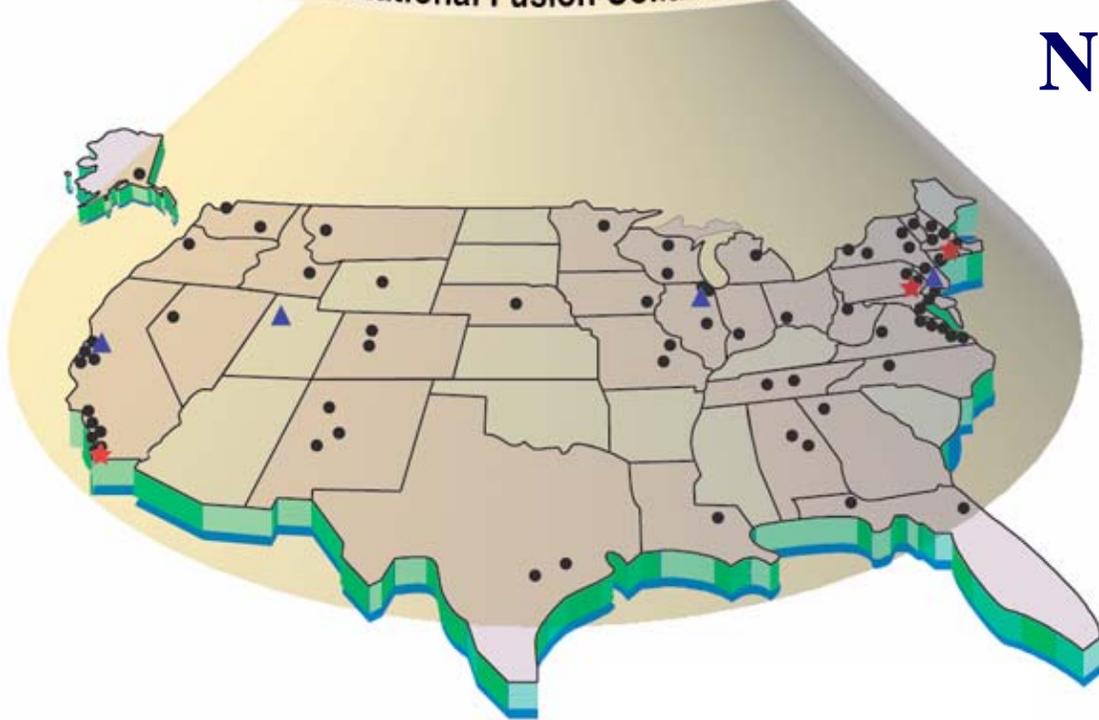




The National Fusion Collaboratory

OVERVIEW: NATIONAL FUSION COLLABOTORY

Presented by
David Schissel
at
SuperComputing 2002

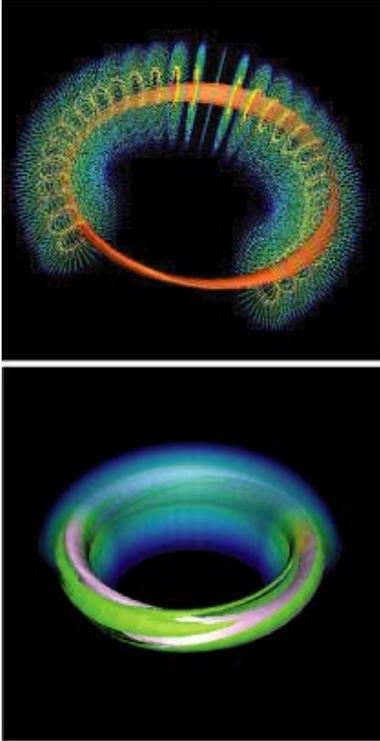


PROJECT OVERVIEW

- Science results facilitated by the NFC presented at IAEA & APS/DPP
 - TRANSP computing on FusionGrid
 - Visualization of NIMROD data with SCIRun
- FusionGrid operational
 - MDSplus and SQL data servers utilizing Globus
 - TRANSP data analysis & simulation code available
- Scientific visualization with SCIRun
 - MDSplus aware
 - Capabilities being expanded – first using NIMROD data
- Shared visualization and remote communication
 - Personal Access Grid (PIG) operational
 - Wall to wall shared visualization

