TSVV3 Regular meeting

# Toolbox for uploading simulation data to IMAS

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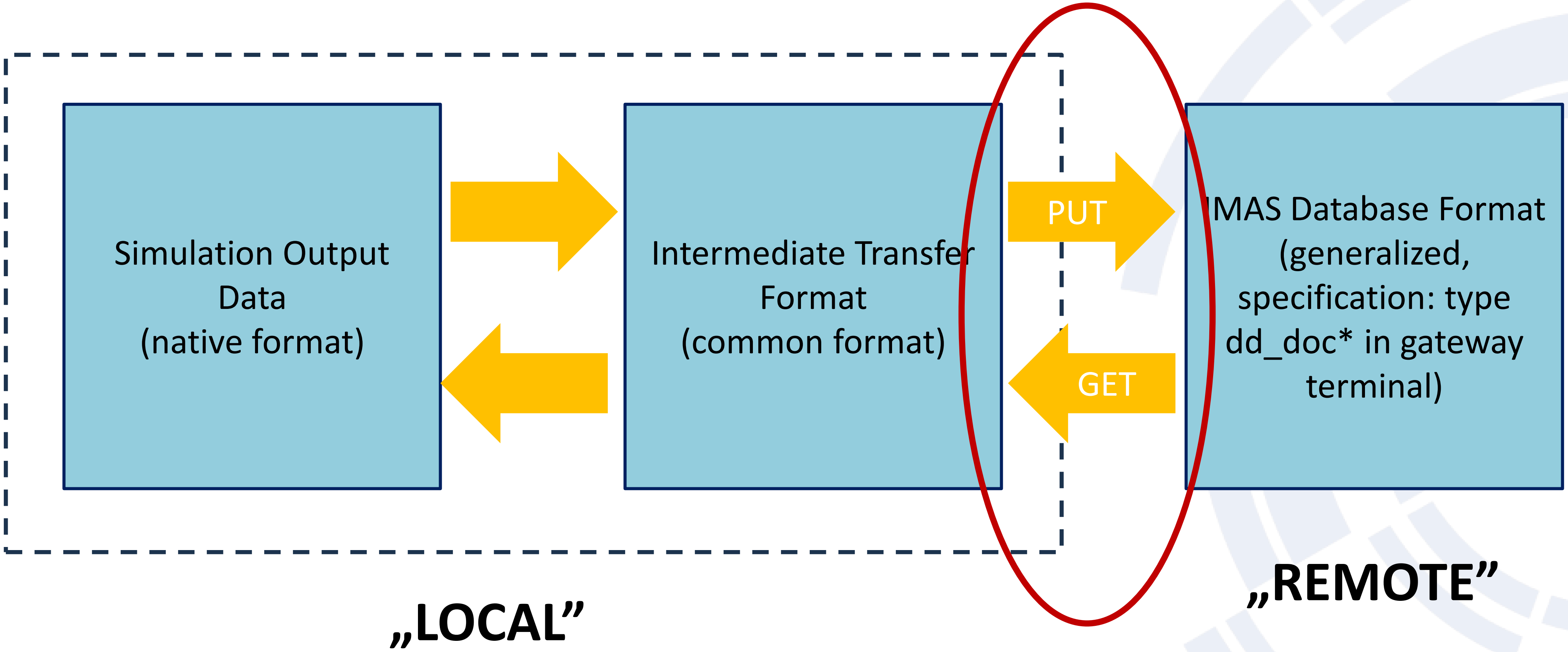
# Outline

