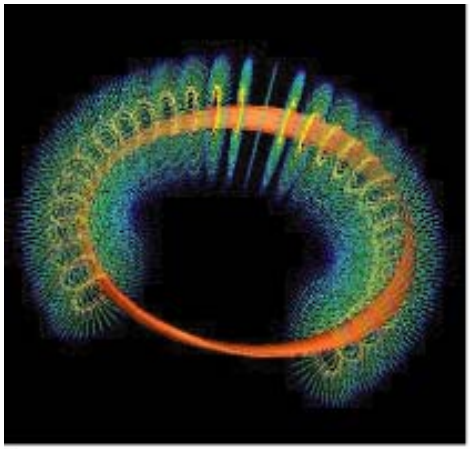

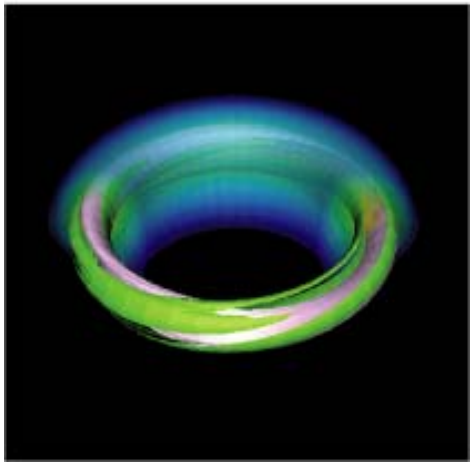

THE NATIONAL FUSION COLLABORATORY

Presented by

Martin Greenwald

ESSC – March 19, 2003

http://www.fusiongrid.org

FusionGRID
www.fusiongrid.org

Nature of Fusion Research Drives Requirements for Computing and Networking

- Experiments
  - Characterized by near real-time interactions of large, extended teams
  - Faster between-pulse analysis translates directly to productivity
  - Barriers to use of powerful analysis tools can be significant
- Theory and Computation
  - Simulations producing very large data sets (GB $\Rightarrow$ TB $\Rightarrow$ PB)
  - Interactive visualization and analysis present a severe challenge for computing and networking
  - Increased code sharing and collaborative development

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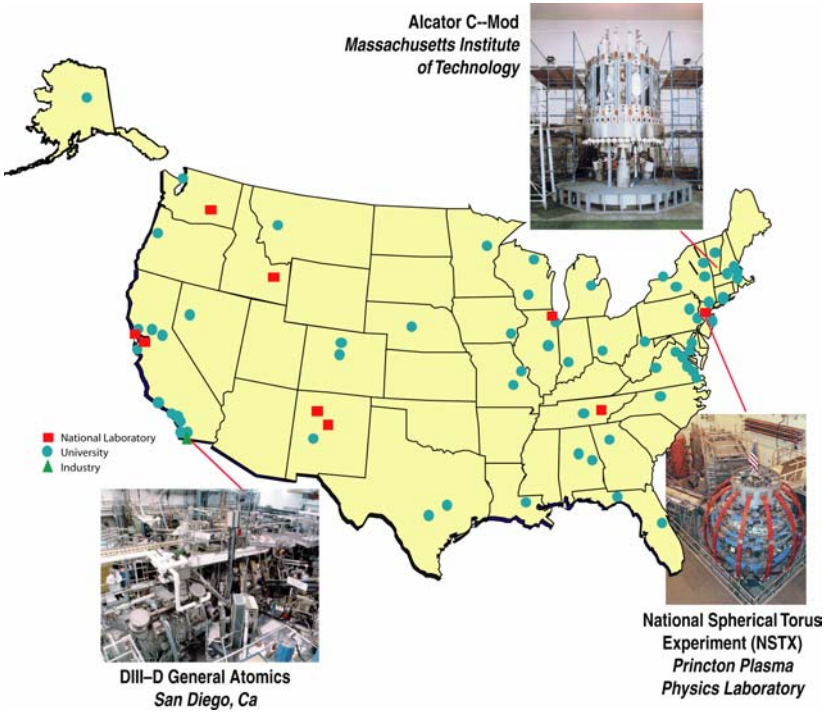
Collaborations in the Fusion Program

Collaboratory is required to advance fusion science: geographically diverse community



- 3 Large experimental facilities (4th under construction)
- > 40 U.S. fusion research sites in 37 states - Over 1500 scientists
- Significant International collaborations

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Collaboratory's Goal is to Advance Scientific Understanding & Innovation in Fusion Research

- Enable more efficient use of experimental facilities through more powerful between pulse data analysis
- Allowing transparent access to analysis and simulation codes, data, and visualization tools, resulting in more researchers having having access to more resources
- Enable more effective integration of experiment, theory, & modeling
- Facilitate multi–institution collaborations
- Create a standard tool set for data access, security, and vis allowing researchers to build these into their own applications

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Vision for the Fusion Collaboratory

- Data, Codes, Analysis Routines, Visualization Tools should be thought of as network accessible services.
- Shared security infrastructure.
- Collaborative nature of research requires shared visualization applications and widely deployed A/V technologies

- We are not focused on CPU cycle scavenging or “distributed” supercomputing (typical GRID justifications)
  - **Optimize the most expensive resource - people’s time**

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Vision – Resources as Services

- Access is stressed rather than portability
- Users are shielded from implementation details.
- Transparency and ease-of-use are crucial elements
- Shared toolset enables collaboration between sites and across sub-disciplines.
- Knowledge of relevant physics is still required of course.

