



Interactive Visual Analysis Tools

– VisIt –

Tutorial: Interactive Visual Analysis of Scientific Data

Gunther H. Weber

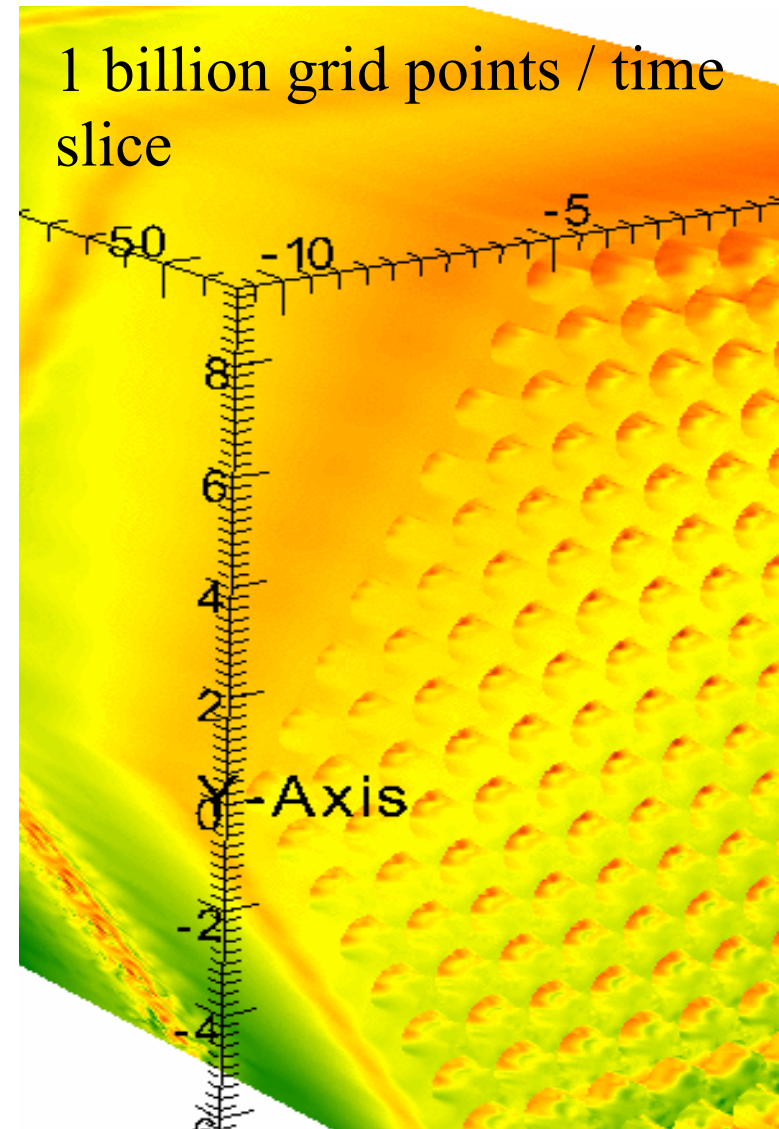


VisIt is an open source, richly featured, turn-key application for large data

- Used by:
 - Visualization experts
 - Simulation code developers
 - Simulation code consumers
- Popular
 - R&D 100 award in 2005
 - Used on many of the Top500
 - >>>100K downloads

