THE COLLABORATIVE TOKAMAK CONTROL ROOM

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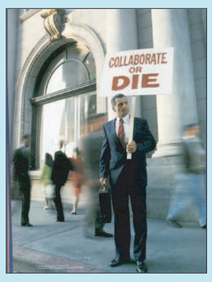
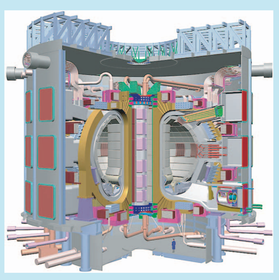
DIII-D NATIONAL FUSION FACILITY

FusionGRID www.fusiongrid.org

INTRODUCTION

COLLABORATION TECHNOLOGY CRITICAL TO FULLY EXPLOIT PRESENT AND FUTURE FES FACILITIES





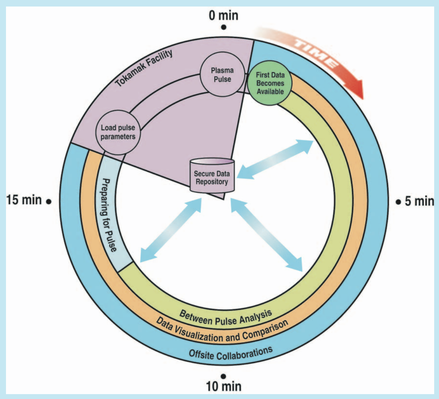
- Collaborative technology critical to FES
  - Fewer larger machines (ITER)
  - A full integrated simulation (FSP)
- FES scientists are using NFC Project tools
  - Modifying/creating new software
- Collaborative technology critical to fully exploit present and future facilities
  - ITER will be supported by a worldwide team
  - Supercomputer: real-time experimental support
  - Extend our existing collaborative tools to meet future needs
  - Both functionality and to the broader international FES community
  - Assist in creating collaborations in other scientific disciplines

FUSION SCIENCE TODAY AND IN THE FUTURE IS VERY MUCH A TEAM SPORT

For Example Today: The DIII-D National Fusion Facility

For Example The Future: ITER

EXPERIMENTAL FUSION SCIENCE IS AND WILL CONTINUE TO BE A VERY DEMANDING REAL-TIME ACTIVITY

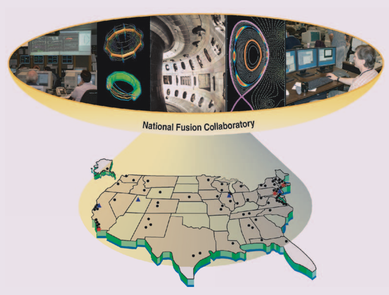


- Changes to the next pulse based on informed decisions

THE NATIONAL FUSION COLLABORATORY PROJECT

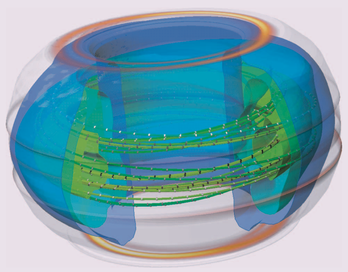
THE NATIONAL FUSION COLLABORATORY PROJECT TOOLS ARE BEING USED TO BETTER FES RESEARCH

- More efficient use of experimental facilities
- Integrate theory and experiment
- Facilitate multi-instituion collaboration
- Create a standard tool set



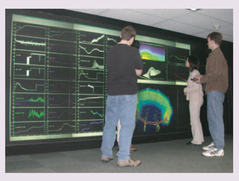
PROJECT VISION: OPTIMIZE THE MOST EXPENSIVE RESOURCE - PEOPLE'S TIME

- Network Services: data, codes, vis tools
- Access is stressed rather than portability
- Shared security infrastructure
- Shared visualization applications and widely and widely deployed collaboration technology



THESE NEEDS DEFINE THE COLLABORATIVE CONTROL ROOM

- Secure computational resources scheduled as required
  - Requires seamless interplay between grid and site security
  - Requires network QoS, CPU scheduling, data management
- Rapidly compare experimental data to simulation results
  - Requires robust and efficient unified data management
- Share individual results with the group via shared large displays
  - Requires display information sharing and concurrent control
- Fully engaged remote scientists with audio, video, shared displays
  - Requires unified and robust collaborative environment

