Software Tools for Enhanced Collaboration at the DIII–D National Fusion Facility

Presented by

J. Schachter

for the DIII–D National Team

Presented to

2nd IAEA Technical Committee Meeting on Control, Data Acquisition and Remote Participation on Fusion Research

July 19–21, 1999
Lisboa, Portugal

DIII–D
NATIONAL FUSION FACILITY
SAN DIEGO

GENERAL ATOMICS

196–99

ACKNOWLEDGMENTS

- The Data Analysis Applications Group
  - Qian Peng, Jeff Schachter, Dave Schissel from GA
  - Ted Terpstra from PPPL
- DIII–D Computer Staff
  - J. Freeman, K. Keith, B. McHarg, C. Parker, T. Warner
- The DIII–D User Community
- From LLNL — Tom Casper, Bill Meyer, and Jeff Moller
- From MIT/C–Mod — Martin Greenwald, Tom Fredian, and Josh Stillerman
- Supported by U.S. DOE Contracts DE-AC03-99ER54463 and DE-AC02-76CH03073

DIII–D
NATIONAL FUSION FACILITY
SAN DIEGO

ENHANCED CAPABILITY MEANS

- Faster
- More efficient
- More productive
- Easier to use
- New possibilities

DIII-D
NATIONAL FUSION FACILITY
SAN DIEGO

GAPlotObj AND MDSplus ENHANCE DATA VISUALIZATION AND ANALYSIS CAPABILITY

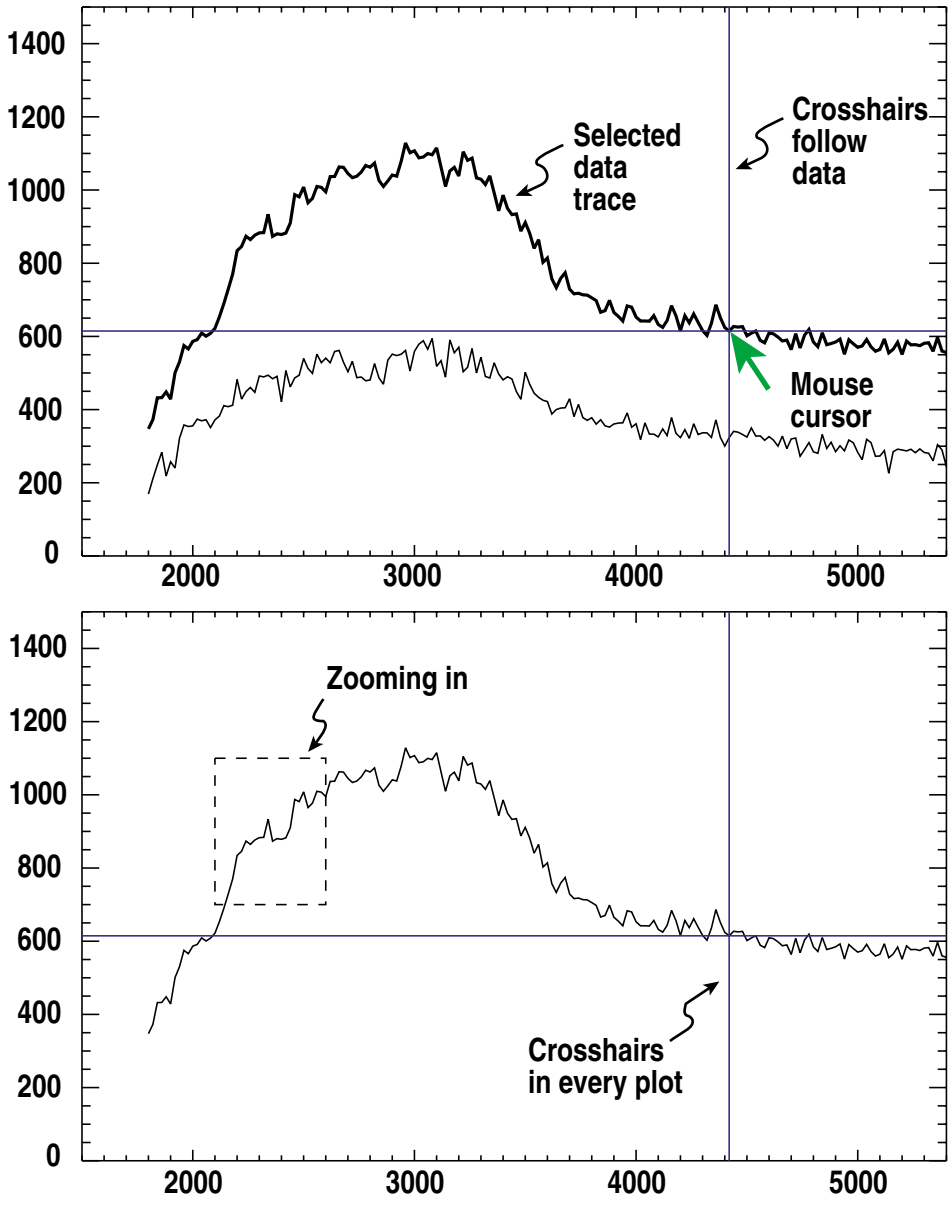
- GAPlotObj
  - Object-oriented library for dynamic plotting in IDL
- MDSplus
  - At DIII–D: a centralized repository for analyzed data
- Two example tools using GAPlotObj and MDSplus
  - ReviewPlus: general 2D and 3D data viewing
  - EFITviewer: rapid assessment of equilibrium fit from EFIT
- Key benefit for collaborators: site independence