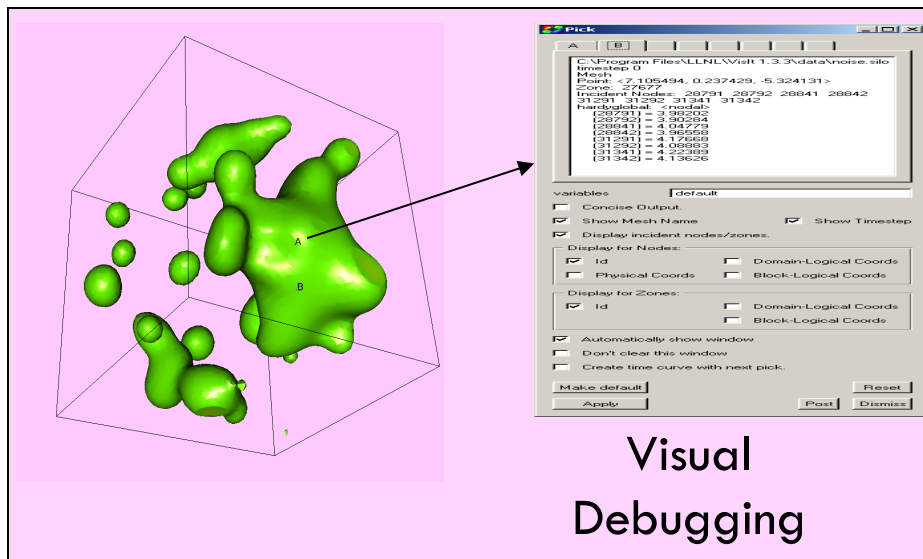


217 pin reactor cooling
simulation
Run on $\frac{1}{4}$ of Argonne BG/P
Image credit: Paul Fischer,
ANL

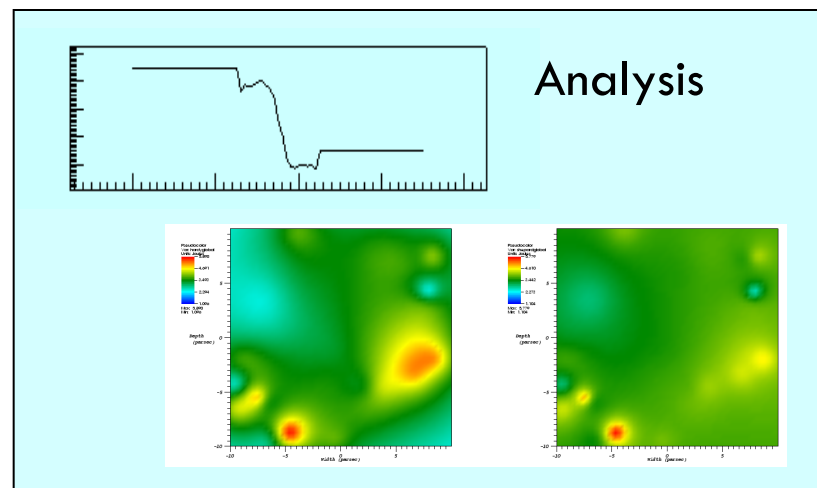


Terribly Named!

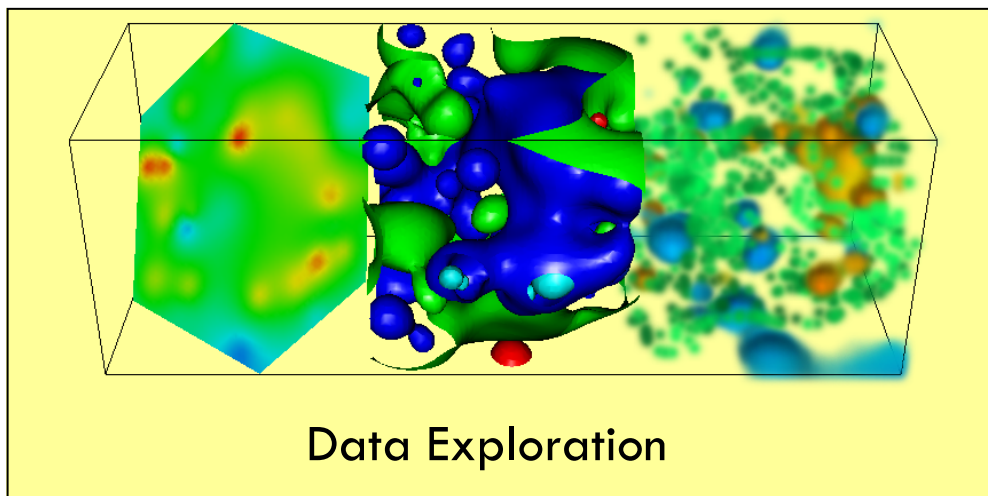
... Intended for much more than just visualization



