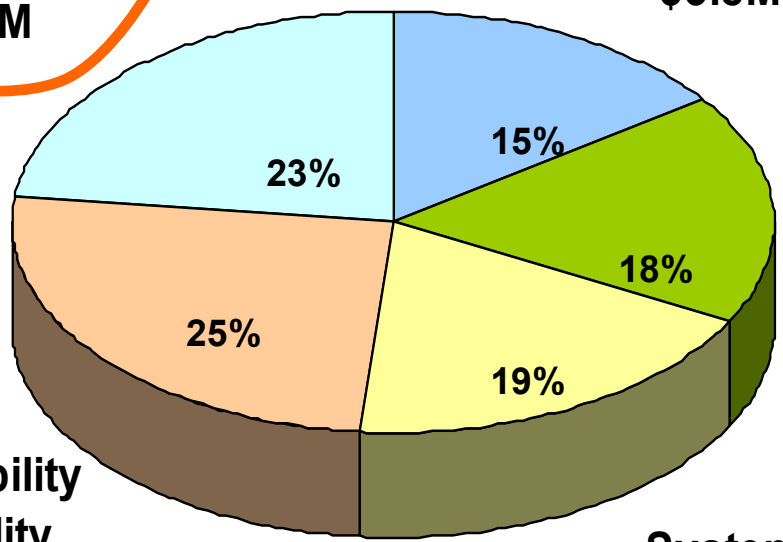
Visualization and Data Understanding

Visualization & Data Understanding $5.8M

Programming Models & Runtime $3.8M



Performance Evaluation & Optimization $4.5M

Interoperability & Portability Tools $6.5M

System Software Environment $4.7M

Visualization and Data Understanding Foci

R&D Goals:

- Data representation, exploration, and understanding for terabyte datasets
- New ways to interact with data and experiments
- Active spaces, remote collaboration and remote visualization

Methodology:

- Fund laboratory-academic collaborations, to the extent possible

Outside program scope (mostly):

- Scalable rendering
- Infrastructure and support

Scientific Data Management ISIC

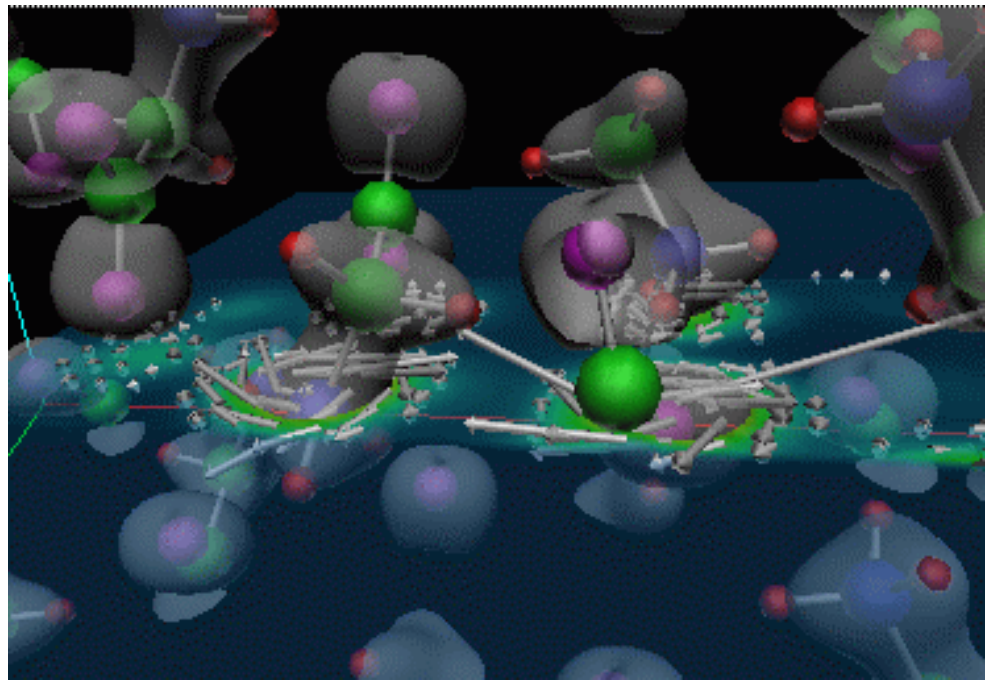
- **The SDM ISIC is doing research in 4 areas of Scientific Data Management**
  - **Parallel and Grid I/O infrastructure**
  - **Exploratory Analysis and Data Mining**
  - **Distributed Heterogeneous Data Integration**
  - **Efficient Processing and Analysis of Very Large Datasets**
- **This ISIC is having a large impact in a number of applications areas, especially high-energy physics**

