The National Fusion Collaboratory Project
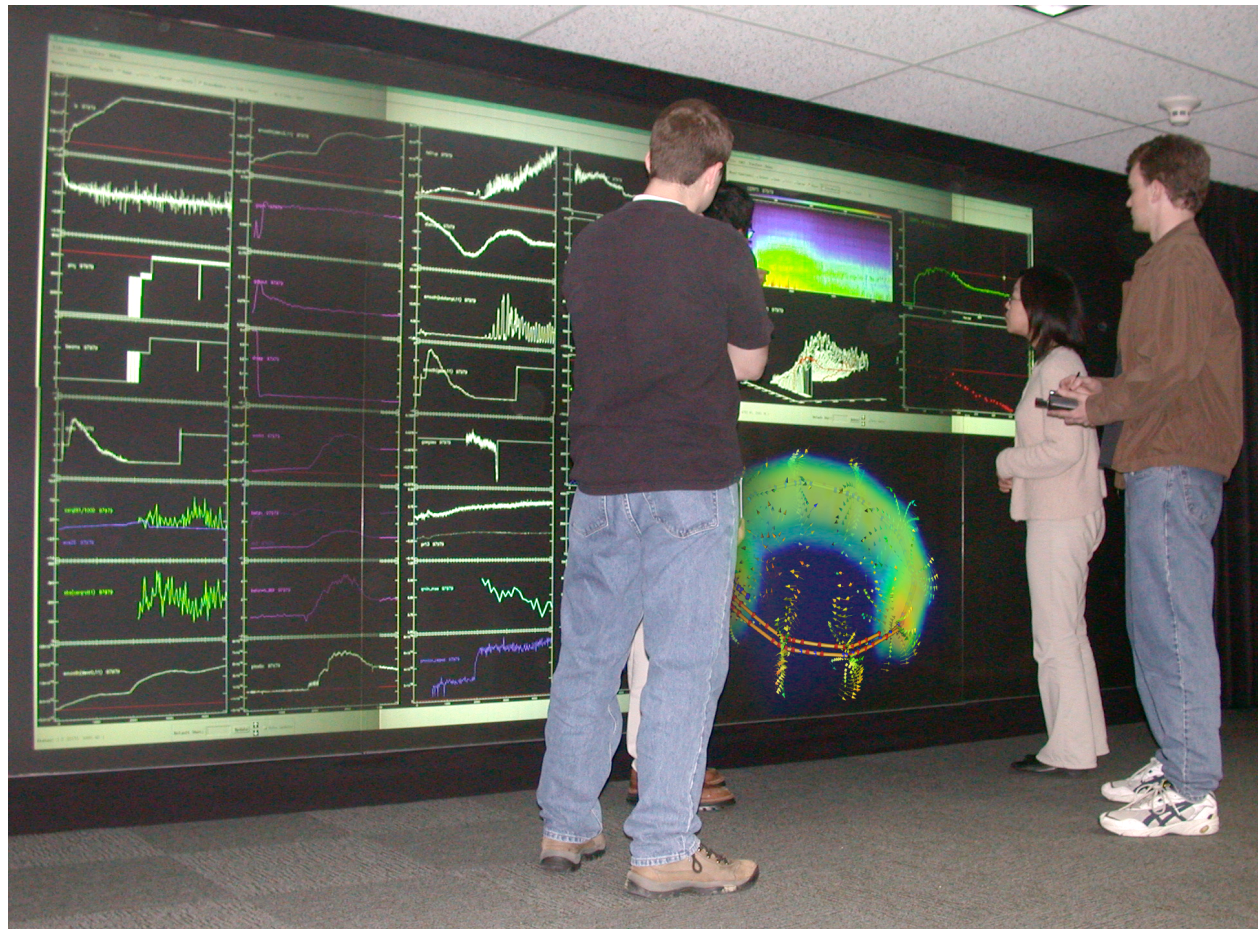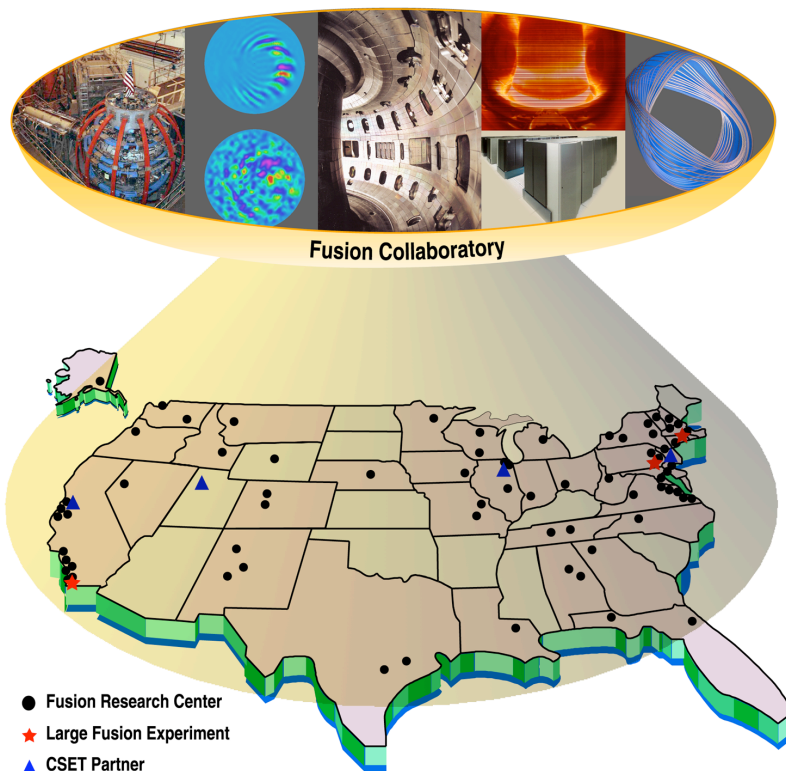