- Aim of IMASification work
- General scheme
- Exemplary implementation

# IMASification effort

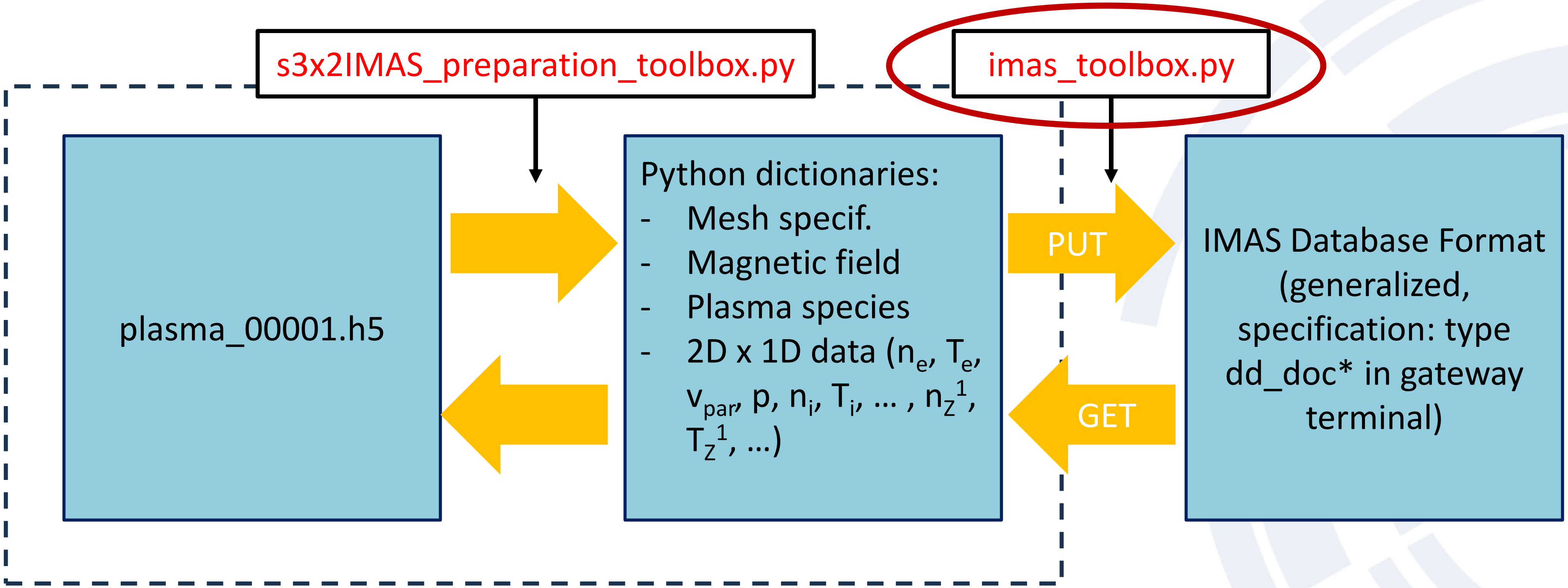
- Standarize the format of output data
  - From experiment
  - From simulation
  - Synthetic diagnostic
  - …
- Allow data interchange between different programs (interface)
- Create a database avaliable to the community

# General scheme


Simulation Output Data
(native format)
Intermediate Transfer Format
(common format)
PUT
GET
IMAS Database Format (generalized, specification: type dd_doc* in gateway terminal)
„REMOTE"
„LOCAL"

* Brings you to: /gw/swimas/core/IMAS/3.31.0/AL/4.8.7/share/doc/imas/html_documentation.html

# General scheme – SOLEDGE3X example



s3x2IMAS_preparation_toolbox.py

imas_toolbox.py

plasma_00001.h5

Python dictionaries:

- Mesh specif.
- Magnetic field
- Plasma species
- 2D x 1D data ($n_e$, $T_e$, $v_{par}$, p, $n_i$, $T_i$, … , $n_Z^1$, $T_Z^1$, …)

IMAS Database Format (generalized, specification: type dd_doc* in gateway terminal)

**equilibrium.py**

**edge_profiles.py**

* Brings you to: /gw/swimas/core/IMAS/3.31.0/AL/4.8.7/share/doc/imas/html_documentation.html

# Intermediate Transfer Format specification (1)

## Dictionaries needed to transfer the mesh and equilibrium data

IMPORTANT:
currently the same 2D poloidal mesh is assumed for all toroidal slices

'griddata' dictionary:

Information on the grid. Generally unstructured.

