



# IMASViz - IMAS visualization utility

L. Fleury, D. Penko



University of Ljubljana  
Faculty of *Mechanical Engineering*



This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

# About the IMASViz project



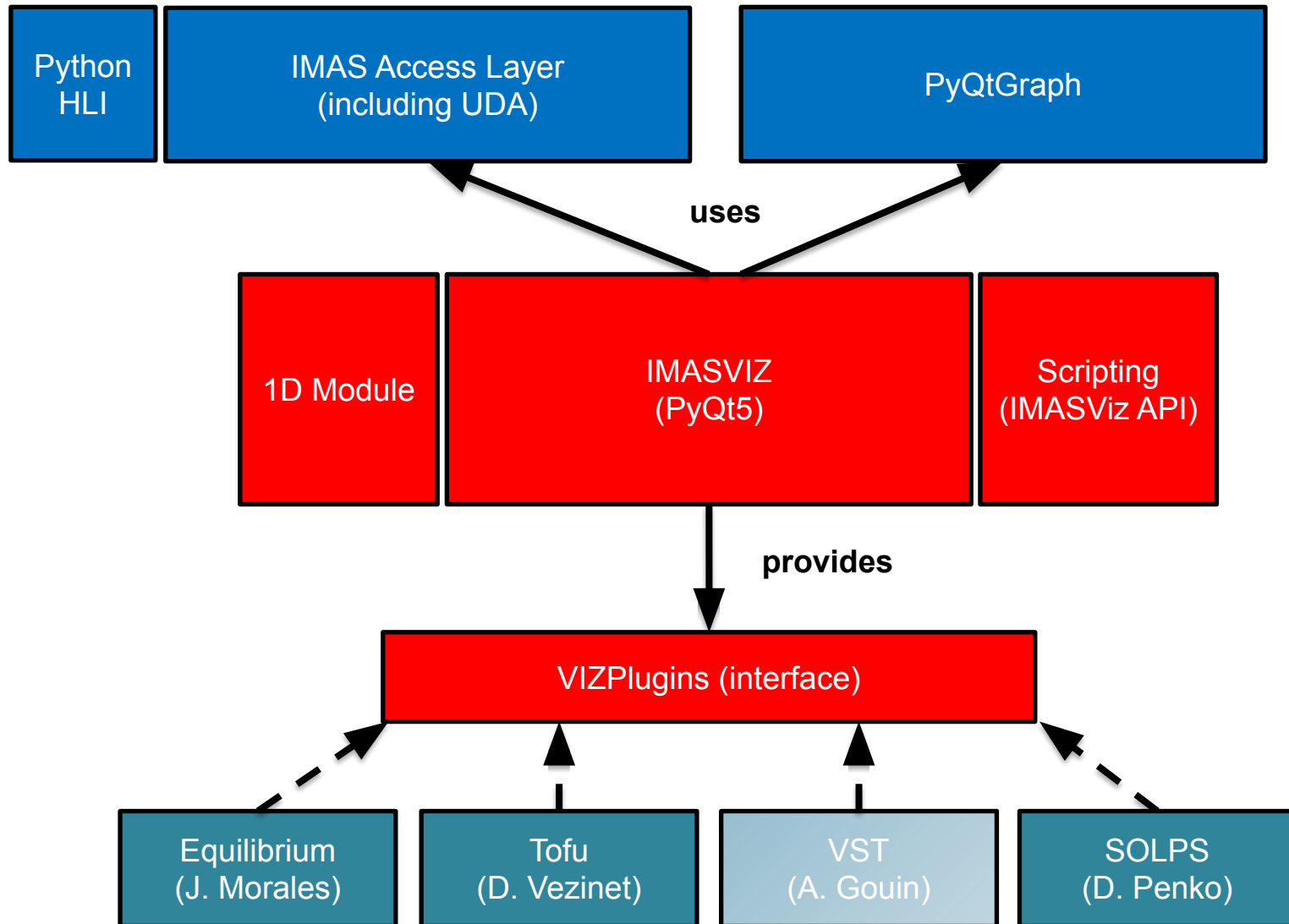
- Started in 2016 (~ 1 year of effective development)
- Written in Python3.7, uses libraries:
  - PyQt5 for graphical user interface (GUI)
  - Pyqtgraph for plotting functionalities (plugins can also use matplotlib)
  - Sphinx for generating documentation (.pdf, .html etc.)
- Project sources hosted at [git.iter.org](https://git.iter.org) (Visualisation/VIZ)
- IMASViz deployed on GateWay, ITER HPC and WEST
- Latest documentation is available on:
  - the GIT repository:
    - .pdf: <https://git.iter.org/projects/VIS/repos/viz/browse/doc/IMASViz.pdf>
    - .zip containing .html documentation (open **index.html** file in web browser): [https://git.iter.org/projects/VIS/repos/viz/browse/doc/IMASViz\\_documentation\\_html.zip](https://git.iter.org/projects/VIS/repos/viz/browse/doc/IMASViz_documentation_html.zip)
  - PSNC webpage: <https://docs.psnc.pl/display/WFMS/IMASViz+v2>

# IMASViz key strengths



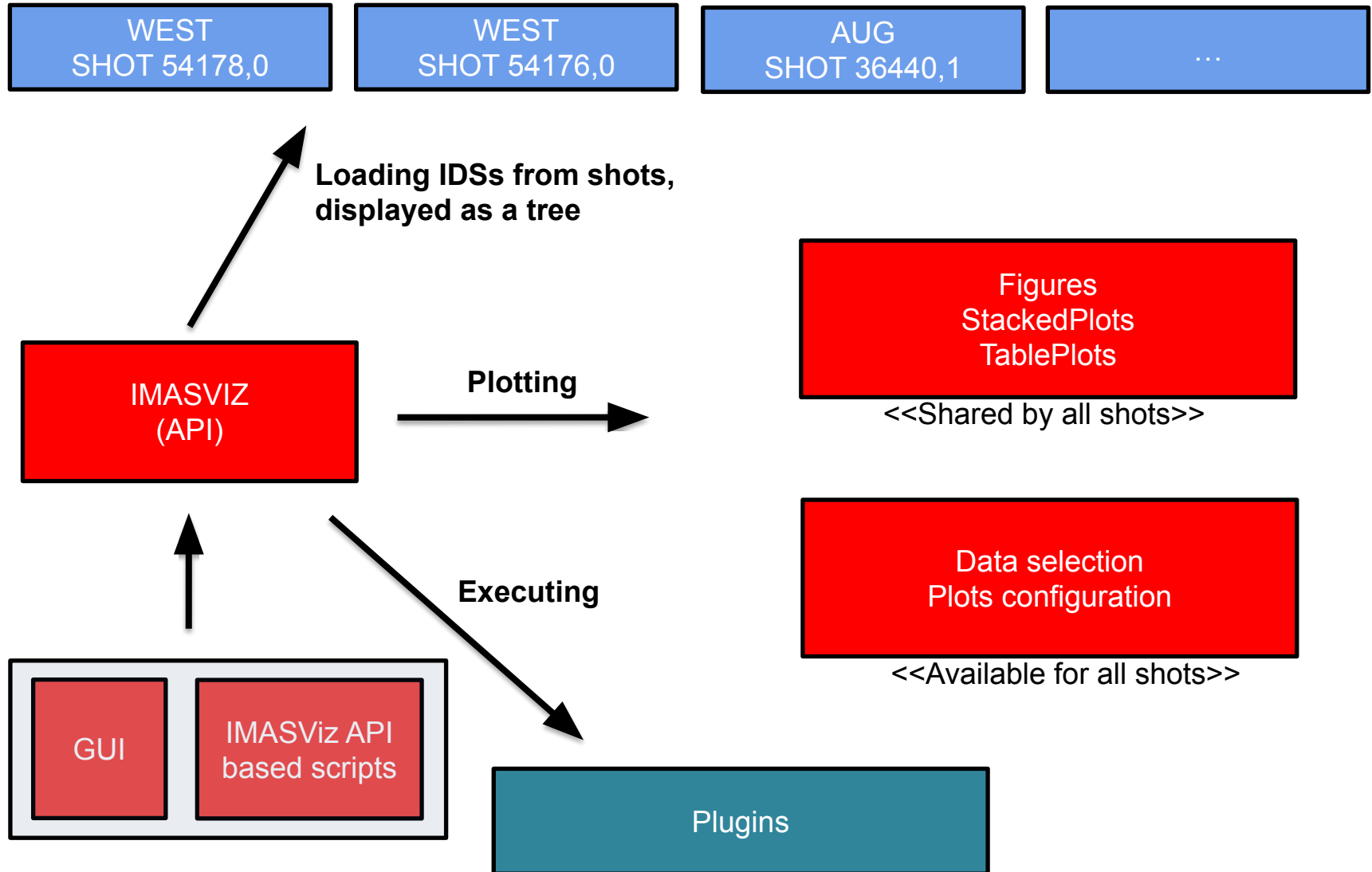
- GUI reflects the Physics Data Model
- No prior knowledge of signals names required
- Use of IMAS Access Layer and UDA for remote access
- GUI/Scripting: API dedicated to data selection in the PDM and plotting
- Quick data comparison between signals from different /shot/run/machine
- Exportable scripts to other platforms
- Tool available for all laboratories using IMAS/UDA solution
- Design of a plugins mechanism for extending available features

# IMASViz design



**NOTE:** Tofu plugin is currently not available on Gateway and HPC-ITER

# IMASViz operation



# About the demo



- ❖ Running IMASViz on the GateWay
- ❖ Loading shot data
  - ❖ Opening several shots, loading IDSs
  - ❖ Managing shots windows
- ❖ Plotting 1D arrays, comparing shots
- ❖ Plot configuration
- ❖ Selecting data
- ❖ Saving a selection
- ❖ Applying a selection on a new shot
- ❖ Visualizing 0D and 1D data embedded in time slices
- ❖ Using UDA: displaying the magnetics IDS from a JET shot
- ❖ Exporting data to a new IMAS pulse file
- ❖ Example of using the plugins – Equilibrium plugin



1. In a new terminal, execute the following command in order to load the

```
> module load imasenv # or any other specific imasenv module version  
> module switch imas-viz/2.3.0 # A suitable IMASViz module might be already loaded  
by the imasenv module
```

2. With the environment set, run the IMASViz by simply typing the following command:

```
> viz
```

An empty dialog window will appear

IMAS\_VIZ (version 2.3.0)

Local data source Experiment data source

User name g2user|

Tokamak

Shot number

Run number 0

Open

Note: IMASViz documentation can be accessed by running the command **> viz-doc**



1. The **Local data source** tab should be selected (default on IMASViz run).
2. In the text boxes set:
  - a. **User name: g2dpc**
  - b. **Tokamak: aug**
  - c. **Shot number: 36440**
  - d. **Run number: 1**
3. Press **Open** button

An empty data tree view (DTV) window will appear (see next slide).

