Monitoring & Display

Simulations run for hours - days

Motivation: Conserve computer & human time

Time step data produced as the sim runs

f(x,t)

f(x,y,t)

Goal: Check results from anywhere on Internet

Check input data

Display on personal computer, laptop

Generalize Approach to Monitoring

Any program that writes a structured netCDF file can be automatically monitored in ElVis. Reads netCDF & template. Updates display.

Simulation Programs

Append data to variables at each time step.

netCDF File

Variables – "unlimited" time dimension

Attributes, Units

Template File

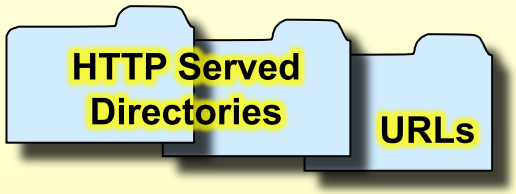
Graph descriptions

Presentation style

Annotation

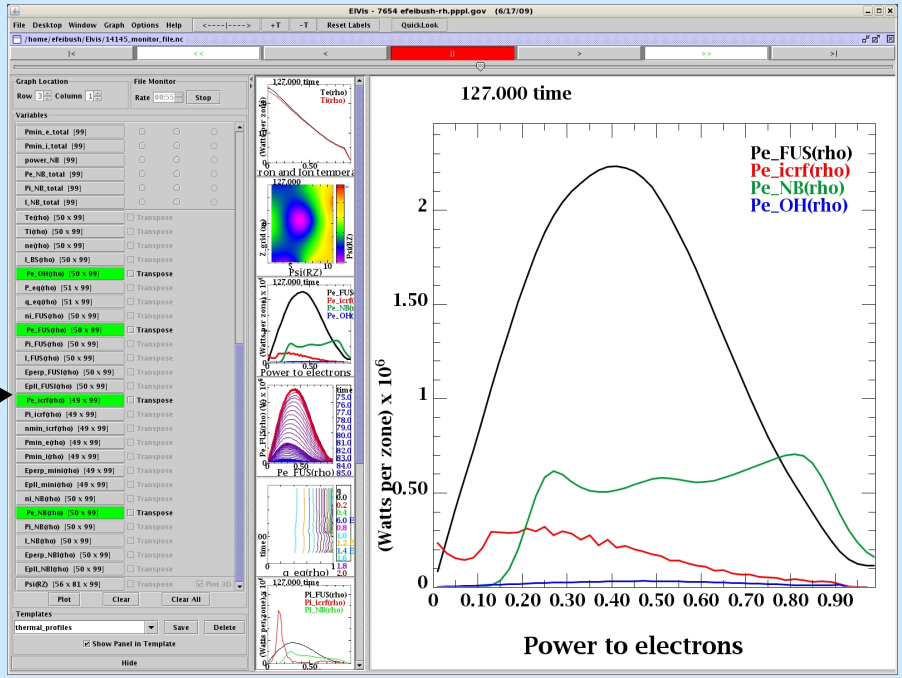
HTTP Web Server

Leverage HTTP server & web directories instead of developing custom data server &protocol.

