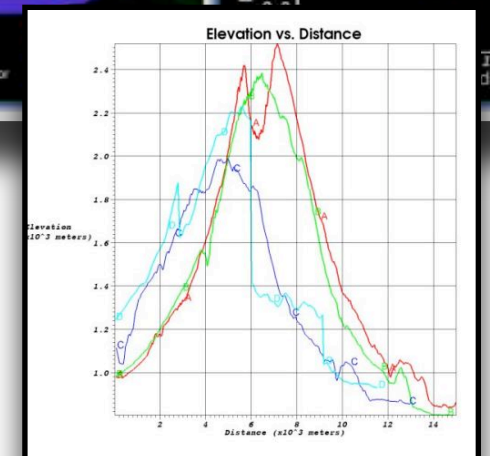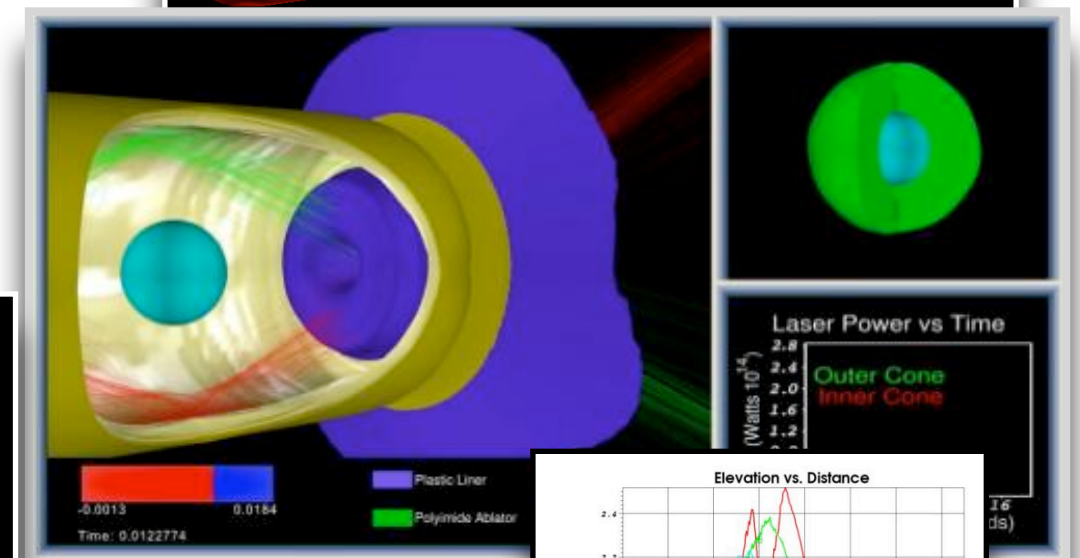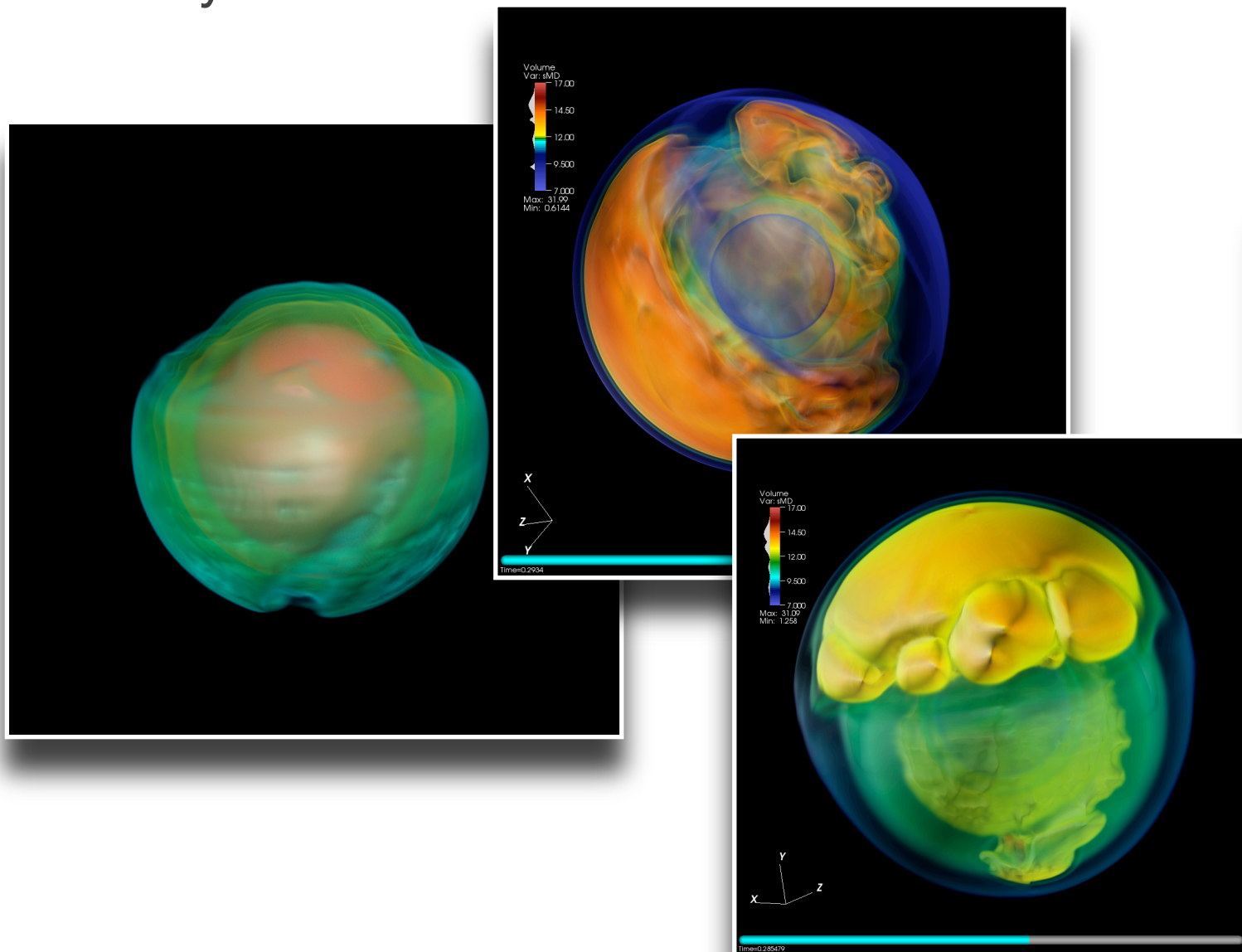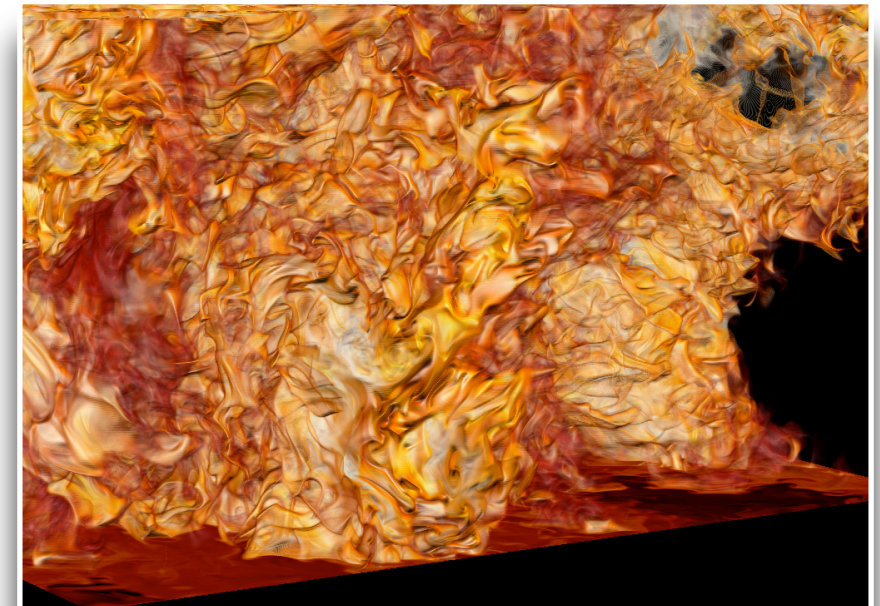# Petascale Analysis and Visualization

