EFDA
EUROPEAN FUSION DEVELOPMENT AGREEMENT
Task Force
INTEGRATED TOKAMAK MODELLING

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Brief overview of experimental data in the ITM framework

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ITM framework : reminder

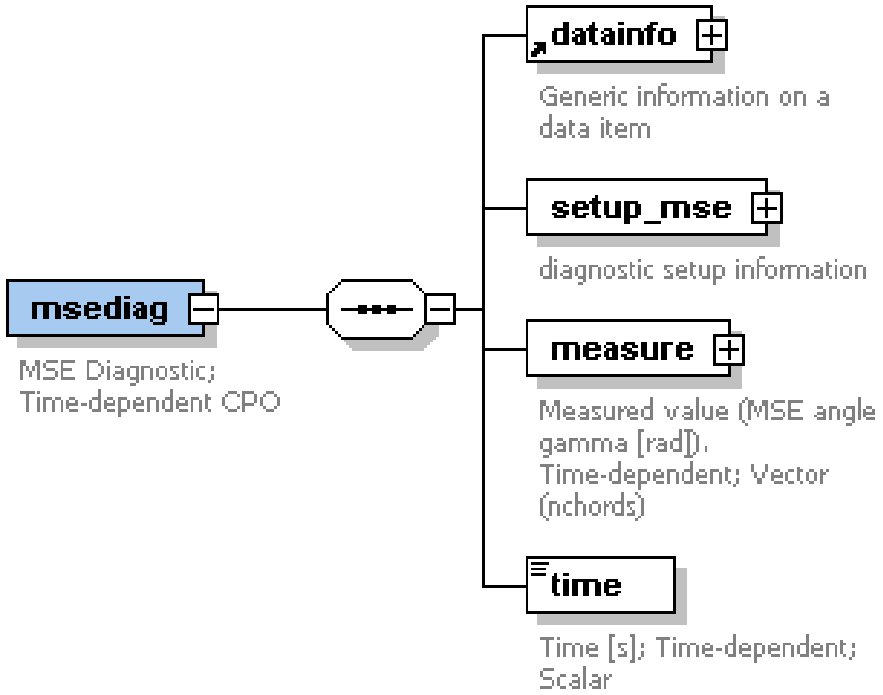
- Definition of standards of exchange between physics modules : Consistent Physical Objects (CPOs) representing physical quantities (e.g. plasma equilibrium) or experimental objects (RF antennas, diagnostics) → ITM data structure
- Standards must be relevant for any tokamak and any physics code
- Physics modules, adapted to use the CPO standards for input/output
- KEPLER : an environment for creating workflows of physics modules
- Universal Access Layer : a multi-language library that allows codes exchanging physical information via CPOs

- All this to provide a versatile and flexible simulation platform, but needs experimental data at some point to test and validate physics models

Experimental Data in the ITM data structure

- Experimental data is part of the ITM data structure and consists in :
  - Machine description (time independent data, valid for several shot numbers)
  - Time-dependent shot-based data
- Consistent Physical Objects (CPOs) often gather the machine description and the time-dependent data

→ consistency guaranteed between a system description and its related time-dependent signals during GET / PUT operations