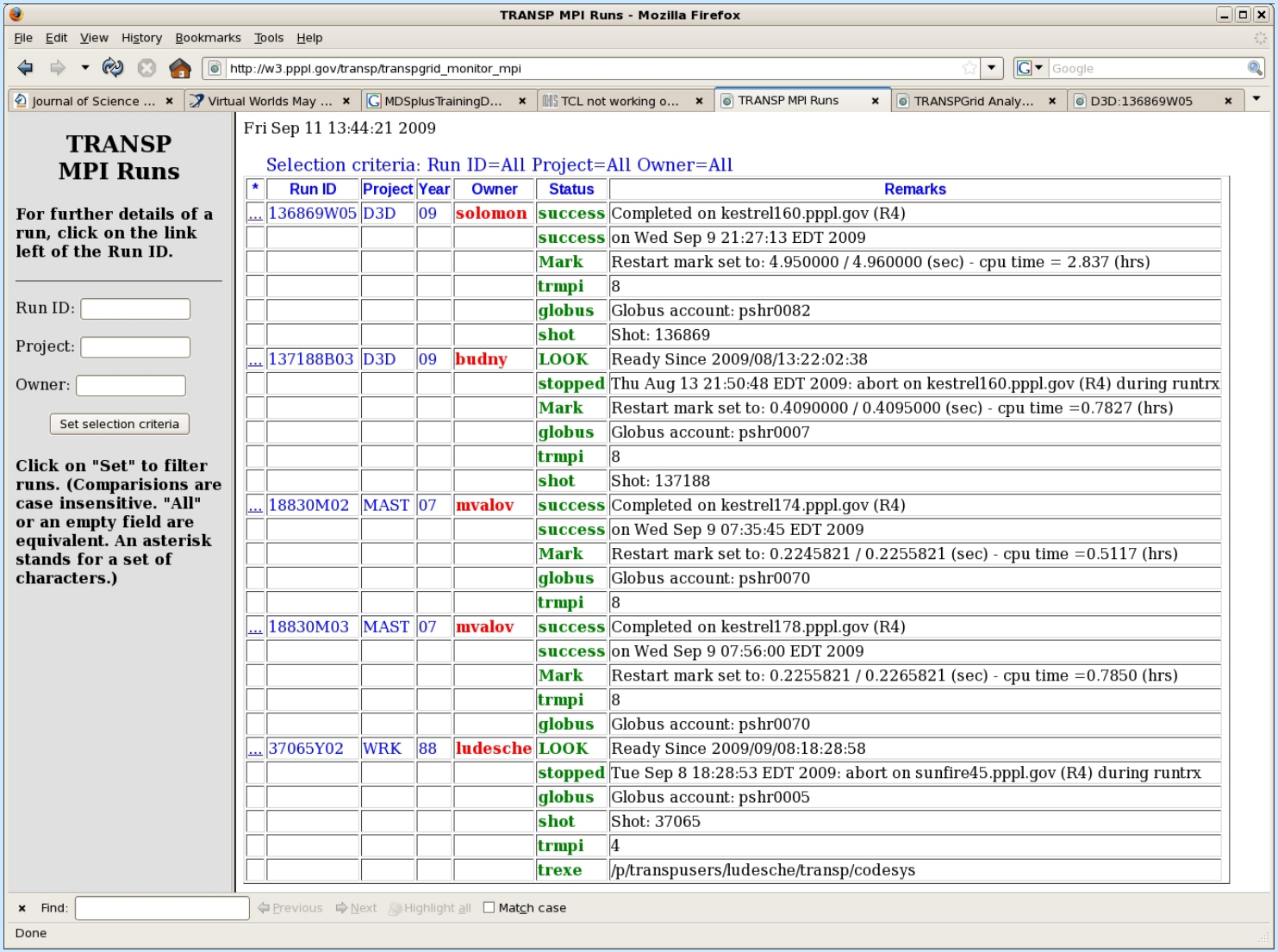


ElVis

Display & Compare



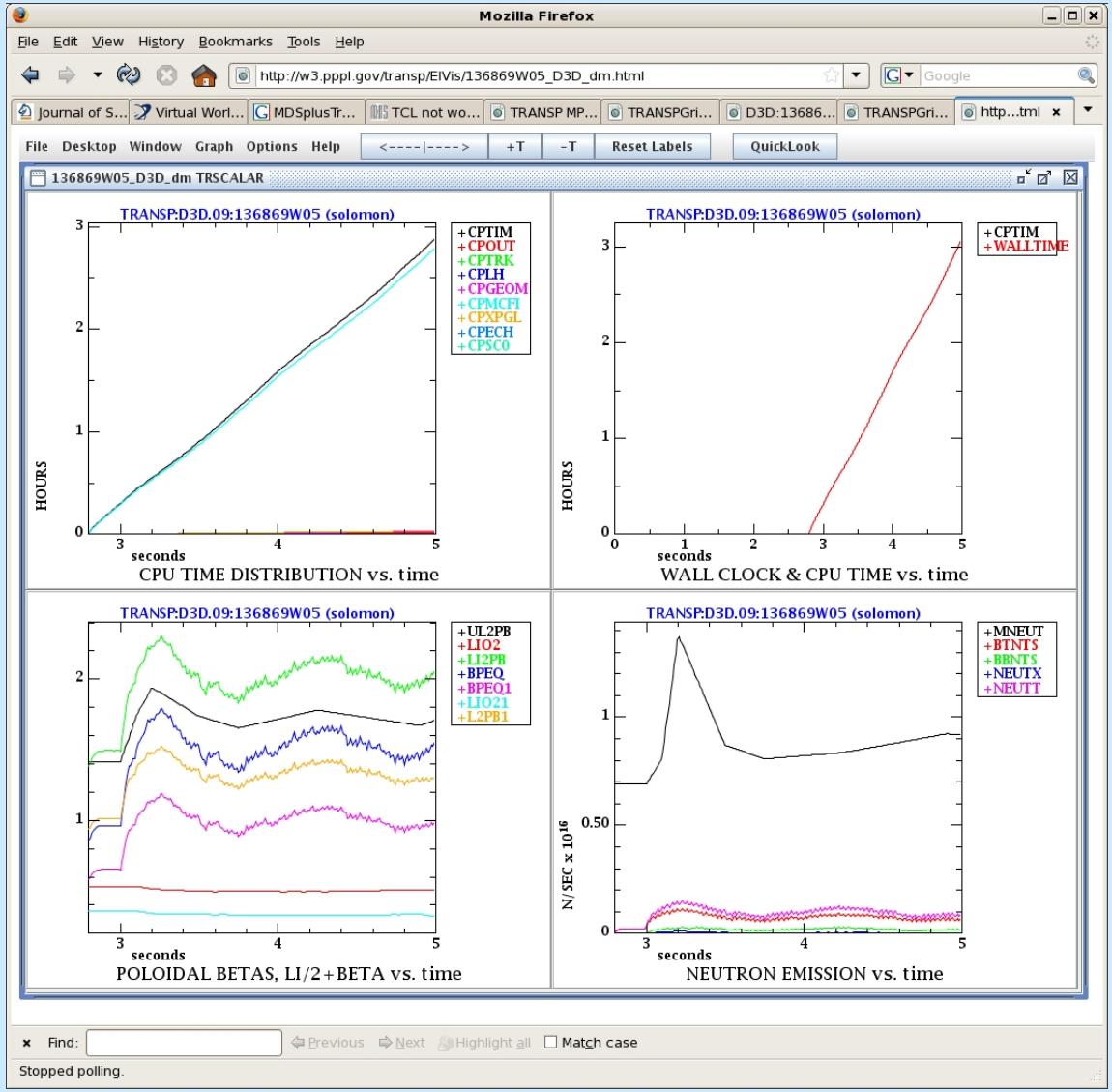
Sim Runs Listed on Web Page



*	Run ID	Project	Year	Owner	Status	Remarks
...	136869W05	D3D	09	solomon	success	Completed on kestrel160.pppl.gov (R4)
					success	on Wed Sep 9 21:27:13 EDT 2009
					Mark	Restart mark set to: 4.950000 / 4.960000 (sec) - cpu time = 2.837 (hrs)
					trmpi	8
					globus	Globus account: pshr0082
					shot	Shot: 136869
...	137188B03	D3D	09	budny	LOOK	Ready Since 2009/08/13:22:02:38
					stopped	Thu Aug 13 21:50:48 EDT 2009: abort on kestrel160.pppl.gov (R4) during runtrx
					Mark	Restart mark set to: 0.4090000 / 0.4095000 (sec) - cpu time =0.7827 (hrs)
					globus	Globus account: pshr0007
					trmpi	8
					shot	Shot: 137188
...	18830M02	MAST	07	mvalov	success	Completed on kestrel174.pppl.gov (R4)
					success	on Wed Sep 9 07:35:45 EDT 2009
					Mark	Restart mark set to: 0.2245821 / 0.2255821 (sec) - cpu time =0.5117 (hrs)
					globus	Globus account: pshr0070
					trmpi	8
...	18830M03	MAST	07	mvalov	success	Completed on kestrel178.pppl.gov (R4)
					success	on Wed Sep 9 07:56:00 EDT 2009
					Mark	Restart mark set to: 0.2255821 / 0.2265821 (sec) - cpu time =0.7850 (hrs)
					trmpi	8
					globus	Globus account: pshr0070
...	37065Y02	WRK	88	ludesche	LOOK	Ready Since 2009/09/08:18:28:58
					stopped	Tue Sep 8 18:28:53 EDT 2009: abort on sunfire45.pppl.gov (R4) during runtrx
					globus	Globus account: pshr0005
					shot	Shot: 37065
					trmpi	4
					trexe	/p/transpusers/ludesche/transp/codesys

Click on run ID to monitor data.