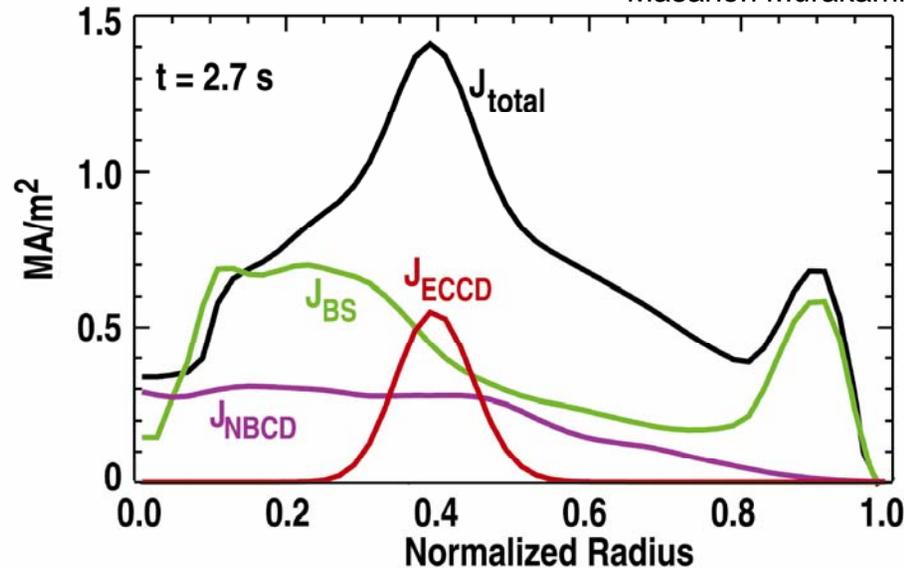
SCIENTIFIC RESULTS FACILITATED BY THE NFC PRESENTED LAST WEEK AT THE APS/DPP MEEING

Dylan Brennan



- SCIRun visualization of NIMROD simulation

Masanori Murakami



- TRANSP running on FusionGrid
- Modeling & simulation critical to the experimental program

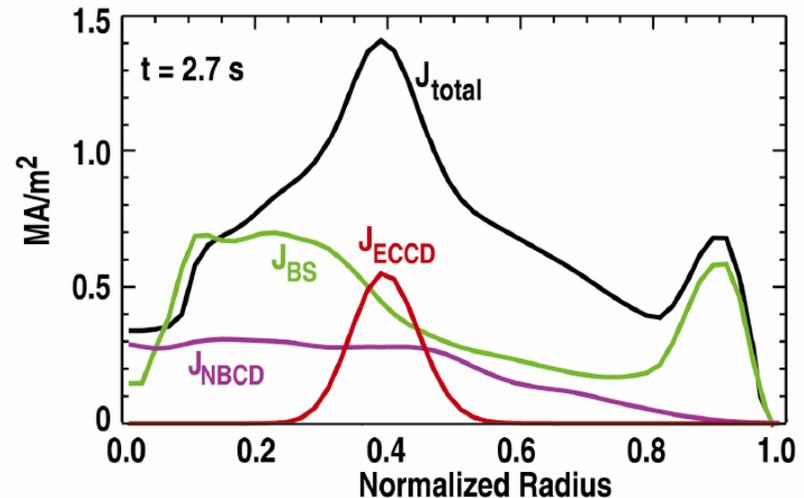
MODELING AND SIMULATION ARE ESSENTIAL FOR THE EXPERIMENTAL PROGRAM

- **TRANSP and ONETWO codes:**

Simulation: Solve J [$B_p(\rho, t)$ diffusion equation] with experimental kinetic profile inputs

Predictive modeling: Solve J , T_e and T_i equations with experiment-based χ_e and χ_i

- **TRANSP run using the Fusion Grid created by the National Fusion Collaboratory Project**



- **ECCD/ECH**

- Used $1.2 \times J_{\text{ECCD}}$ (TORAY-GA)

- **NBCD**

- Monte-Carlo slowing down with a modest spatial diffusion of beam ions

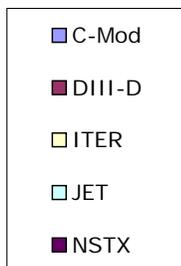
- **Bootstrap current**

- Used Hirshman 78 model (Large R/a approx.)