A screenshot of the IMAS\_VIZ (version 2.3.0) software interface. The window title bar shows 'IMAS\_VIZ (version 2.3.0)'. There are two tabs: 'Local data source' (selected) and 'Experiment data source'. Below the tabs are four text input fields: 'User name' containing 'g2dpc', 'Tokamak' containing 'aug', 'Shot number' containing '36440', and 'Run number' containing '1'. At the bottom of the window is a large 'Open' button.

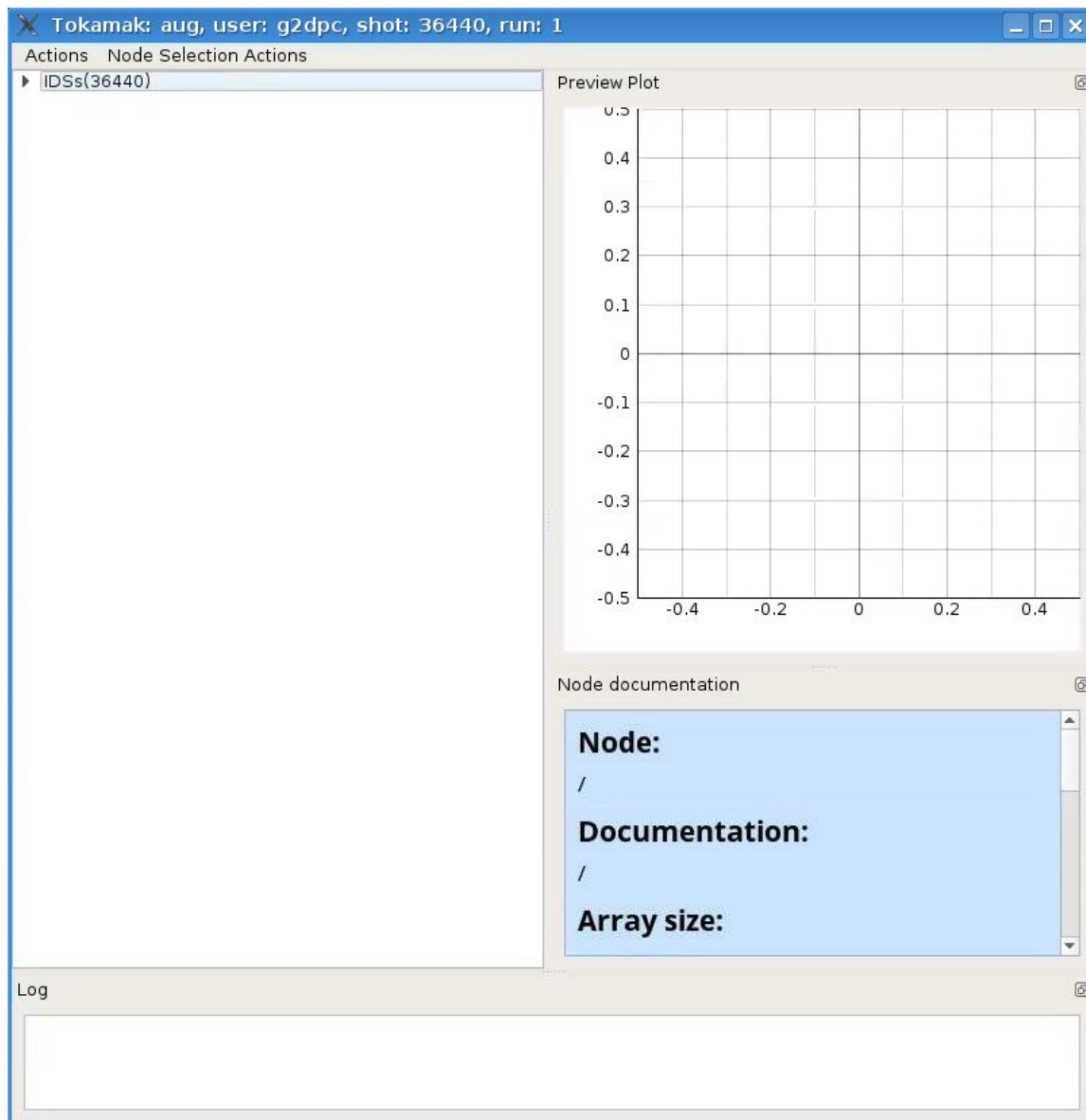


# GUI overview: Data Tree View (DTV)



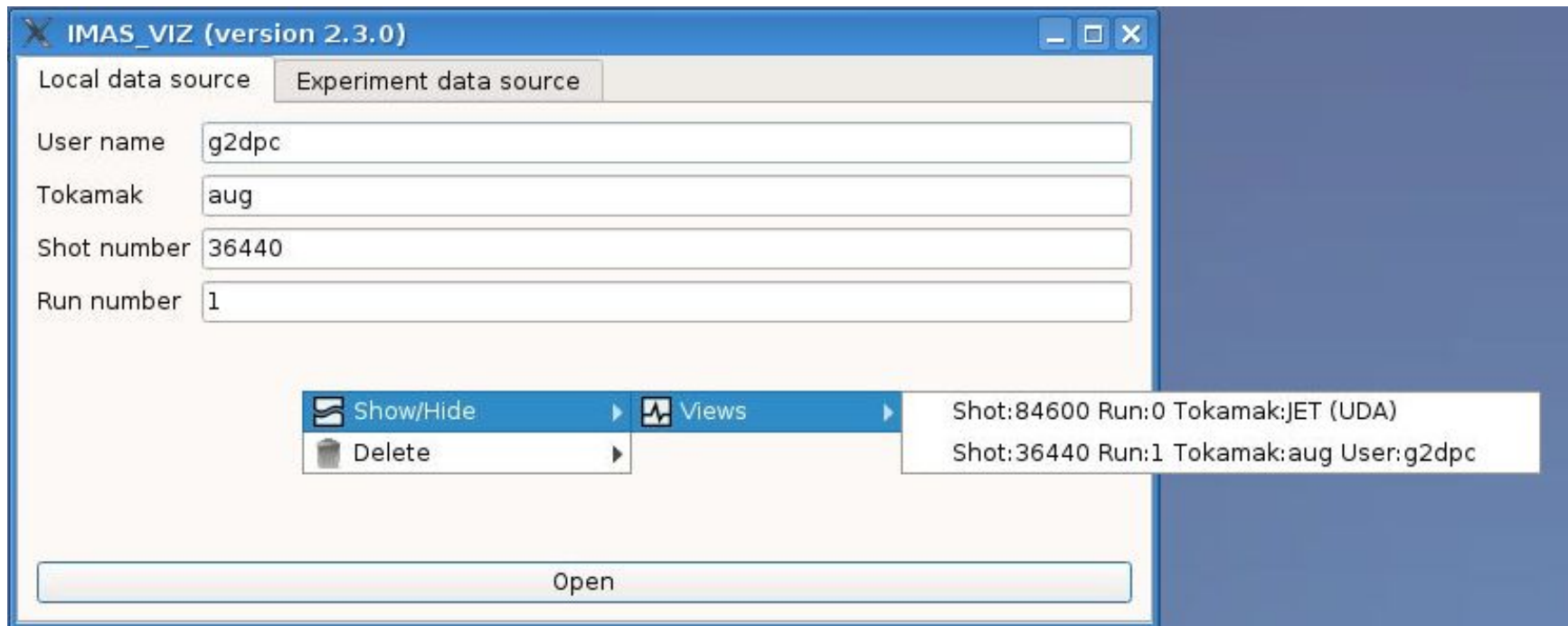
- In IMASViz each opened shot is opened in a separate data tree window (DTV).
- The main components are:
  - **Menu bar** (on top)
  - **Data tree browser** (left)
  - **Preview Plot widget** (top right)
  - **Node Documentation widget** (bottom right)
  - **Log window** (bottom)

**NOTE:** closing the window with the cross button only hides the DTV. Deleting DTV can be performed (see next slide)





**Right clicking on the main GUI tab allows you to show/hide or delete a shot window**





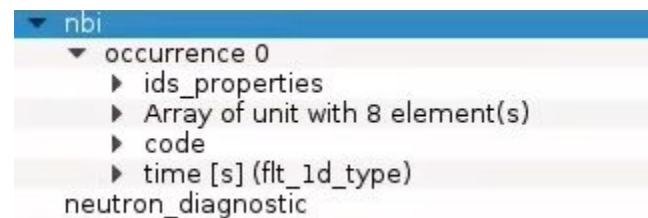
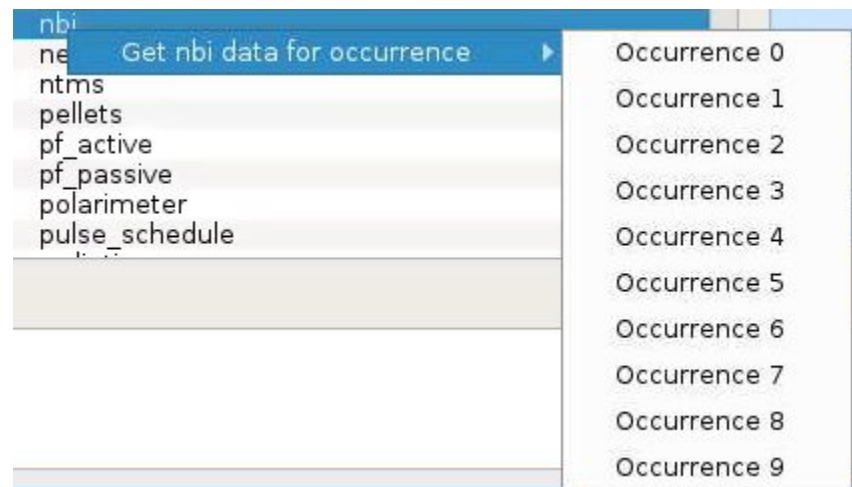
In the DTV, filled IDSs are marked by **blue color**.

To open an IDS (in this case **nbi IDS**):

1. In the DTV, right click on the **nbi**
2. In the available selection, select the wanted occurrence (in our case **Occurrence 0**) (note: same can be achieved by double clicking on the IDS label)

Reading the IDS might take a few seconds, depending on the size of the contents found in the IDS.

3. Click on the arrow beside the **nbi** label. The IDS tree structure will be shown



# Navigating through database



The tree view allows navigating through the database.

1. Navigate to and select:
  - **nbi**
  - **Array of unit with 8 element(s)**
  - **unit 3/8**
  - **power\_launched [W]**
  - **data [W] (FLT\_1D)**

A **Preview Plot** will be displayed (top right window) and **Node Documentation** will be populated, displaying some basic info.