Presented by
David P. Schissel

at
The PSACI PAC
June 5-6, 2003
Princeton, NJ

THE GOAL OF THE NFC IS TO ADVANCE SCIENTIFIC UNDERSTANDING & INNOVATION IN FUSION RESEARCH

Fusion Collaboratory

- Fusion Research Center
- Large Fusion Experiment
- CSET Partner

- **Experimental Facilities**
  - — **More efficient use resulting in greater progress with less cost**

- **Theory & Modeling**
  - — **Integrate theory & experiment**

- **Facilitate multi-institution collaboration**
  - — **Integrate geographically diverse groups**

- **Create standard tool set**
  - — **To build in these services in the future**

FusionGRID
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VISION FOR THE FUSION GRID

- **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 collaboration technologies**
  - Integrate geographically diverse groups

- **Not focused on CPU cycle scavenging or "distributed" supercomputing (typical Grid justifications)**
  - Optimize the most expensive resource - people's time

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

VISION – SECURITY INFRASTRUCTURE

- **Strong authentication identifies users**

- **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 & controlled

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VISION – VISUALIZATION AND A/V TOOLS

- **Maximum interactivity for visualization of very large datasets**
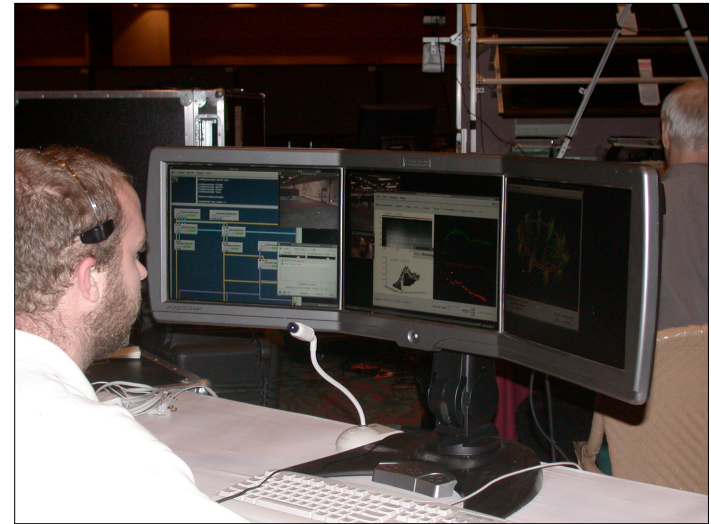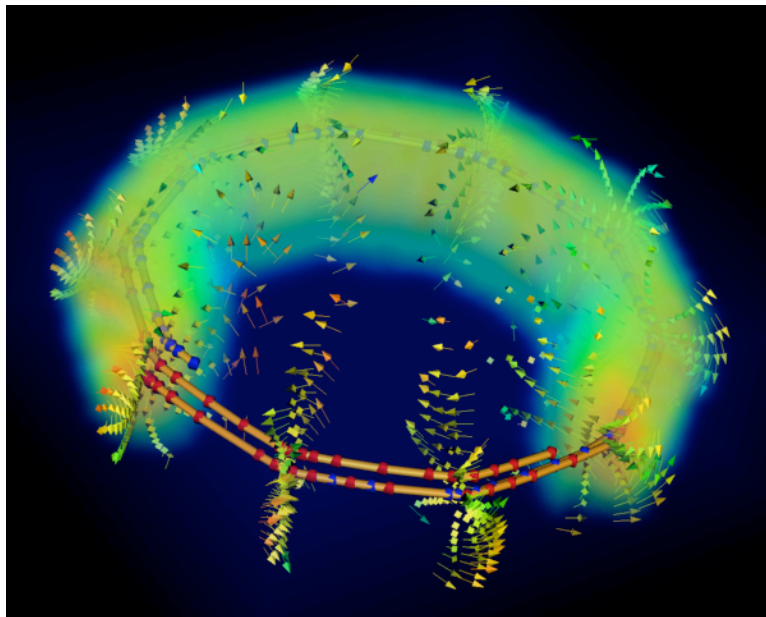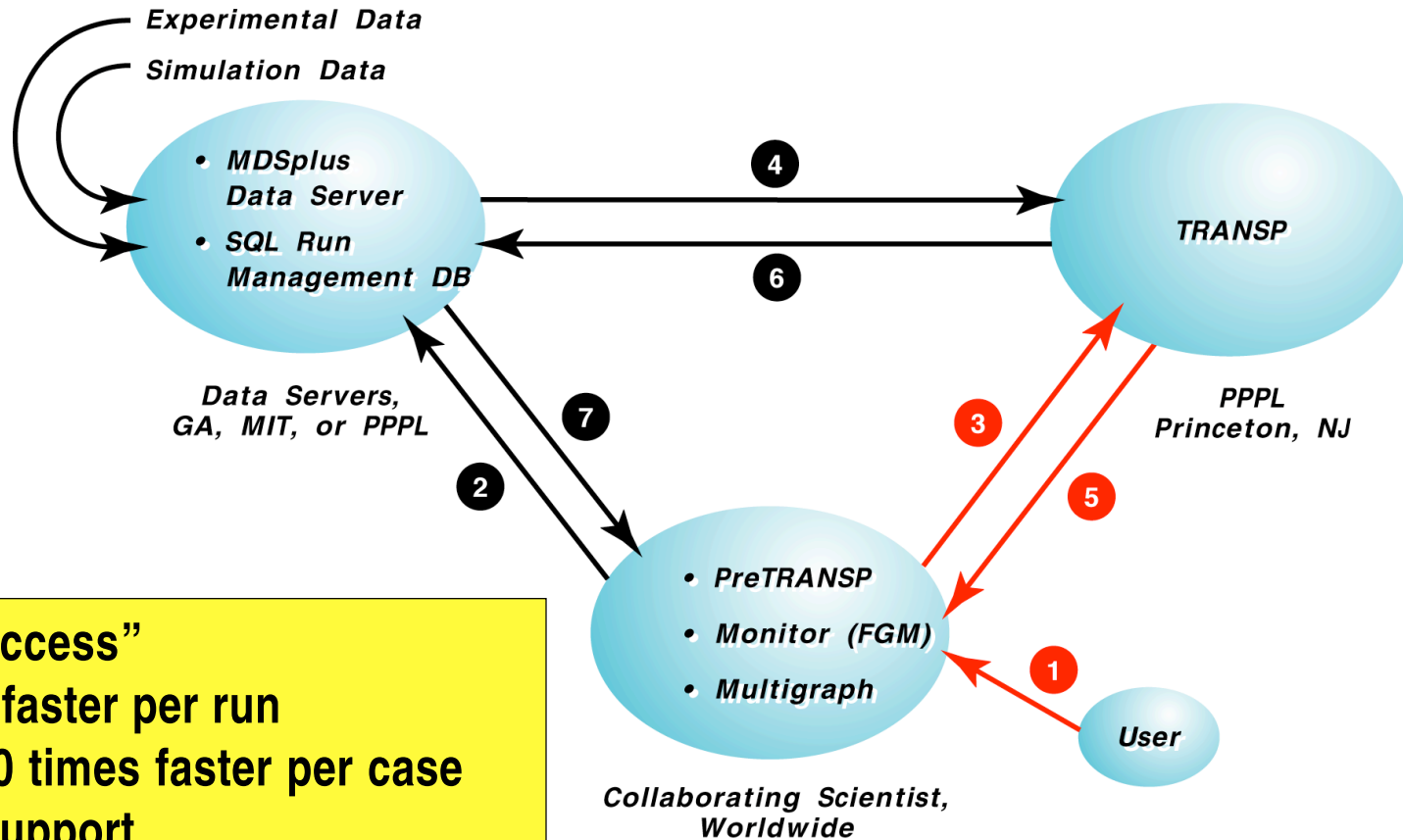