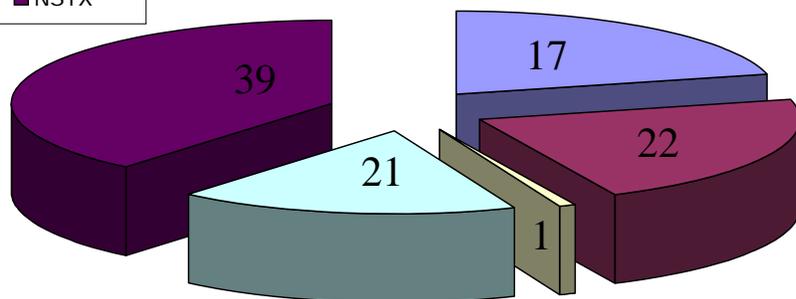
- Underestimate by $\sim 10\%$ compared with NCLASS and Sauter models

Murakami
Invited APS
Presentation

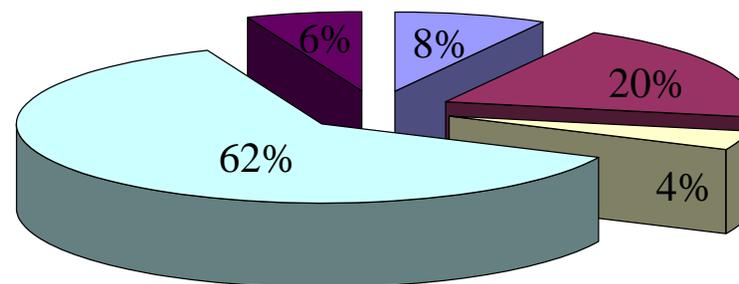
TRANSP IS THE FIRST CODE TO BE USED ON THE PRODUCTION FUSIONGRID



FusionGrid TRANSP Runs



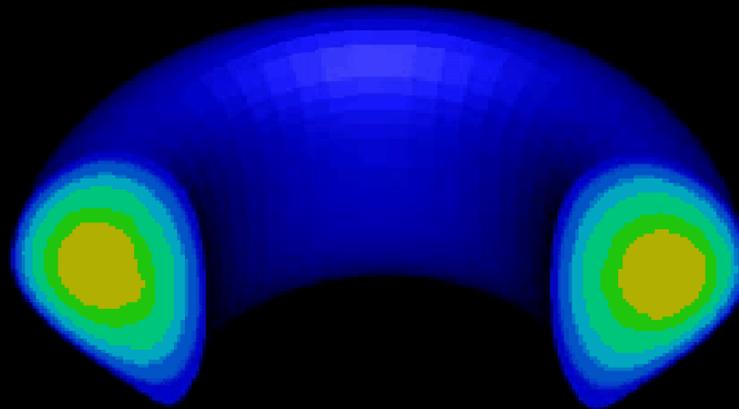
FusionGrid TRANSP CPU Time



- Statistics for October, the first full month of operation
- Note US scientists supporting JET (UK based) and ITER
- Raises interesting authorization policy issues
 - One scientist can work on numerous projects with different authorizations
- Needs to be made robust, still more computer scientists than plasma scientists

Studying the structure and nonlinear evolution of these modes with NIMROD can lead to new intuition and new physics