The screenshot shows the Tokamak database interface. The tree view on the left displays a hierarchy of nodes, with 'nbi' selected. The 'Preview Plot' window on the right shows a graph of 'data[W] (x1e+06)' versus 'unit(i1).power\_launched.ti'. The plot shows a square pulse that rises from 0 to approximately 2.45 at unit 1.5, remains constant until unit 6.5, and then falls back to 0. The 'Node documentation' window on the right shows the selected node 'nbi.unit[2].power\_launched.data' and its documentation, including the array size.

**Node:**  
nbi.unit[2].power\_launched.data

**Documentation:**  
Data

**Array size:**

**Log:**  
18/10/2019 11:48:47|INFO|Loading occurrence 0 of nbi IDS ended successfully, building view...|  
18/10/2019 11:48:47|INFO|Building node for nbi/unit(4)...|  
18/10/2019 11:48:47|INFO|Building tree view took 0.07932591438293457 seconds.|  
18/10/2019 11:48:47|INFO|View update ended.|

# Plotting 1D arrays



To create a basic plot:

1. Right click on **data [W] (FLT\_1D)**

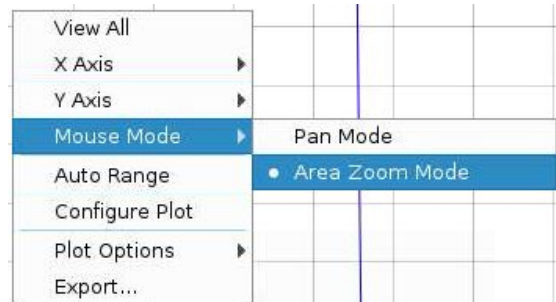
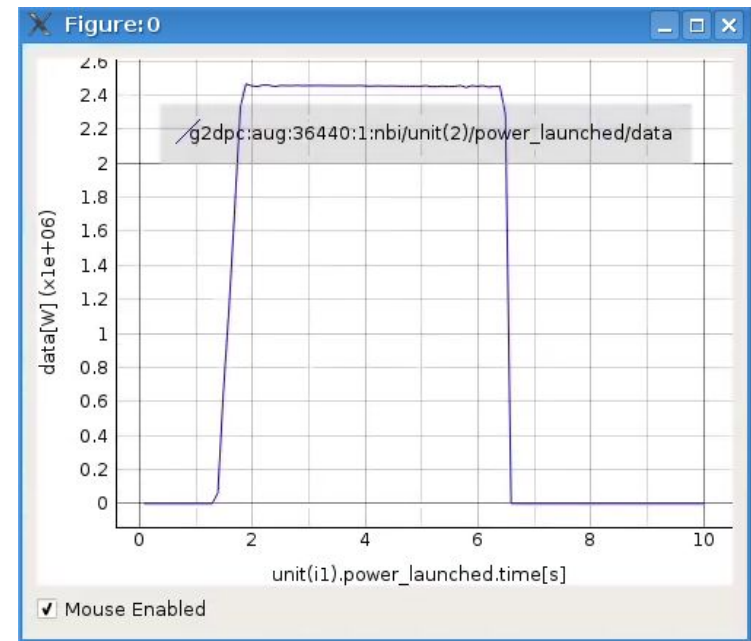
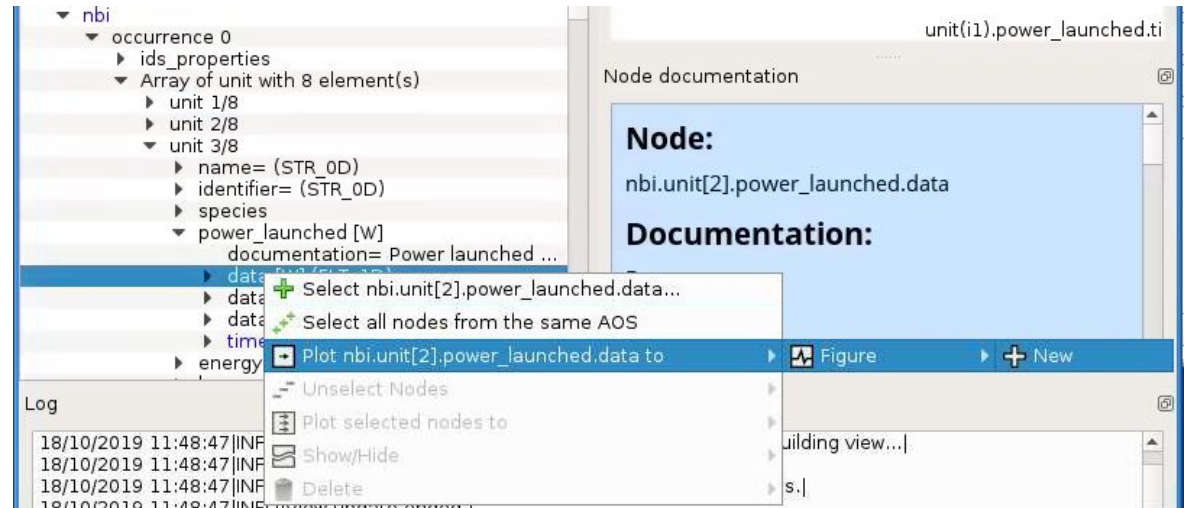
Plottable data is marked by **blue color**.

2. In the open menu select:

- **Plot**
- nbi.unit[2].power\_launched.data to**
- **Figure**
- **New**

A new window with the plotted data will be shown.

**NOTE:** Right clicking within the plot window displays a menu from which many available features for plot analysis such as setting the mouse button mode to **Zoom to area**, exporting the plot to matplotlib window etc.



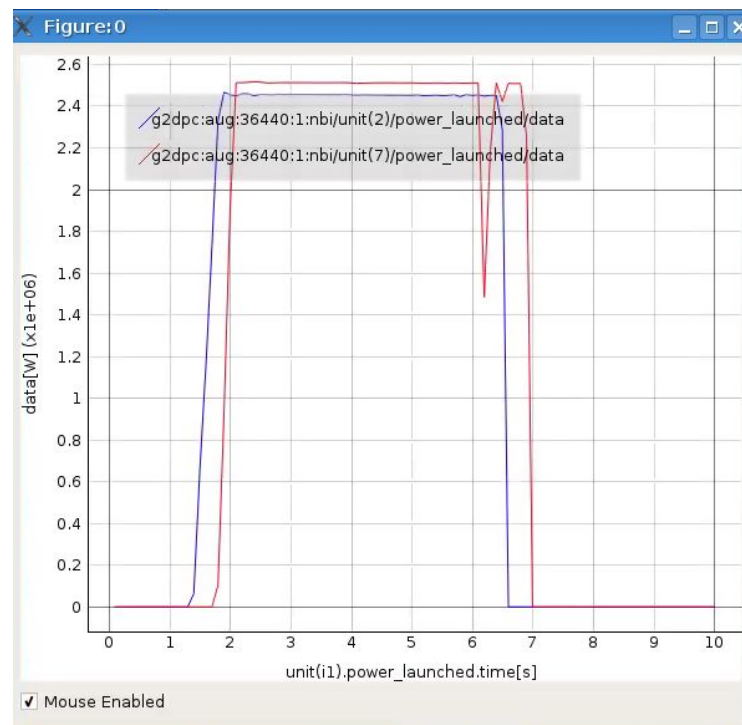
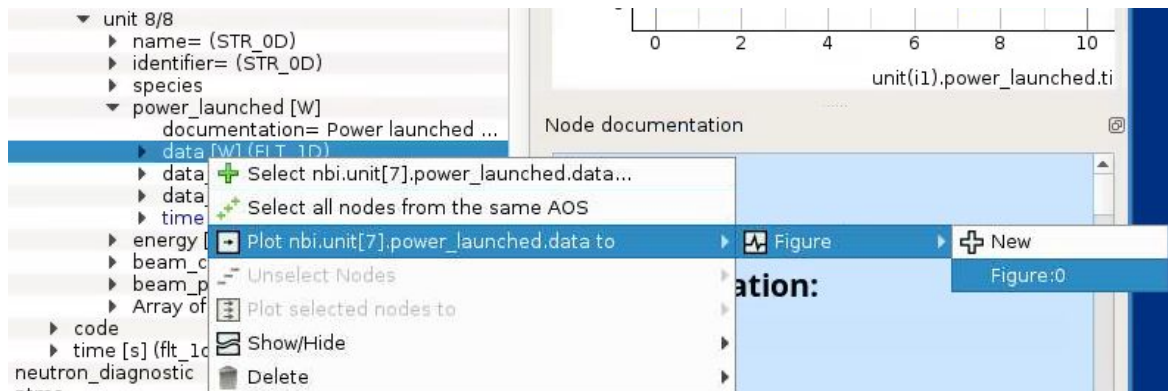
# Plotting data to existing figure



IMASViz allows adding plots to already existing plots.

Example:

1. In DTV, navigate to **nbi.unit[7].power\_launched.data...**
2. Right click on the node and in the open menu select:
  - **Plot nbi.unit[7].power\_launched.data to**
  - **Figure**
  - **Figure:0**



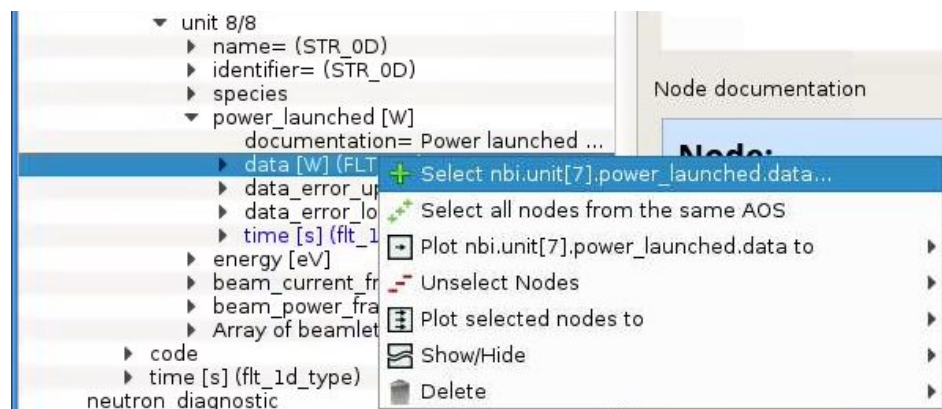
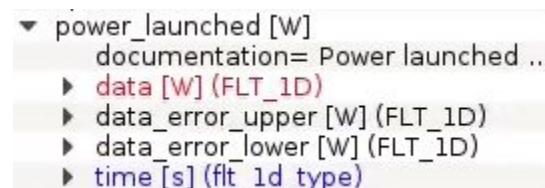
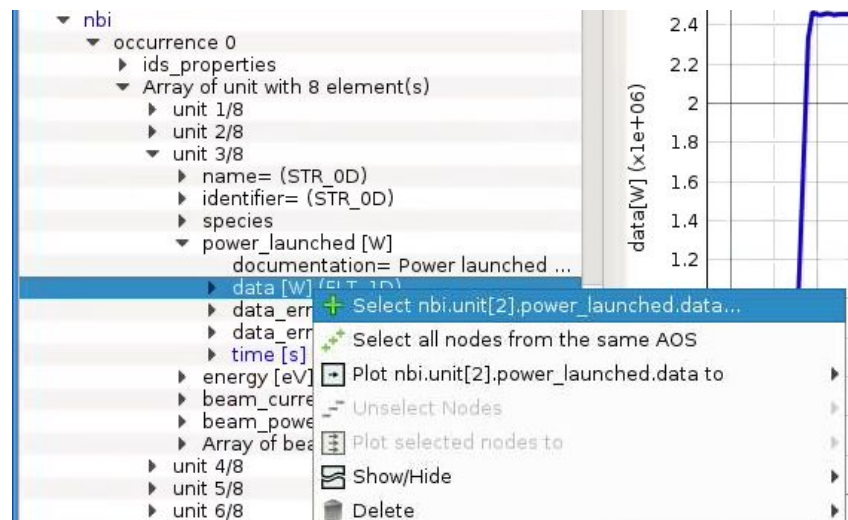
The plot will be added to the previous plot window.