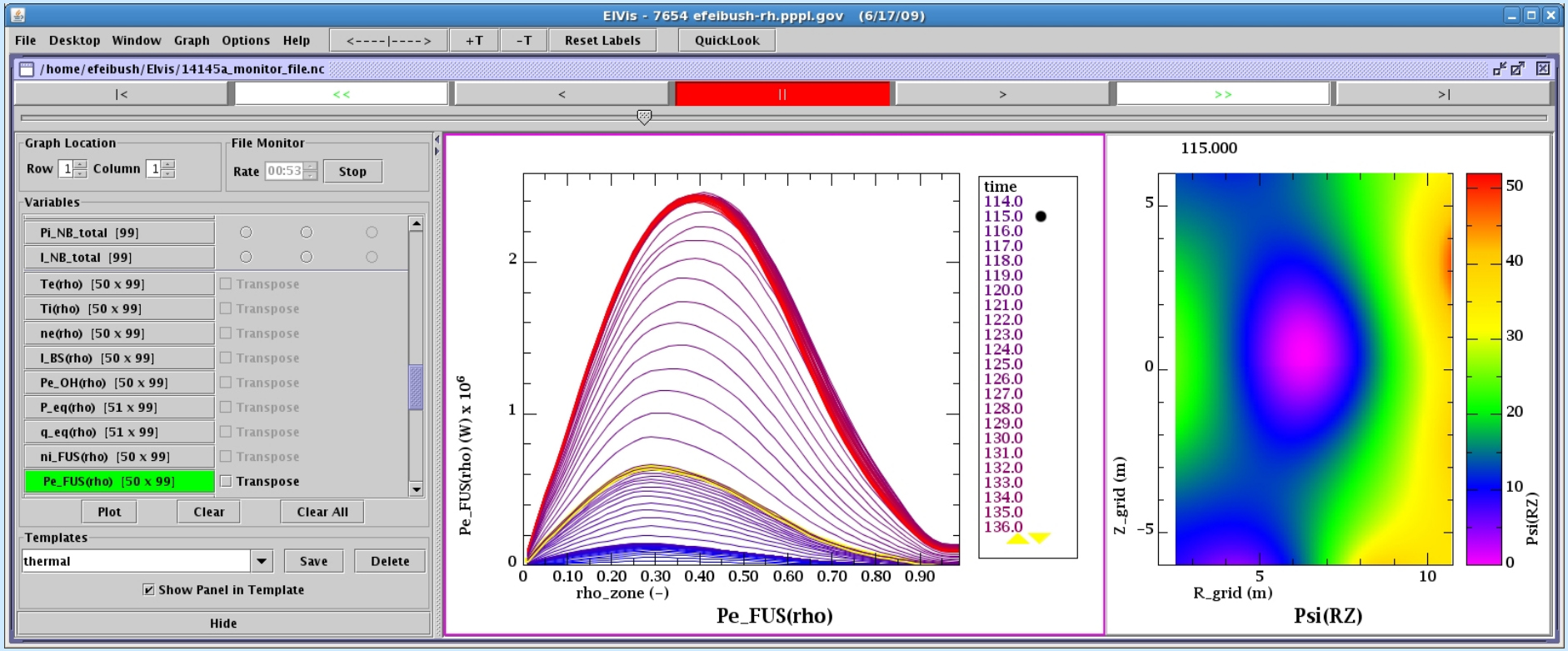
Monitor Data for a Run



Automatically checks for new data.