- **node_p** - 2D array of size Nnodes x 2 providing the R coordinate and the Z coordinate of each node in the poloidal plane
- **cell_p** - 2D array of size Ncells x 4 providing in direct order the indices of the nodes acting as vertices for the quadrangular cells in the poloidal plane
- **node_t** - 1D array of size Nphi-1 specifying the toroidal angle in radians of the toroidal direction coordinate for each poloidal plane.

'mag_field' dictionary:

The components of magnetic field ordered by toroidal slices. In each slice the points are ordered first by radial coordinate then by poloidal.

- **Br** - 2D array of size Nnodes x (Nphi-1) radial component of the magnetic field
- **Bz** - 2D array of size Nnodes x (Nphi-1) z component of the magnetic field
- **Bphi** - 2D array of size Nnodes x (Nphi-1) toroidal component of the magnetic field

# Intermediate Transfer format specification

## Dictionaries needed to transfer 2D (or 3D) physical quantities data: densities, energies …

'atdata' dictionary, keys:

Lists of species present in the plasma. Convention: electrons as index 0, deuterium as 1 and all charge stages of impurities following

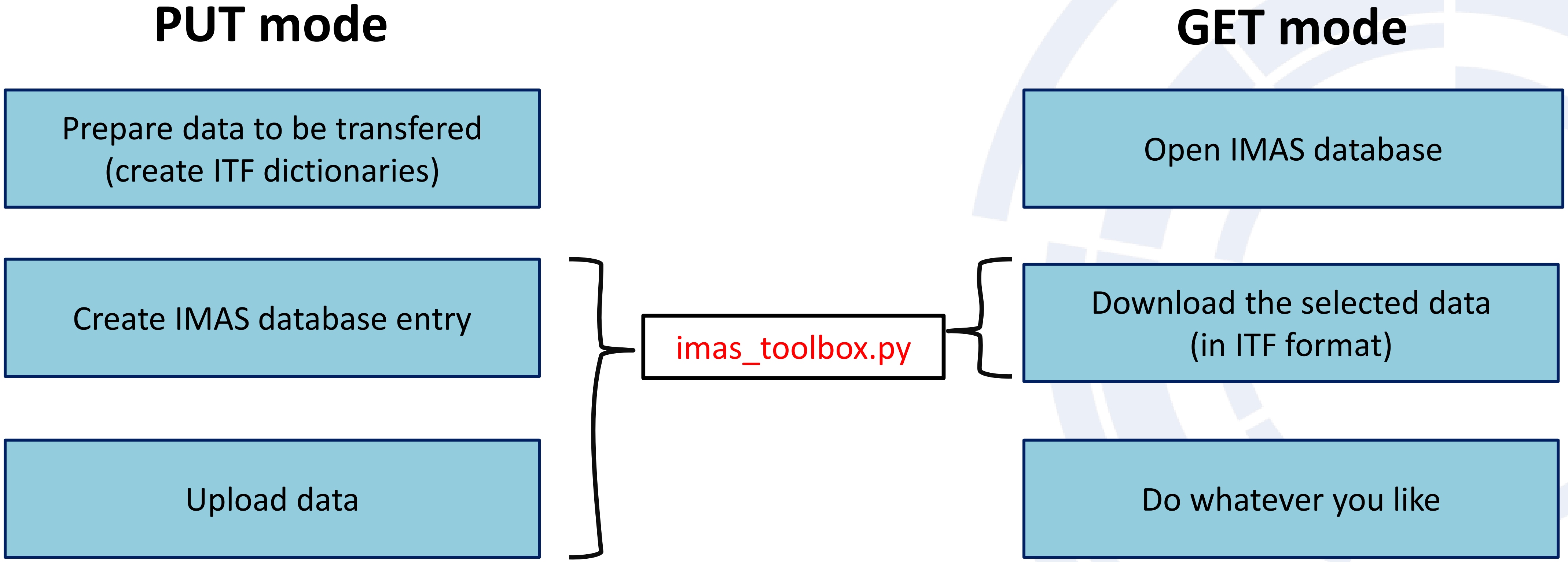
- **ions** - 1D array of all ions with different charge states (labels - chemical symbols)
- **masses** - 1D array with unit masses for each ion charge state (in atomic mass units)
- **charges** - 1D array of different ion charge states
- **Numsp** - 0D, number of species, including electrons and deuterons, each charge state separately

'data' dictionary

Selected data from the simulation output.