- **Use of extended tool sets for remote collaboration**
  - Flexible collaboration environment
  - Shared applications

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FEEDBACK FROM THE PSACI PAC JUNE 2002

"The PAC was impressed with the illustrative demonstrations of advanced collaboratory software tools to various fusion theoretical and experimental groups and the effective solicitation and use of the feedback received. There's also been a very effective engagement with OSCAR SciDAC groups to bring advanced network and visualization software tools into the fusion program to facilitate nationally distributed computing using the MDSplus framework. We endorse early deployment of these tools."

SUCCESSFUL GRID COMPUTING FOR FUSION SCIENCE

Experimental Data

Simulation Data

- MDSplus Data Server
- SQL Run Management DB

4

6

TRANSP

Data Servers, GA, MIT, or PPPL

7

2

PPPL
Princeton, NJ

3

5

- PreTRANSP
- Monitor (FGM)
- Multigraph

1

User

Collaborating Scientist, Worldwide

"This is a success"
- 4 times faster per run
- Up to 20 times faster per case
- Better support

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NFC ACCOMPLISHMENTS: REMOTE COMPUTING

- **FusionGrid created: MDSplus data system secured with Globus GSI**

- **FusionGrid released with complete monitoring: TRANSP fusion code remotely accessible via Globus/Akenti and fine-grain authorization via GRAM**
  - **FusionGrid replaced old system, now supports U.S. TRANSP usage**
  - **Sample statistics through March 2003: 755 runs, 4657 CPU hours**

- **Large demonstrations to the user community at 3 major fusion science meetings**
  - **Both user education and user feedback to the NFC team**

- **FusionGrid used for scientific calculations presented at the APS/DPP Mtg**
  - **Advancing the science**