Adds to display

Variety of Graph Displays

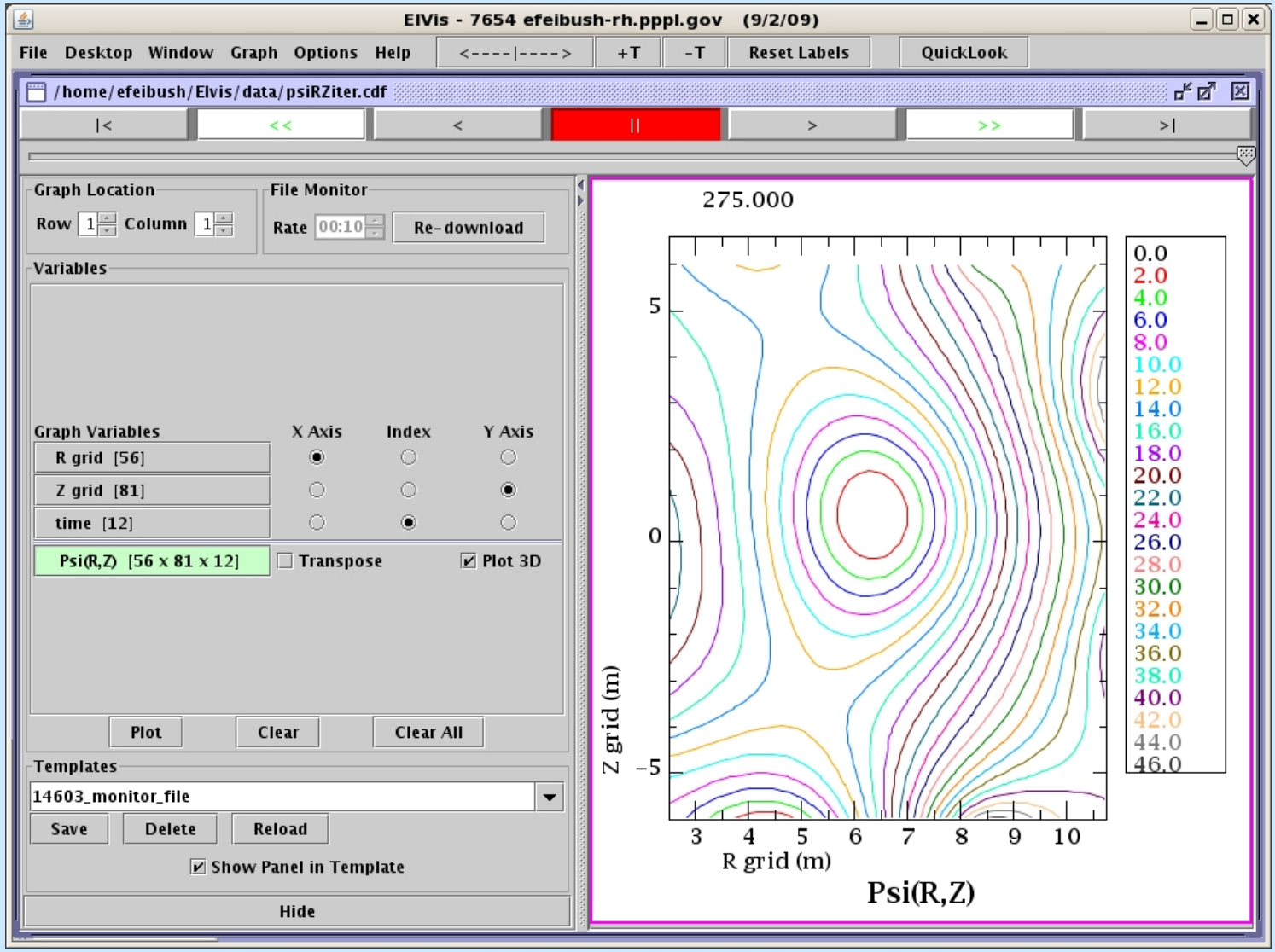


All time indexed curves in 1 graph.
Color gradient, red to blue,
shows time order.