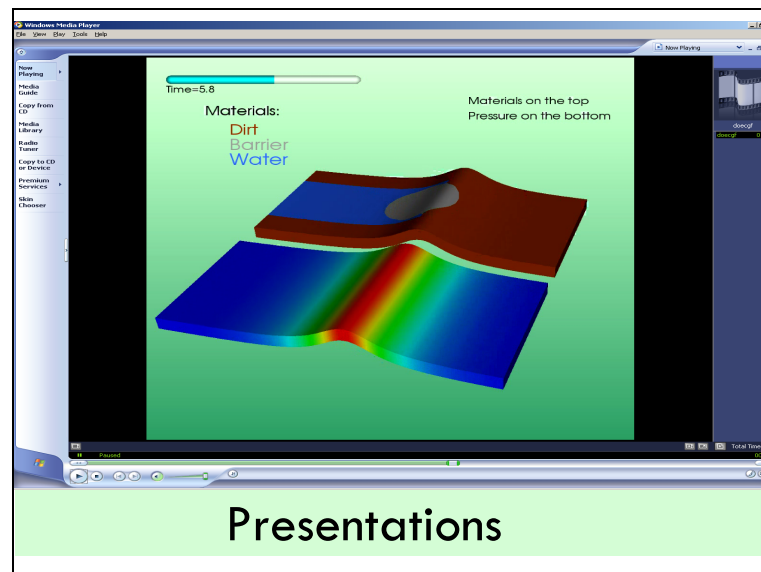
Visual Debugging



Analysis



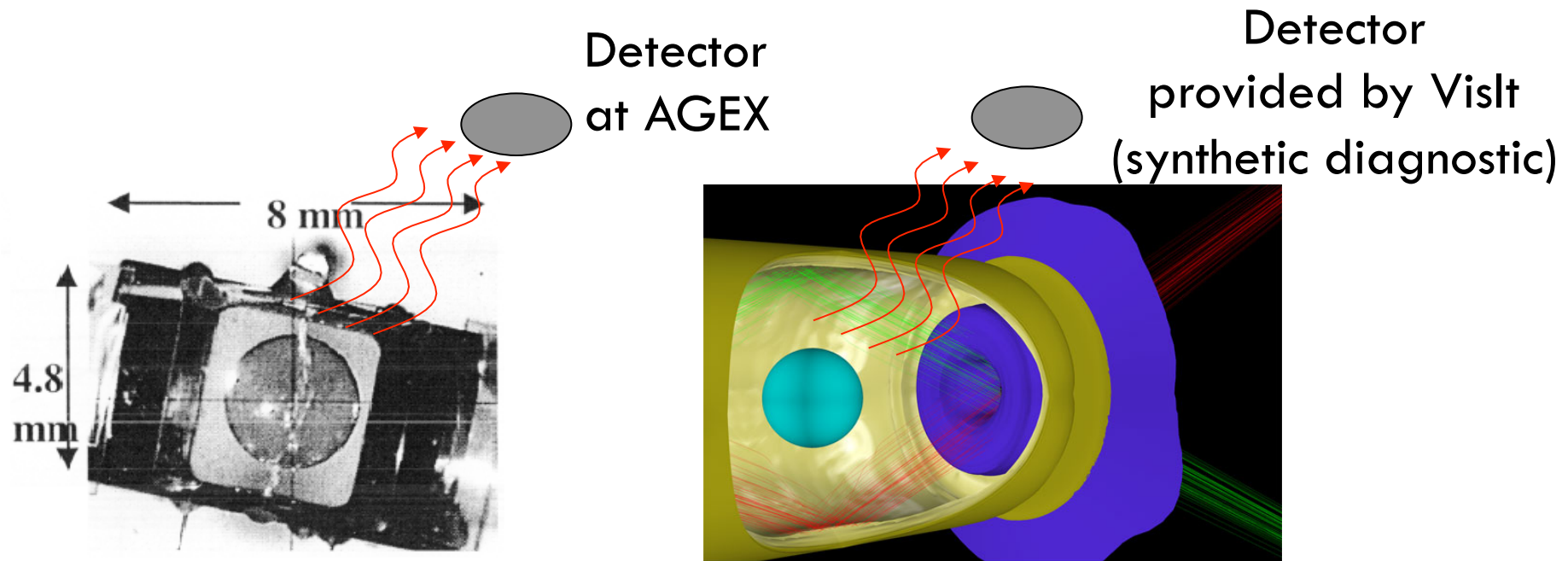
Data Exploration



Presentations

What sort of analysis is appropriate for VisIt?