- **Prototyped: between pulse pre-emptive scheduling, parallel MDSplus I/O**

- **GS2 low-frequency turbulence code being tested on FusionGrid**
  - **Considerably less time to grid-enable the second code**
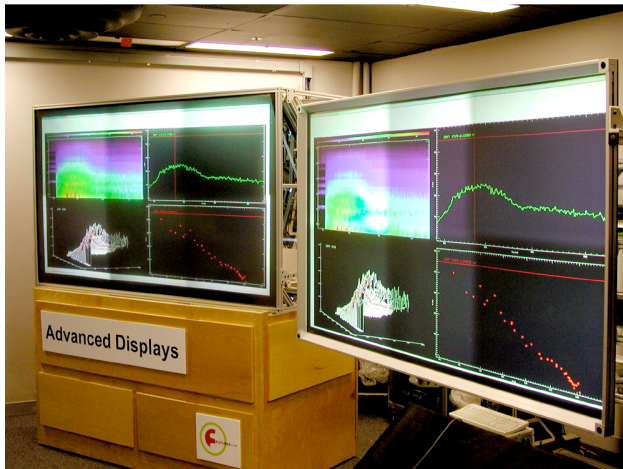
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SUCCESSFUL EDUCATION AND FEEDBACK ON POTENTIAL VISUALIZATION CAPABLITIES FOR FUSION SCIENCE
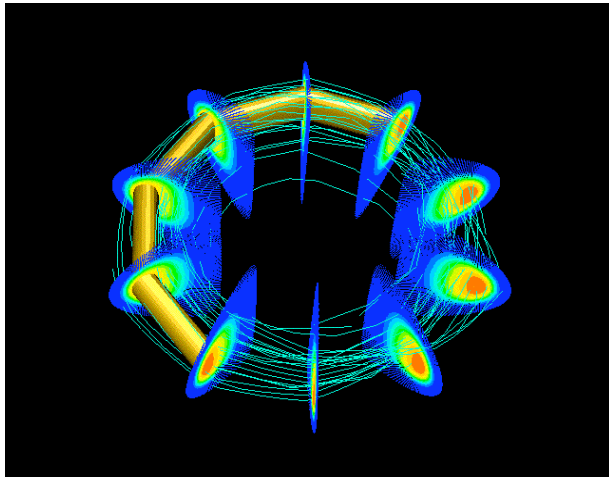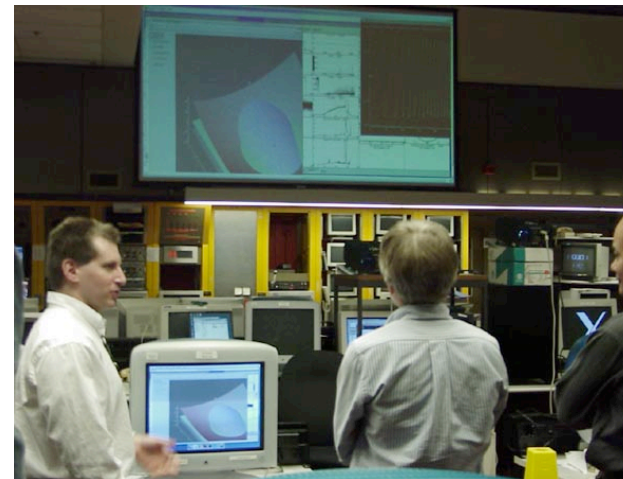

SCIRun visualization of NIMROD Data


Personal Access Grid

Shared Tiled Walls at ANL

Testing Tiled Wall at NSTX Control Room

NFC ACCOMPLISHMENTS: VISUALIZATION

- **SCIRun 3D visualization of NIMROD fusion data via MDSplus**
  - New capability in 3D visualization & animation via MDSplus data

- **SCIRun visualizations used for scientific work presented at APS/DPP**
  - Advancing the science

- **Access Grid functional on Tiled Wall as well as small scale system (PIG)**
  - Allows investigation of diverse AG usage in fusion science

- **Collaborative Visualization: Wall to wall/workstation (VNC, DMX), ELVis**
  - Detailed analysis back into the control room
  - Collaborative working meetings

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NFC TOOLS USED TO CALCULATE AND PRESENT SCIENTIFIC RESULTS AT THE APS/DPP MEETING

M. Murakami 2002 APS/DPP

D. Brennan 2002 APS/DPP
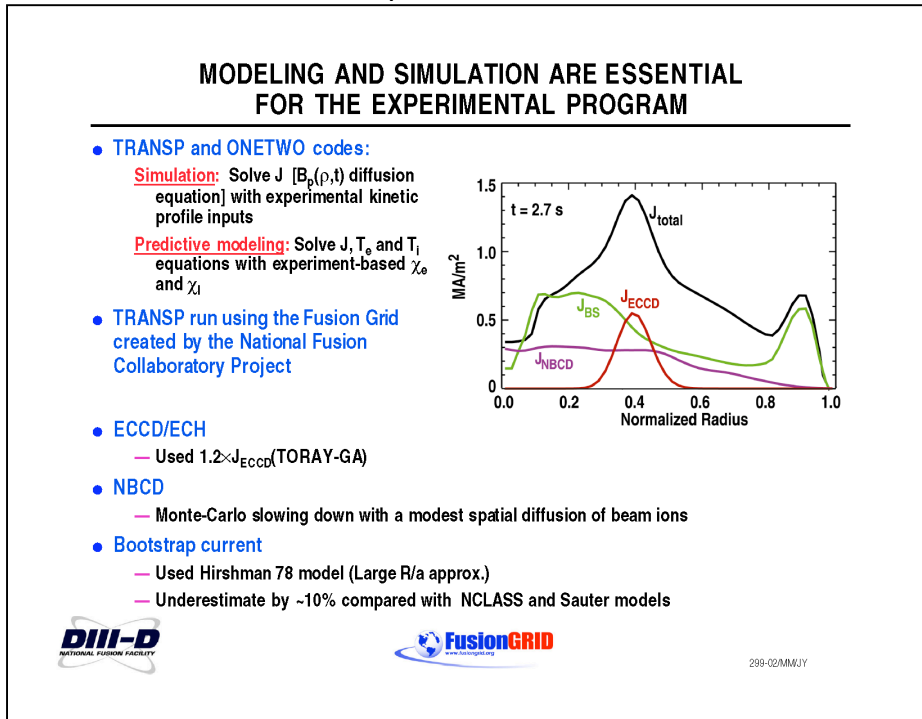
Greater number of TRANSP calculations than previously possible via FusionGrid
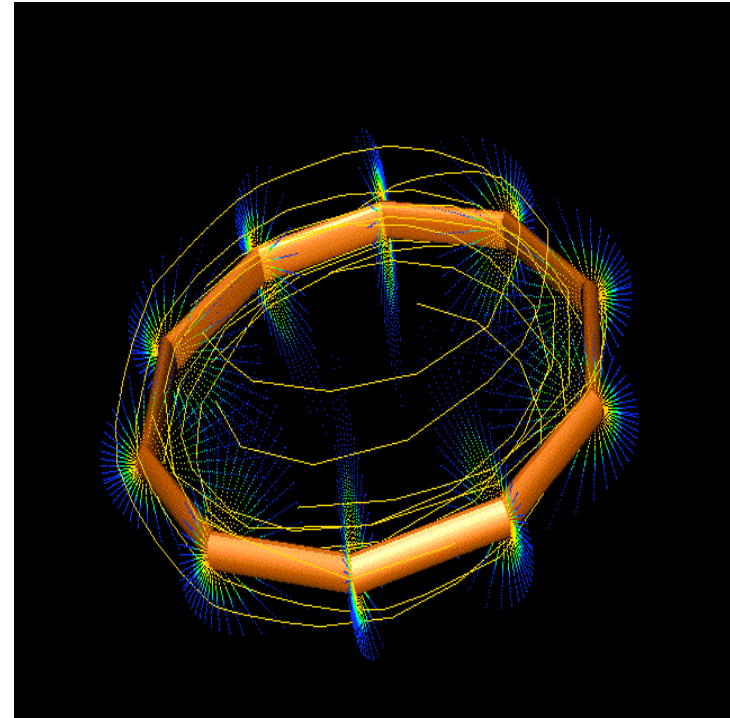
New capability in 3D visualization & animation via MDSplus stored data