GAPlotObj: AN OBJECT-ORIENTED LIBRARY FOR DYNAMIC PLOTTING

- Visualization tools at GA are written in IDL (from RSI)
  - Rich, easy to use language
  - Extensive, powerful interactive graphics
- GAPlotObj: IDL class library encapsulating dynamic plotting
  - Written by Data Analysis Applications group and Fanning Consulting
  - Used in many applications
  - Not IDL's OpenGL-based "Object Graphics"
- Benefits to user
  - Interactive plotting = rapid feedback, no change of focus
  - Same interface in every tool

DIII-D NATIONAL FUSION FACILITY SAN DIEGO

DYNAMIC PLOTTING WITH GAPlotObj



Five "Mouse Modes"

1) Select
- Data values
- Copy, delete
- Math

2) Zoom
- On Feature of interest
- Toggle between single and multiple plots

3) Edit
- Add, move, delete points in data trace

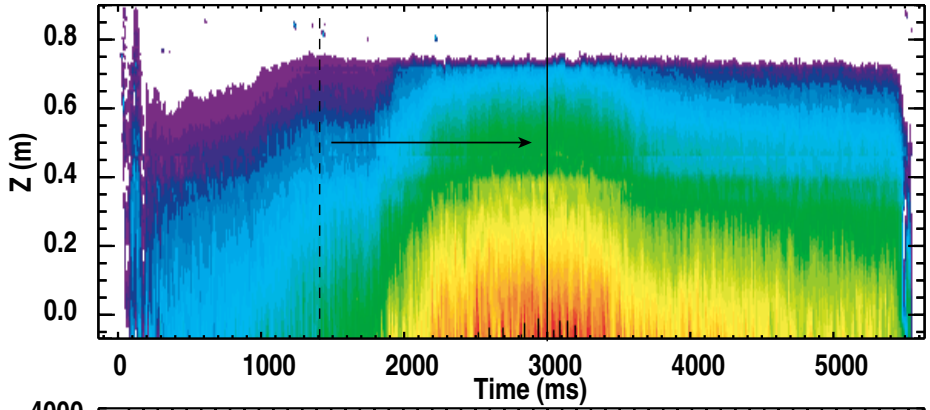
4) Cursor
- Mark reference points

5) Slice
- 2D & 3D Coupling

DIII-D NATIONAL FUSION FACILITY SAN DIEGO

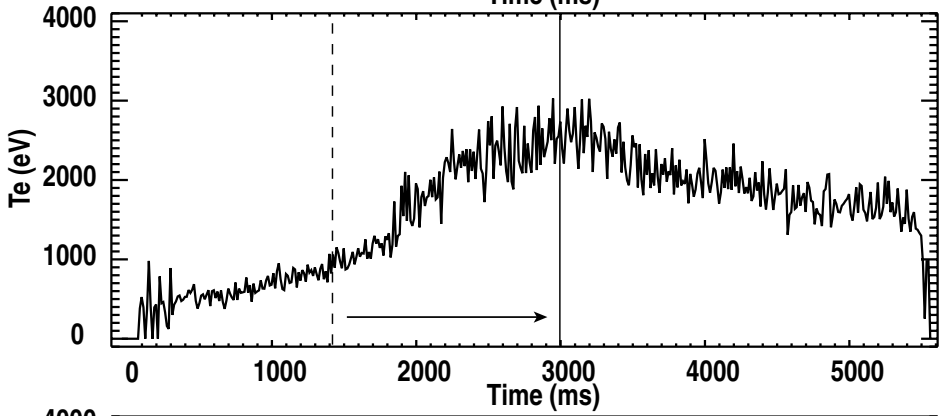
2D AND 3D PLOT INTERACTION

Image plot of T_e



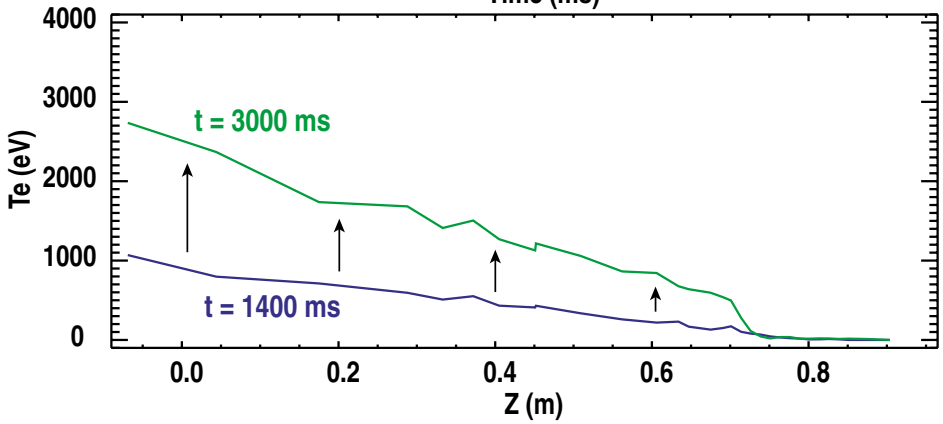
Move crosshairs from t = 1400 to t = 3000 ms

Time history (Z = 0 m)