- General analysis techniques (e.g. integration, volumes, surface areas, etc.)
- Specialized analysis (e.g. hohlraum flux at AGEX)

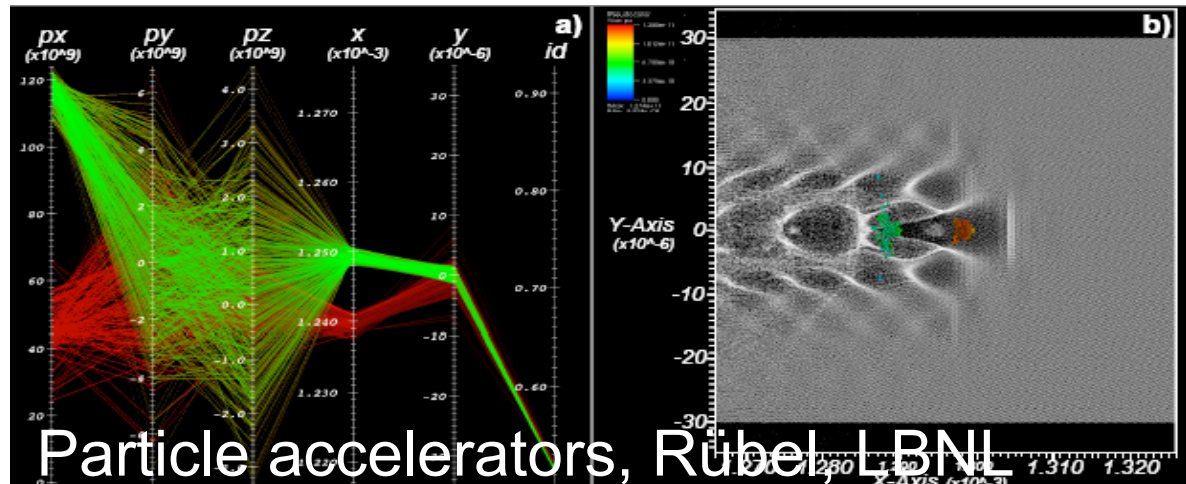
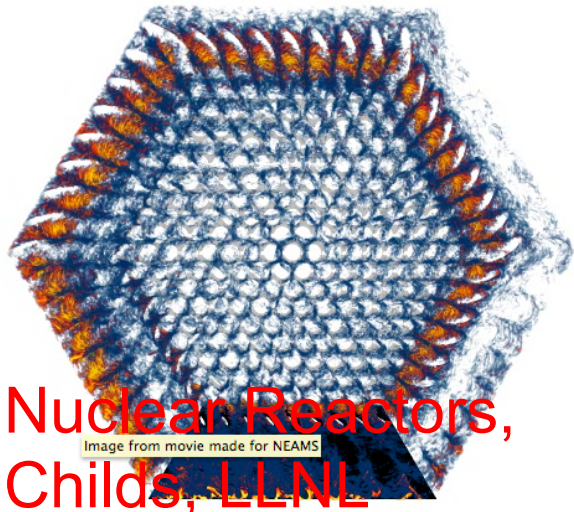
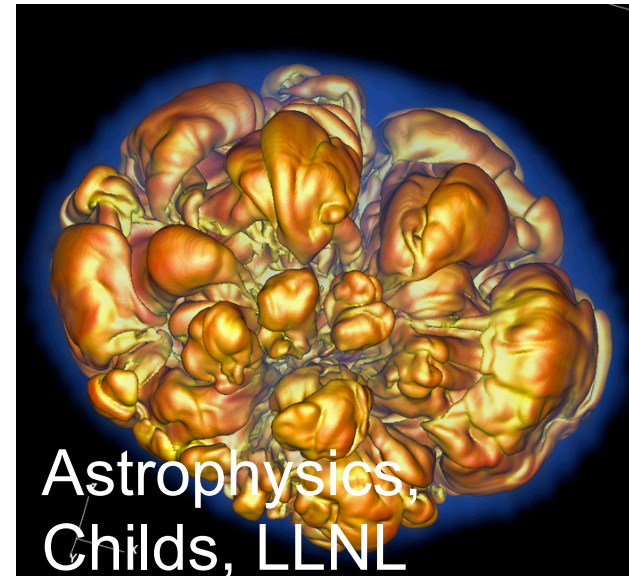
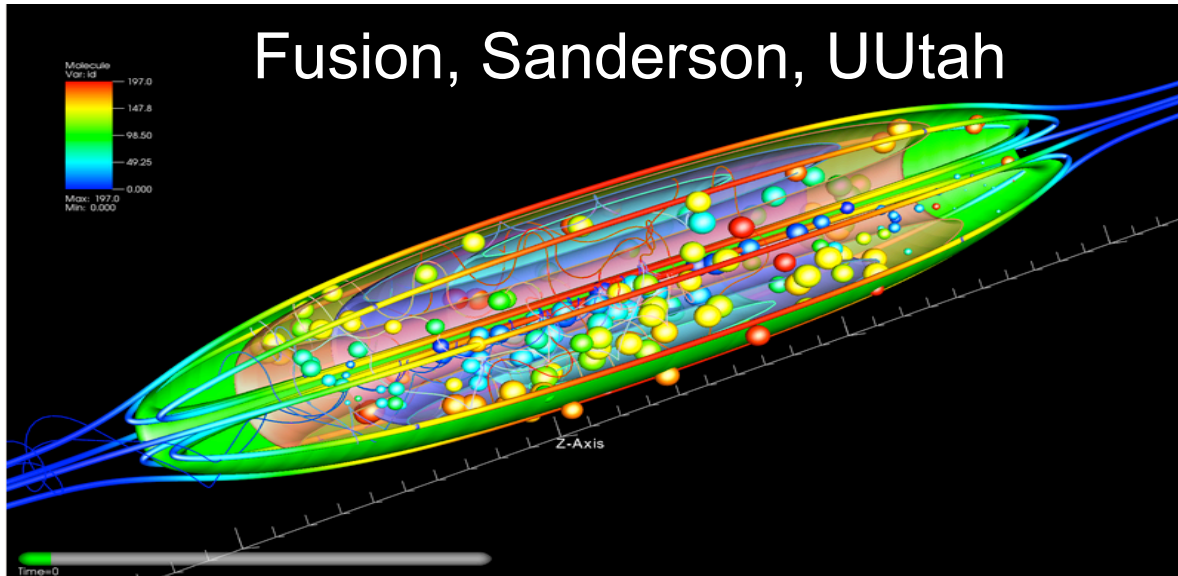