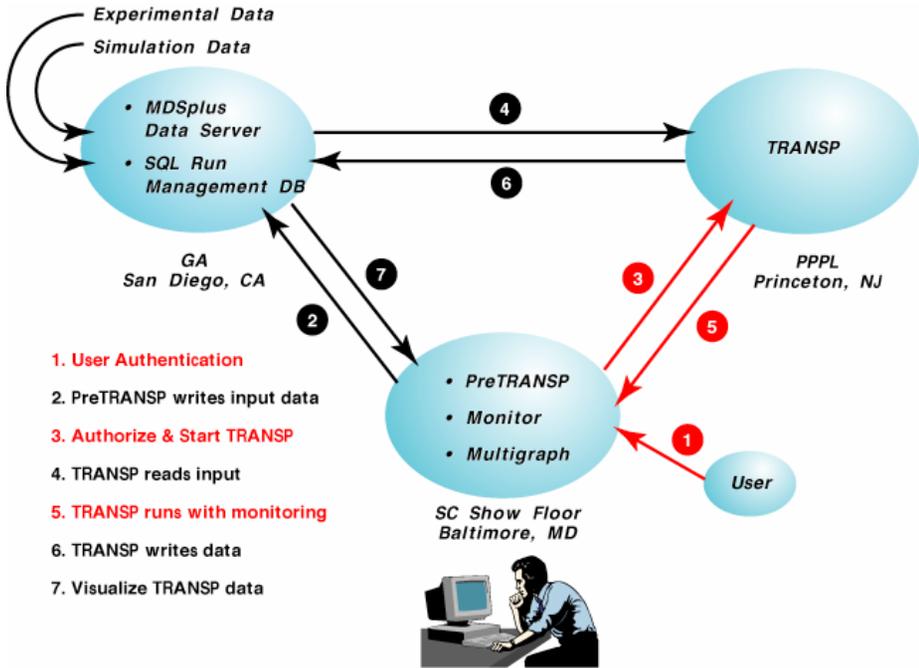
Brennan
Invited APS
Presentation



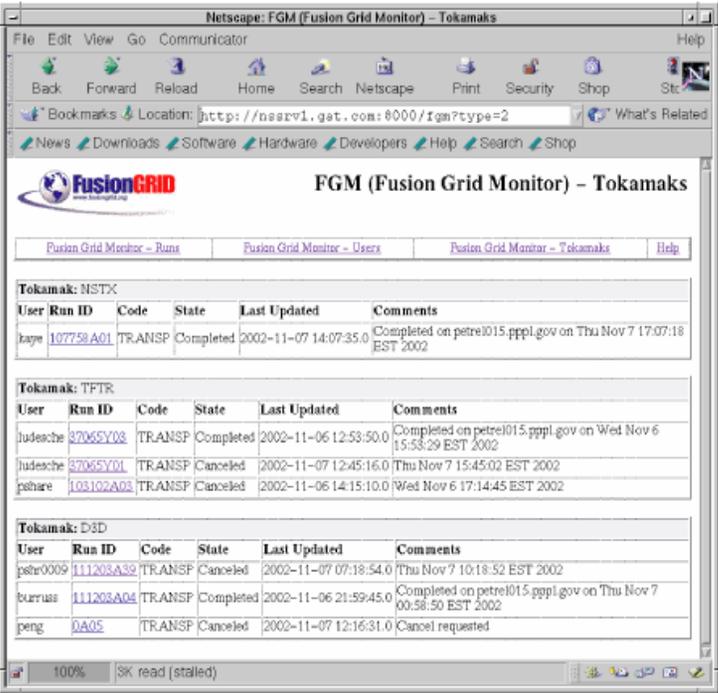
FUSION COLLABORATORY DEMONSTRATIONS AT SC02

- Remote computing and security (FusionGrid)
 - Remote computing with TRANSP & preemptive scheduling
- Visualization
 - 3D visualization with SCIRun
 - Shard visualization and personal AG node
- ANL Booth
 - Tues 2:00 - 2:30 & 5:30 - 6:00, Wed & Thurs 2:00 - 2:30
- LBNL Booth
 - Tues 11:00 - 12:00, Wed 4:00 - 5:00
- Utah Booth
 - Demonstrations available upon request