Crosshairs in time history slice plot also move

$T_e(Z)$ profile

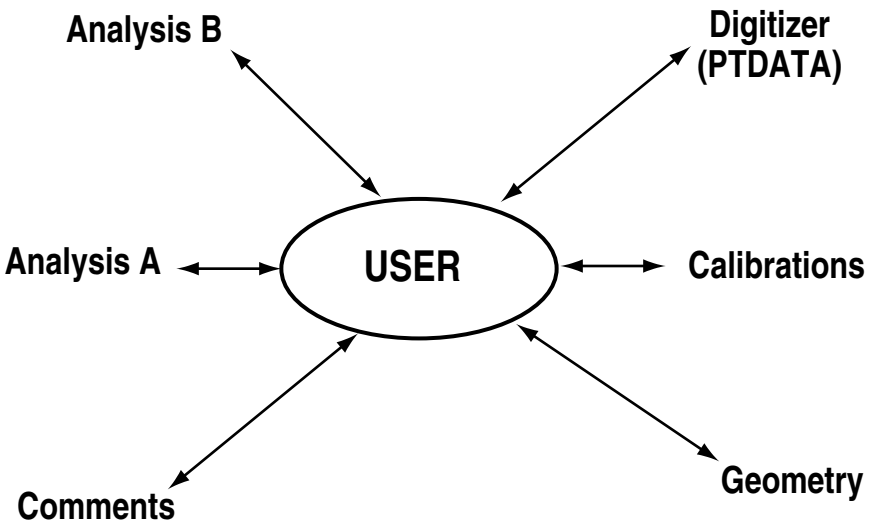


Profile slice plot changes from t = 1400 ms to t = 3000 ms

DIII-D NATIONAL FUSION FACILITY SAN DIEGO

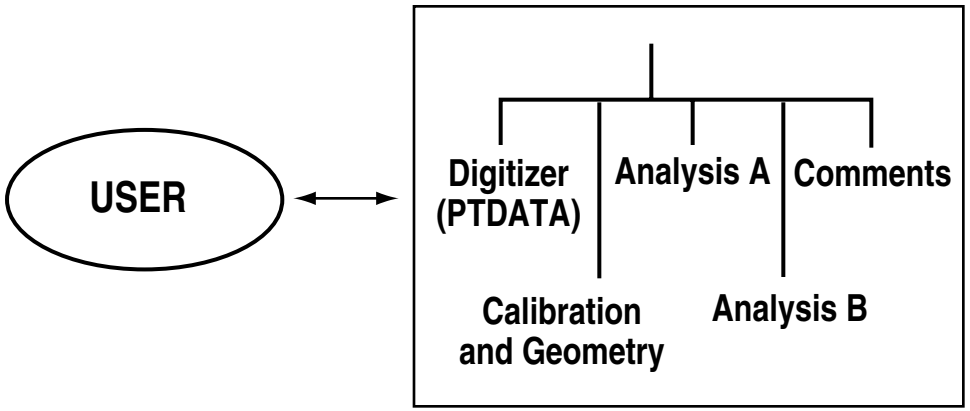
MDSplus SIMPLIFIES DATA ACCESS

Conventional Storage