VisIt has a rich feature set.

- Meshes: rectilinear, curvilinear, unstructured, point, AMR
- Data: scalar, vector, tensor, material, species
- Dimension: 1D, 2D, 3D, time varying
- Rendering (~15): pseudocolor, volume rendering, hedgehogs, glyphs, mesh lines, etc...
- Data manipulation (~40): slicing, contouring, clipping, thresholding, restrict to box, reflect, project, revolve, ...
- File formats (~110)
- Derived quantities: >100 interoperable building blocks
 - +, -, *, /, gradient, mesh quality, if-then-else, and, or, not
- Many general features: position lights, make movie, etc
- Queries (~50): ways to pull out quantitative information, debugging, comparative analysis

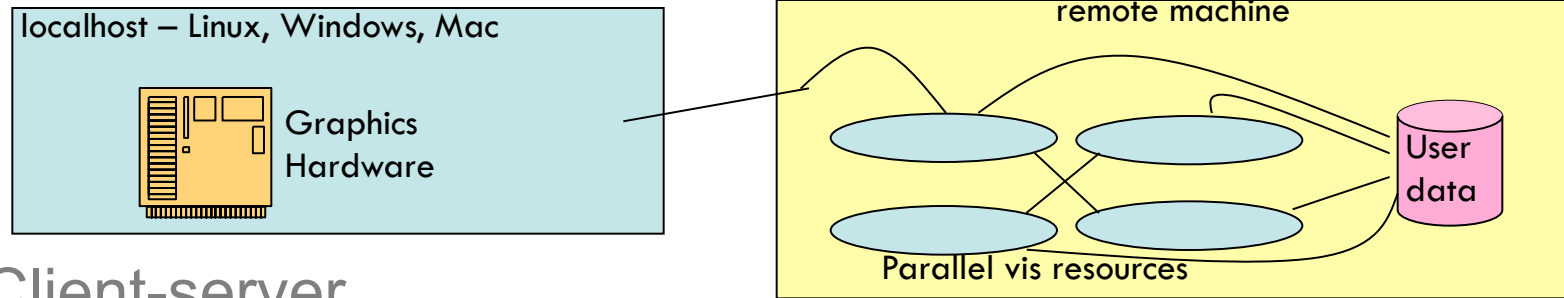
VisIt is used to look at lots of types of simulated and experimental data

Fusion, Sanderson, UUtah



Particle accelerators, Rubel, LBNL

VisIt employs a parallelized client-server architecture



- Client-server observations:

- Good for remote visualization
- Leverages available resources
- Scales well
- No need to move data

- Additional design considerations:

- Plugins
- Multiple UIs: GUI (Qt), CLI (Python), more...