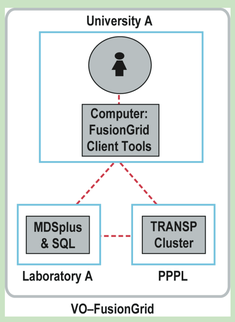


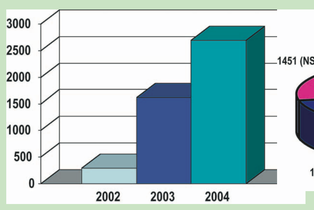
THE COLLABORATIVE CONTROL ROOM

FUSIONGRID: SECURE ACCESS TO FES RESOURCES

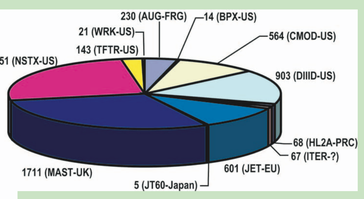
- Authentication: PKI via X.509 certificates and the FusionGrid CA
- MyProxy centralized certificate management
- Authorization: customized ROAM system
- Data: MDSplus data acquisition and management system

SUCCESSFUL GRID COMPUTING FOR FES: E.G. TRANSP





Runs per year

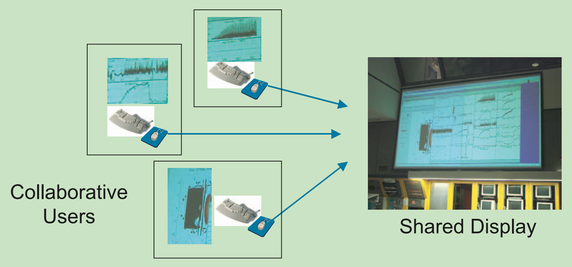


Runs in FY 2004

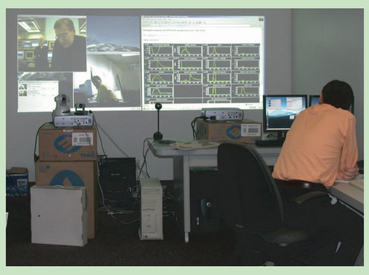
- Centralized expertise for better support
- Reduced administrative work at other labs

SHARED DISPLAYS INSTALLED IN FUSION CONTROL ROOMS

- Display information sharing
  - Move computational results from scientist's desktop to shared display
  - Display information of common interest
- Concurrent control
  - scientists can simultaneously edit, interact, annotate visualizations



ACCESS GRID: REAL TIME COMPLEX COMMUNICATION FOR EXPERIMENTAL OPERATION

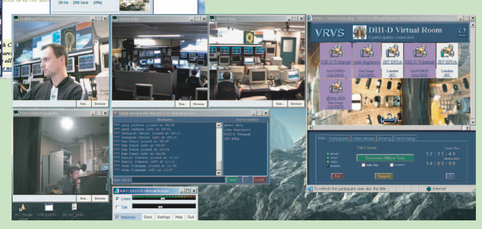


- Being used for seminars, working meetings, tokamak operations
  - Linux, Windows, and Macintosh OS X; small to large immersive nodes

VRVS: WEB CLIENT COMMUNICATION FOR EXPERIMENTAL OPERATIONS

JAERI Participation in DIII-D Experiment March 2005

- Since March 9, 2004
  - 341 unique users
  - 539 unique computers
  - 3480 total hits
- Closed source model limits customized expansion

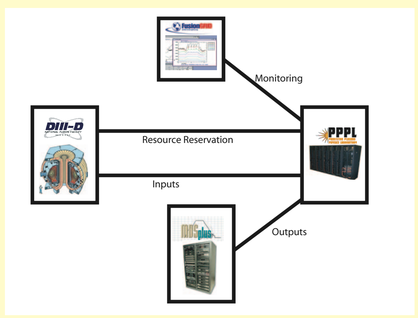


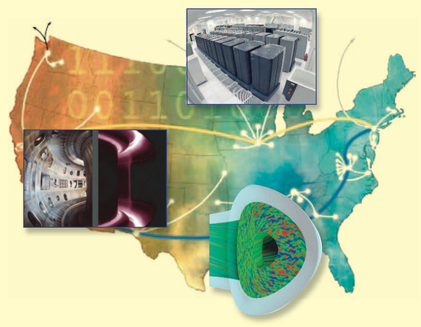
JET Participation in DIII-D Experiment January 2005