MAJOR DEMONSTRATION AT THE 2002 APS/DPP MEETING

"Demonstrations have been of great educational value but for the next year move towards tutorials on services." – NFC Oversight Committee 11/02

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THE NFC PROJECT IS INTEGRATING BASIC COMPUTER SCIENCE RESEARCH WITH DEPLOYMENT TO THE END USER
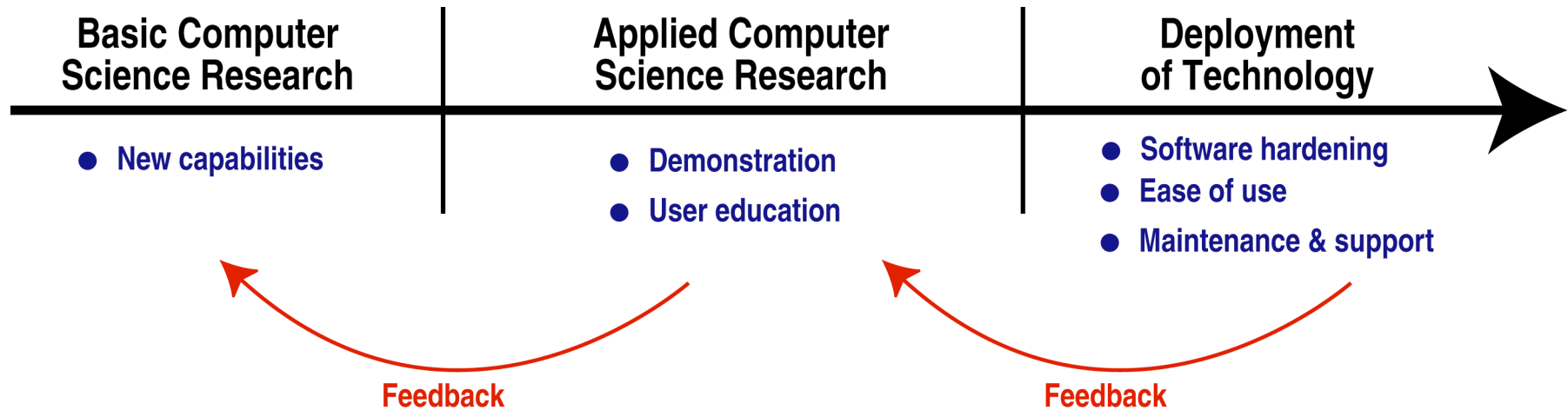
Basic Computer Science Research

Applied Computer Science Research

Deployment of Technology

- New capabilities

- Demonstration
- User education

- Software hardening
- Ease of use
- Maintenance & support

Feedback

Feedback

- Close coupling between basic and applied is valuable
  — Feedback easier with unified team

- Last step critical to advancing domain science
  — Publication in domain specific journal

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NEAR TERM FOCUS: SECURITY & EASE OF USE

- **Security (certificates & Firewalls)**
  - Easy management for administrators, developers, users
  - Must identify a workable solution for the diverse Fusion community
  - Work with ESnet, DOE Science Grid, Fusion security people
  - International usage
  - Other authentication models (e.g. SecureID)

- **Authorization**
  - Easy management of policy for administrators & service providers
  - Finer granularity

- **FusionGrid packaging and support**
  - Easier to install and manage system (one step rpm)
  - Investigate light weight solution

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NEAR TERM FOCUS: SECURITY & EASE OF USE (2)

- **New services for FusionGrid**
  - Codes GS2, GYRO at the TCF, DCON
  - Faster data movement for larger datasets
  - Graphical extensions to FGM
  - MDSplus server at NERSC

- On demand computation requires resource management
  - Support for between plasma pulse data processing
  - Policy enforcement and dynamic accounts

- Creating a new way of working: code developers and users
  - New paradigm for resource sharing: accessibility versus portability
  - Tutorials and workshops (TTF, Sherwood, APS, lab visits)
  - Expanding documentation and web site

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THRUST OVER NEXT 18 MONTHS: SCIRun EASE OF USE

- **SCIRun and MDSplus**
  - Usage for large datasets for interactive visualization
  - MDSplus server at NERSC
  - SCIRun as a service

- **SCIRun ease of use**
  - Generalized MDSplus reader extending to all data
  - 2D graphics
  - Animation

- **SCIRun extensions and integration**
  - Tiled wall and AG
  - Uncertainty visualization

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NEAR TERM FOCUS: COLLAB USAGE MODALITY