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Vision – Security Infrastructure

- Strong authentication identifies users (currently based on x.509 certificates from DOE Science Grid).

- Distributed authorization allows stakeholders to control their own resources.
  - Facility owners can protect computers, data and experiments
  - Code developers can control intellectual property
  - Fair use of shared resources can be demonstrated and controlled.

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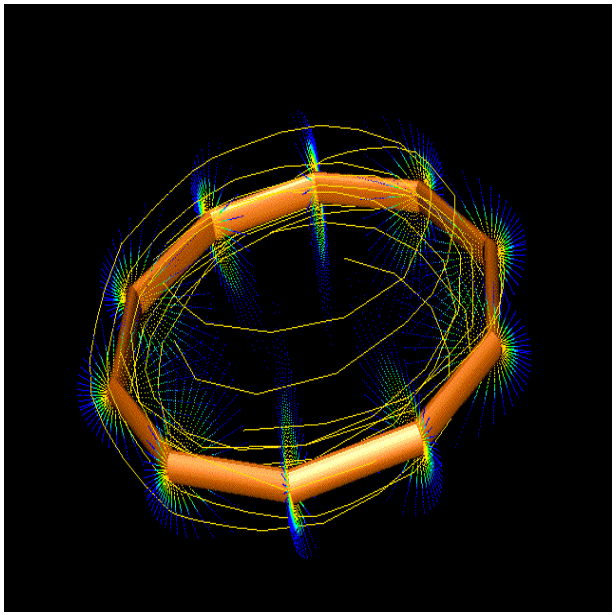
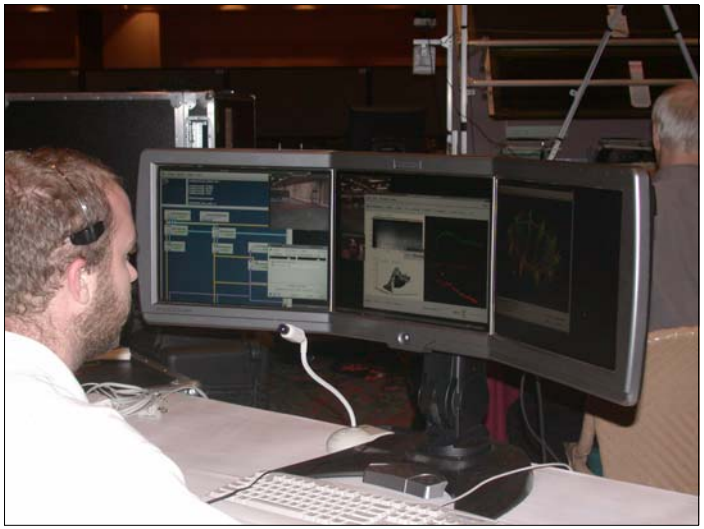
Vision – Visualization and A/V Tools

- Maximum interactivity for visualization of very large data sets





- Use of extended tool sets for remote participation
  - Flexible audio and video links
  - Shared applications

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Who is Working on the Collaboratory?

- **Fusion Labs**
  - General Atomics
  - MIT – Plasma Science & Fusion Center
  - Princeton Plasma Physics Laboratory

- **Computer Science Labs**
  - Argonne National Laboratory
  - Lawrence Berkeley National Laboratory
  - Princeton University
  - University of Utah

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Input from Fusion Science Programs is Actively Sought

- Presence at scientific meetings in Apr. 02 and APS-DPP in Nov. 03
  - Both the experimental and theoretical user community
  - First of their kind demonstrations at these meetings
- Demonstrations to the large experimental teams
  - Shared visualization ANL to San Diego and PCS to PPPL
- Comments and discussions with Oversight Committee
  - Represents broad cross–section of fusion community

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NFC Tools and Technologies

- Secure MDSplus using Globus GSI available
  - Authentication and Authorization using DOE CA/ AKENTI
- TRANSP code - worldwide production usage on FusionGrid
  - GRAM, Beowulf cluster, client applications, complete job monitoring
- Personal Access Grid (PIG) software and specifications available - Installed at MIT and GA; PPPL has large AG node
- SCIRun for 3D visualization including MDSplus stored data
- Toolkits for sharing visualization wall to wall and on AG
  - Tiled walls at GA and PPPL

