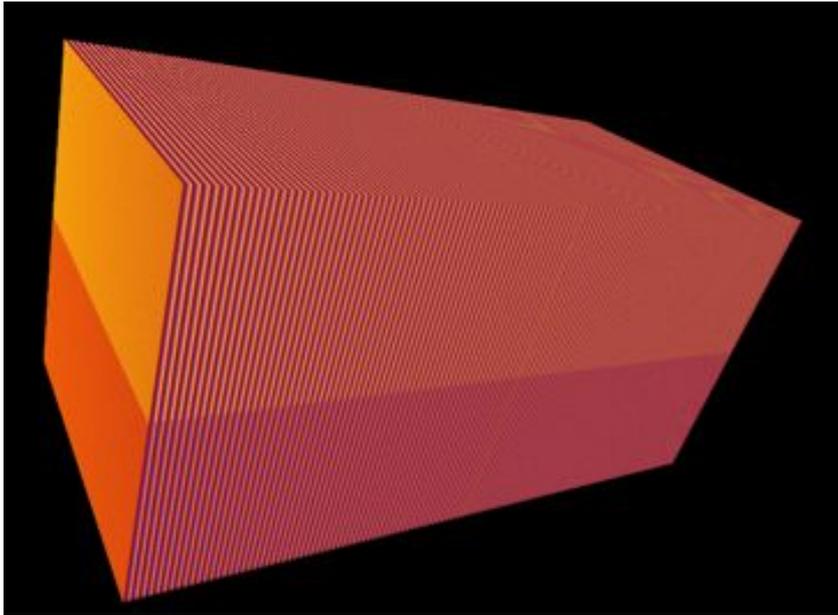


- ⊙ 512^3 (~ 230 Million light-years on a side) from a single process (right image)
- ⊙ $10K \times 10K \times 800$ (~ 13 Billion light-years on a side) from a single I/O node (left image)

Visualization as Diagnostics: Color by Thread ID



Visualization as Diagnostics: Color by Thread ID



Visualization as Diagnostics: Color by Process ID