You do not have to run VisIt this way!

You can run all on localhost

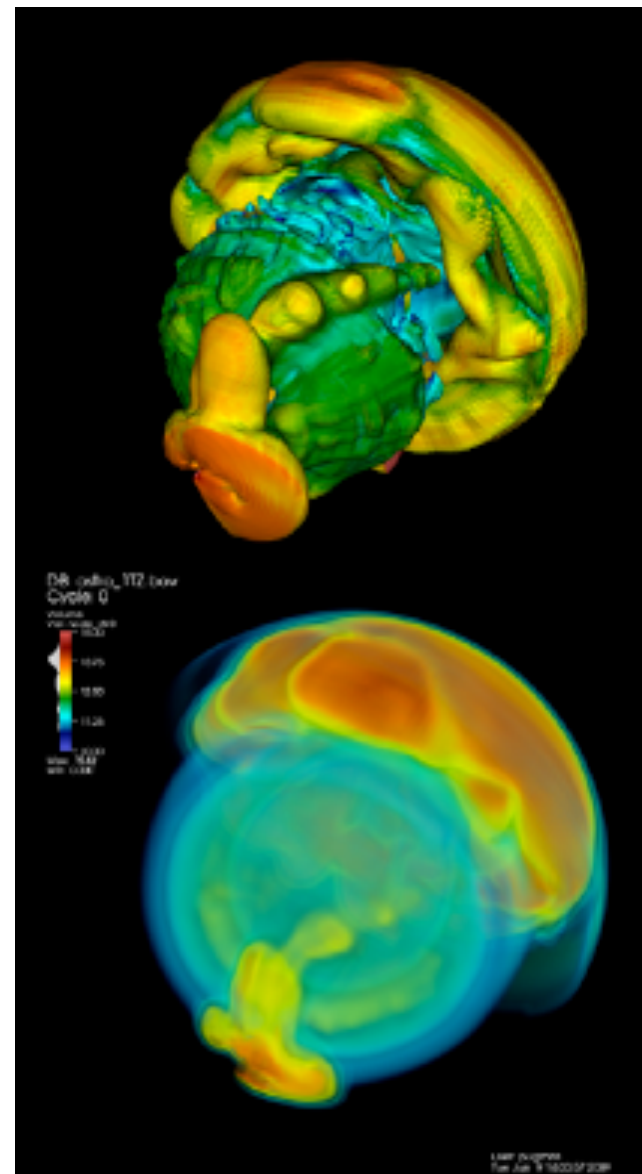
You can tunnel through ssh and run all on the remote machine

Visit recently demonstrated good performance at unprecedented scale.

- Weak scaling study: ~62.5M cells/core

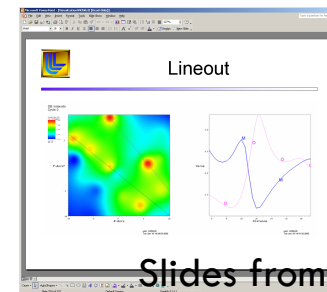
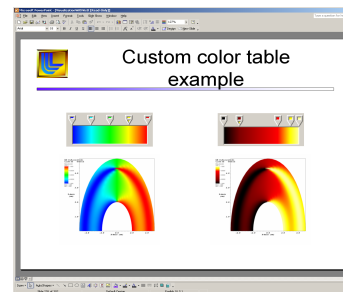
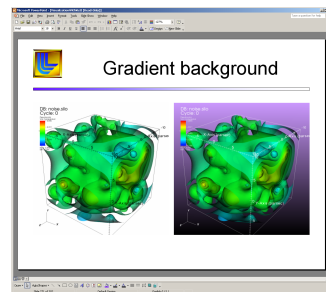
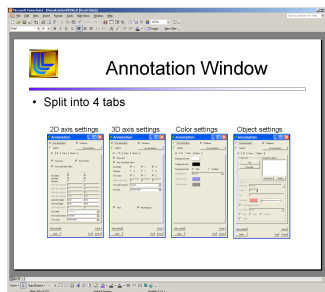
Machine	Model	Problem Size	#cores
Franklin	Cray XT4	1T, 2T	16K, 32K
Dawn	BG/P	4T	64K
JaguarPF	Cray XT5	2T	32K
Juno	X86_64	1T	16K
Purple	IBM P5	0.5T	8K
Ranger	Sun	1T	16K