Base Research in SDM

- Arie Shoshani's group at LBL
  - Focus is fast algorithms and design of SDM databases
  - Large impact in HENP
  - Potential strong coupling to biology starting to be explored
- Related project in feature extraction
  - LBL project in image processing (Parvin)
  - Incipient projects at other labs

Role of Visualization in Science

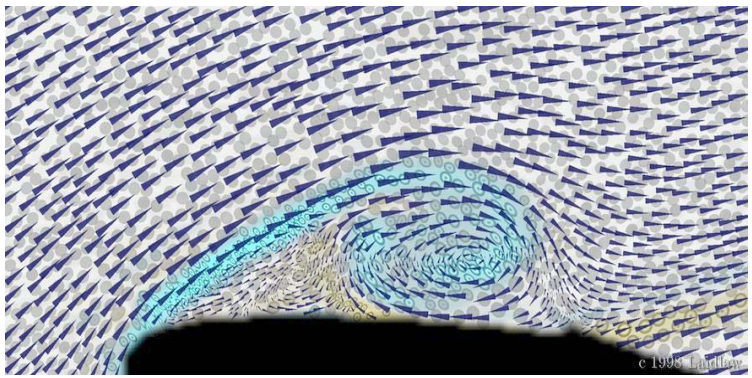
- Visualization provides the means to "see" data in order to create the opportunity for scientific insight. Data is often abstract, dimensionless, and unfamiliar
- Rapid exploration of large and complex data sets. Find "interesting things," serendipitous browsing, "Ah-Ha!" and "Uh, what's that?" discoveries
- Communicate findings to colleagues, funders and the public



Something doesn't "look right" in this picture – what happened?

Data representation, user interfaces

As R.W. Hamming noted, "the purpose of computing is insight, not numbers"



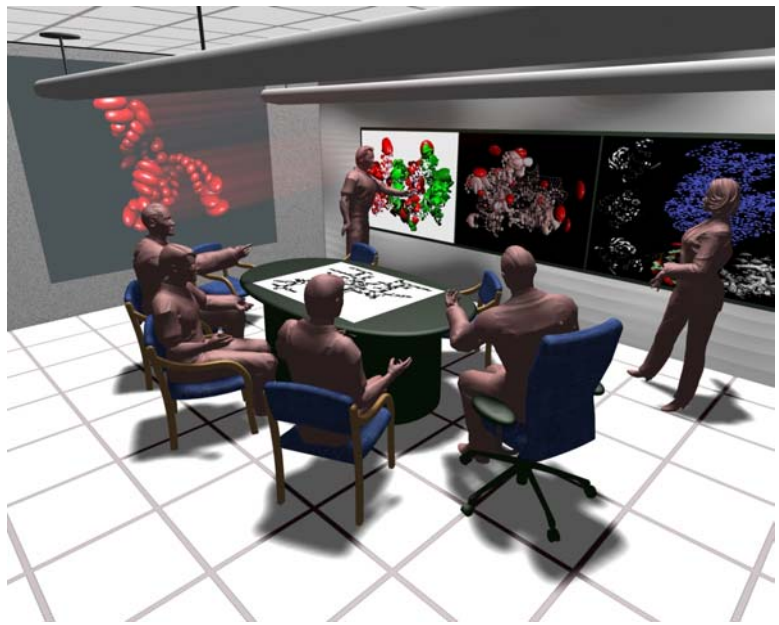
New visualization techniques are needed to glean maximum insight from simulations and experiments

A collaborative project between Brown University and PNNL in immersive visualization for microbial cell biology was just funded.