f(x,y,t) – color map plot

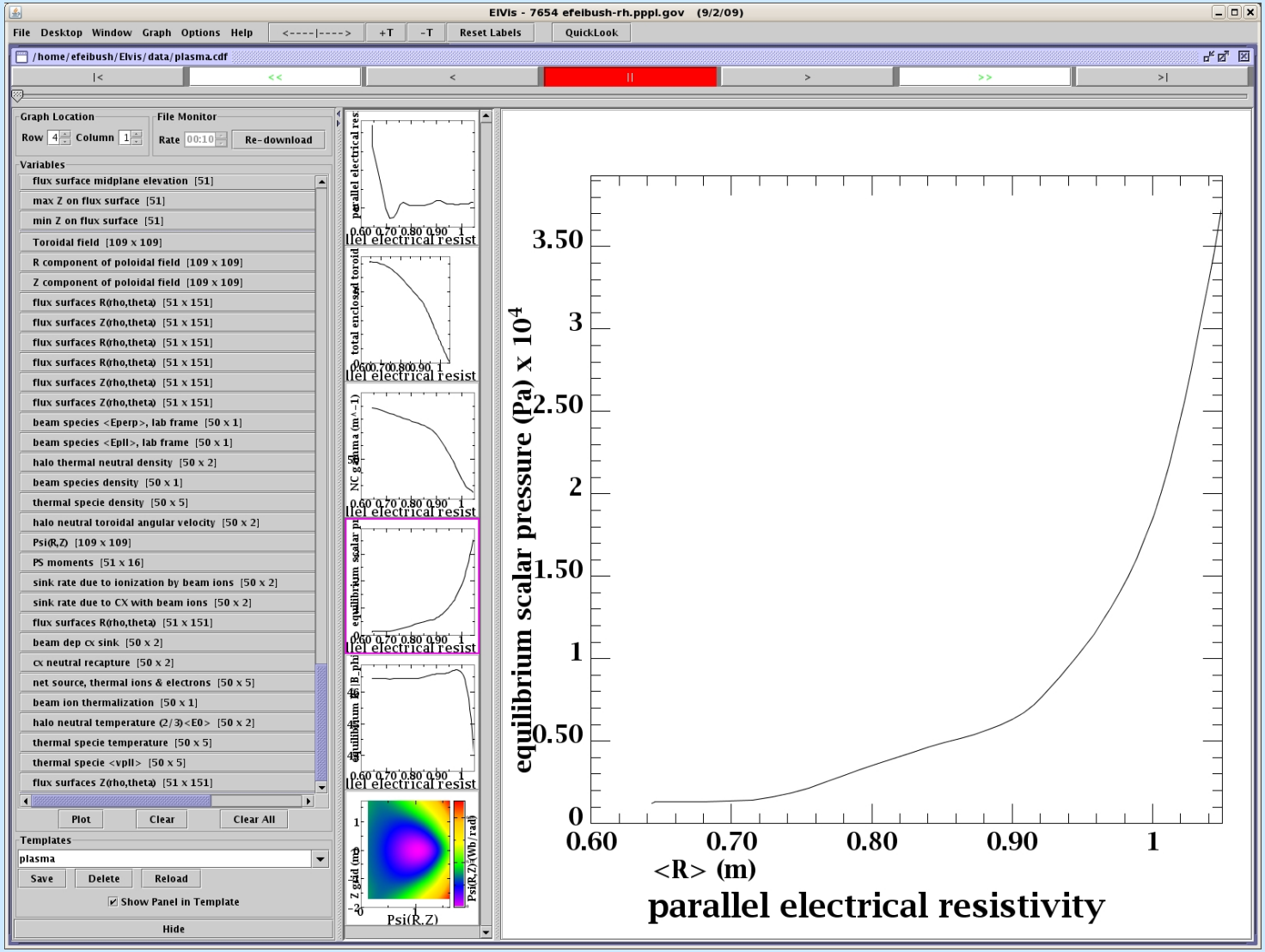
animates in time

Contour Plot



Requested by users for comparison to other programs.

