

Garching 18-19 March 2010



EFDA

EUROPEAN FUSION DEVELOPMENT AGREEMENT

Task Force
INTEGRATED TOKAMAK MODELLING

Exp2ITM : populate ITM database with experimental data

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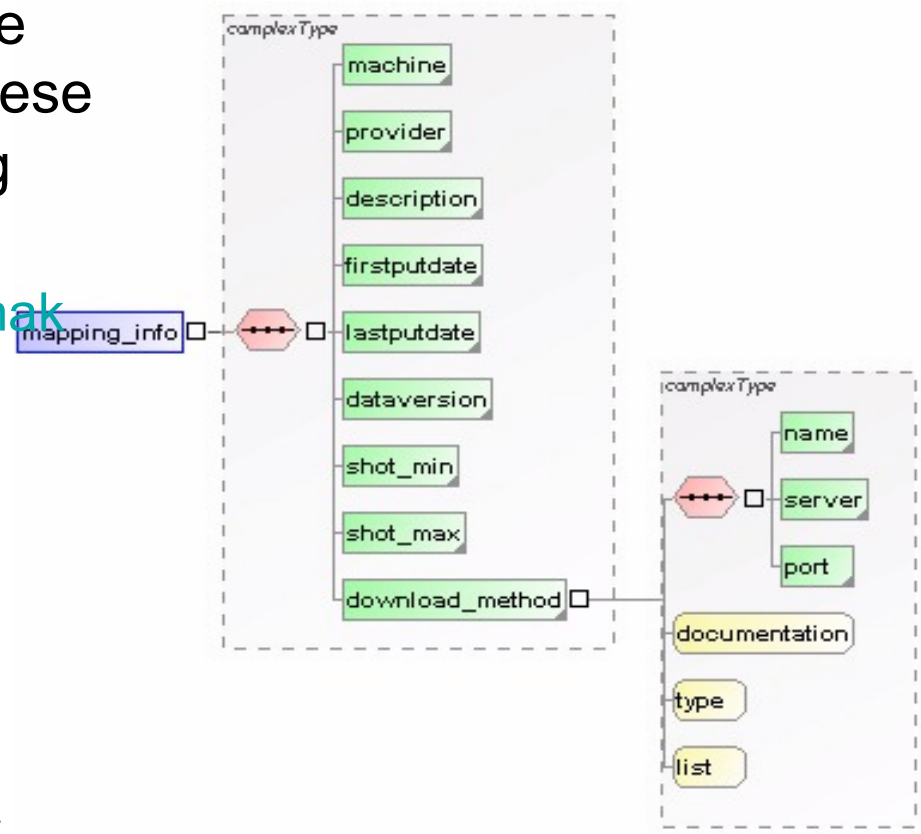
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- Provide a tool to download shot-based data from European databases, map them into the ITM format and finally upload them into the ITM database
- Transpose local experimental data structure into the ITM data structure
 - Comply with the highly structured ITM data organisation (Consistent Physical Objects)

→ How is local data mapped to ITM DS ?!

- Correspondence between CPOs and local signals depends on the local data format
 - The XML Mapping file is describing this correspondence
- The method used to describe this correspondence must be generic
 - The Exp2ITM files are generated dynamically from the Mapping file : generic method
- All signals in a CPO have the same time base
 - Interpolation on a common time base per CPO is carried out by Exp2ITM (following Mapping file directives)
- The ITM DS can “concatenate” the local database, e.g. 2π and saddle loops will fit in *magdiag/flux_loops*)
 - Carried out by Exp2ITM (following Mapping File directives)

- **General information : tag <mapping_info>**
 - machine name, version of the data structure used, shot range (shot_min /shot_max) : these information will be checked when launching exp2ITM for a machine/shot number
 - Several mapping files may exist for a Tokamak (e.g. for different shot range)
 - Provider name, description, dates : for information only