Dave Pugmire
Oak Ridge National Laboratory

# VisIt Parallel Analysis

- Petascale vis/analysis tool first developed by LLNL/NNSA

- Now open source, developed by 5+ institutions

# More than pretty pictures



Data Exploration



Comparative Analysis


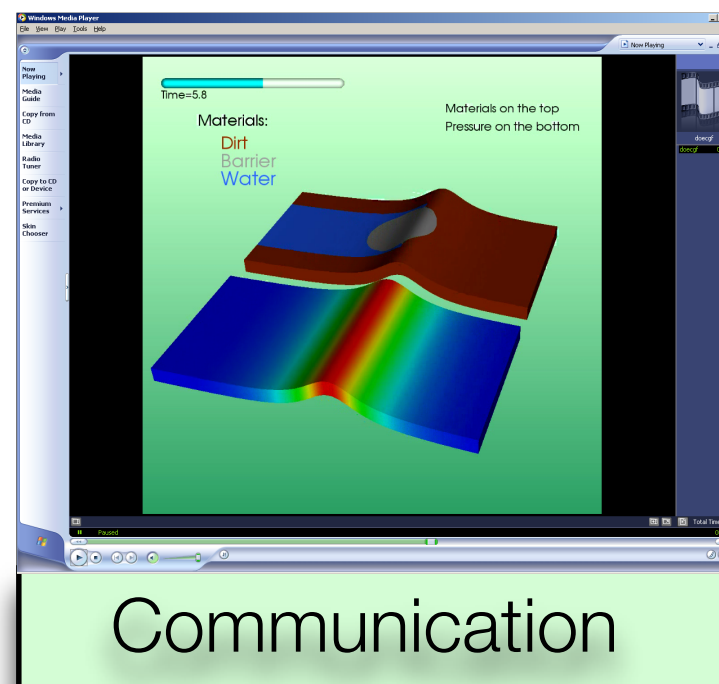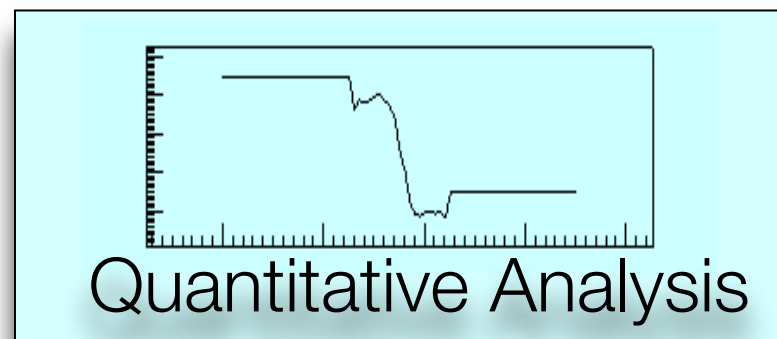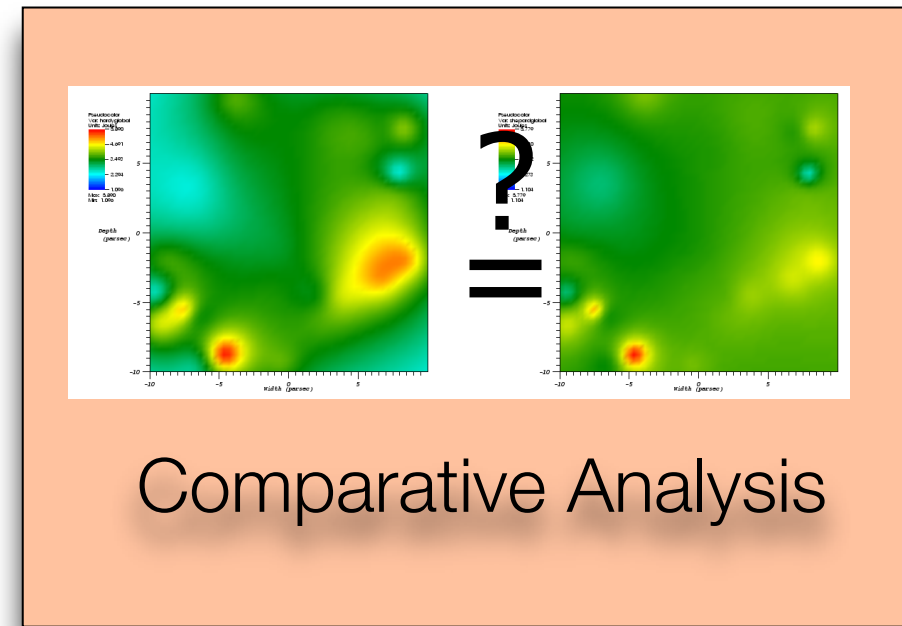