Bookkeeping

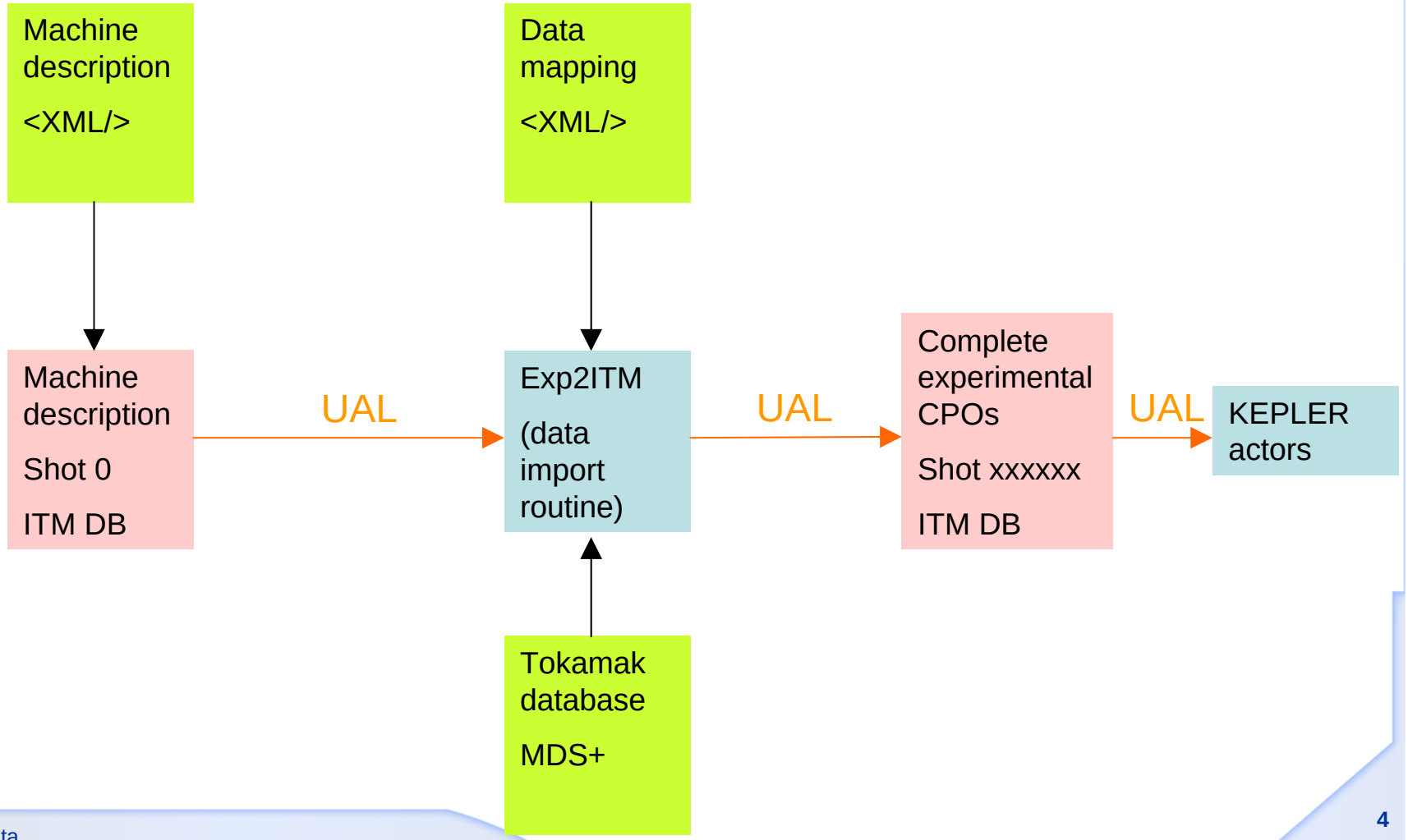
Diagnostic Description

Time-dependent measurements (MSE angles γ)