Active Collaborative Spaces

"Active Space" is a rubric for a set of technologies including:

- Transparent wireless migration of data, images, and video between laptops, PDAs, active tables and walls (video surfaces you can write on)
- Electronic notebooks and data annotation schemes
- Telepresent access to remote participants and facilities



Active Collaborative Spaces (cont.)

It is apparent that:

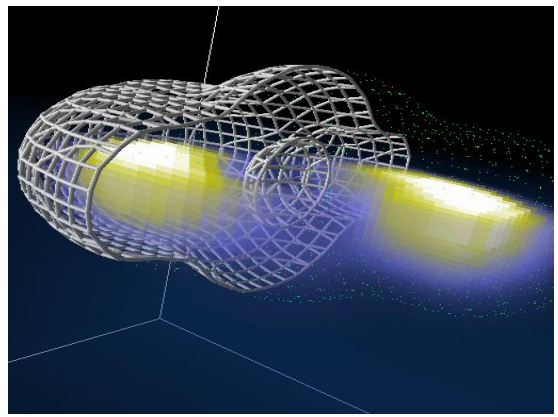
- Science is intrinsically collaborative
- Science is distributed, with both facilities and researchers geographically spread out

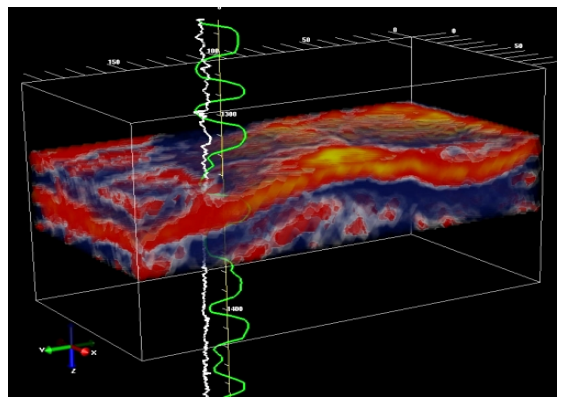
We believe that:

- Emerging electronic infrastructure can amplify the efforts of scientists and make distance interactions as productive as current face-to-face meetings

Visualization in SciDAC

- Visualization is an integral part of many SciDAC projects -- but there's no SciDAC funding of Graphics/Visualization per se
- Salt Lake City workshop on SciDAC Visualization:
  - the state of the art in scientific visualization
  - general visualization issues across application domains
  - what are the over-arching issues that might make sense in an ISIC?