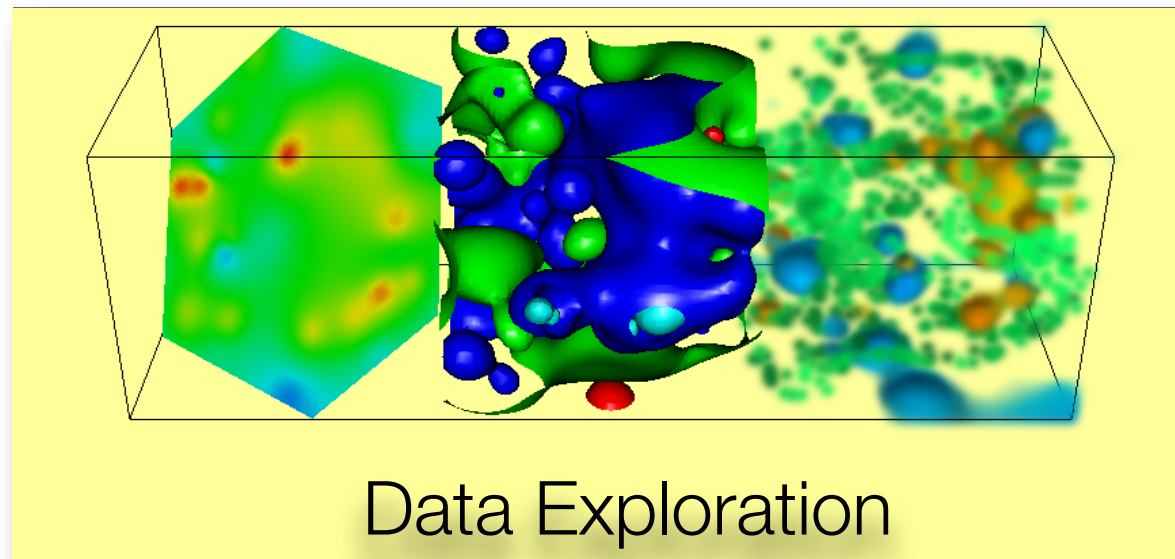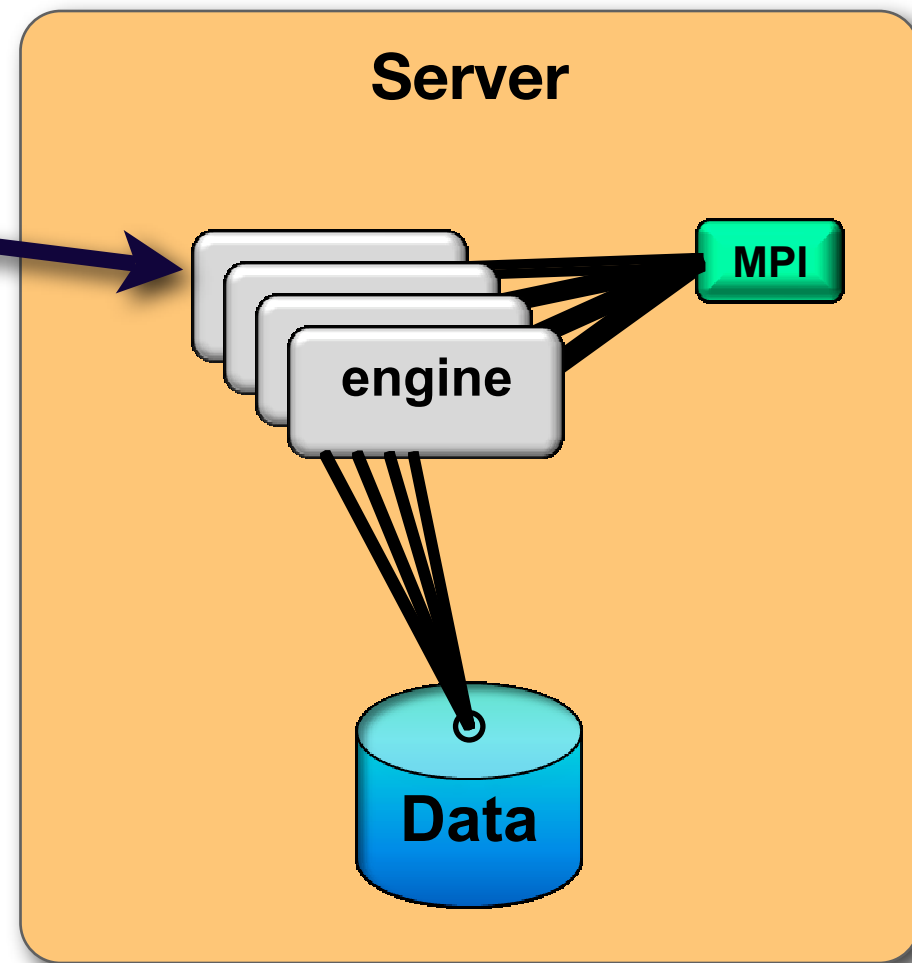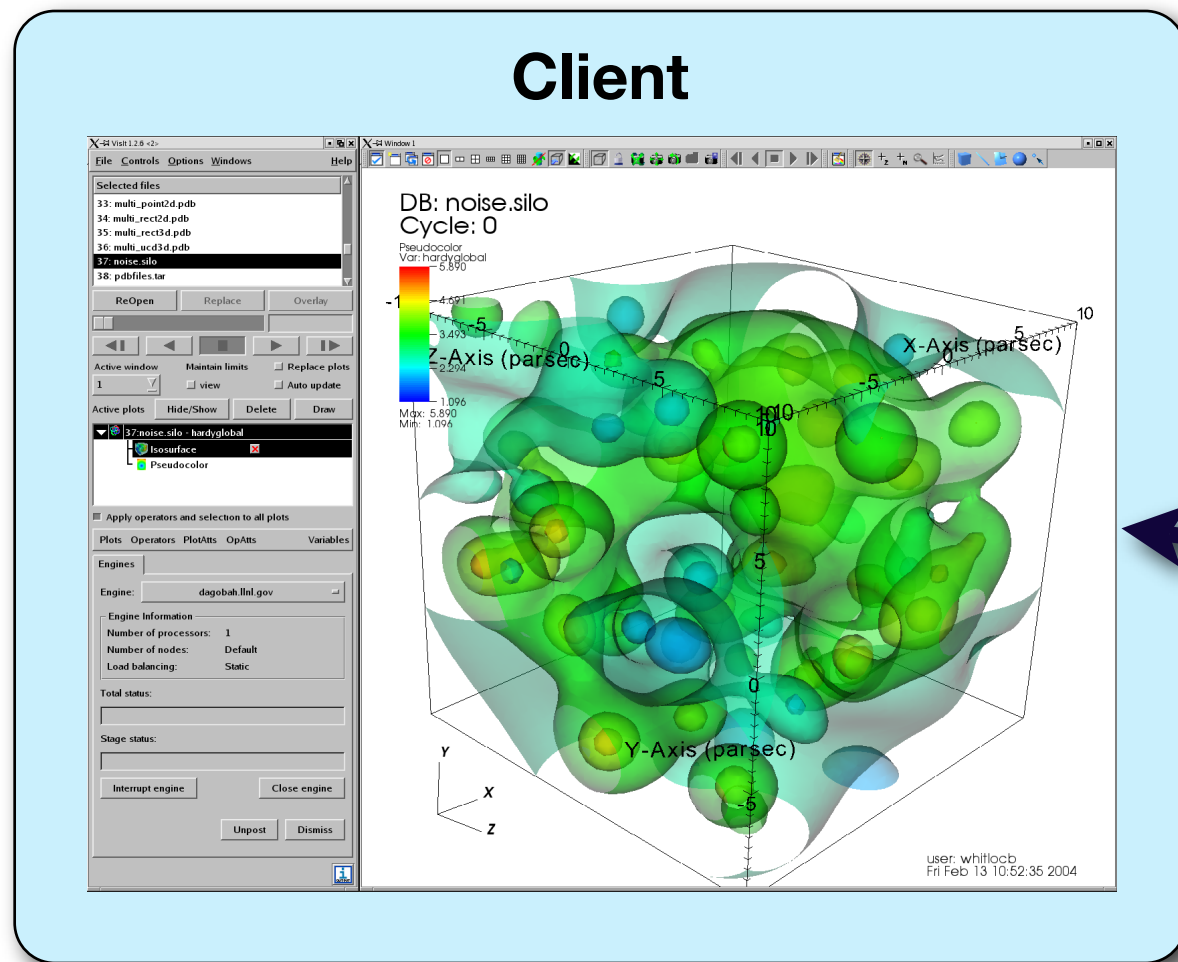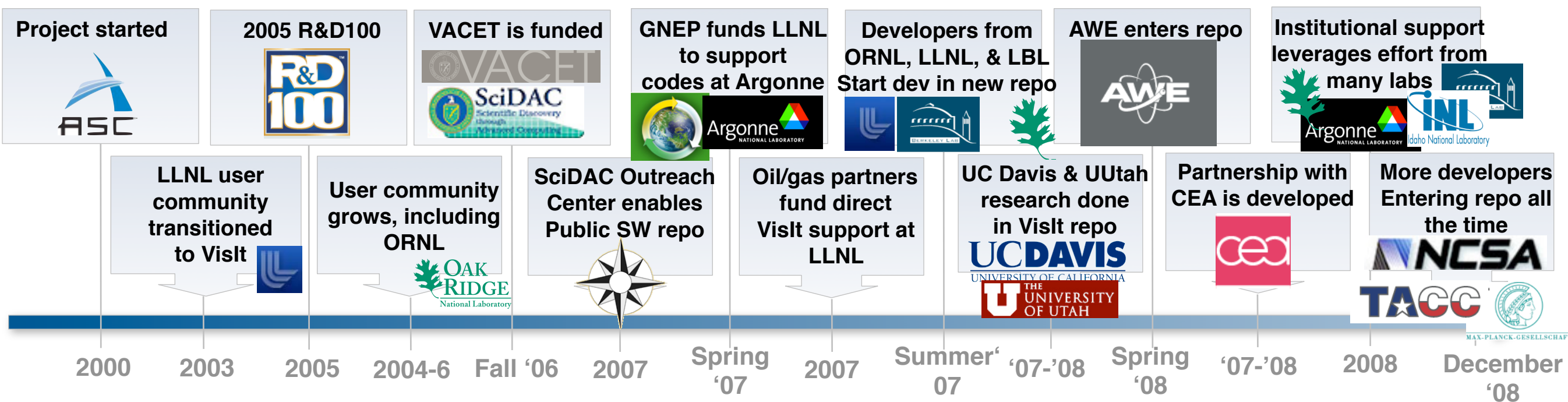
Quantitative Analysis