EXAMPLES OF SCIENTIFIC RESULTS

REAL-TIME GRID COMPUTING TO SUPPORT FES EXPERIMENTS

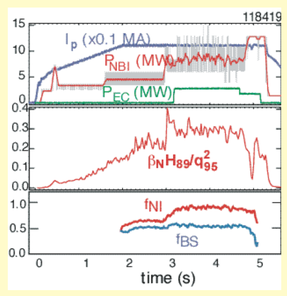
- Transport analysis to support real-time experimental science
- Eventually desire supercomputers to support real-time science



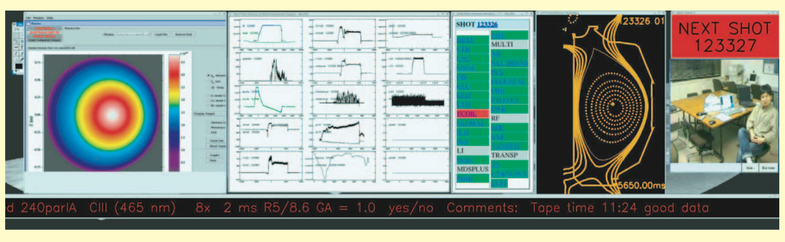


FES GRID BASED DATA ANALYSIS TO MOVE THE SCIENCE FORWARD

- Nearly full noninductive current drive
- Only limited by available hardware
- Stationary operation of a fusion plasma
- At fusion performance levels required for ITER operation

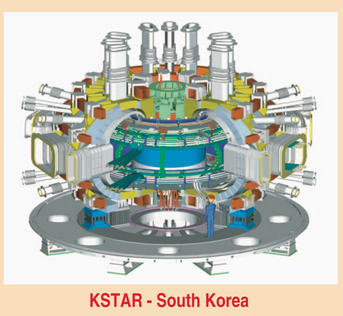


SHARED DISPLAY WALL CONTENT AT DIII-D DURING EXPERIMENTAL OPERATIONS

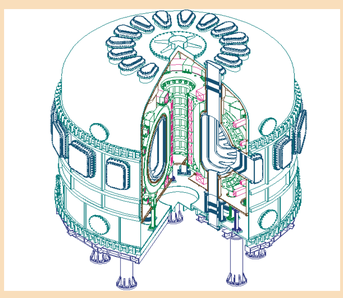


SUMMARY

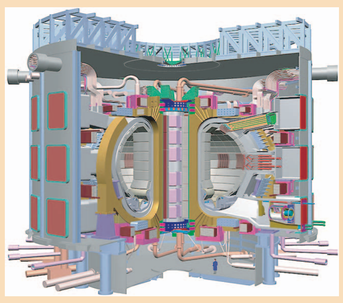
THE SUCCESS OF FUTURE MACHINES BOTH TO THE INDIVIDUAL PARTNERS AND THE WORLD REQUIRES A ROBUST REMOTE COLLABORTORY CAPABILITY



KSTAR - South Korea



EAST - China



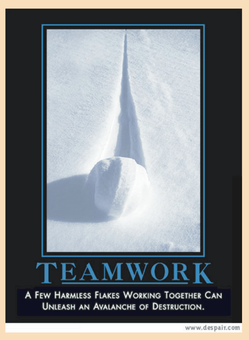
ITER - physically in France

PATH TO SUCCESS HAS BEEN DEMONSTRATED AND PARTIALLY DEPLOYED

- The NFC Project is implementing and testing new collaborative technology
- Clear vision and work scope forward to the Collaborative Control Room
- Collaborative technology critical to the success of the FES program
- Potential to apply to new sciences leading to new collaborations, particularly in China and South Korea

SUBSTANTIAL WORK REMAINS TO CREATE A ROBUST INFRASTRUCTURE

- Create a unified environment, not individual pieces
  - SIP and VoIP are potential emerging technologies
  - Requires network QoS, CPU scheduling, data management
- Grid Security and Site Security working together
  - Physical tokens for One Time Password (e.g. SecureID)
- Schedule computational grids as required
  - Nework QoS, grid computational scheduling, visualization, large data management, CPU scheduling
- Data management for simulation (large) datasets
  - Parallel I/O, caching, replication



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