- **data** - 2D array of size Nnodes x (Nphi-1) with selected data, organized by toroidal cross-sections and then 1D vectors for all data points. In the 1D vectors the points are ordered first by radial coordinate then by poloidal. Generally unstructured.
- **time** - 0D integer, the time index of output file
- **spec** - 0D integer, index of species of interest, corresponds to the index in atdata, 0: electrons, 1: D+1 ions, ... (secondary importance)
- **field** - string, selected field of interest name, currently accepted: 'n', 'T', 'v_par', 'v_rad', 'p’.
- **charge** - 0D double, charge state, the same as in atdata['charges']
- **mass** - 0D double, mass, the same as in atdata['masses']
- **element_symb** – 0D string, name of the element, the same as in atdata['ions']
- **Npts_pol** – 0D integer, number of points in a single toroidal plane (secondary importance - size of data in the poloidal plane ‚direction’)
- **Npts_tor** – 0D integer, number of toroidal planes (secondary importance - size of data in the toroidal direction)

# Exemplary flow of data upload/download



## PUT mode

Prepare data to be transfered (create ITF dictionaries)

Create IMAS database entry

Upload data

imas_toolbox.py

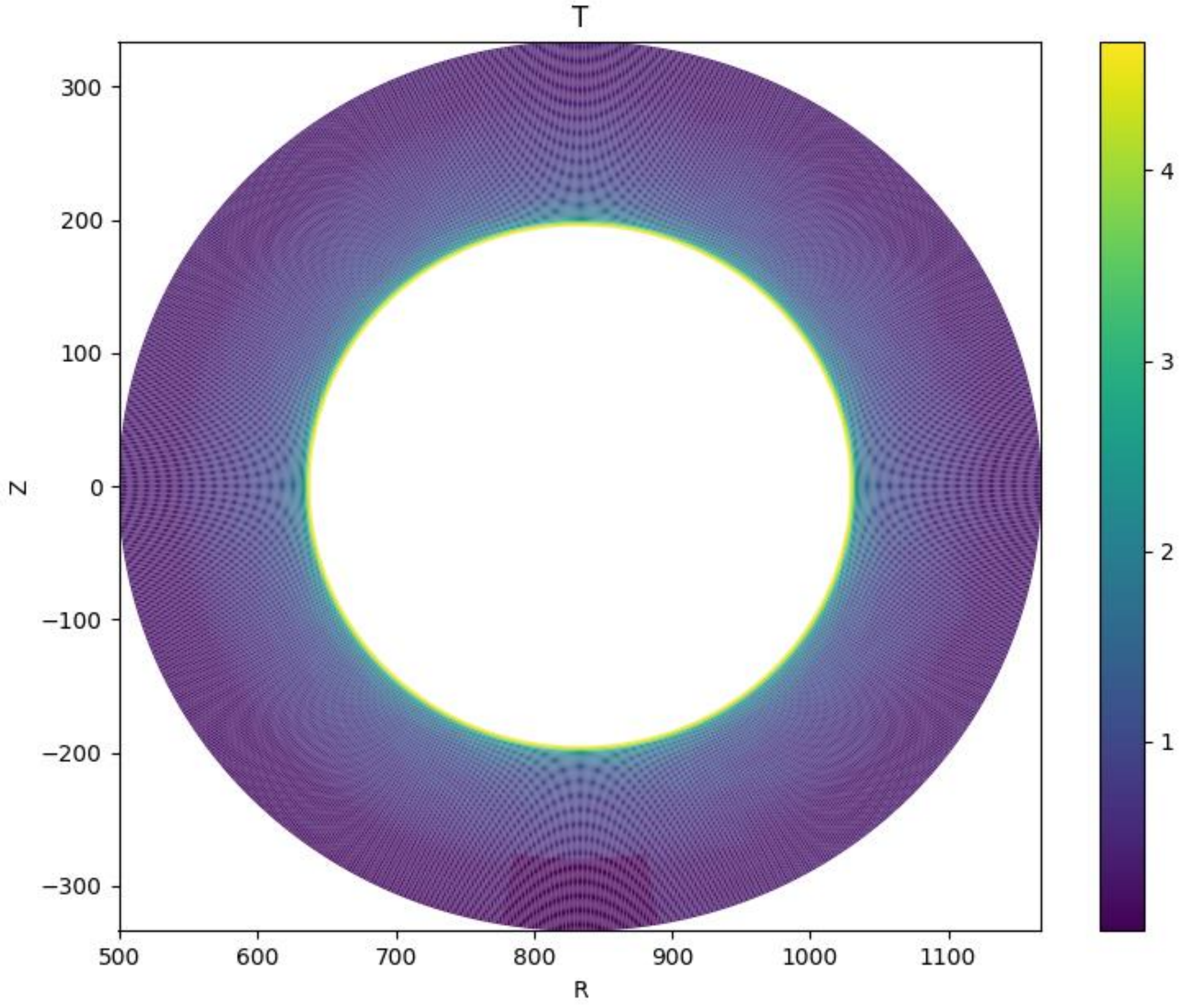
## GET mode

Open IMAS database

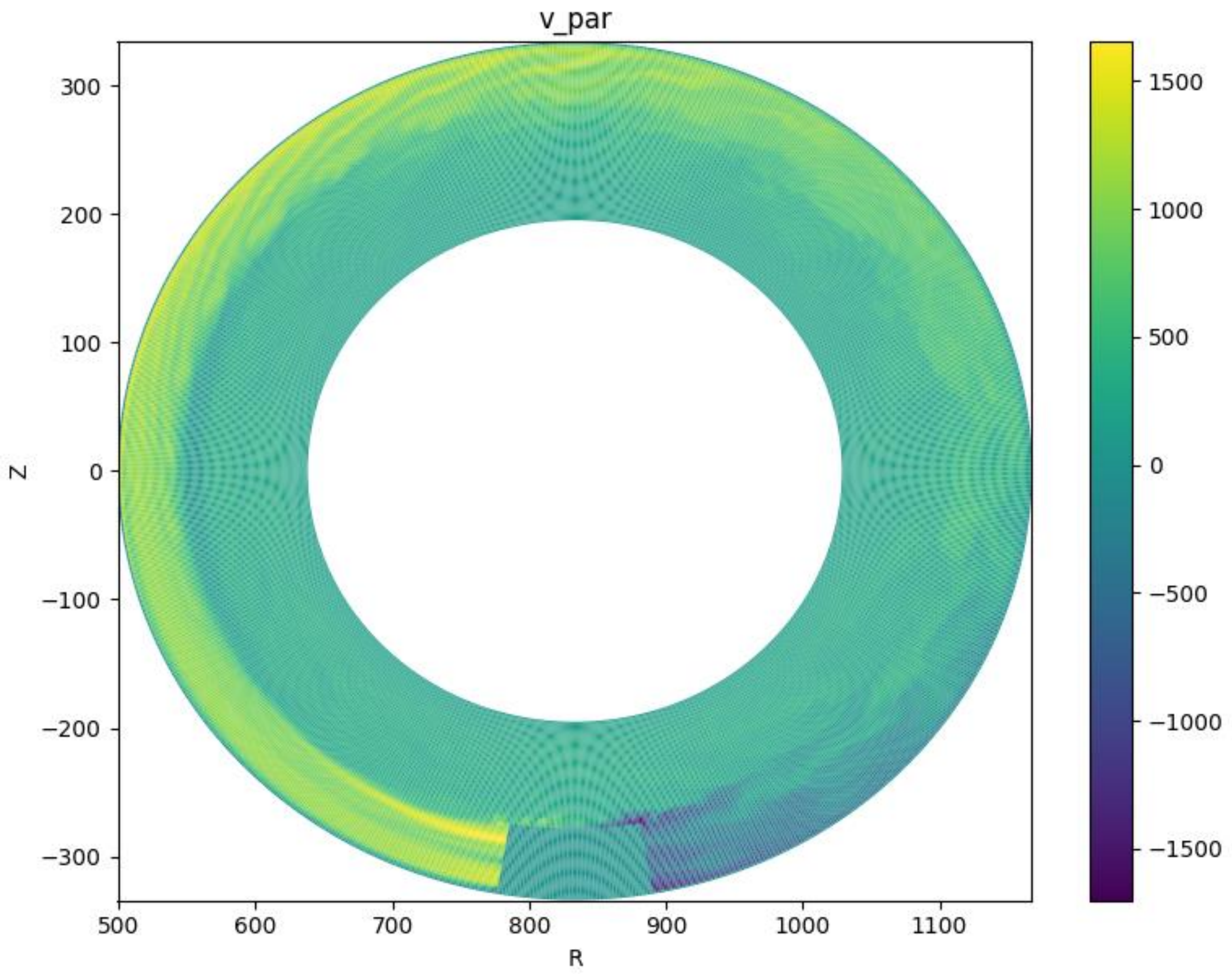
Download the selected data (in ITF format)