Time array

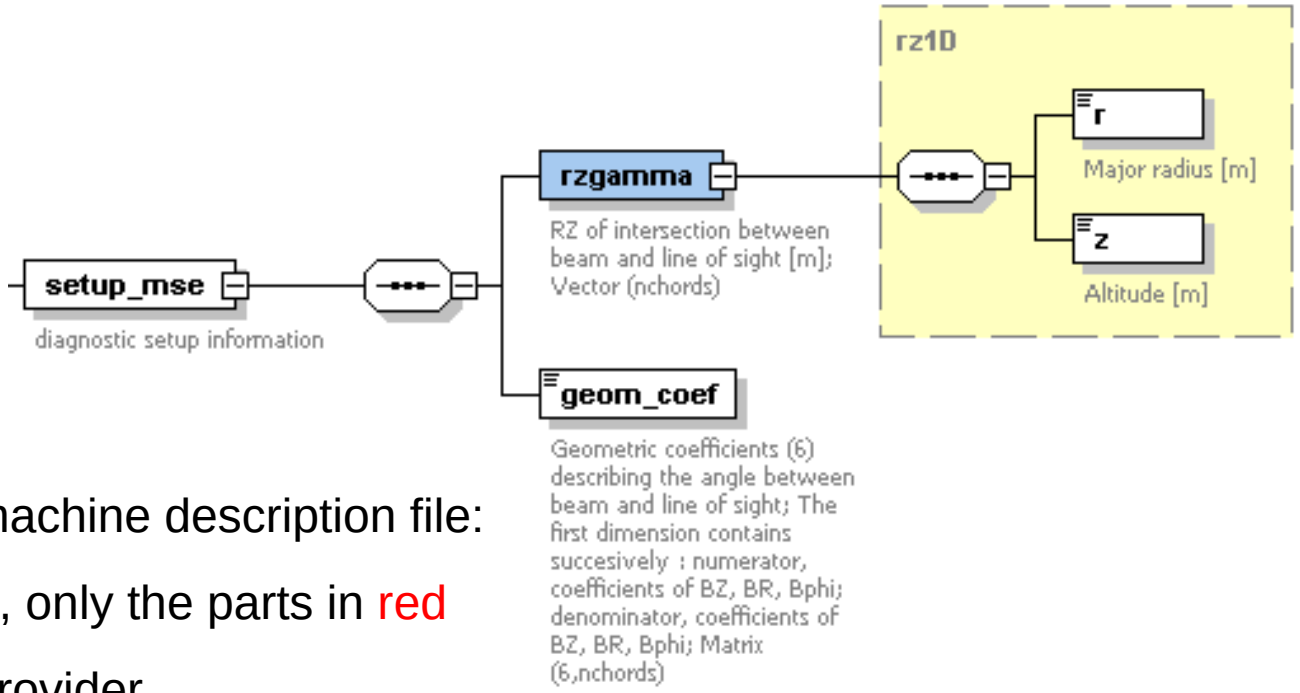
User's view of experimental data

- 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.



Machine description

- Example : diagnostic geometry (MSE)



- Highlight of the XML machine description file:
- A template is provided, only the parts in red are filled by the data provider

- <msediag type="CPO" documentation="MSE Diagnostic; Time-dependent CPO">
- <setup_mse type="structure" documentation="diagnostic setup information">
- <rzgamma type="structure" documentation="RZ of intersection between beam and line of sight [m]; Vector (nchords)">
- <r type="vecflt_type" documentation="Major radius [m]" path="setup_mse/rzgamma/r" dim="35">0.709000, 0.718000, 0.729000, 0.743000, 0.759000, 0.790000, 0.809000, 0.830000, 0.851000, 0.873000, 0.911000, 0.934000, 0.957000, 0.980000, 1.00300, 1.04300, 1.06600, 1.08900, 1.11200, 1.13400, 1.17300, 1.19500, 1.21700, 1.23800, 1.26000, 1.29600, 1.31700, 1.33800, 1.35800, 1.37900, 1.41300, 1.43300, 1.45200, 1.47100, 1.49100</r>
- <z type="vecflt_type" documentation="Altitude [m]" path="setup_mse/rzgamma/z" dim="35">0.00000, 0.00000 </z>
- </rzgamma>
- </setup_mse>
- </msediag>

Time-dependent data

- The exp2ITM tool has been develop to import time-dependent data into ITM format
  - the exp2ITM code is generic, machine-independent
  - it uses an XML description of the mapping of local data to the ITM format. This XML file is machine-dependent
- Mapping example (a template is provided, only the parts in red are filled by the data provider)

```
<magdiag>
    <ip>
        <value path="magdiag/ip/value">
            <name>SIPMES</name>
            <download>
                <download>mds+</download>
                <fixed_value/>
            </download>
            <interpolation>3</interpolation>
            <dimension>1</dimension>
            <time_dim>1</time_dim>
        </value>
    </ip>
</magdiag>
```