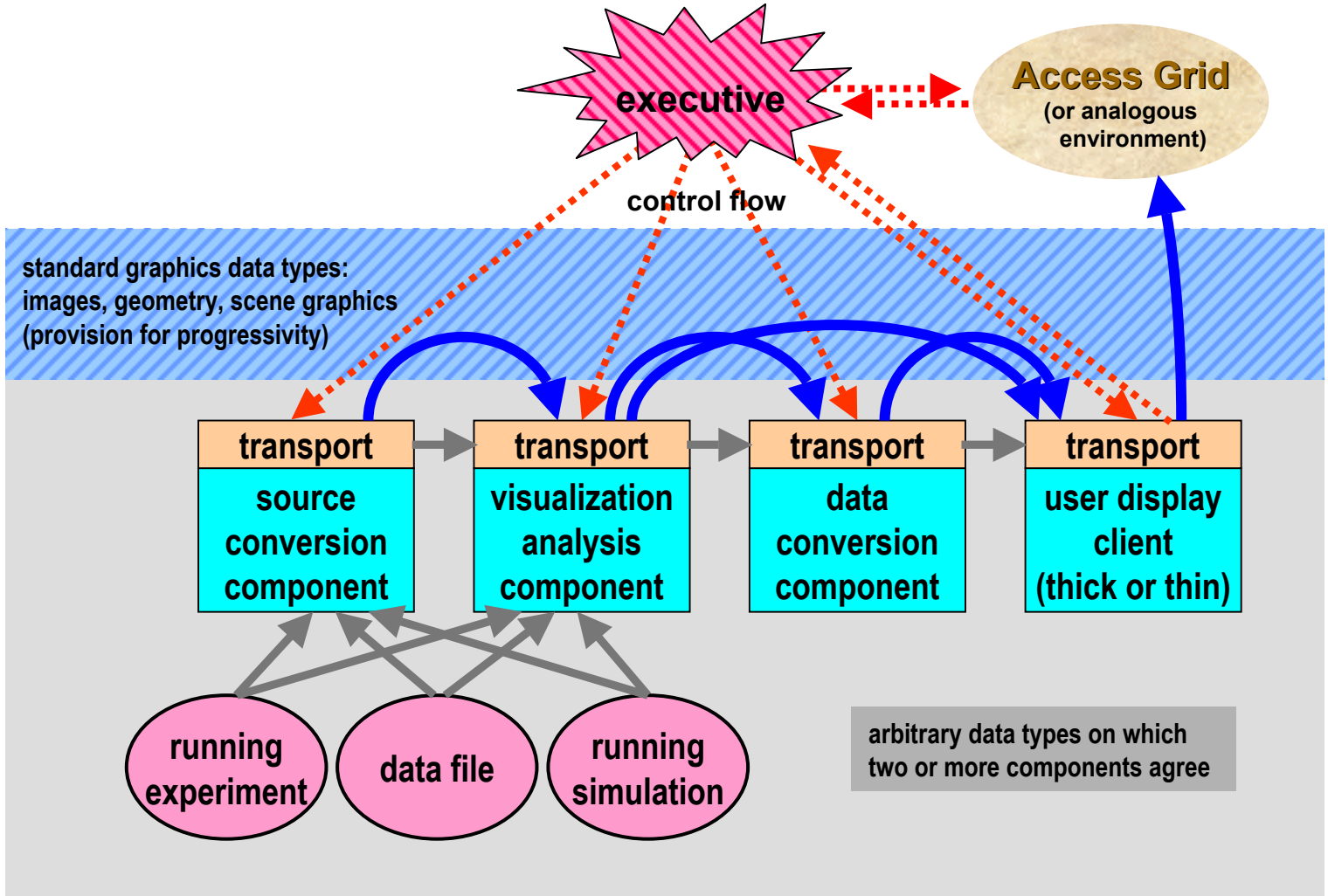




Program Strengths and Weaknesses

- **Strengths:**
  - Very strong research community driven by applications needs
  - Important applications drivers
- **Weaknesses**
  - Orthogonal or uncoupled efforts between labs and academic partners
  - Inadequate resources to make significant progress

Emerging plan to create a DOE-wide SW framework (probably CCA-based) for visualization research …

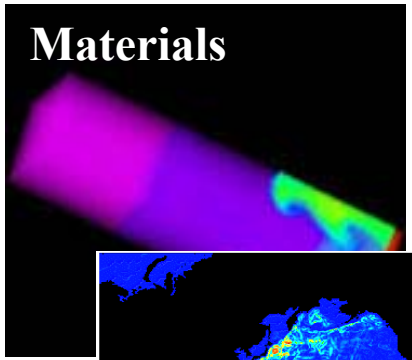


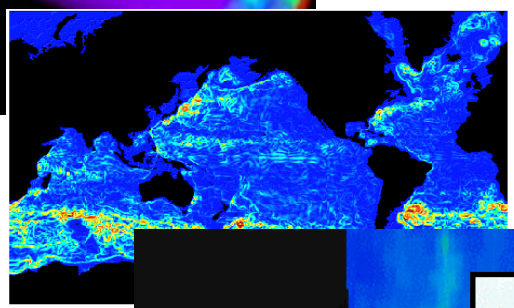
Hardware for Visualization Research

- **Scalable Rendering has become <u>much</u> cheaper than it used to be:**
  - **Chromium software (from Stanford with ASCI funding) allows Linux clusters to replace high-end SGI machines**
  - **HP Sepia promises to be even better**
- **Even so, vis./graphics research cannot be done without appropriate research infrastructure**
- **DOE labs have large unmet needs for research (as opposed to production) hardware for Graphics/Vis:**
  - **ANL, ORNL, LBL, LLNL, ORNL, PNNL, …**