Filmstrip Layout for Selecting Graphs

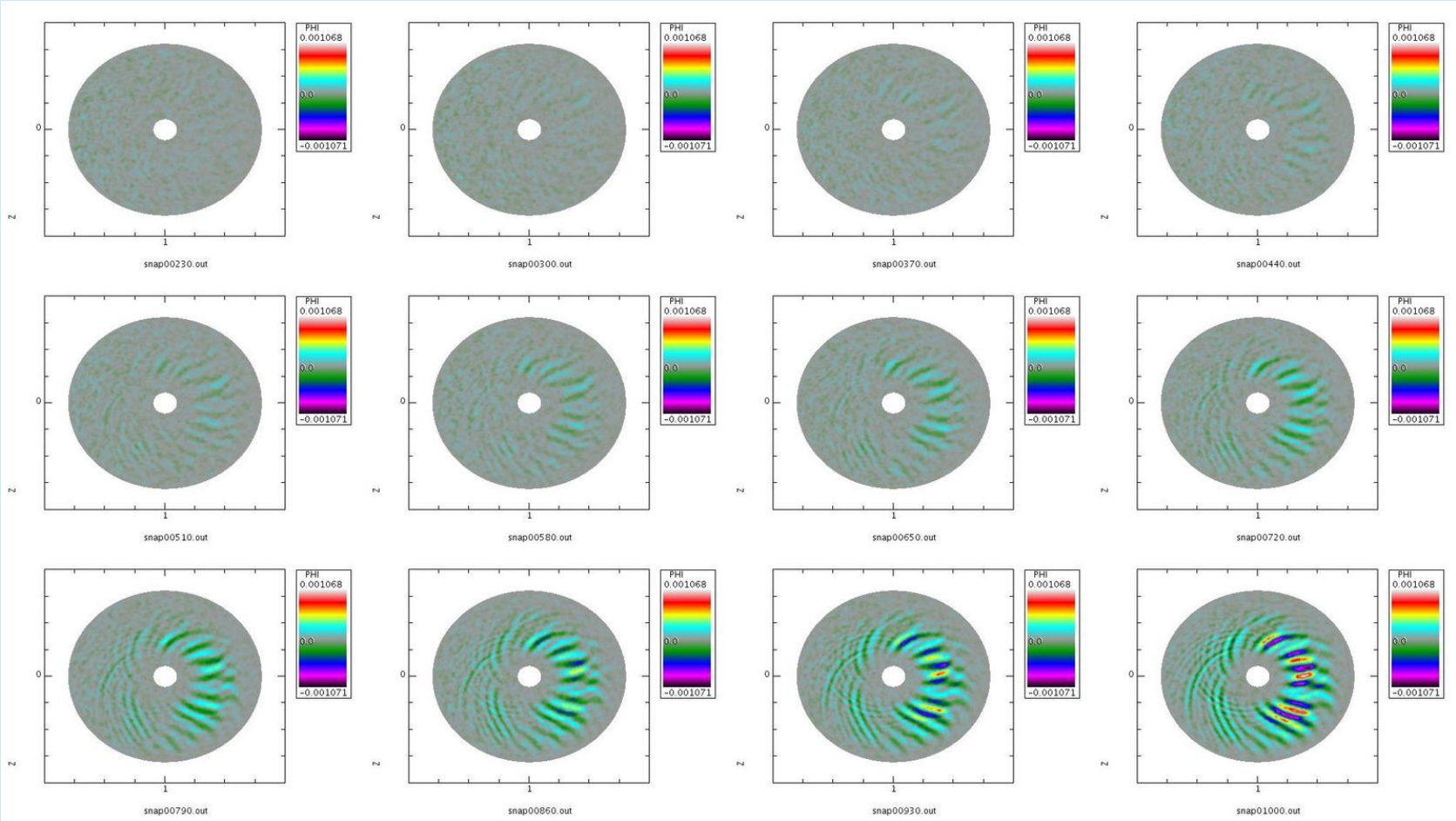


Alternative Technique:

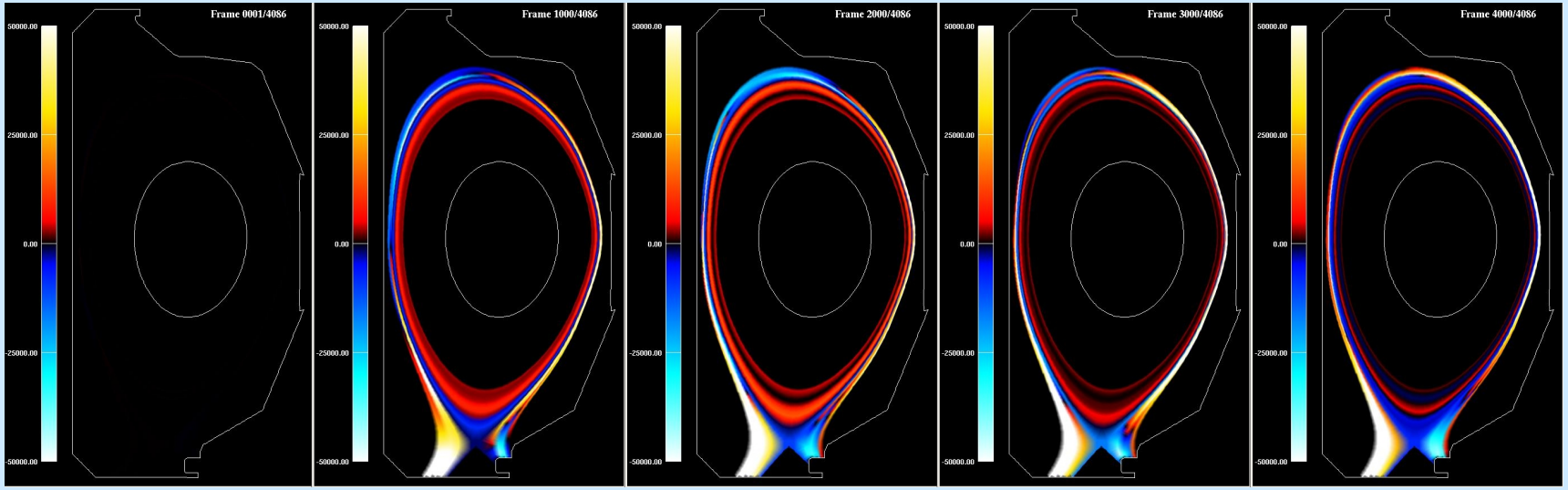
Time Step Image Sequences

- Larger datasets – too large for PC download
- Complex vis rendering on server side
  - Visit
  - Rescale images to global min/max
- Sequence of images = movie
  - Download images from URLs instead of variables
  - Fast enough for informative images
- Display program can show multiple runs
  - compare time steps

Image Sequence from GTC



XGC Image Sequence



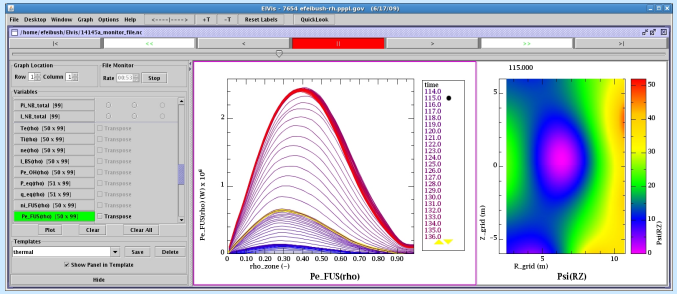
Monitoring & Display Systems

- Incorporated user feedback
- Experience from
  - TRANSP
  - CPES
  - SWIM (Plasma State netCDF file = 1 time step)
  - MSE
  - GTC / GTS / GTCneo