Conclusions

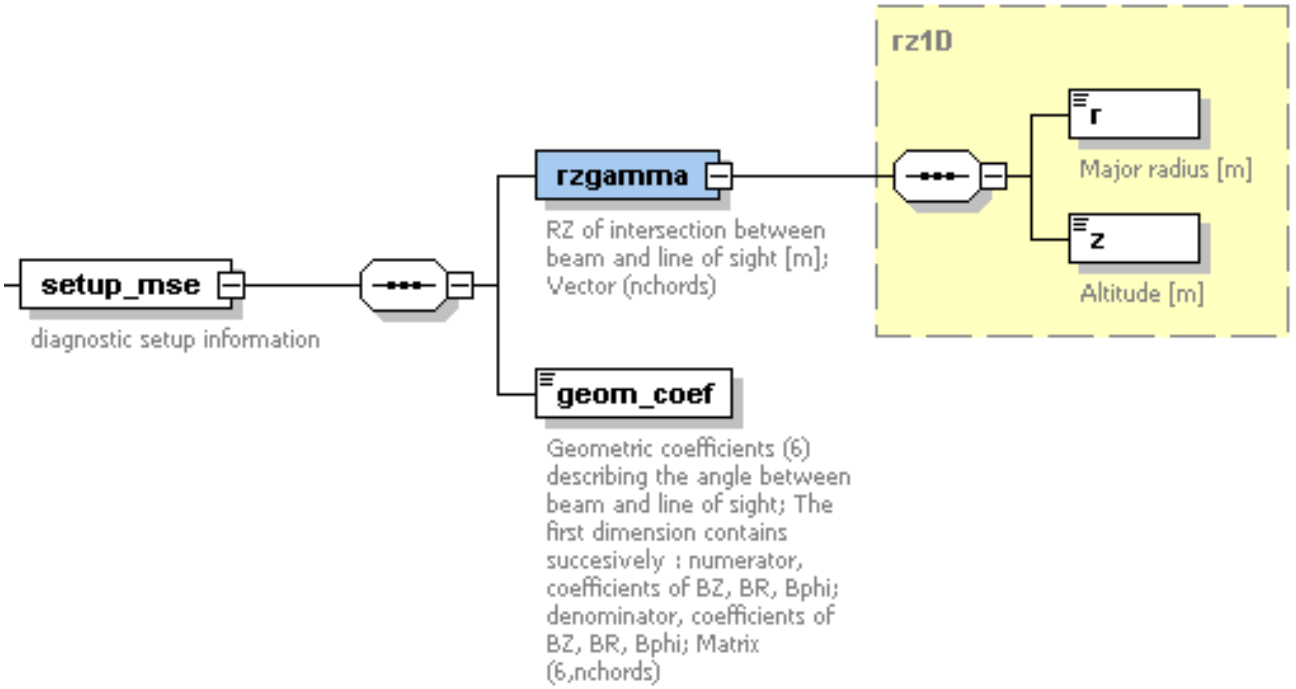
- A suite of tools have been developed to make experimental data of any tokamak device available to modellers in a standard format
- Data providers are only required to provide Machine Description and Data Mapping → copy/paste data in ASCII files.
- Only a few diagnostics in the ITM data structure for the moment, needs to be extended → participate in the definition of the diagnostic standards

More technical details to follow …

- You do not need to read this now …

Machine description

- Example : diagnostic geometry (MSE)



- Machine descriptions are provided to the ITM by local contact persons, in the form of an XML file (consistent with the ITM data structure)
- They are then compiled by ISIP tools and PUT in the ITM database under the MDS+ tree of the corresponding tokamak, shot 0.
- Different versions can coexist in the ITM database (e.g. valid for different shot ranges), all stored under shot 0 with different run numbers.
- A machine description can be loaded with the UAL by opening shot 0, the proper run number, and GETting the CPOs. They will be of size 1 if time-dependent and contain only the machine description part of the data structure.

Time-dependent data

- The exp2ITM tool has been develop to import time-dependent data into ITM format
  - the exp2ITM code is generic, machine-independent
  - it uses an XML description of the mapping of local data to the ITM format. This XML file is machine-dependent
- Three steps :
  - access the data in the local database (mostly MDS+ based) and map it to the ITM format, following the rules described in the machine mapping file
  - initialises the ITM CPOs with
    - the relevant machine description from the ITM DB
    - the calculated common time base
  - puts back the complete CPO (machine description + time-dependent data) in the ITM database.
- Presently, exp2ITM is a Java tool that must be run stand-alone. In the future, it can be used as an actor in the Kepler workflows.

Time-dependent data : example

- Write machine, shot number and run number in exp2itmArgFile.txt
- (set environement variables for MDS+ tree and UAL properly, caution, the Java UAL path is set in exp2ITM.sh)
- Execute exp2ITM.sh
  - it creates a new entry
- Execute plot_expdata.f90 to check what happened
  - Calls to ppplib to create images of the data