# Manually selecting multiple data



IMASViz allows selecting multiple data at once. Selected data is marked by **red color**.

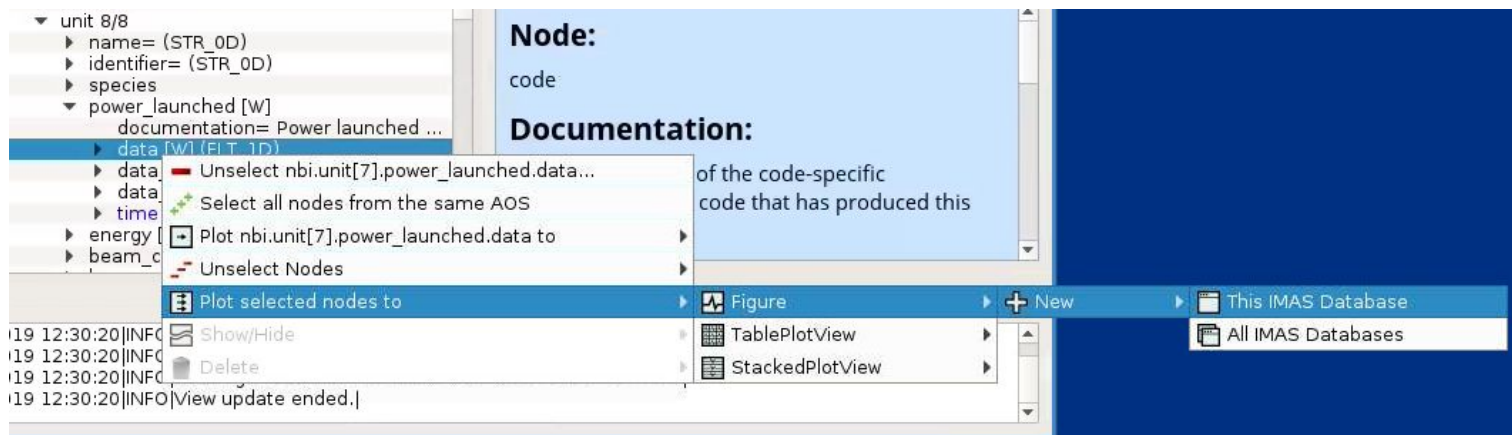
1. Right click on the **nbi.unit[2].power\_launched.data**
2. Select **Select nbi.unit[2].power\_launched.data...**
3. Navigate to
  - unit 8/8
  - power\_launched [W]
  - data [W] (FLT\_1D)
4. Select **Select nbi.unit[7].power\_launched.data...**



# Plotting a selection



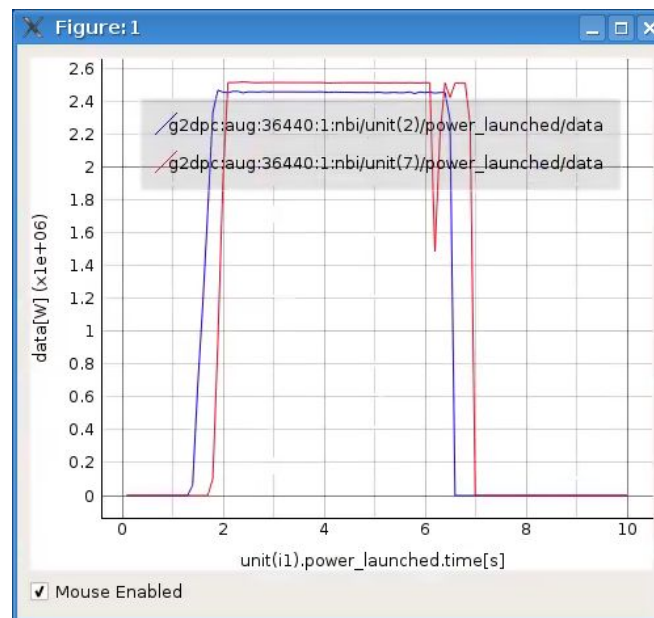
To plot the data from selected signals:



1. Right click on one of the selected signals (marked by **red color**)
2. Select:
  - **Plot selected nodes to**
  - **Figure**
  - **New**
  - **This IMAS Database**

A new plot containing both signal data will be shown.

**NOTE:** when plotting on figures, IMASViz check that data share the same coordinates and the same units, otherwise the plot cannot be performed. This note concerns only figures, not stacked or table plots since data are not sharing plot axis for such plots.



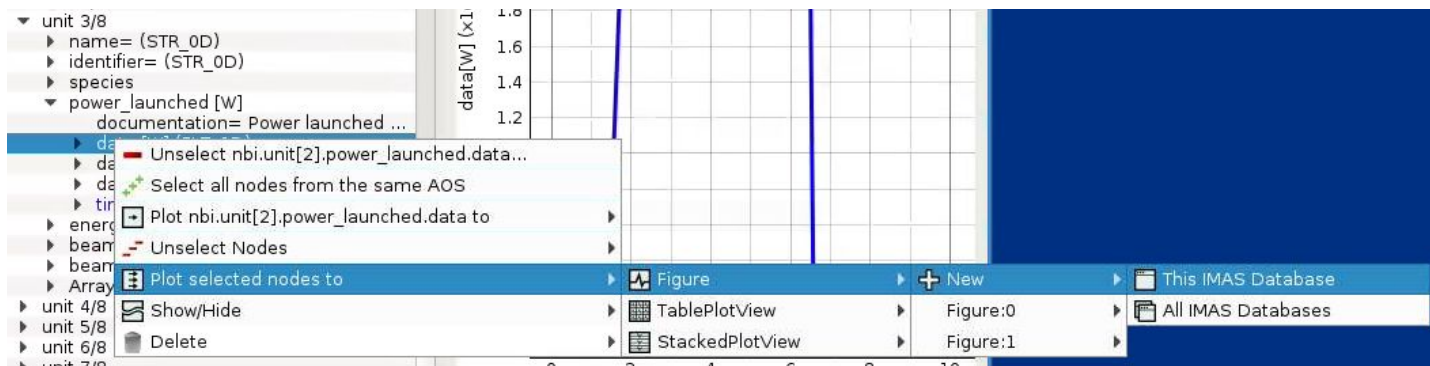
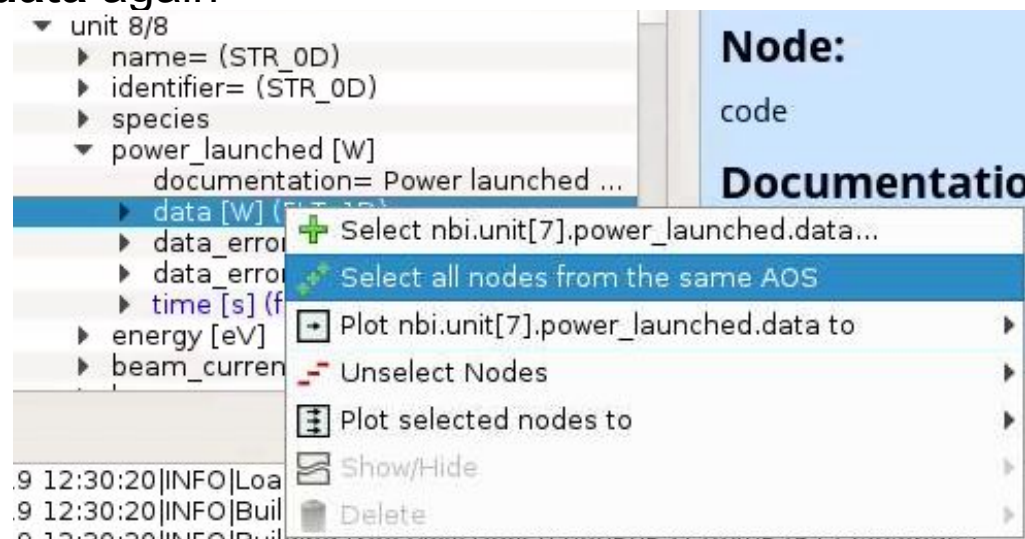


# Selecting all data in the AOS (Array of Structures)



IMASViz allows selecting all data found in the AOS at once:

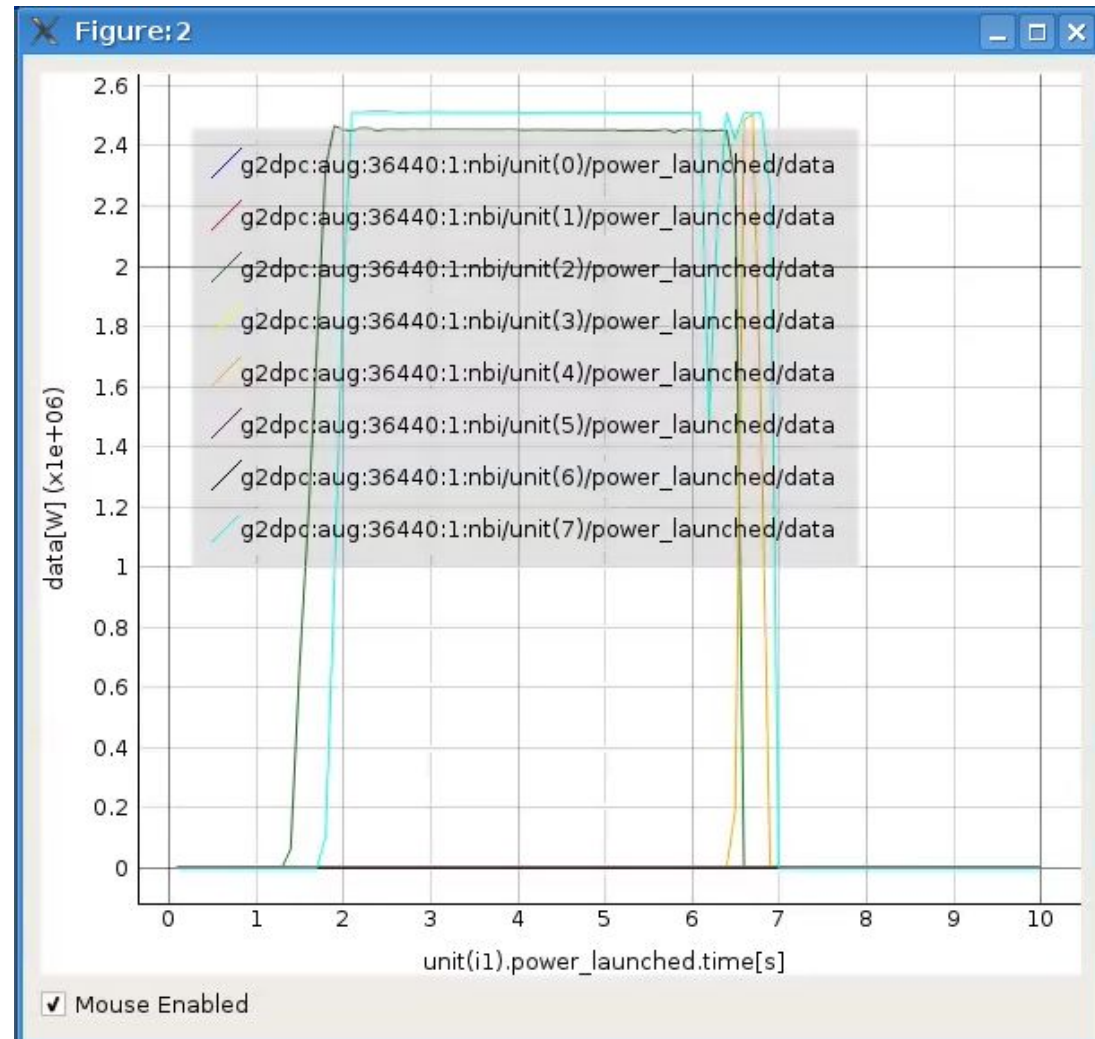
1. Right click on any **nbi.unit[:].power\_launched.data**
2. Select **Select all nodes from the same AOS**
3. In order to plot the selection, same as before, right click on any **nbi.unit[:].power\_launched.data** again
4. Select:
  - a. **Plot selected nodes to**
  - b. **Figure**
  - c. **New**
  - d. **This IMAS Database**



# Selecting all data in the AOS (Array of Structures) plot



The result of plotting all `nbi.unit[:].power_launched.data` is shown on the right figure.

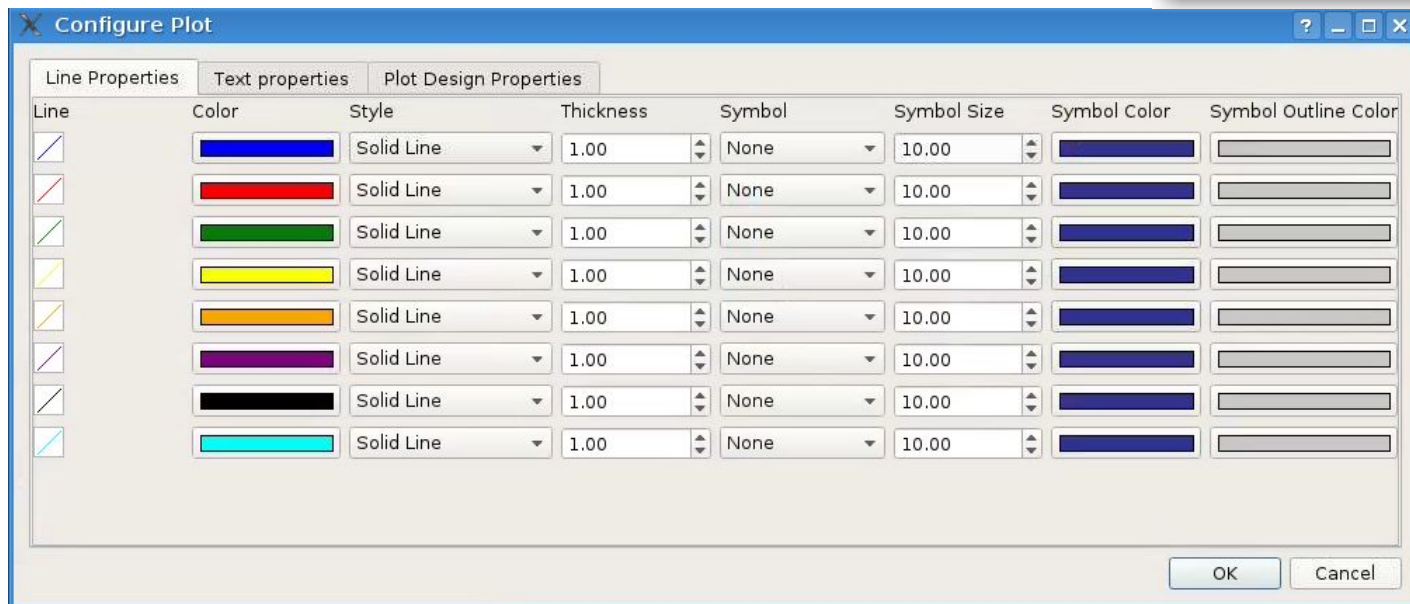
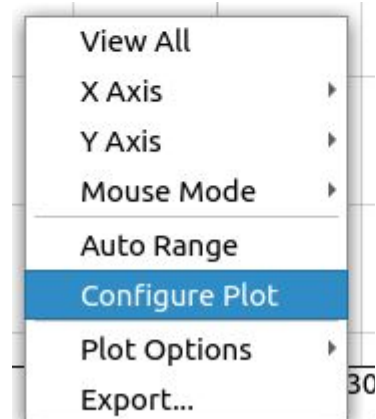




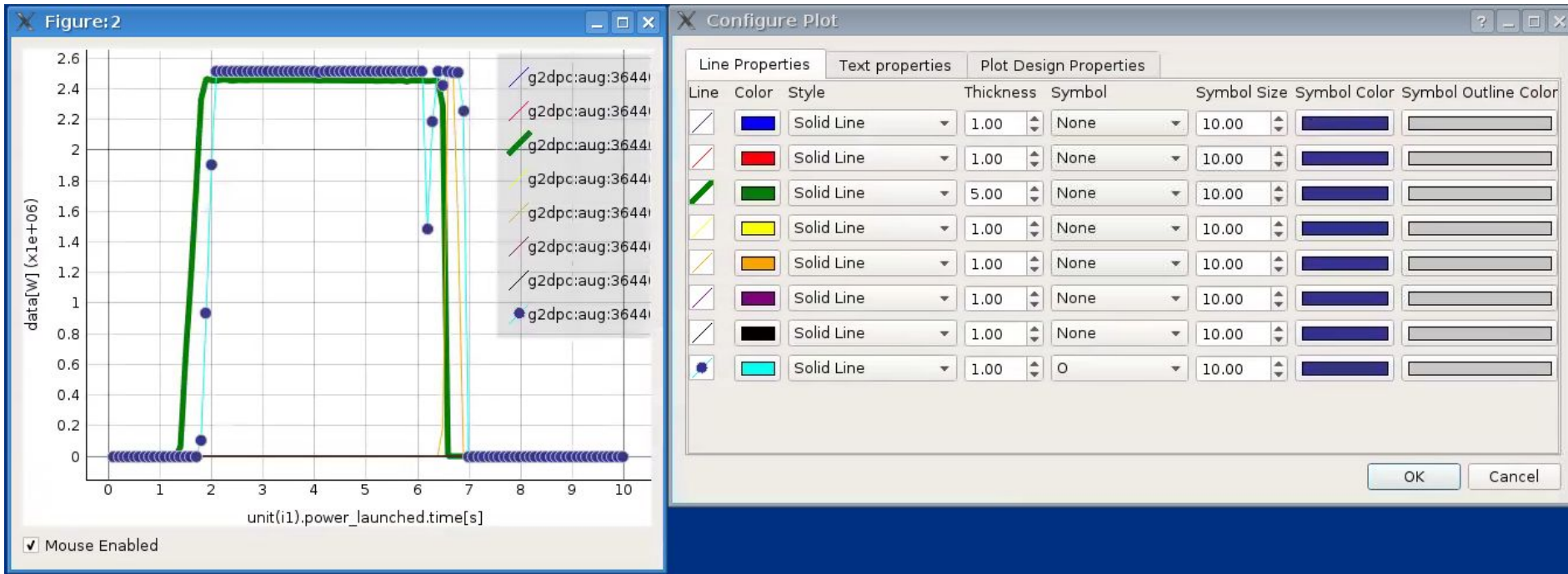
IMASViz enables some of the plot configuration features (not provided by PyQtgraph library).

1. Right click anywhere inside the plot
2. Select **Configure plot**

A Plot Configuration User Interface will be shown

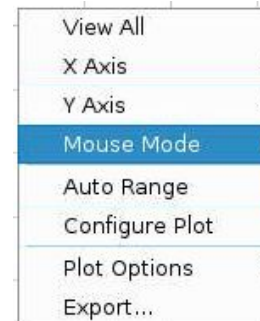


# Plot configuration: Example



**Note:** a menu is available when right-clicking on a plot (including subplot) for:

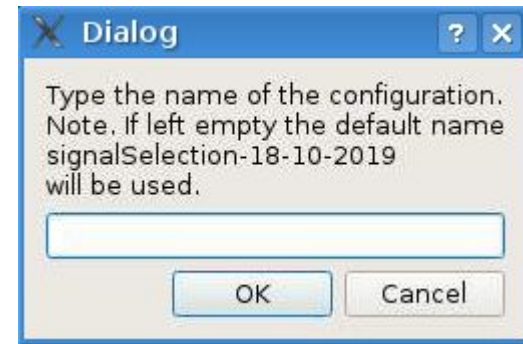
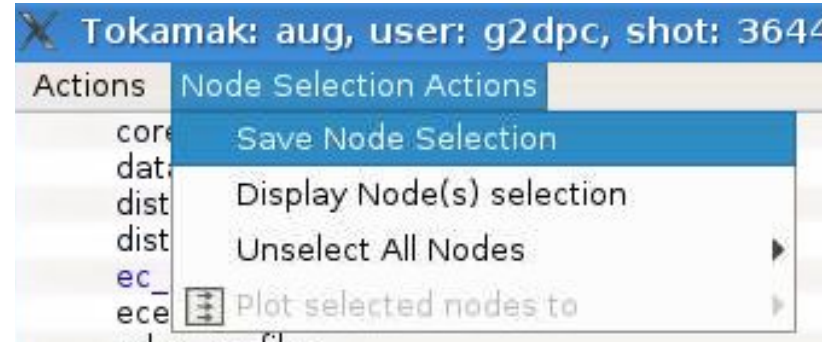
- zooming
- executing filters on the data
- exporting plot to different formats
- ...