- **Tiled wall: ease of use**
  - Real world usage in NSTX and DIII-D control rooms
  - Display and computer hardware evaluation
  - Multi–user control and control room issues
  - Interface and control issues for administration

- **Access Grid technology**
  - PIG real world C–Mod & DIII–D: meetings & control room
  - Flexible shared collaborative environment for one on one
  - Large scale AG node in control room?
  - Integrate with existing security model
  - Tiled wall integration

- **Creating a new way of working**
  - AG tutorials and workshops (TTF, Sherwood, APS, lab visits)
  - Expanding documentation and web site

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PROJECT WEB SITE WILL FLIP TO FUSIONGRID SERVICES SITE

FusionGRID
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- FAQ
- Contact Us

People
- Team
- Collaborators
- Sponsors

Activities
- Recent News
- Meetings
- Related Work

Project
- Services
- Research
- Management
- Publications
- Working

Site Search:

Search Help

The National Fusion Grid is a SciDAC Collaboratory Pilot project to create and deploy collaborative software tools throughout the magnetic fusion research community. The goal of the project is to advance scientific understanding and innovation in magnetic fusion research by enabling more efficient use of existing experimental facilities and more effective integration of experiment, theory, and modeling.

Project News:

GS2 Testing on FusionGrid:
March 2003, The second computational code on FusionGrid is being tested. more »

APS/DPP Meeting:
November 11 - 15, 2002, The US magnetic fusion scientist community gathered in Orlando, FL for their annual meeting. more »

Collaboratory Project Review: May 29 & 30, The Collaboratory Project will be reviewed in an open forum by an expert panel. more »

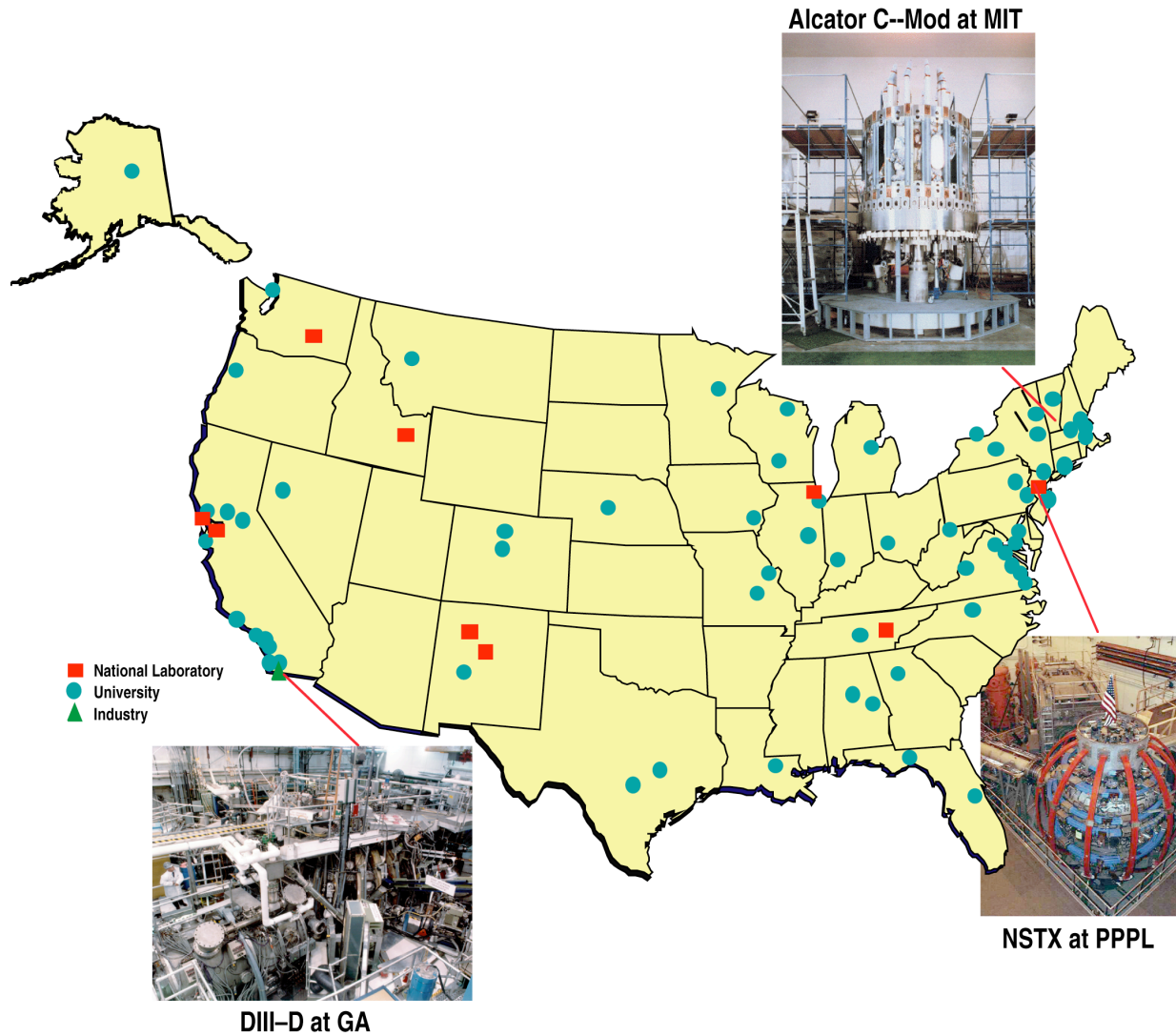**SuperComputing 2002:** November 16 - 22, 2002, The Collaboratory demonstrated new capabilities. more »

Visit the Collaboratory Project archives for more project news.