Visualization Techniques for Monitoring Simulations

Eliot Feibush Princeton Plasma Physics Laboratory

Visualization Client

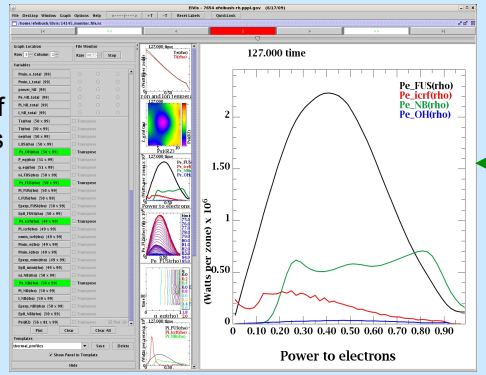


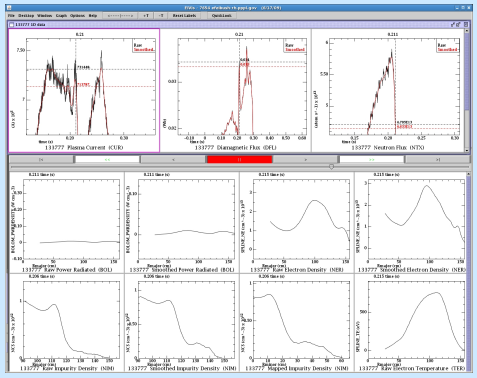
Visualizing Time Indexed Data in a Single Graph

A color gradient legend, from blue to red, is applied to *f*(x,t) curves of Pe_FUS(rho). The color sequence conveys the time ordering in one static graph. The yellow triangles in the legend box control scrolling the list of time indices. The client periodically checks for new data and automatically adds it to the graphs.

Filmstrip Layout

Scientists need to organize an increasing number of graphs. Thumbnails are shown in scrollable column. Variables highlighted for selected graph. Easy to learn layout based on digital photo and slide program paradigm.





Integrated Animation

f(x) data in the top row is interactively examined with digital readout by dragging the cursor along time axis. Animation is advanced simultaneously to closest time step in second & third rows. This feature was requested by user.

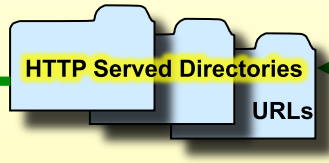
Automated Data Monitoring Scientific Graphics Display

f(x,y,t) data for Psi(R,Z) is downloaded and visualized in the client program. Having the data locally improves interactive exploration.

HTTP Web Server

Scientists can monitor long running programs from anywhere on the Internet.

Leverage use of HTTP server and web directories to send data to client instead of developing custom data server and protocol.



Client checks URL for new data. Adjusts polling rate to simulation's update rate throughout the run.

Implementation

Client software written in Java for portability of single version.
Runs as trusted applet in browser or as Java application to access more memory.
Visualizations can be saved to PostScript or PDF files for publication quality output.

Simulations

Monitoring Variables with Graph Templates

Simulation programs on cluster or super-computer write monitor data to netCDF files. Variables are defined with an "unlimited" dimension in time. Append data to variables at each time step. API in client reads netCDF file stored at URL.

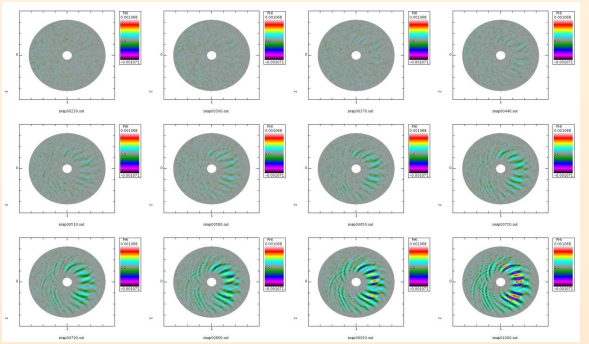
Any program that writes a structured netCDF file can be automatically monitored.

Template file is paired with netCDF file to specify variables to plot. Load new run with established presentation. Compare runs.

netCDF File
Variables
Attributes
Units

Template File
Graph descriptions
Presentation style
Annotation

Monitor Data



Monitoring with Sequence of Image Files

Gyrokinetic Toroidal code produces data too large to download so an image is rendered for each time step.
Client downloads images sequentially to display animation and checks for new images when last image is displayed.
Images are rescaled to global range at end of run.
A portable movie maker program combines images into a movie file and avoids copying the images to another platform.

http://w3.pppl.gov/elvis