TRANSP ON THE FUSIONGRID AS DEMONSTRATED AT SC02

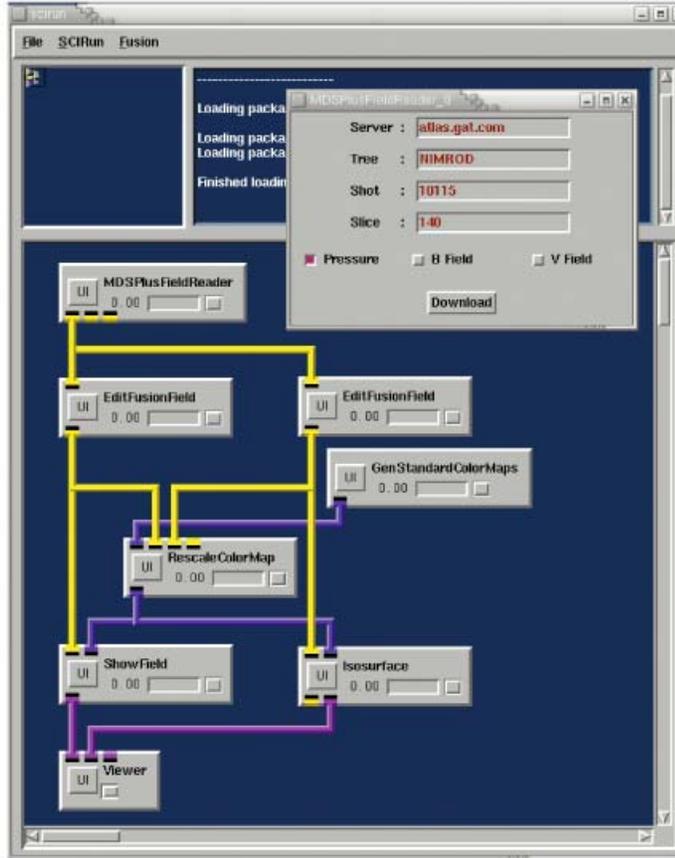
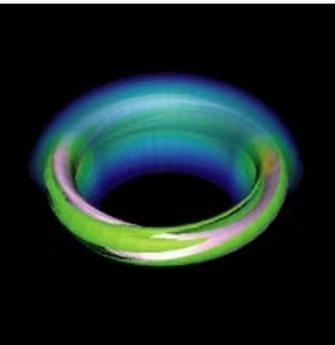
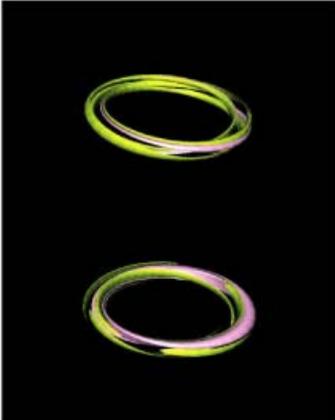
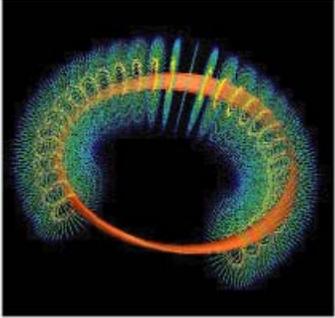


1. User Authentication
2. PreTRANSP writes input data
3. Authorize & Start TRANSP
4. TRANSP reads input
5. TRANSP runs with monitoring
6. TRANSP writes data
7. Visualize TRANSP data



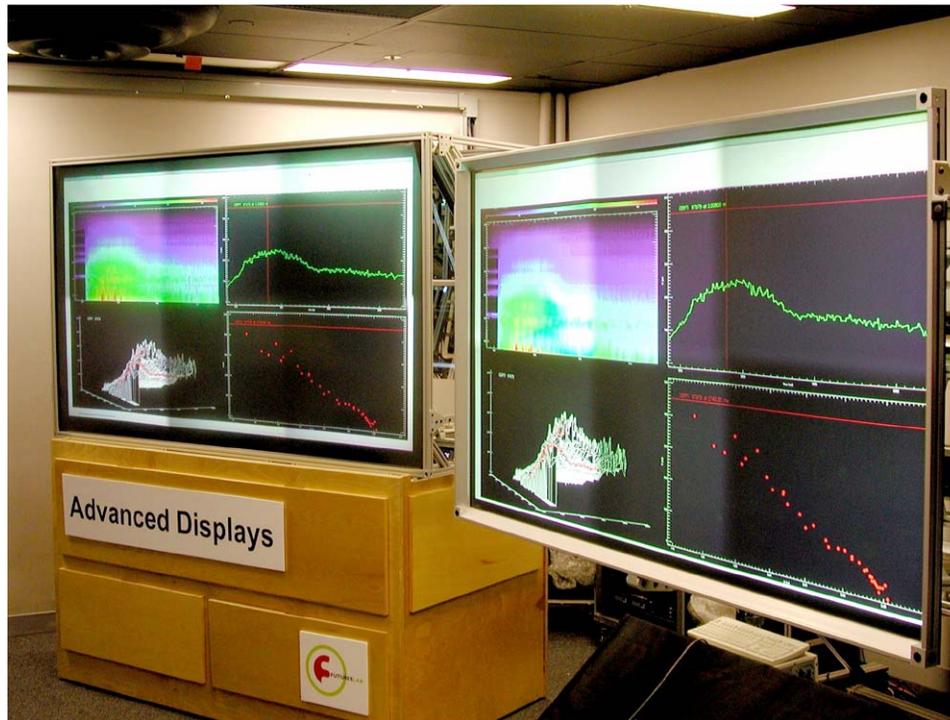
- Monitoring adapted from fusion community system