- Separate interface for each data type
- Must know data format and file location
- Data and context stored separately
- Hard to share results

MDSplus



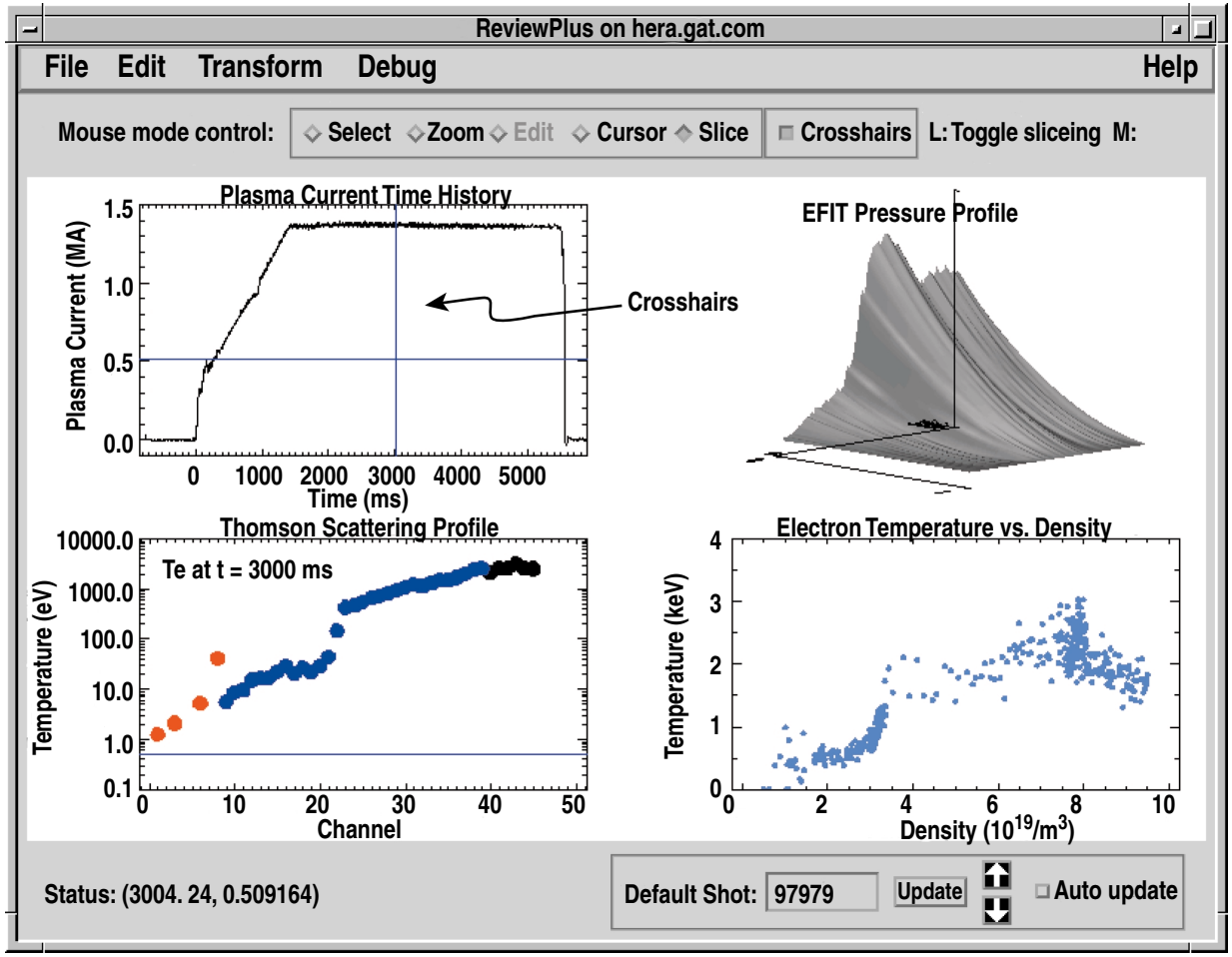
- One interface to many data types
- Only need location of data in tree
- Store all relevant information
- Remote exploration of data productive