Extract of the MachineMapping_template.xml file :

```

<machine documentation="Name of the experimental device" type="xs:string">Put value here</machine>
<provider documentation="Name of the person who has filled this file" type="xs:string">Put value here</provider>
<description documentation="Detailed description of this mapping file" type="xs:string">Put value here</description>
<firstputdate documentation="Date when this file was first submitted to the ITM" type="xs:string">Put value here</firstputdate>
<lastputdate documentation="Date when this file was last updated" type="xs:string">Put value here</lastputdate>
<dataversion documentation="Data structure version" type="xs:string">Put value here</dataversion>
<shot_min documentation="Minimum shot number in the experiment database for which this mapping file is valid" type="xs:integer">Put value here </shot_min>
<shot_max documentation="Maximum shot number in the experiment database for which this mapping file is valid" type="xs:integer">Put value here </shot_max>
  
```

- When several remote data access methods are possible, repeat the tag `<download_method>` with all its sub-tags for each method.
 - The attribute 'list' of the tag `<download_method>` must be set to 'yes'
- Machine dependent syntax for remote access is hardcoded in exp2ITM (e.g. `jet('...')`, `augdiag(...)` or `gettsbaseitm(...)`)

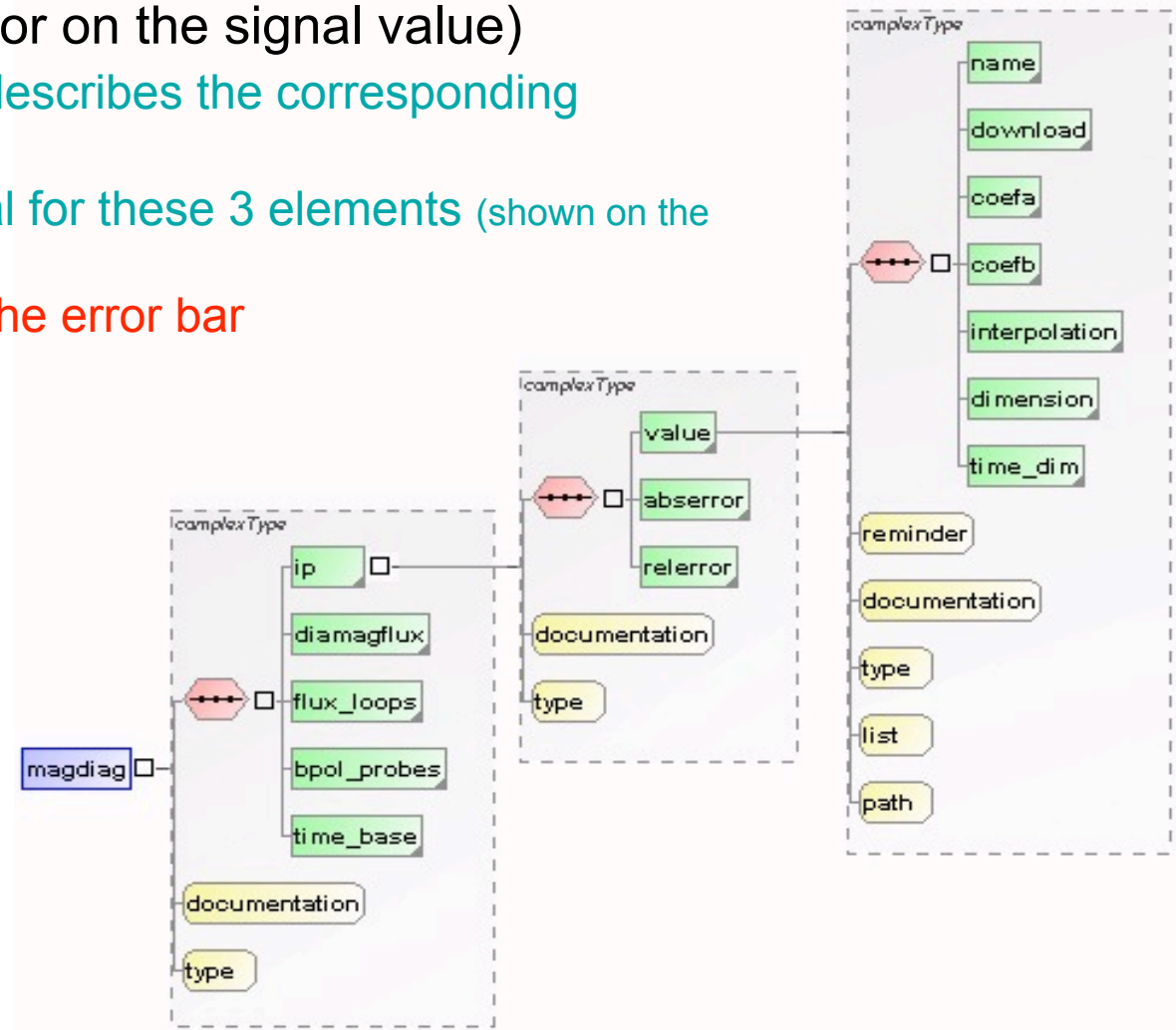
Example extract from the TSMapping.xml file :

```
<download_method... list='yes'... >  
  <name...>mds+</name>  
  <server...>192.168.1.1</server>  
  <port...>8000</port>  
</download_method>  
<download_method ... list='yes'... >  
  <name...>tslib</name>  
  <server...>132.169.8.138</server>  
  <port...>5880</port>  
</download_method>
```