SCIRUN VISUALIZATION FROM DATA STORED IN MDSPLUS



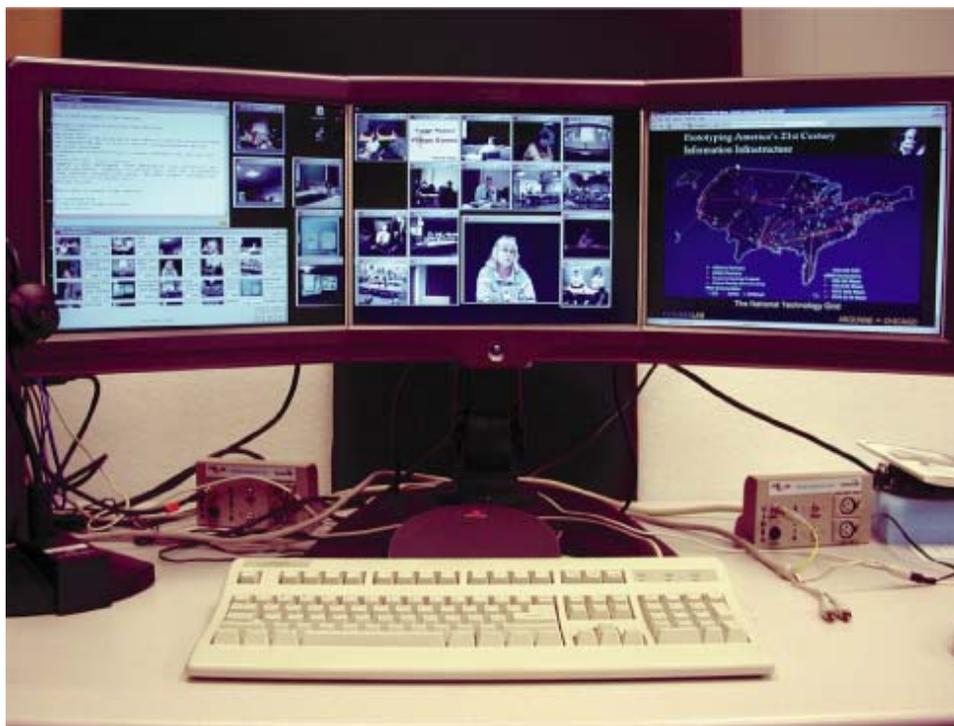
- Adapted for Fusion
 - Open Source, low cost
- NIMROD data from MDSplus
 - Testing storage paradigm
- Deployable hardware path
 - Linux vis stations
 - Low cost (~\$2k)

SHARED VISUALIZATION BETWEEN TILED WALLS



- Workstation to Wall and Wall to Wall is possible – communicate to control room
- Demonstrated from ANL to DIII-D and PCS to PPPL with positive feedback

REMOTE COMMUNICATION WITH PERSONAL AG NODE



- Targeted for the small research center
 - For one to one and one to many interactions
- Usage example: communication to a tokamak control room
 - Includes sharing of complex visualization (e.g. SCIRun)

THROUGHOUT THE YEAR THE COLLABORATORY HAS ACTIVELY SOUGHT OUT SCIENTIFIC USER INPUT

- Two scientific meetings in April
 - 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

POSITIVE DEMONSTRATION OF GRID COMPUTING AT THE TRANSPORT TASK FORCE MEETING IN APRIL

- Demonstration of TRANSP on the FusionGrid (first of its kind)
 - Concept and goals well received by experimental community
- Educate the community on these computer science concepts
 - New to most everyone we talked with
- Discussion of international users and future codes