IMASViz allows saving the signal selection and then applying it to another shot.

1. In the menu bar, navigate to and select:
  - **Node Selection Actions**
  - **Save Node Selection**
2. A dialog window will be shown. There a configuration label can be specified. Leave it empty for now.
3. Press **OK**.

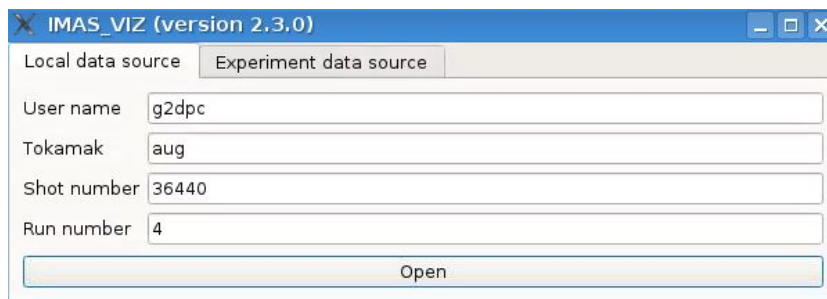


# Applying selection to a new shot (1)



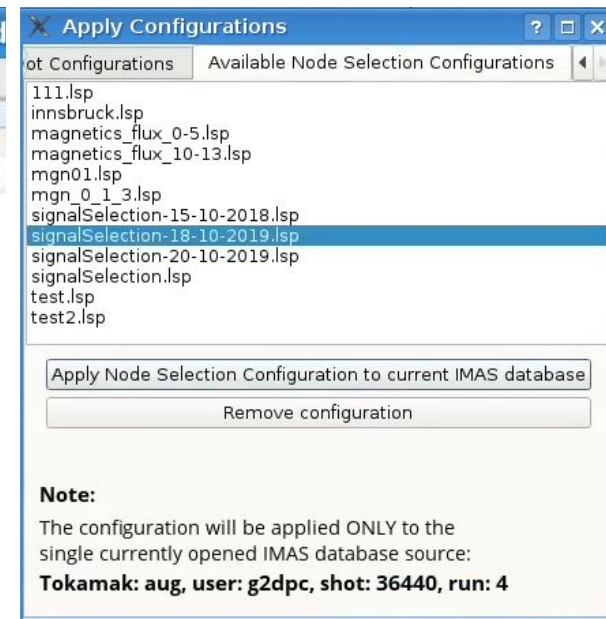
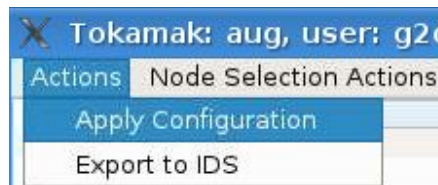
To apply the saved selection to a new shot:

1. Bring up the IMASViz initial window
2. In the text boxes set new values:
  - a. User name: **g2dpc**
  - b. Tokamak: **aug**
  - c. Shot number: **36440**
  - d. **Run number: 4**
3. Press **Open** button



A new DTV window will appear. There:

4. In menu bar navigate to:
  - **Actions**
  - **Apply Configuration**
5. In the open window select tab **Available Node Selection Configurations**
6. From the list select the configuration name (if default label was used it should be **signalSelection-<day>-10-2019.lsp**)
7. Press button **Apply Node Selection**

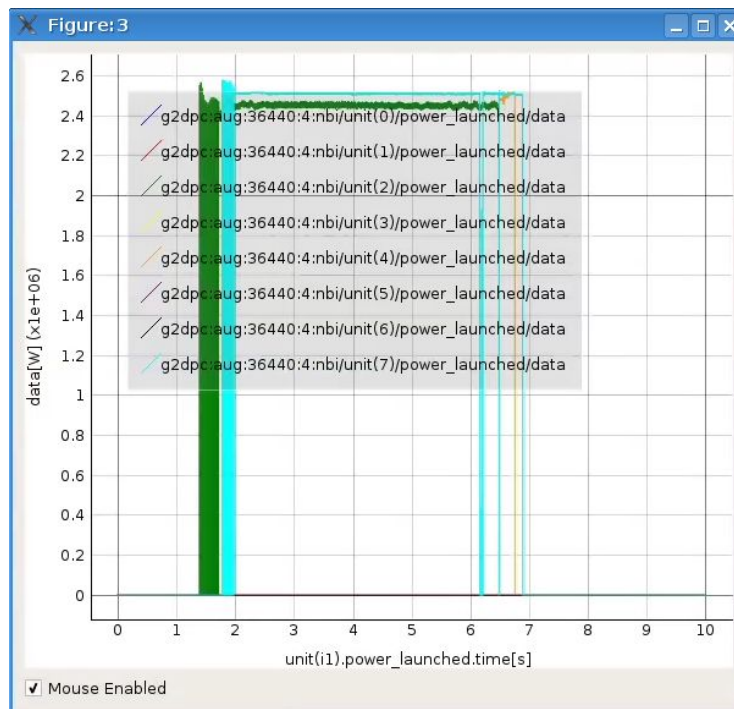
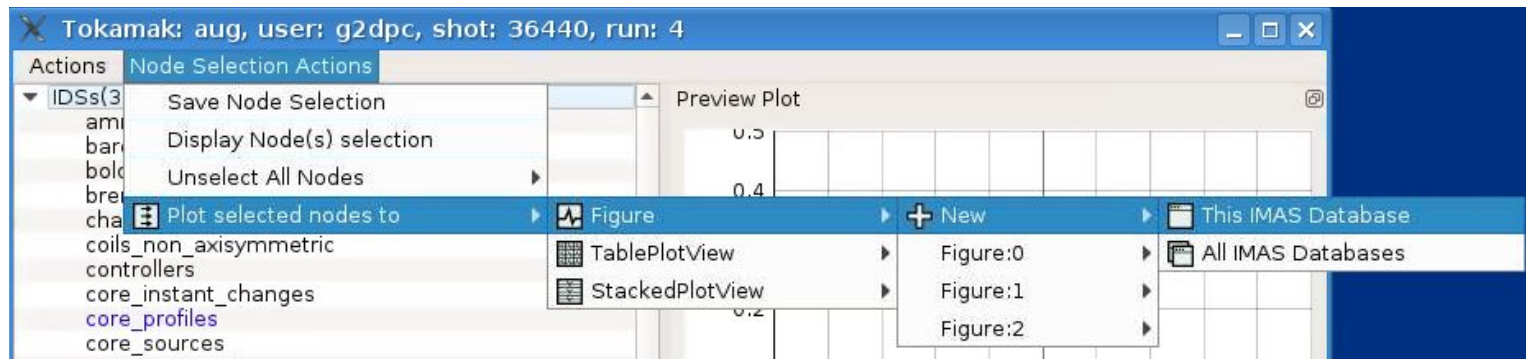


# Applying selection to a new shot (2)



To plot the selected data (no navigation required), in the menu bar select:

- **Node Selection Actions**
- **Figure**
- **New**
- **This IMAS Database**



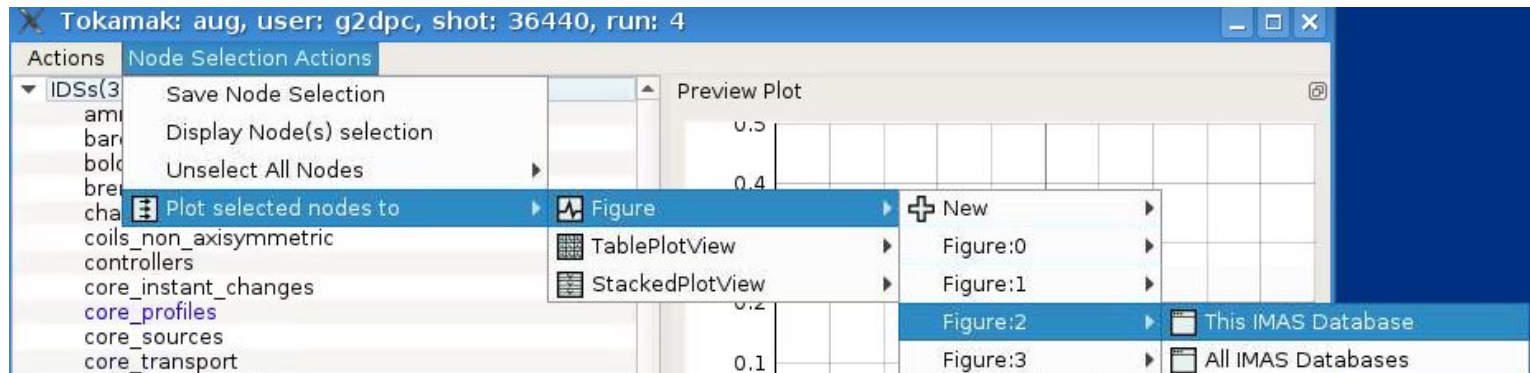
# Comparing shots (1)



Selections from 36440/4 can be added to existing plot containing data from 36440/1 shot.