DIII-D NATIONAL FUSION FACILITY SAN DIEGO

MDSplus SUCCESSFULLY DEPLOYED FOR DIII–D

- Stores analyzed data from 4700 shots so far
  - All shots since 1998 plus most popular old shots
  - 40 GB total file usage
  - Currently up to 16 datasets per shot (20 MB/shot), more being added
- Now using Unix MDSplus
  - Compaq DEC Alpha workstation (Tru64 Unix) with 100 GB RAID 5
  - Integrates more closely with Unix computing environment
  - Upgradable path for CPU and storage
- Most analyzed data loaded between pulses by event-driven system
- Can load at any time

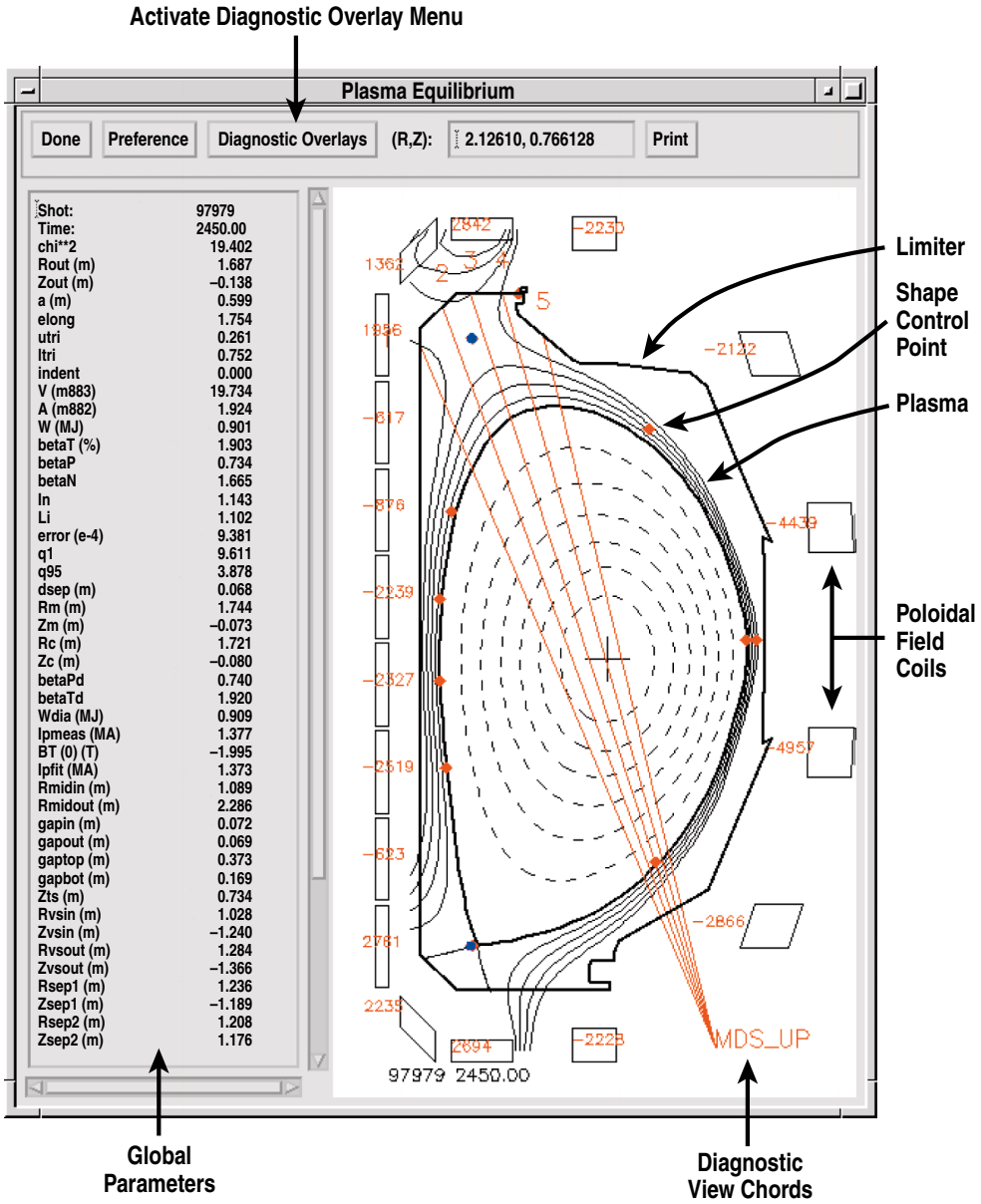
ReviewPlus: GENERAL 2D AND 3D DATA VIEWING



- Data combinations
- Overplotting
- Any Y versus any X
- Math functions
- 2D and 3D coupling
- Signal menu and web help
- Automatic updating

DIII-D NATIONAL FUSION FACILITY SAN DIEGO

EFITviewer: RAPID ASSESSMENT OF EFIT EQUILIBRIUM FIT



- Poloidal cross section of flux contours
- Tokamak and diagnostic geometry overlays
- Multi-shot overlays
- Time histories and profiles of EFIT results
- Fit quality
- Kinetic profiles
- Customizable display