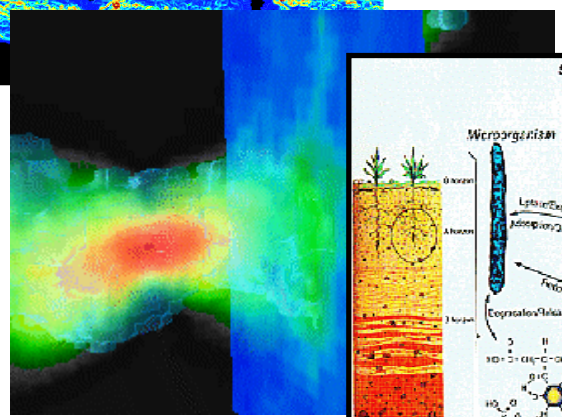
Impact of Scientific Visualization

Visualization can have a huge impact across the entire Office of Science mission

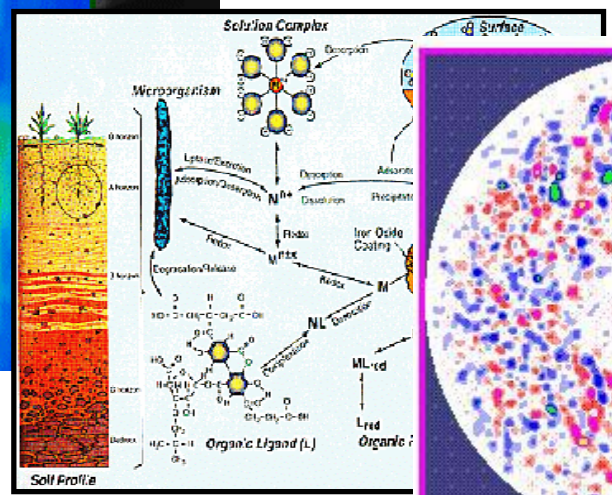




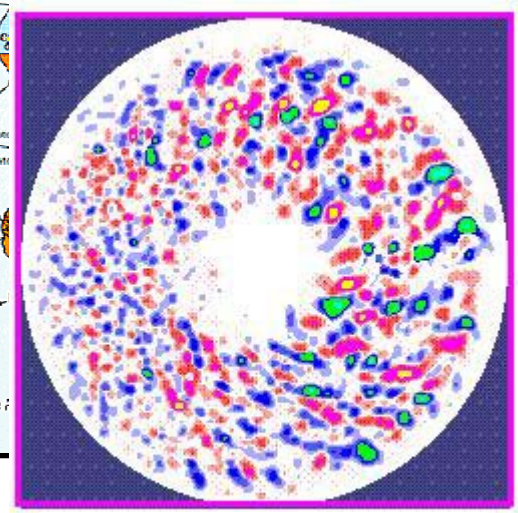
Global Climate



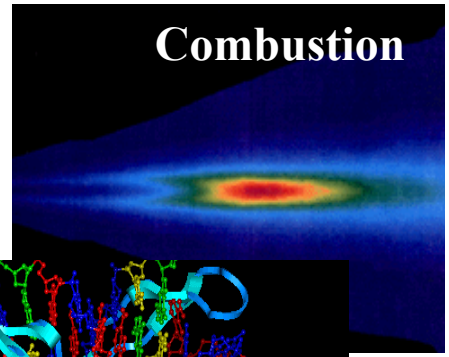
Components of Matter

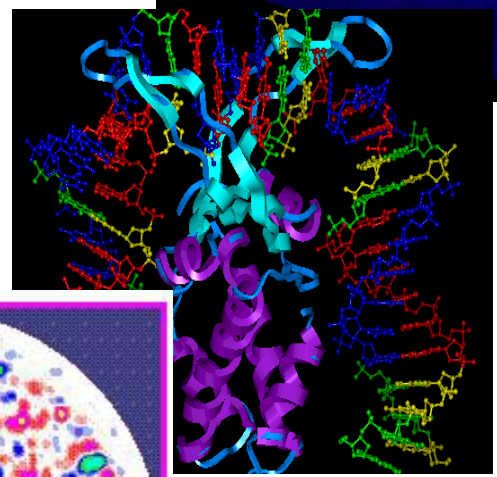


Subsurface Transport



Fusion Energy





Health Effects, Bioremediation