In menu bar, navigate to:

- **Node Selection Actions**
- **Plot selected nodes to**
- **Figure**
- **Figure:2**
- **This IMAS Database**

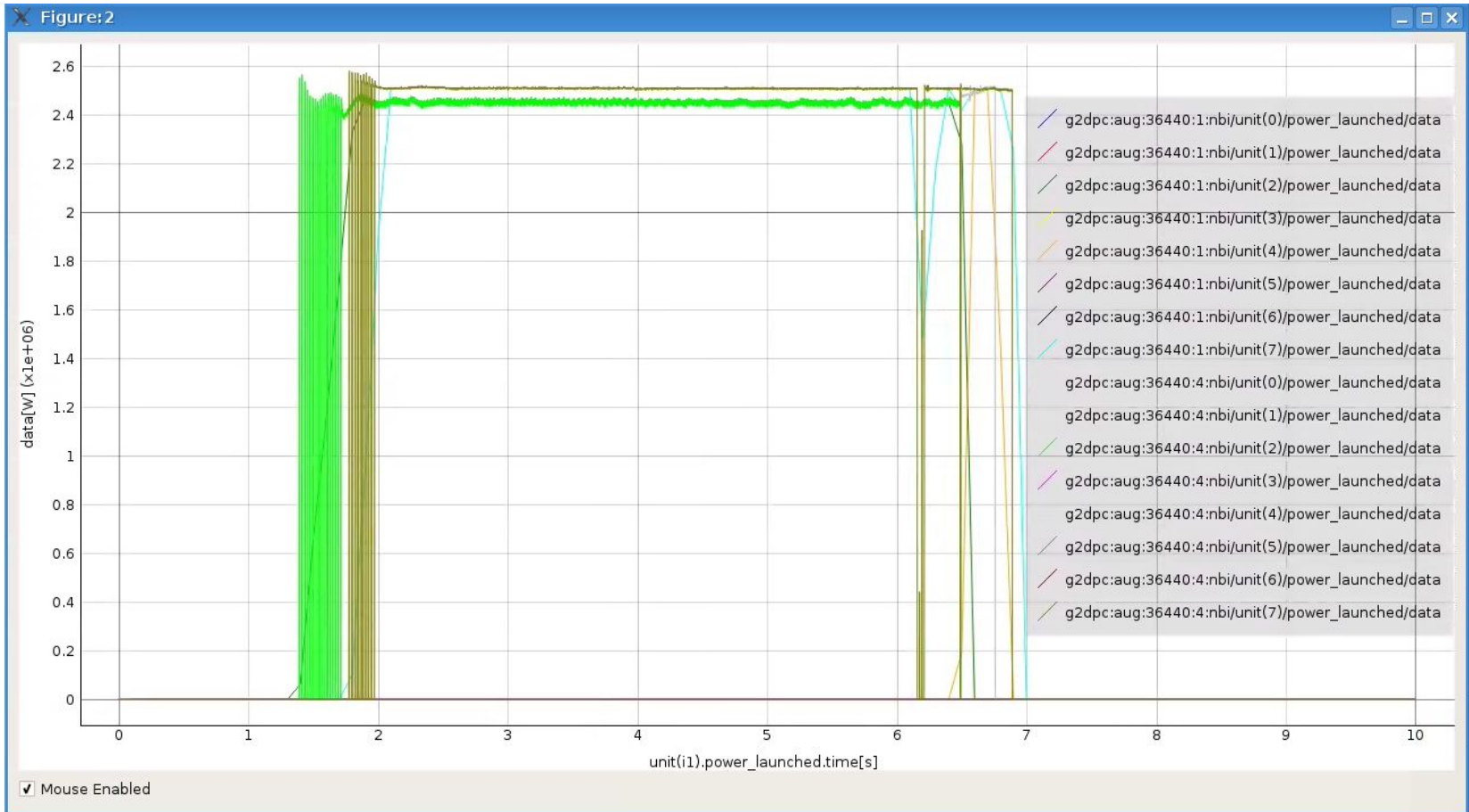




# Comparing shots (2)



The **Figure:2** will get updated with the added plots from the 36440/4 case.



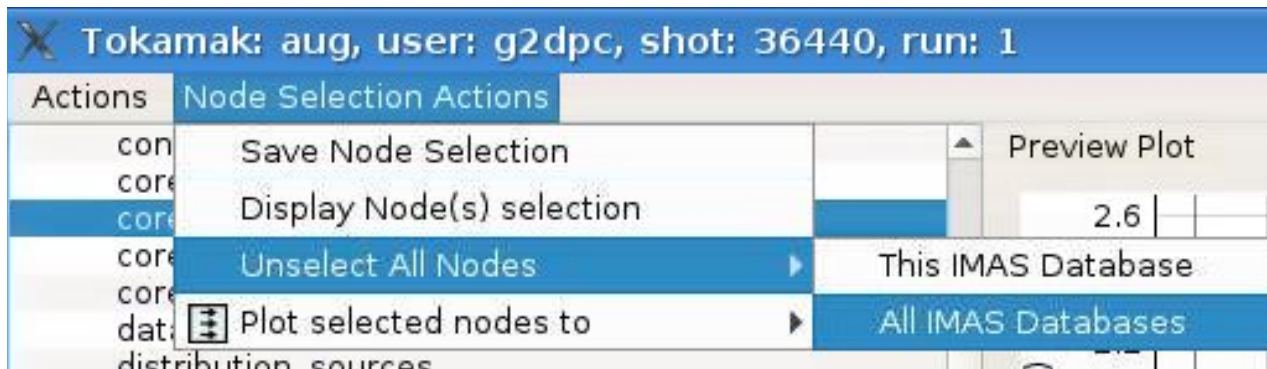
Note: With signals selected in 36440/1 and 36440/4 DTV, the same could be achieved by using (from the menu bar): **Node Selection Actions -> Plot selected nodes to -> Figure -> New -> All IMAS Databases**

# Unselecting signals



To unselect signals in the menu bar select:

- **Node Selection Actions**
- **unselect All Signals**
- **All IMAS Databases**



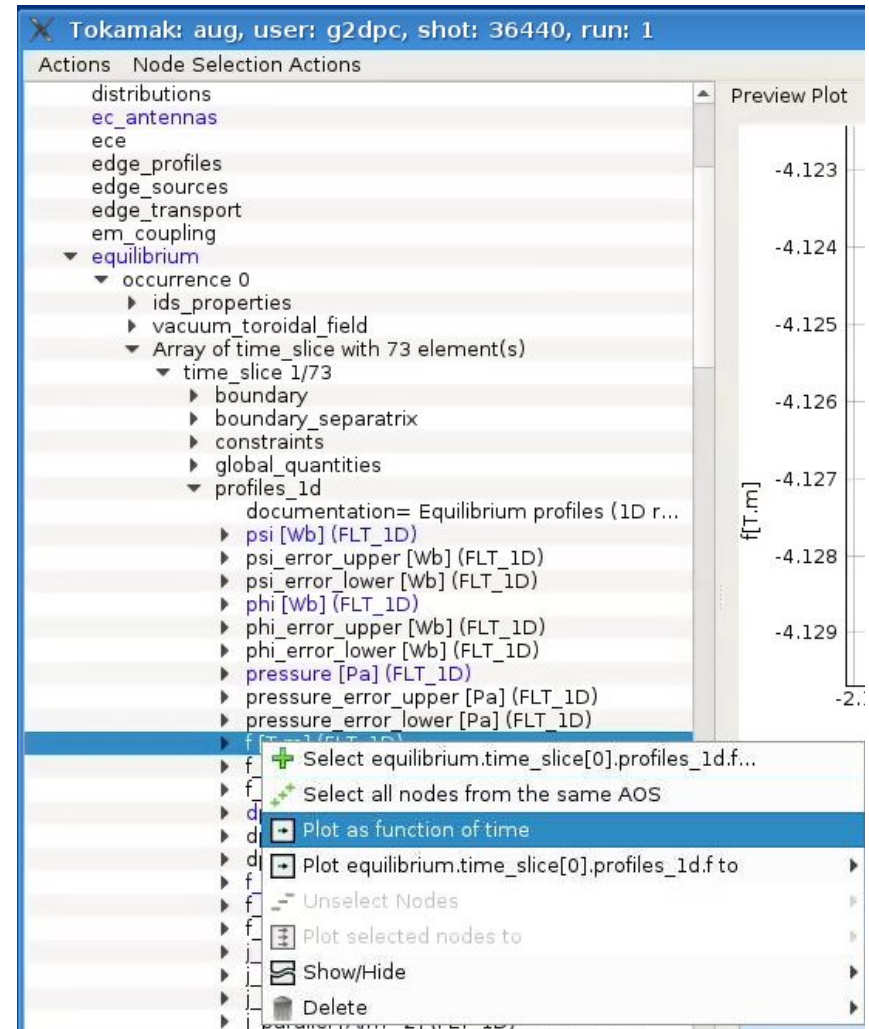
This will unselect all signals selected in all opened IDS cases (DTV windows).

# Plotting 1D data embedded in time slices (1)



In opened 36440/1 case DTV window:

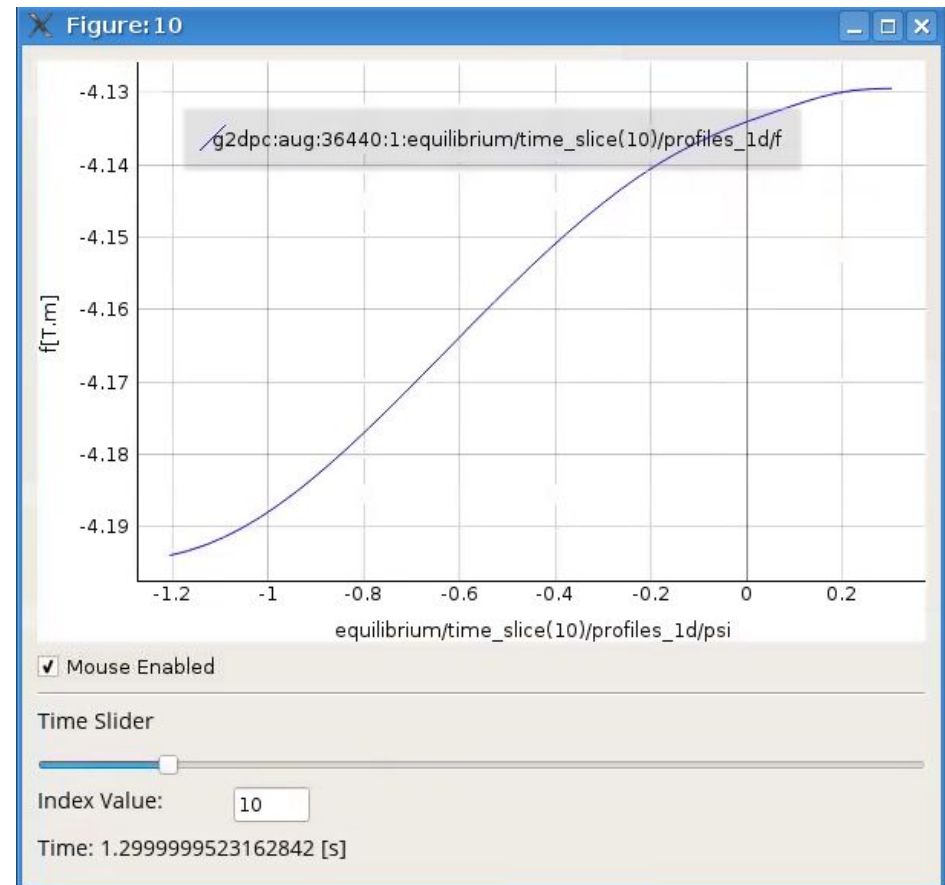
1. Open **equilibrium IDS**
2. In tree view navigate to
  - **equilibrium**
  - **Occurrence 0**
  - **Array of time\_slice with 73 elements**
  - **time\_slice 1/73**
  - **profiles\_1d**
  - **f [T.m] (FLT\_1D)**
3. Right click on the node and select **Plot as function of time**



# Plotting 1D data embedded in time slices (2)



In the opened plot window the **time slider** on the bottom can be moved and the plot will update accordingly.



**NOTE:** The X-axis corresponds to **coordinate1**, in this case **psi** found under **equilibrium/time\_slice(<time index>)/profiles\_1d/psi**.