Two trillion cell data set,
rendered in Visit by David
Pugmire on ORNL Jaguar
machine



The VisIt team focuses on making a robust, usable product for end users.

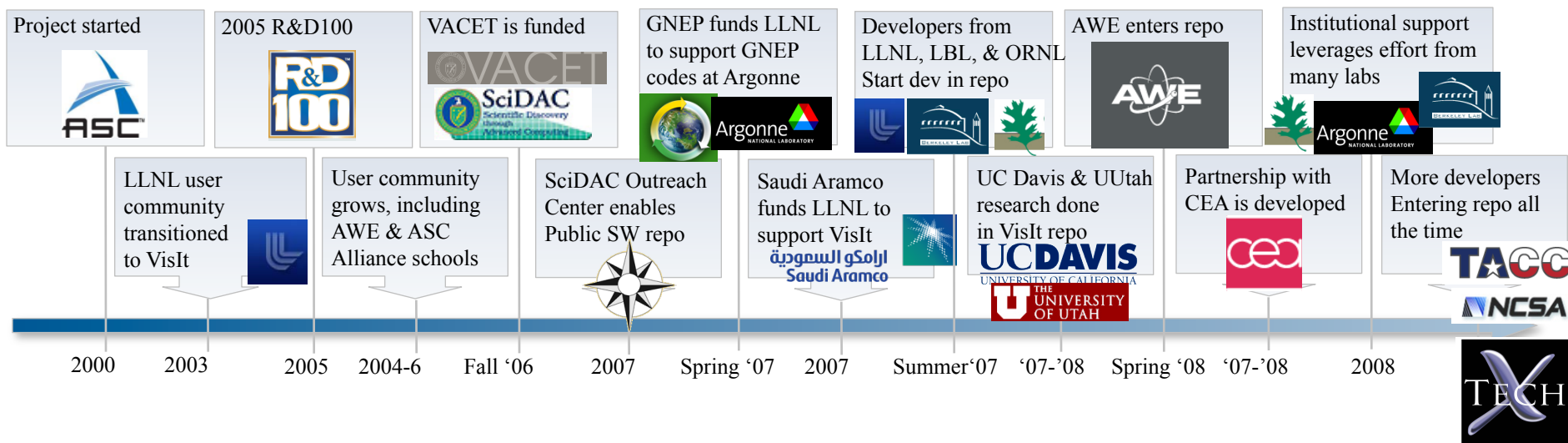
- Manuals
 - 300 page user manual
 - 200 page command line interface manual
 - “Getting your data into VisIt” manual
- Wiki for users (and developers)
- Revision control, nightly regression testing, etc
- Executables for all major platforms
- Day long class, complete with exercises



Slides from the VisIt class

VisIt is a vibrant project with many participants.

- Over 75 person-years of effort
- Over 1.5 million lines of code
- Partnership between: Department of Energy's Office of Science, National Nuclear Security Agency, and Office of Nuclear Energy, the National Science Foundation XD centers (Longhorn XD and RDAV), and more....



VisIt: What's the Big Deal?

- Everything works at scale
- Robust, usable tool
- Features that span the “power of visualization”:
 - Data exploration
 - Confirmation
 - Communication
- Features for different kinds of users:
 - Vis experts
 - Code developers
 - Code consumers
- Healthy future: vibrant developer and user communities

Summary

- VisIt is a richly featured visualization tool that is capable of visualizing data from many different application areas.
- VisIt has excellent built in support for large data sets.
- User resources:
 - Main website: <http://www.llnl.gov/visit>
 - Wiki: <http://www.visitusers.org>
 - Tutorial:
[http://www.visitusers.org/index.php?title=Short Tutorial](http://www.visitusers.org/index.php?title=Short_Tutorial)
 - General VisIt user email list: visitusers@ornl.gov