about the fusion grid | fusiongrid research

Last modified 04/29/03. Comments? webmaster
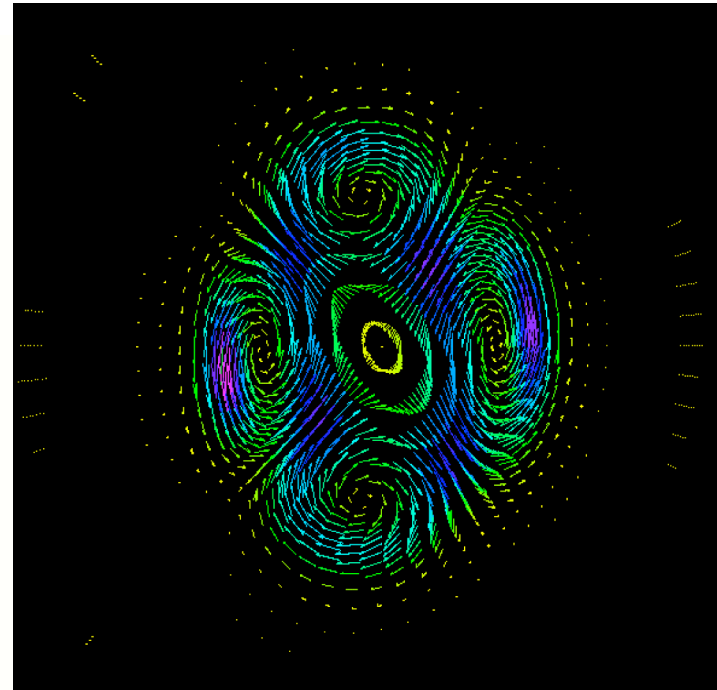
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POTENTIAL NEW CUSTOMERS BEYOND OUR PRESENT SET

Alcator C--Mod at MIT

National Laboratory
University
Industry

NSTX at PPPL

DIII–D at GA

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FUSION SIMULATION PROJECT (FSP): INTEGRATED SIMULATION & OPTIMIZATION OF FUSION SYSTEMS
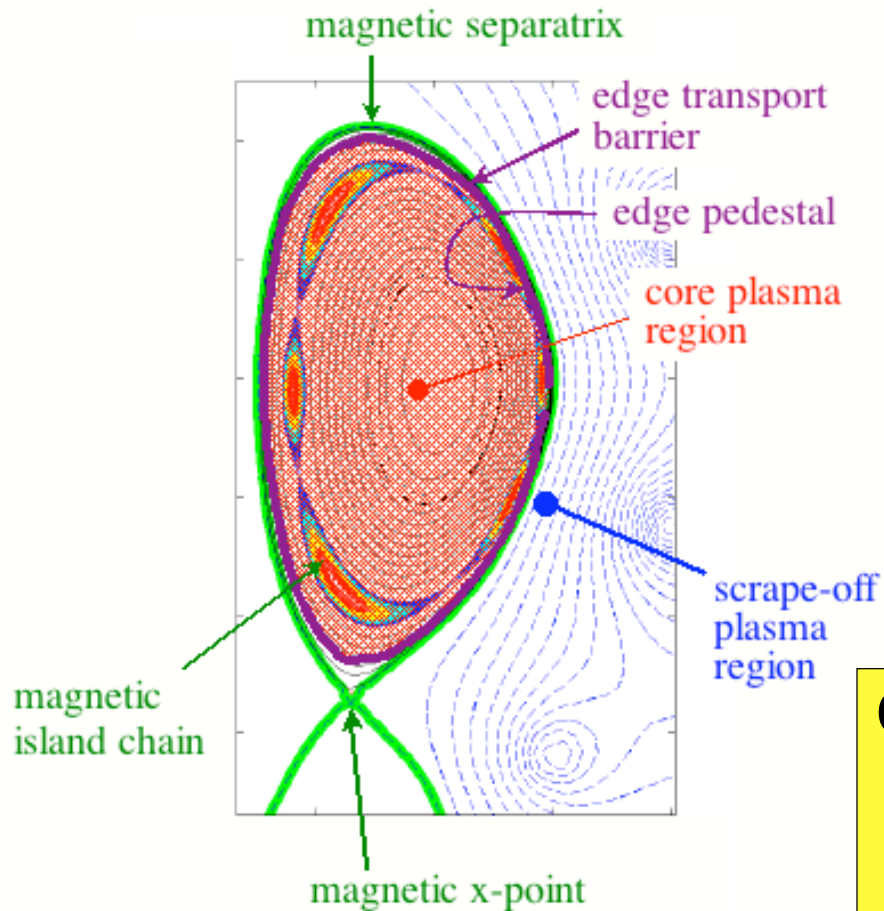
Goals of joint OFES & OASCR Program:
– **Comprehensive models**
– **Architecture for integration**
– **Computational infrastructure**