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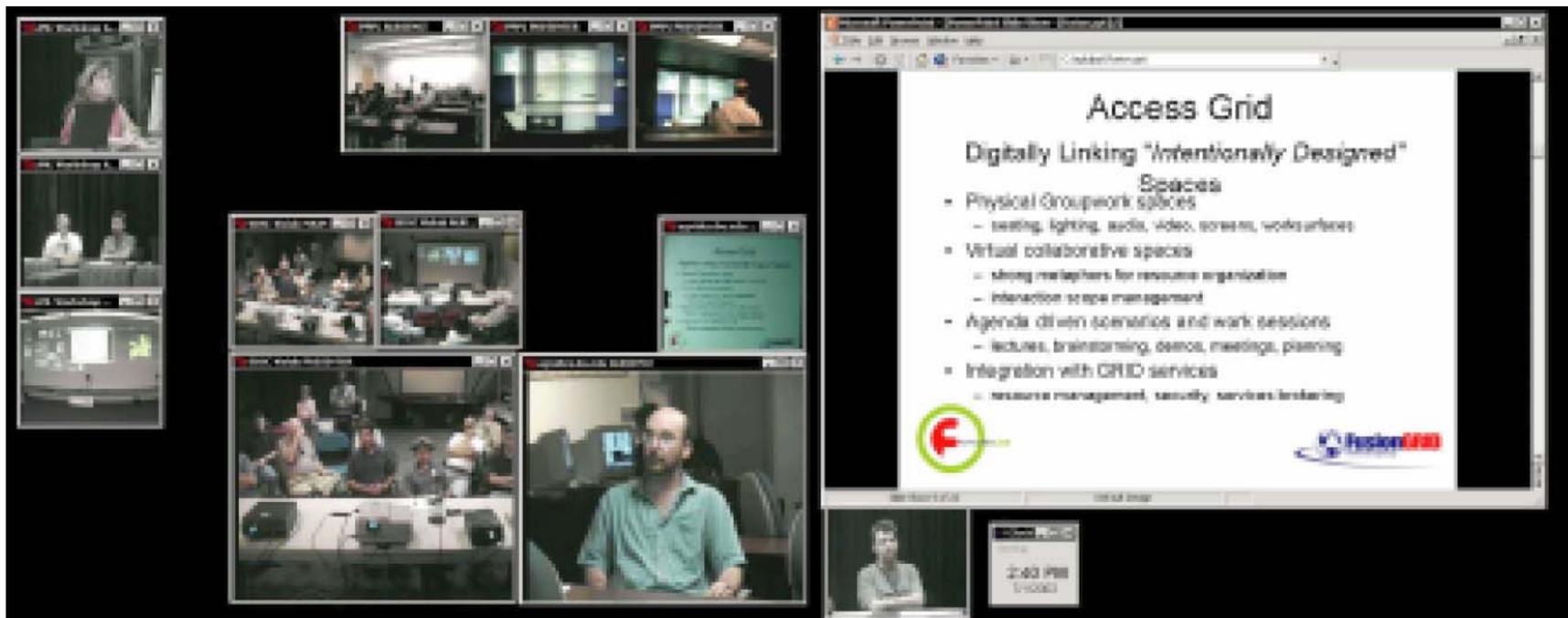
POSITIVE DEMONSTRATION OF GRID COMPUTING & VISUALIZATION AT THE SHERWOOD THEORY MTG IN APRIL

- Demonstration of FusionGrid computing and SCIRun vis
 - Concept and goals well received by the theory community
- Educate the community on these computer science concepts
 - New to most everyone we talked with
- Discussion of more involved visualization capability

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A DEMONSTRATION ACCESS GRID MEETING TOOK PLACE BETWEEN C-MOD, DIII-D, NSTX, AND ANL



- Positive response but with a wide variety of opinions on how to use
 - PPPL has large node, C-Mod has PIG, DIII-D will build PIG
- Users needed to be able to share any application in an AG session
 - Is being integrated into the AG capability

APS/DPP 2002 CAPABILITY DEMONSTRATIONS

- Largest gathering of fusion scientists in the U.S. (1500)
- Same demonstrations as at SC02
 - TRANSP FusionGrid, SCIRun, Shared Visualization, PIG
- Our presence and technology was very well received



POSTIVE REVIEW AND ENDORSEMENT BY PSACI PAC

“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.” William L. Kruer, PSACI PAC Chair 6/24/02

PSACI is the Plasma Science Advanced Computing Institute that is funded by the USDOE Office of Fusion Energy Sciences



WORK OVER THE NEXT 12 MONTHS

- **Grid Computing**

- Add the GS2 code to FusionGrid
- Facilitate the grid–security/site–security

discussion

- Reduce the support required for FusionGrid

- **Visualization: SCIRun**

- Extend the time–dependent capabilities
- General MDSplus reading capability

- **Visualization: Tiled Walls/AG**

- Improved ease of use for remote sharing–usage in

Fusion

- Installation and use of AG PIGs within Fusion
- Evaluation during tokamak operation