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MDSplus – Data Standard for the Fusion Grid

- MDSplus is a set of software tools for data acquisition and storage and a methodology for management of complex scientific data. http://www.mdsplus.org
- Developed by MIT, LANL, IGI (Padua)
- **"Service"** rather than file oriented
- Hierarchical, self-descriptive, extensible, scalable, simple but powerful API
- Remote access based on client-server model - MDSIP (RPC)
- Servers at about 30 fusion sites – mostly experiments

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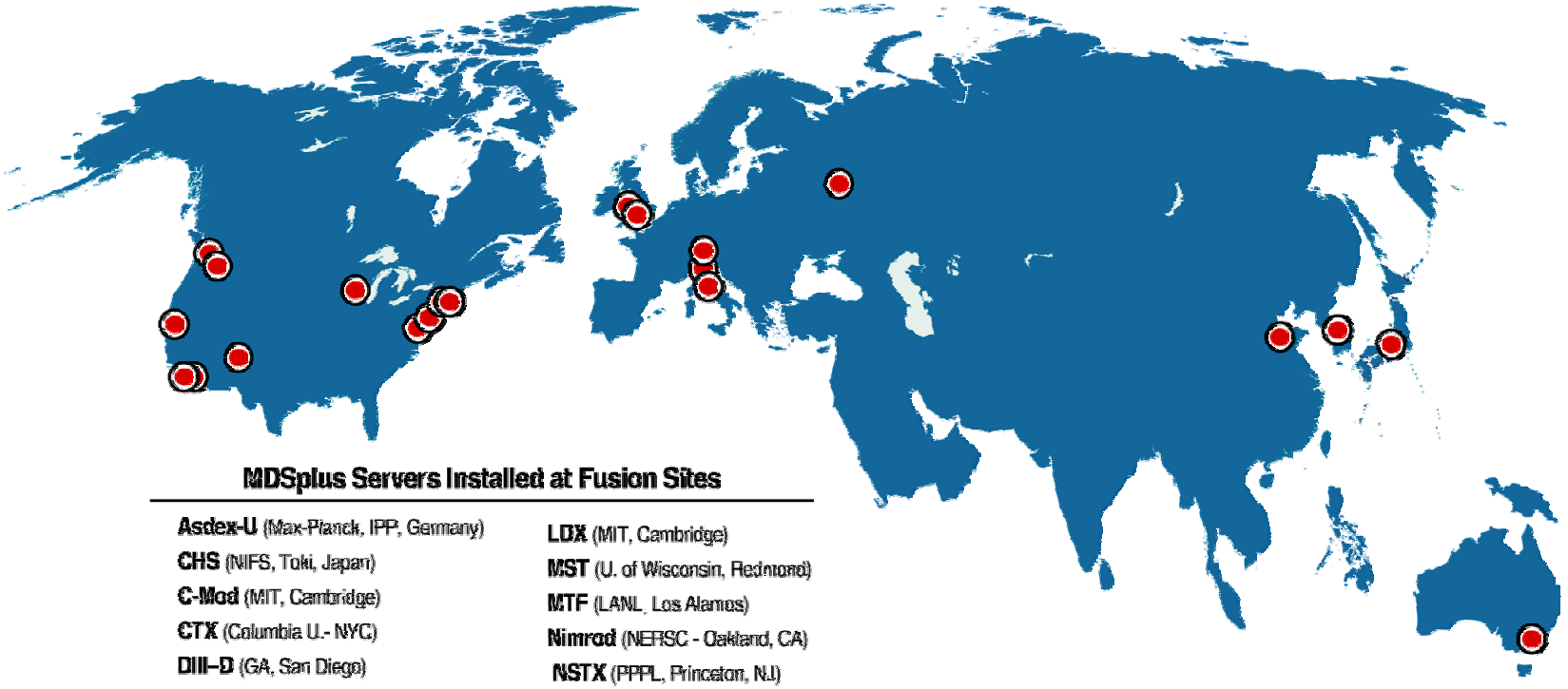
MDSplus is Widely used in the Fusion Community



MDSplus Servers Installed at Fusion Sites

Asdex-U (Max-Planck, IPP, Germany)
CHS (NIFS, Toki, Japan)
C-Mod (MIT, Cambridge)
CTX (Columbia U.- NYC)
DIII-D (GA, San Diego)
FRX-L (LANL, Los Alamos)
FTU (Frascati, Italy)
gs2 (U. Md. - College Park, Md)
HT (ANU, Canberra, Australia)
LDX (MIT, Cambridge)
MST (U. of Wisconsin, Redmond)
MTF (LANL, Los Alamos)
Nimrod (NERSC - Oakland, CA)
NSTX (PPPL, Princeton, NJ)
PISCES (UCSD, San Diego)
RFX (IGI, Padua, Italy)
T-10 (Kurchatov, Moscow, Russia)
TCS (U. of Washington, Seattle)

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