NB : in all the examples, all the tags attributes are not shown to be more clear

CPO Mapping description(1)

- For each CPO :
 - The mapping file describes the local signal(s) to read to compute the common time base
 - Each signal in the CPO is set up with 3 elements : 'value' (the signal value itself), 'abserror' (the absolute error on the signal value) and 'relerror' (the relative error on the signal value)
 - for each of them, the mapping file describes the corresponding signal(s) in the local database
 - the needed information are identical for these 3 elements (shown on the right image)
 - Convention adopted for assigning the error bar is $\text{Max}(\text{abserror}, \text{relerror} * \text{signal})$



NB : in this schema, the yellow fields represent information given in the template file; they must not be changed except, in particular cases, the 'list' attribute

- When there is a one-to-one correspondence between the local name and the ITM name
 - there is only one tag <value> (or one tag <abserror> or one tag <relerror>) with all its sub-tags

Example from TSmapping.xml file:

```
<toroidfield...>
  <current...>
    <value...>
      <name...>SITOR</name>
      <download...>
        <download...>mds+</download>
        <fixed_value...></fixed_value>
      </download>
      <interpolation...>2</interpolation>
      <dimension...>1</dimension>
      <time_dim...>1</time_dim>
    </value>
```

Example of fixed value :


```
<abserror...>
  <name...>abserror</name>
  <download...>
    <download...>fixed</download>
    <fixed_value...>0.0005</fixed_value>
    <fixed_repeat...>1</fixed_repeat>
  </download>
  <interpolation...>0</interpolation>
  <dimension...>1</dimension>
  <time_dim...></time_dim>
</abserror>
```

In this case, no local signal corresponds to the abserror signal (however the tag <name> must not be null) but a fixed value will be given to it. Of course, no interpolation will be done and the information given by the <time_dim> tag is not necessary.

Another example of fixed value with fixed_repeat:

```
<abserror...>
  <name...>abserror</name>
  <download...>
    <download...>fixed</download>
    <fixed_value...>0.001 0.0084</fixed_value>
    <fixed_repeat...>6 30</fixed_repeat>
  </download>
  <interpolation...>0</interpolation>
  <dimension...>1</dimension>
  <time_dim...></time_dim>
</abserror>
```

In this case, the final vector will have 6+30 values; 0.001 will be repeated 6 times and 0.0084 will be repeated 30 times

- When an ITM signal is formed from several local signals
 - There are as many tags <value> with their sub-tags as local signals
 -  The attribute 'list' of the tags <value> must be set to 'yes'
 - The local signals are assumed to have the same size
 - **Fixed values** : assuming 15 element array with (3x)100.d and (12x) 35.d, instead of 15 tags, use