Communication



Visual Debugging
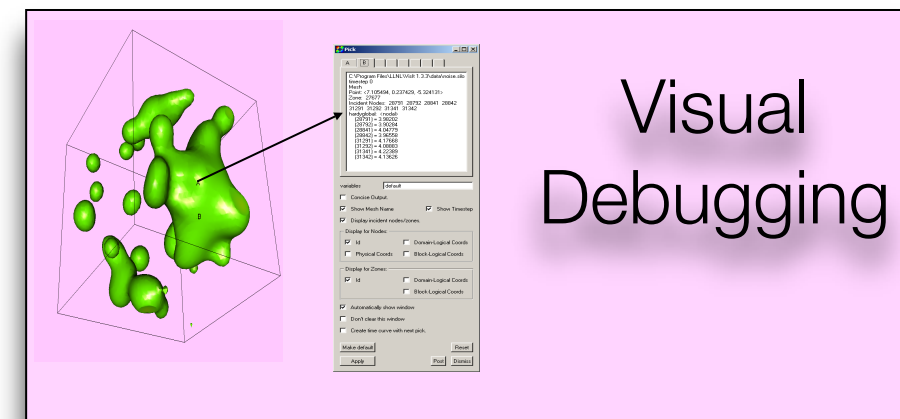
# VisIt Architecture

# Growing developer community

- Over 50 person-years of effort
- Close to two million lines of code
- Partnership between: Department of Energy's Office of Science, Office of Nuclear Energy, and National Nuclear Security Agency, and among others

| Project started | 2005 R&D100 | VACET is funded | GNEP funds LLNL to support codes at Argonne | Developers from ORNL, LLNL, & LBL Start dev in new repo | AWE enters repo | Institutional support leverages effort from many labs |
|---|---|---|---|---|---|---|

| | LLNL user community transitioned to VisIt | User community grows, including ORNL | SciDAC Outreach Center enables Public SW repo | Oil/gas partners fund direct VisIt support at LLNL | UC Davis & UUtah research done in VisIt repo | Partnership with CEA is developed | More developers Entering repo all the time |
|---|---|---|---|---|---|---|---|

| 2000 | 2003 | 2005 | 2004-6 | Fall '06 | 2007 | Spring '07 | 2007 | Summer' 07 | '07-'08 | Spring '08 | '07-'08 | 2008 | December '08 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

# Trillion-zone experiment

| | | | |
|---|---|---|---|
|  |  | Dave Pugmire, Sean Ahern | **ORNL** |
|  |  | Mark Howison, Prabhat | **LBNL** |
|  | | Hank Childs | **LBNL/UC Davis** |
|  | | Katie Antypas | **NERSC** |

- ## Questions:

  - Is it possible to run production-quality analysis tool on petascale machines?