Do whatever you like

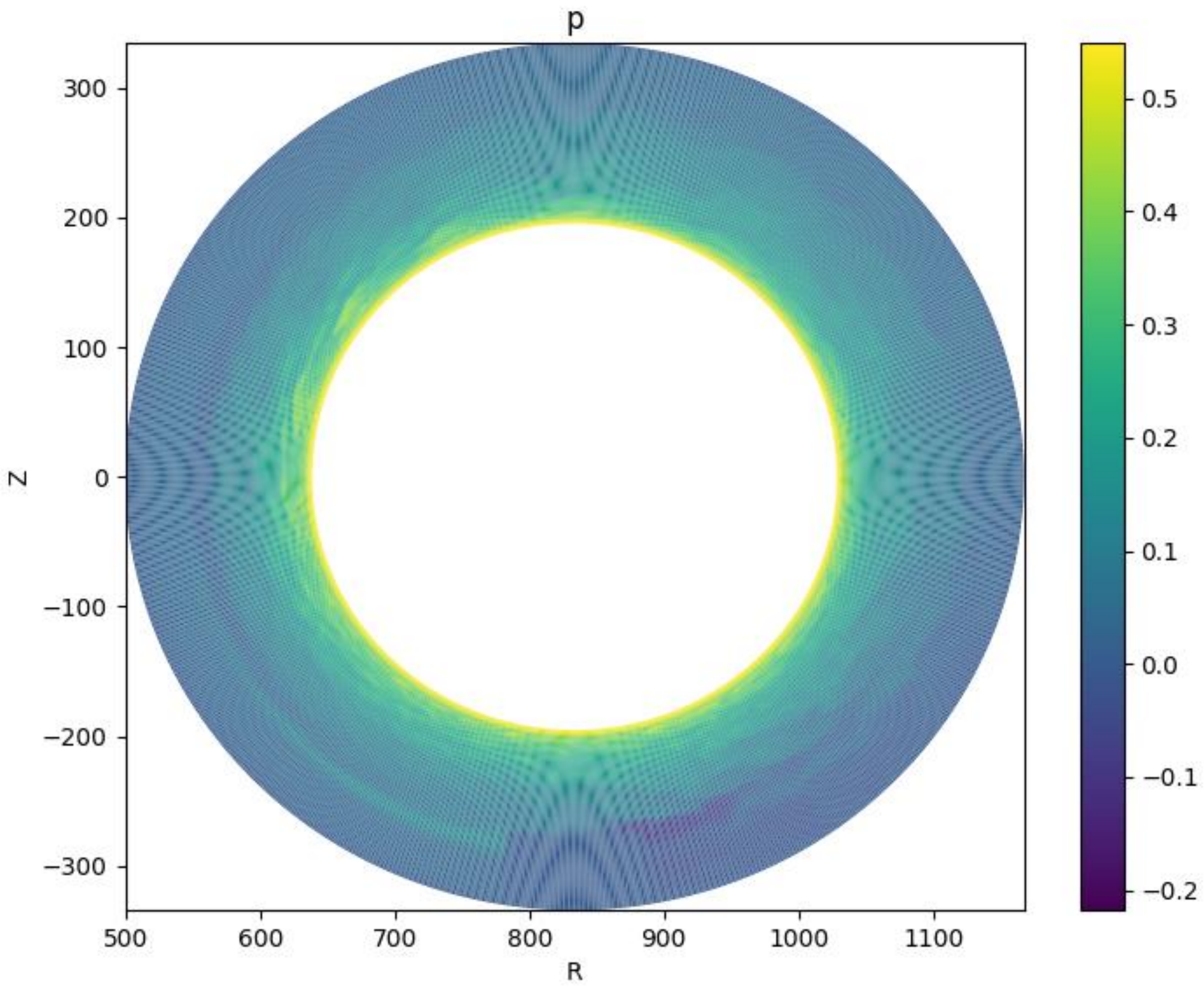
# Data uploaded/downloaded example



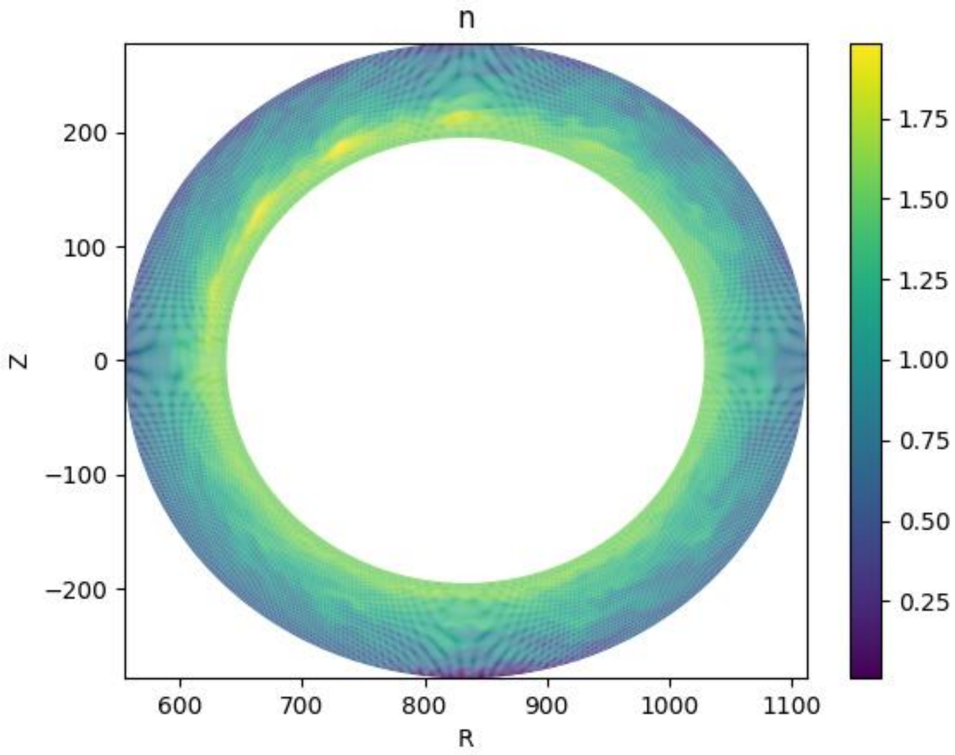