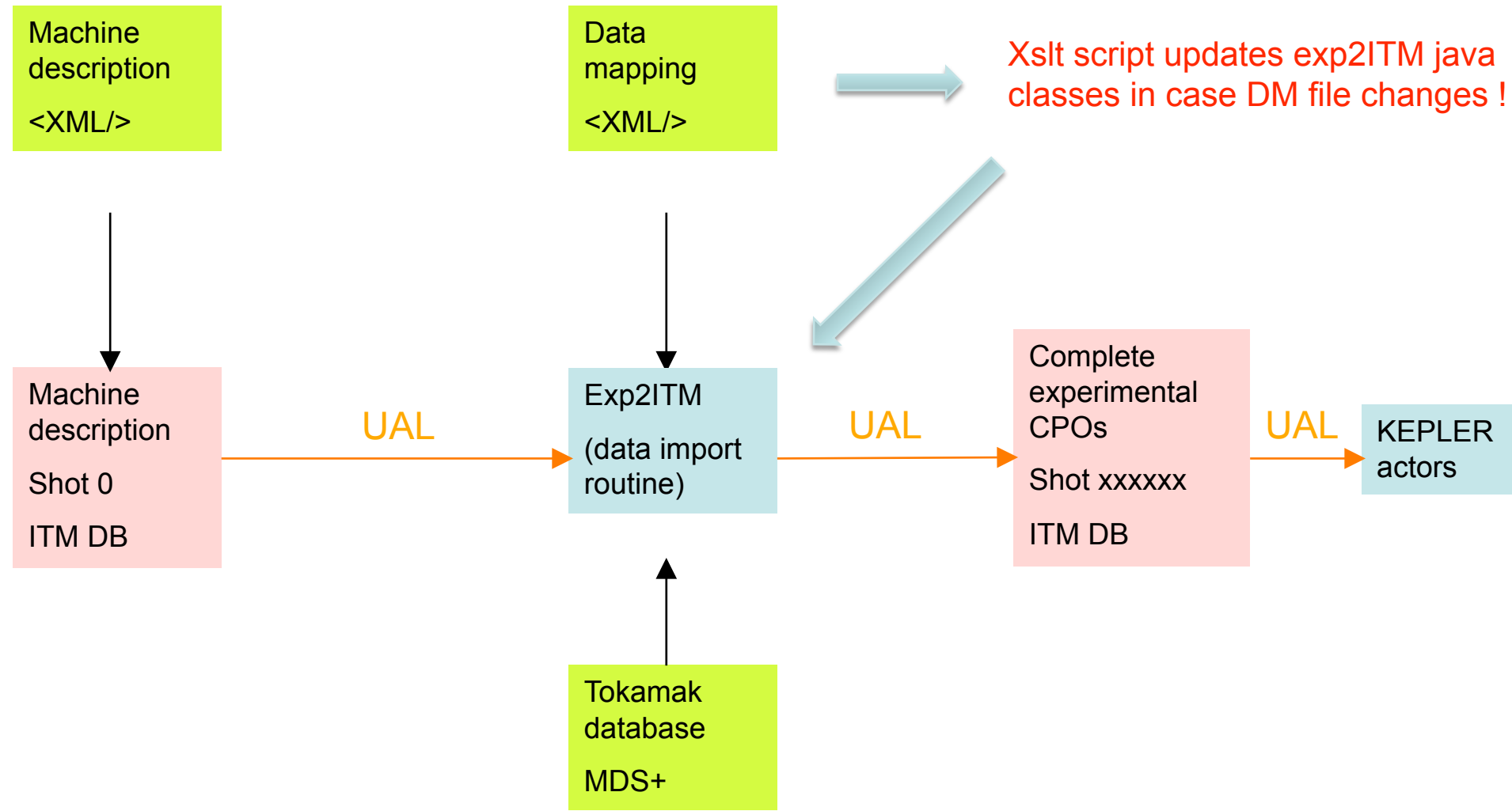

```
<fixed_value...>100.d 35.d</fixed_value>
                    <fixed_repeat...>3 12</fixed_repeat>
```