  - What obstacles do we encounter at this scale?
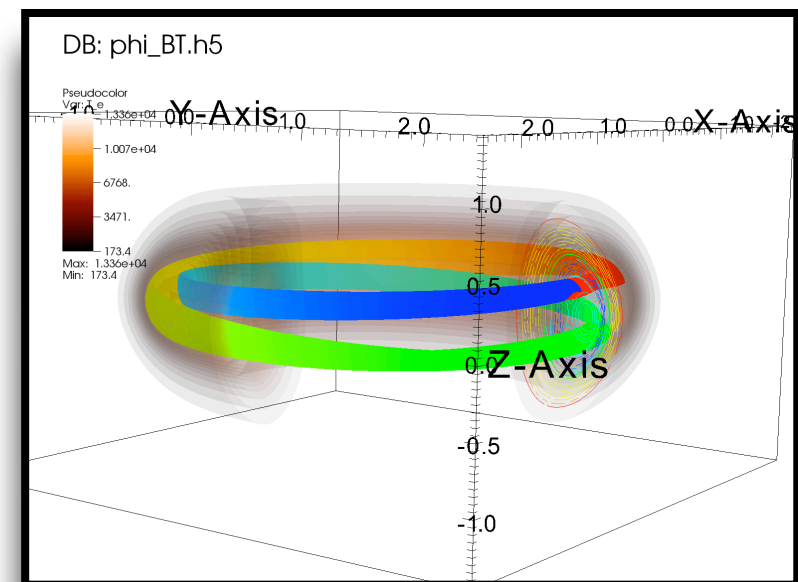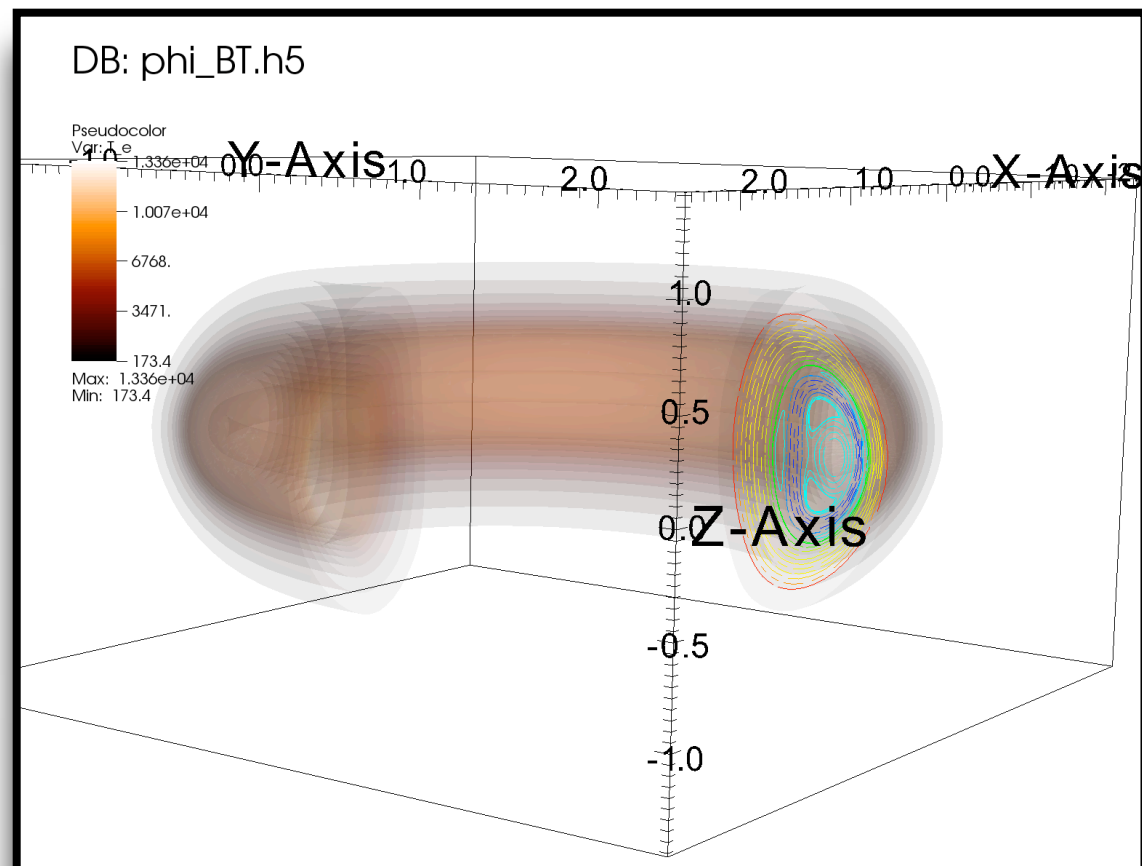
# Trillion-zone experiment

- Two common visualization techniques:

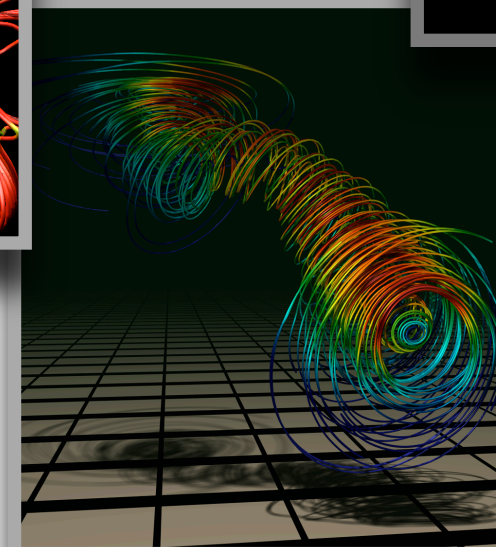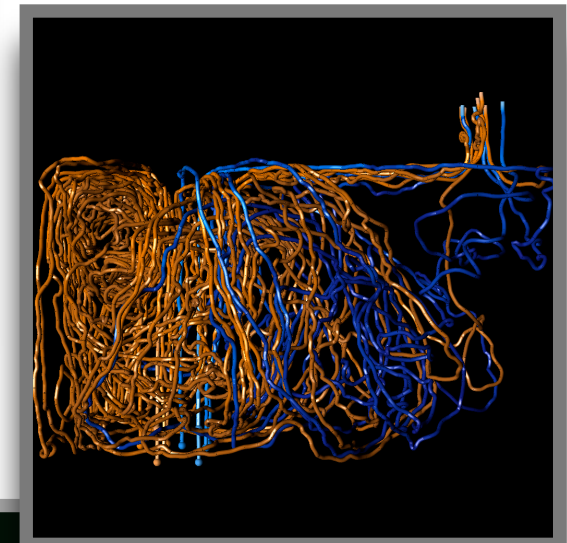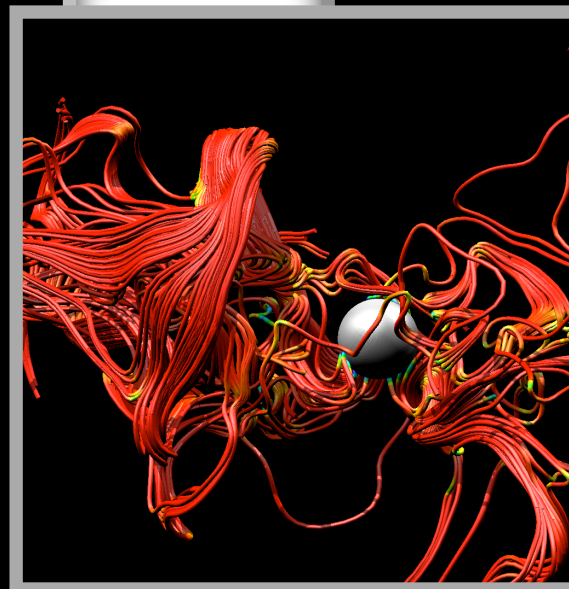  - Volume rendering, isocontouring.
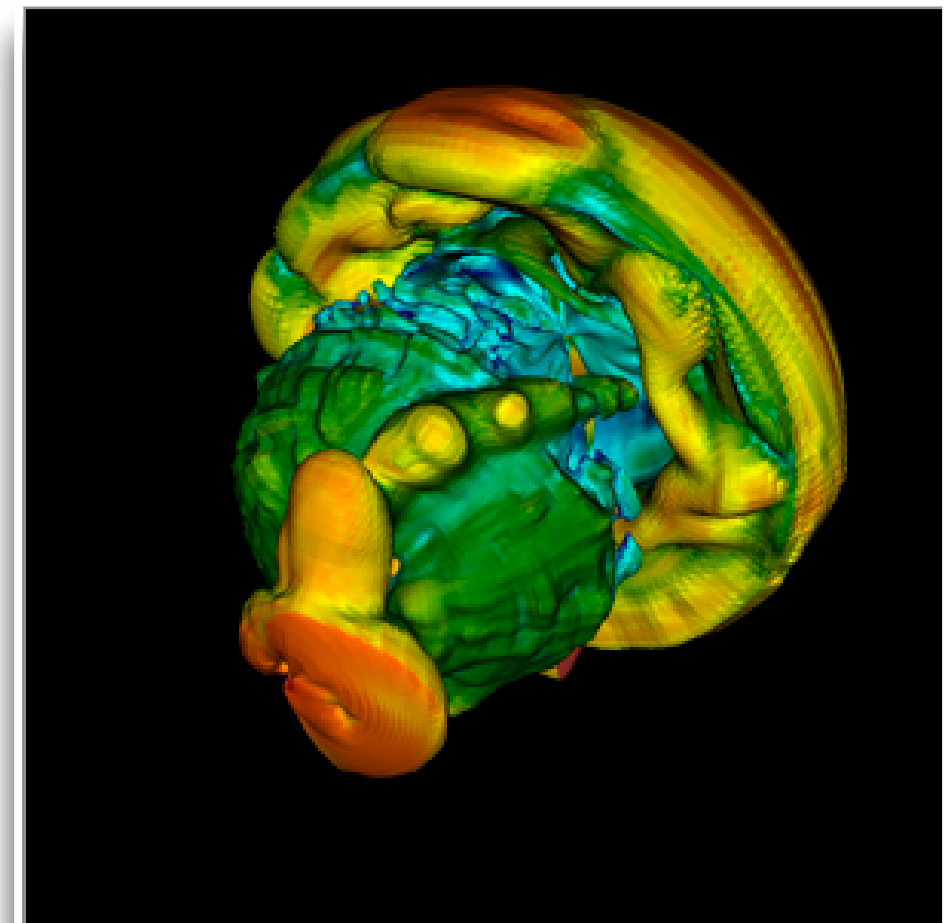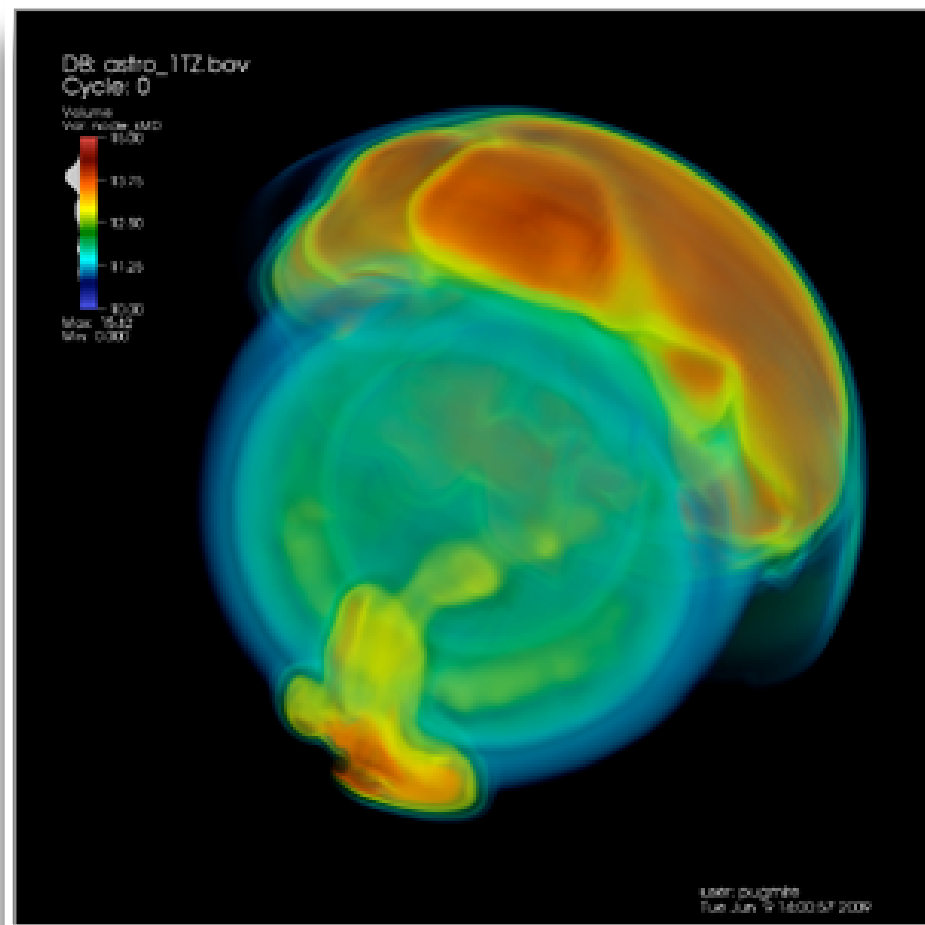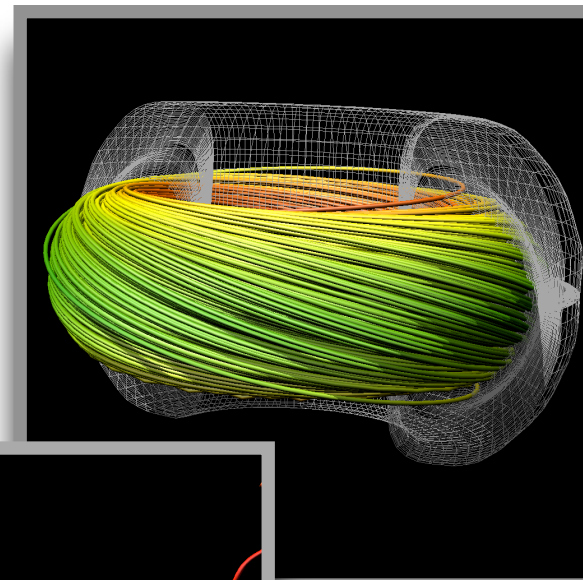
# Trillion-zone experiment

| Machine | Model | Problem | #cores |
|---|---|---|---|
| Dawn | BlueGene/P | 4TZ | 64K |
| JaguarPF | Cray XT5 | 1,2TZ | 16K,32K |
| Franklin | Cray XT5 | 1,2TZ | 16K |
| Juno | X86_64 | 1TZ | 16K |
| Ranger | Sun | 1TZ | 16K |
| Purple | IBM P5 | 0.5 TZ | 8K |

# Analysis for the Fusion Community

# Parallel Streamlines

- ***Scalable Computation of Streamlines on Very Large Datasets***. Pugmire, Childs, Garth, Ahern, Weber (to appear SC09)

# Parallel streamlines