# Data uploaded/downloaded example

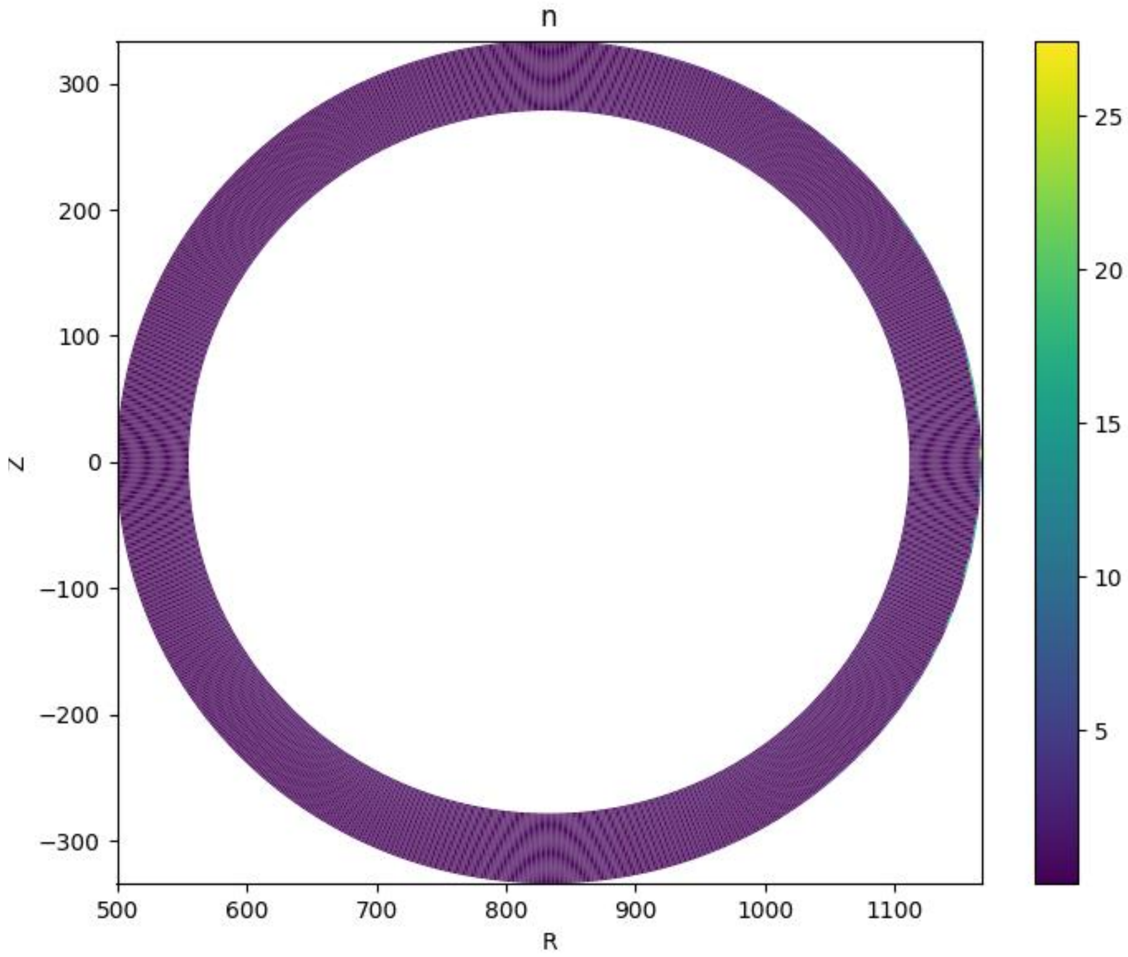


# Data uploaded/downloaded example



# Data uploaded/downloaded example





# Where to find it

Acces by Gateway account/password.

- https://gitlab.eufus.psnc.pl/ach/imas-interfaces/soledge3x

# Thank you for your attention