Example from TSmapping.xml file:
 Several local signals:

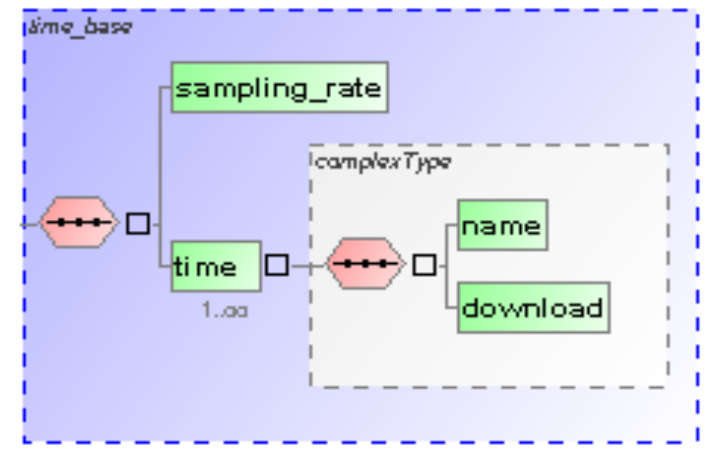
```
<magdiag...>
<flux_loops...>
  <measure...>
    <value...list='yes'...>
      <name...>SBFT</name>
      <download...>
        <download...>mds+</download>
        <fixed_value...></fixed_value>
        <fixed_repeat...></fixed_repeat>
      </download>
      <interpolation...>2</interpolation>
      <dimension...>1</dimension>
      <time_dim...>1</time_dim>
    </value>
    <value...list='yes'... >
      <name...>GBFT</name>
      <download...>
        <download...>mds+</download>
        <fixed_value...></fixed_value>
        <fixed_repeat...></fixed_repeat>
      </download>
      <interpolation...>2</interpolation>
      <dimension...>2</dimension>
      <time_dim...>1</time_dim>
    </value>
```


User's view of experimental data

- Machine description and data mapping are originally provided as XML files
- Machine data and time-dependent data are made available to users as Entries of the ITM database, i.e. CPOs that can be GET using the UAL.



- All signals in a CPO must have the same time base. For a given CPO, the mapping description file describes how many distinct local time bases exist (for the local signal entering this CPO)



Extract of the MachineMapping_template.xml file :

```


<time_base documentation="Declaration of the multiple time bases in the experimental database, used for calculating the common (CPO) one"
type="structure">
  <sampling_rate documentation="String 'min' or 'max' : Use the highest sampling rate (min) or the lowest sampling rate (max) of all
experimental time bases to define the common time base" type="xs:string">Put value here</sampling_rate>
  <time documentation="List of the experimental time bases used for this CPO (replicate this element if more than one must be used, and
indicate it by changing the 'list' attribute to 'yes')" list="no" type="structure">
    <name documentation="Name of the time base in the experimental database" type="xs:string">Put value here</name>
    <download documentation="Name of the download method, as listed in the top element mapping_info/download_method/name"
type="xs:string">Put value here</download>
  </time>
</time_base>
  
```

- If several local signals must be read to compute the common time base of the CPO, the contributor repeats the tag `<time>` with its sub-tags for each local signal.
 - The attribute 'list' of the `<time>` tag must be set to 'yes'



Example extract of a TSMapping.xml file :

```
<time_base...>  
  <sampling_rate...>min</sampling_rate>  
  <time... list="yes"...>  
    <name...>GCOUBOB</name>  
    <download...>mds+</download>  
  </time>  
  <time... list="yes"... >  
    <name...>GTENGMES</name>  
    <download...>mds+</download>  
  </time>  
  <time... list="yes"... >  
    <name...>GTENTEN</name>  
    <download...>mds+</download>  
  </time>  
  <time... list="yes"... >  
    <name...>GIBOBGEN</name>  
    <download...>mds+</download>  
  </time>  
</time_base>
```