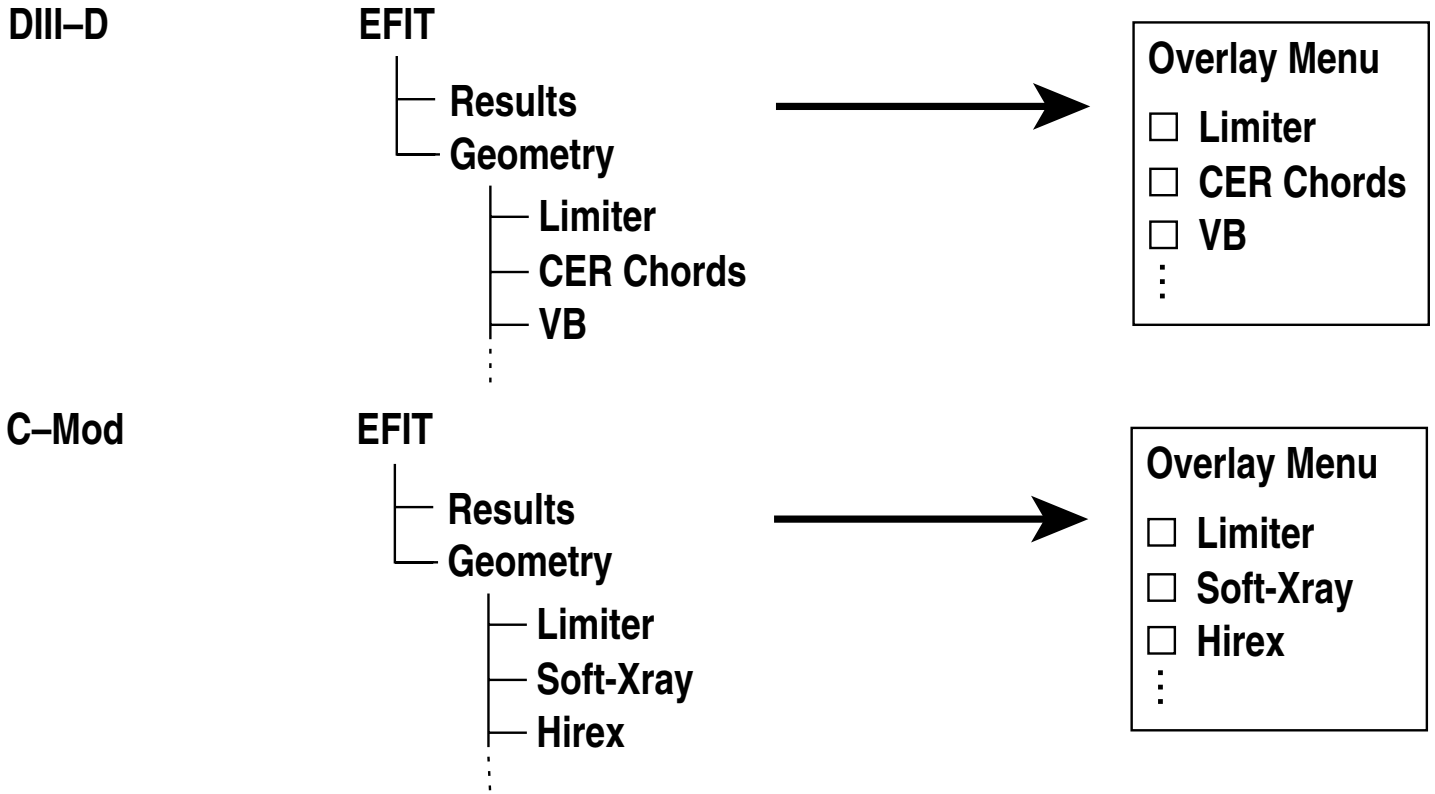
DIII-D NATIONAL FUSION FACILITY SAN DIEGO

MULTIPLE SITES AND SITE-INDEPENDENCE

- ReviewPlus and EFITviewer can run on DIII–D at any site with IDL and MDSplus
- Better for collaborator: run anywhere to view data from anywhere else
- Reviewplus can access data from any site with MDSplus
- EFITviewer is not fully site-independent
  - Can plot EFIT results from any site
  - But machine-specific geometry and diagnostic overlays
- Can use MDSplus to make EFITviewer site-independent
  - Store machine-specific information with data, not in code

MDSplus: THE KEY TO SITE-INDEPENDENT TOOLS

- Tools driven by structure of data in MDSplus
- Example: EFITviewer



- Many codes can benefit
  - EFIT
  - TRANSP
  - Theory and simulation
- Discussions are underway between U.S. fusion sites to collaborate on tools of common interest

SUMMARY: GAPlotObj AND MDSplus ENHANCE COLLABORATOR ABILITY TO ANALYZE DIII–D DATA

- **GAPlotObj**
  - Interactive plotting = rapid feedback, no change of focus
  - Unified interface in all tools
- **MDSplus**
  - Simplified data access and storage
  - Remote exploration of data
- **Both used in ReviewPlus and EFITviewer**
  - Bring new capabilities to user
  - Can run at any site with IDL and MDSplus
- **Collaboration is the future of software in fusion community**
  - Run any code anywhere on any data from any site

DIII–D NATIONAL FUSION FACILITY SAN DIEGO