NFC IS WELL POSITIONED TO FILL THESE POTENTIAL NEEDS

- **FSP core expertise resident in the DOE Office of Science**
  - OASCR, OBES, OFES, SciDAC
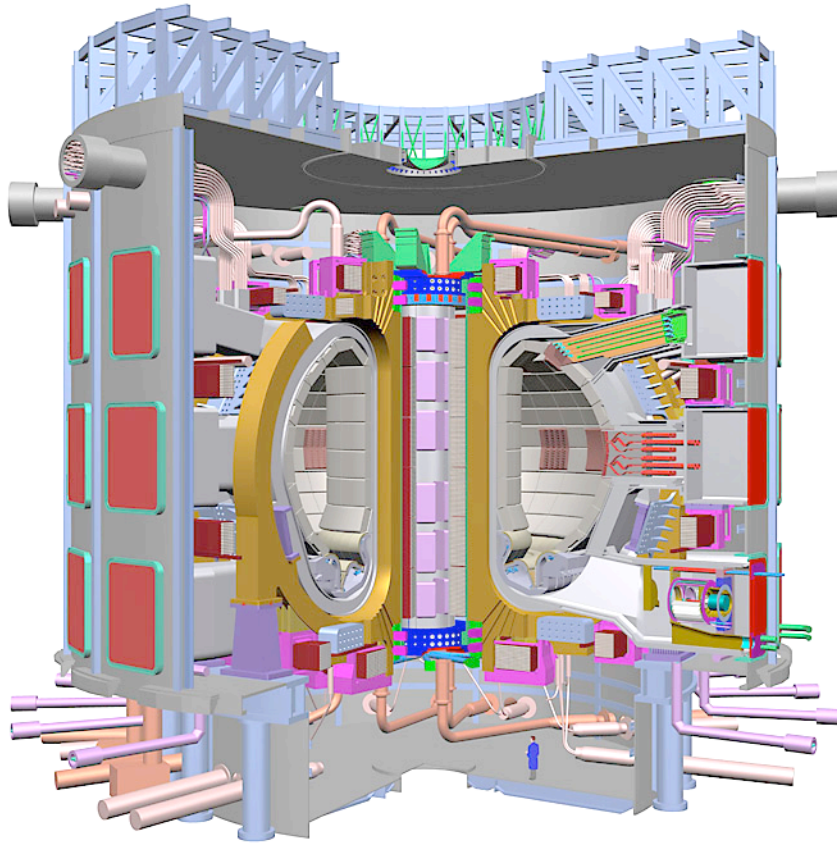 - Architecture for integrated code development and use
  - Analysis and communication tools for remote collaboration

- **For ITER we have proposed that the U.S. take the primary responsibility for definition, design, and implementation of software for data acquisition, data management, and remote participation**
  - Presently being negotiated

FUSION COLLABORATORY CAPABILITIES THROUGH 2007

	Year	2003	2004	2005	2006	2007

FUSIONGRID COMPUTATION

- NEW CODES AS SERVICES

GS2
DCON
GYRO AT TCF
ONETWO

- AUTHENTICATION, FIREWALLS, AUTHORIZ.

EASE OF USE
NON-U.S. Usage
Security Plan

- UNIFIED MDSPLUS

NERSC
LARGE SIM STORAGE
MDSPLUS DATA DIR SERVICES

- BETWEEN PULSE

RESEARCH
NON CRITICAL TESTING
EXPERIMENTAL SCIENCE
Implementation Plan

FUSIONGRID VISUALIZATION

- ACCESS GRID

PIG
SATELITE SITE DEPLOY
CONTROL ROOM EVAL
CONTROL ROOM DEPLOY
AG Plan

- TILED WALL

CONTROL ROOM EVAL
CONTROL ROOM PLAN
CONTROL ROOM DEPLOY
Large Dataset Plan
TW Plan

- SCIRUN

FULL MDSPLUS
AG/TW SUPPORT
EASE OF USE
SATELITE SITE DEPLOY
UNCERTAINTY VIS

EDUCATION & SITE VISITS

TTF   APS   ST TTF   APS   ST TTF   APS   ST TTF   APS

Potential New Customers for NFC Developed Capabilities

Fusion Simulation Project

- DEFINE SPECIFICATIONS

SPECIFICATIONS

- IMPLEMENTATION

IMPLEMENTATION

ITER

- DEFINE SPECIFICATIONS

INITIAL SPECIFICATIONS   REVISED SPECIFICATIONS

- PROTOTYPES

EARLY PROTOTYPES   REVISED PROTOTYPES

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POSITIVE REVIEW LAST WEEK BY DOE OASCR

- **Things we are doing well**
  - Results of the project impressive, especially at half–way point
  - Good outreach to fusion community, interest is building
  - Grid based TRANSP transition to THE service a tremendous success
  - Team is committed
- **Concerns**
  - Subgroups quite independent, clouding the external view as coherent whole
  - Scope appears larger than budget
  - Balance between ease of use and adding new capabilities
- **Recommendations**
  - Prepare an effective coherent marketing approach for growing user base
  - Revisit priorities and plans to assure maximum impact
  - Formalize focus on developing a long–term international vision and path
  - Continue to be a driver for remote collaboration for ITER

**Bateman, Sarff (Kritz) from Fusion
Meyers, Pancerella, Severance from CSET**

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HOW SHOULD THE NFC ADDRESS THE PR PROBLEM?

•Prepare a coherent, effective marketing approach for your growing user base

  –Write a short externally-focused vision/architecture document that implicitly answers many of the review questions (to the skeptic in/outside fusion)

  –Communicate what users will have by when (when will new codes come in, when will a control room test happen, what will it involve/not involve?)

  –Use the technology (AG) to sell the technology (to advertise and do tutorials)

  –Expand services part of the web page

  –Provide a focused, effective way to communicate with potential new users (now)

  NFC OASCR REVIEW COMMITTEE MAY 2003

● **The NFC Project would welcome ideas for the marketing approach**

  — **What is the best way to communicate to our potential user base?**

CONCLUDING COMMENTS

- **The National Fusion Collaboratory Project is implementing and testing new collaborative technologies for fusion research**
  - **Grid computing**
  - **Shared visualization and communication**

- **Positive response from our user community**
  - **Helping to advance fusion research**
  - **We must work smarter to get the word out**

- **Collaborative technology critical to the long term success of fusion**
  - **Experimentally today: 3 large facilities**
  - **Experimentally tomorrow: new large non−U.S. facility (e.g. ITER)**
  - **Computationally today: numerous simulation codes**
  - **Computation tomorrow: begin integrated simulation**

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