- Exp2ITM defines the common time base :
 - Find the minimum common time to all local time bases (for signals going to the CPO) : $\max(\min(\text{local_time_bases}))$
 - Find the maximum common time to all local time bases : $\min(\max(\text{local_time_bases}))$
 - Use the sampling rate defined in the mapping file
 - `<sampling_rate...>min</sampling_rate>` → Highest sampling rate : $(\min(\text{diff}(\text{local_time_base})) \rightarrow \text{large number of time slice}$
 - `<sampling_rate...>max</sampling_rate>` → Lowest sampling rate : $(\max(\text{diff}(\text{local_time_base})) \rightarrow \text{less time slice}$
 - If the sampling rate is not constant in local signals, all value of the local time base are read to find the highest or the lowest value
 - Build the common time base, sized $(\max \text{ value} - \min \text{ value} / \text{rate}) + 1$
 -  Interpolate signals when necessary on the computed time base → **there can be only one time base/rate within a given CPO**

- 1) Create in your working space a directory called exp2ITM and import the package subdirectory from the svn repository
svn export <http://gforge.efda-itm.eu/svn/exp2itm/trunk/package> ./package
- 2) In the package/files directory import the Mapping file corresponding to the Tokamak for which you want to run exp2ITM
svn export http://gforge.efda-itm.eu/svn/md_and_dm/trunk/datamapping/TOKAMAK/TOKAMAKmapping.xml ./TOKAMAKmapping.xml
- 3) In the package/files directory, modify the *exp2itmArgFile.txt* to specify the parameters for the mapping operation
- 4) Check that your environment variables are correctly set (run the ITMv1 script specifying the Tokamak and the data structure release). Be sure that you have copied in your private database the shot 0 describing the machine description parameters (from the public database)
- 5) In the package/bin directory, run the exp2ITM.sh script : *exp2itm.sh*
 - If you want to keep the messages sent by the program in *mylogfile.log* , launch exp2ITM as :
exp2itm.sh | tee mylogfile.log

Input file for exp2ITM

```
# euitmMappingArgFile.txt : parameters for the mapping operation
# Name of mapping file
mappingFile=JETmapping_011009.xml

# Name of the tokamak from which data will be read
machine=jet

# Shot number to import
shot=78092

# Run number
run=2

# User name – optional – to access to a private local database
localUserName=

# Sequence number - optional (only for JET)
sequence=1111

# Run number to access to the Machine description parameters (different RUN numbers can exist !)
machineRun=3

# User name to access to the Machine description parameters – optional – not used for the moment
machineUserName=

# Start time of the time base – optional – not used for the moment
startTime=

# Stop time of the time base – optional – not used for the moment
stopTime=

# CPO (one per ligne) - optional
```

exp2itm release has an associated DM file (cross consistency of Gforge projects t.b.i. through revision n°)

To bypass storage of shot 0 in my db...

Original purpose

- Experimental **diagnostic data** on magdiag (diamagflux, bpol_probes, flux_loops), mmediag, interfdiag, polardiag, *ECE, TS, CX,...*
- **Time traces** of shot based “hardware”, i.e. toroidfield, pfsystems, antennas.

Enhancements longed for...

- *Validated exp.data for “fast track” V&V of transport and other codes*
 - Independent approach to encompass “best-fit” profiles emanating directly from device data analysis experts.
 - Does not rule out storage, by the ITM, of experimental data from the individual diagnostics concurring for, e.g. n_e , T_e → *Useful for Synthetization*
- ✓ Coreprof is in testing in exp2itm (coreprof/rho_tor, toroid_field, psi, te, ti, ne, ni, vtor) and data mapping is ready for JET
- Other CPOs to follow (NBI, waves, coresource, coredelta, equilibrium,...) targeting v4.08a, *to be released soon...*