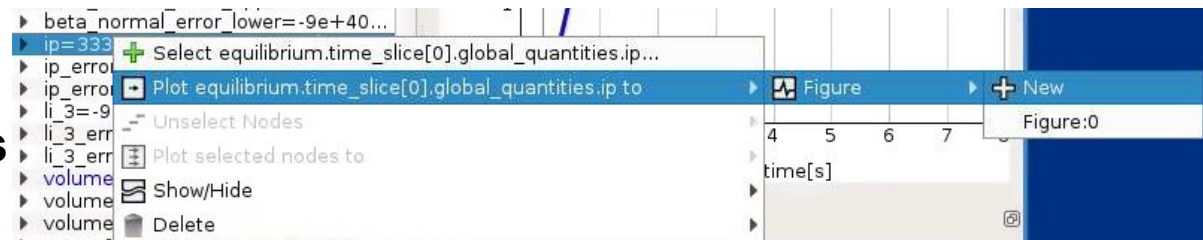
```
▶ pressure_error_lower [Pa] (FLT_1D)
▼ f [T.m] (FLT_1D)
  coordinate1=time_slice[itime].profiles_1d.psi
  documentation= Diamagnetic function (F=R B_Phi)
  name=equilibrium.time_slice[0].profiles_1d.f (STR_0D)
▶ f_error_upper [T.m] (FLT_1D)
```

# Plotting 0D data

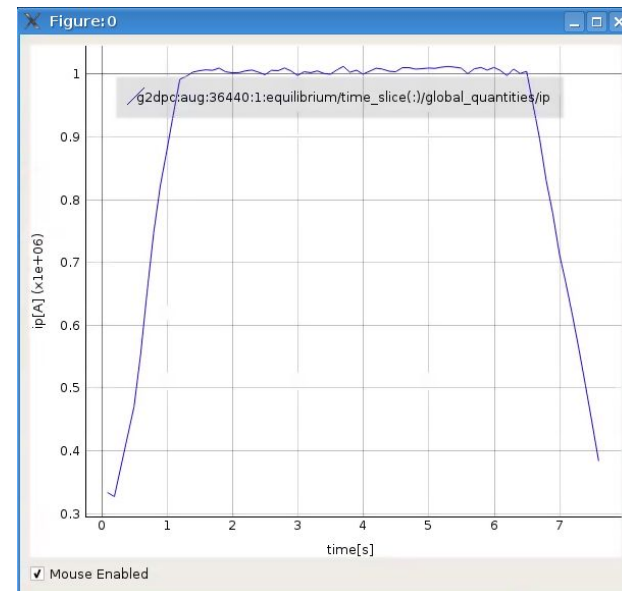


In opened 36440/1 case DTV window:

1. Open **equilibrium IDS**
2. In tree view navigate to
  - **equilibrium**
  - **Occurrence 0**
  - **Array of time\_slice with 73 elements**
  - **time\_slice 1/73**
  - **global\_quantities**
  - **ip**



Right click on the node and select **Plot as function of time.**



# Using UDA: UDA requirements for IMASViz on the Gateway



TCV, AUG and WEST requires a configuration file for enabling the UDA connection. The file should be located in your home directory. However UDA JET access is public, nothing to set.

## Accessing TCV

You have to provide a file '.exp2imas' with the following content in a single line:

```
TCV username password
```

The file should be located in your home directory (filename='.exp2imas', do not forget the dot !).

## Accessing AUG

You have to provide a file '.exp2imas' with the following content in a single line:

```
AUG username password
```

The file should be located in your home directory (filename='.exp2imas', do not forget the dot !).

## Accessing WEST

You have to provide a file '.west\_tunnel' with the following content in a single line:

```
WEST username password
```

The file should be located in your home directory (e.g. filename='.west\_tunnel', do not forget the dot !).

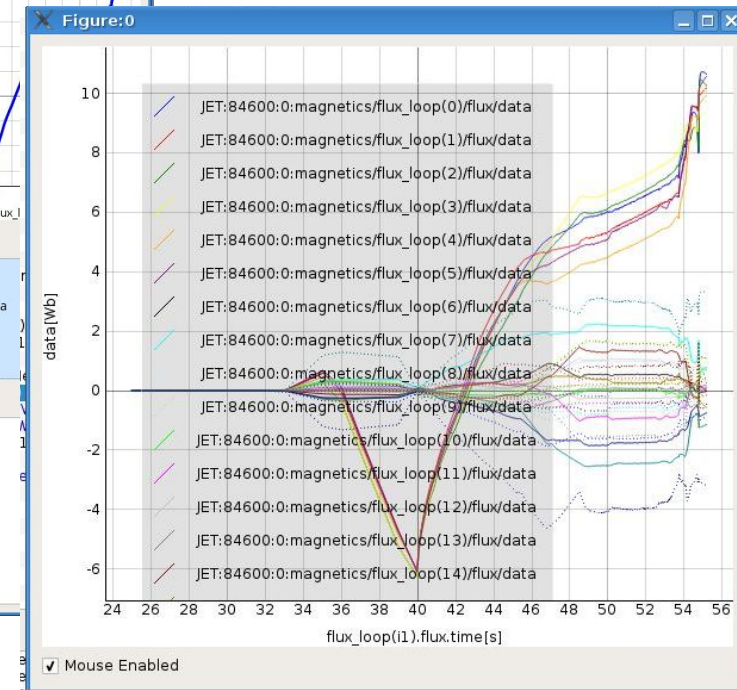
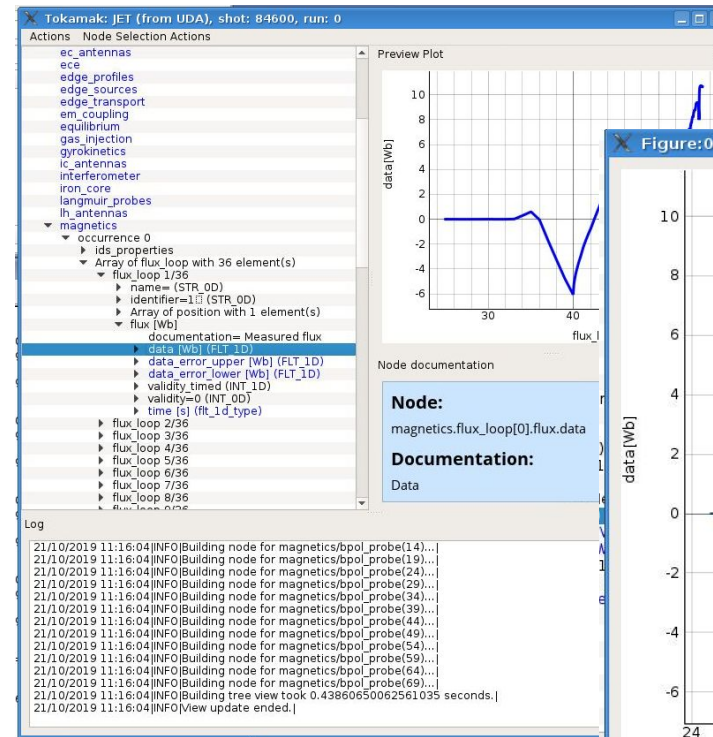
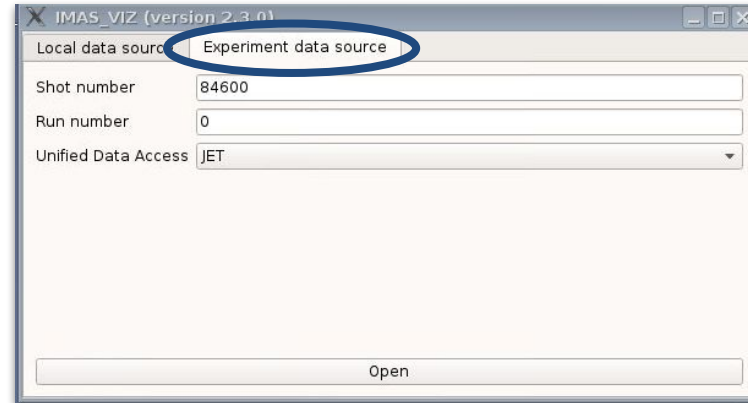
**IMPORTANT:** For the UDA to work, ~/logs/uda directory must exist! On the GW this can be done with:

```
> cd $HOME
> mkdir logs
> cd logs
> mkdir uda
```

# ❖ Using UDA: displaying the magnetics IDS from a JET shot



1. **Select tab 'Experiment data source' from the main GUI**
2. **Fill the fields according to the picture (shot 84600 from JET)**
3. **Click open (takes a few seconds to load data)**
4. **Load the magnetics IDS**
5. **Right click on one flux\_loop and execute 'Select all nodes from the same AOS'**
6. **Plot all selected nodes to a new figure.**



# Exporting data to a new IMAS pulse file

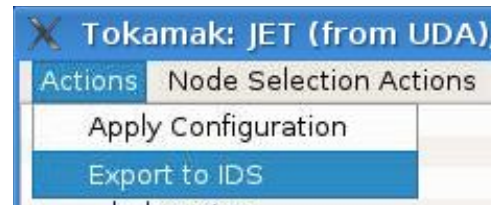


To export the opened IDSs from the DTV to a new local IMAS pulse files:

1. In the menu bar navigate to

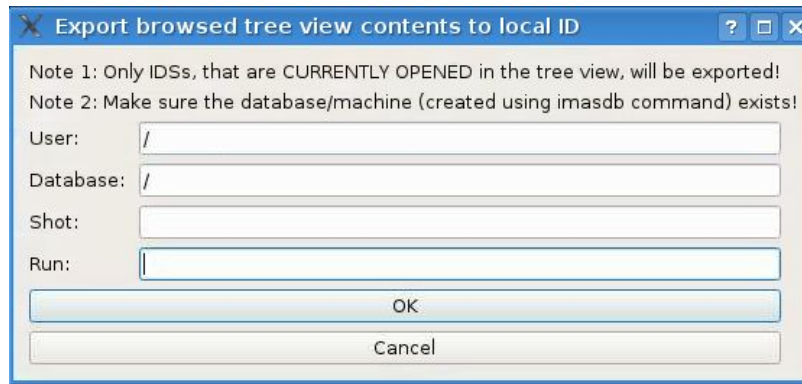
➤ **Actions**

➤ **Export to IDS**



2. In the opened window set the database parameters

(Note that the **Database** must exist!)



3. Press **OK**



# Example of using the plugins – Equilibrium plugin



1. Open the **WEST** shot (**g2lfleur,west,54178,0**)
2. While keeping the **shift** keyboard button pressed, **right-click** on the **'equilibrium'** IDS
3. Select the **'Equilibrium plugin'**

The Equilibrium overview plugin window will be shown.

The **slider** on the bottom of the window can be used to show data for different time values.

