EFDA
EUROPEAN FUSION DEVELOPMENT AGREEMENT
Task Force Integrated Tokamak Modelling

Discharge Evolution: Edge Transport Modelling

Goal: Implementation, integration, verification and validation of edge codes

Edge codes participating in the ITM effort:

- **SOLPS** (2d multi-species fluid plasma; 2d fluid neutral or 3d kinetic neutral)
- **BIT1** (1D PIC kinetic code)
- **ERO** (3d Monte-Carlo impurity code)
- **ASCOT** (3d trace ion/electron Monte-Carlo code)
- **EMC3-EIRENE** (3d multi-species fluid Monte-Carlo code; 3d neutral kinetic code)
- **EUNOMIA** (3d neutral Monte-Carlo code)

Present status

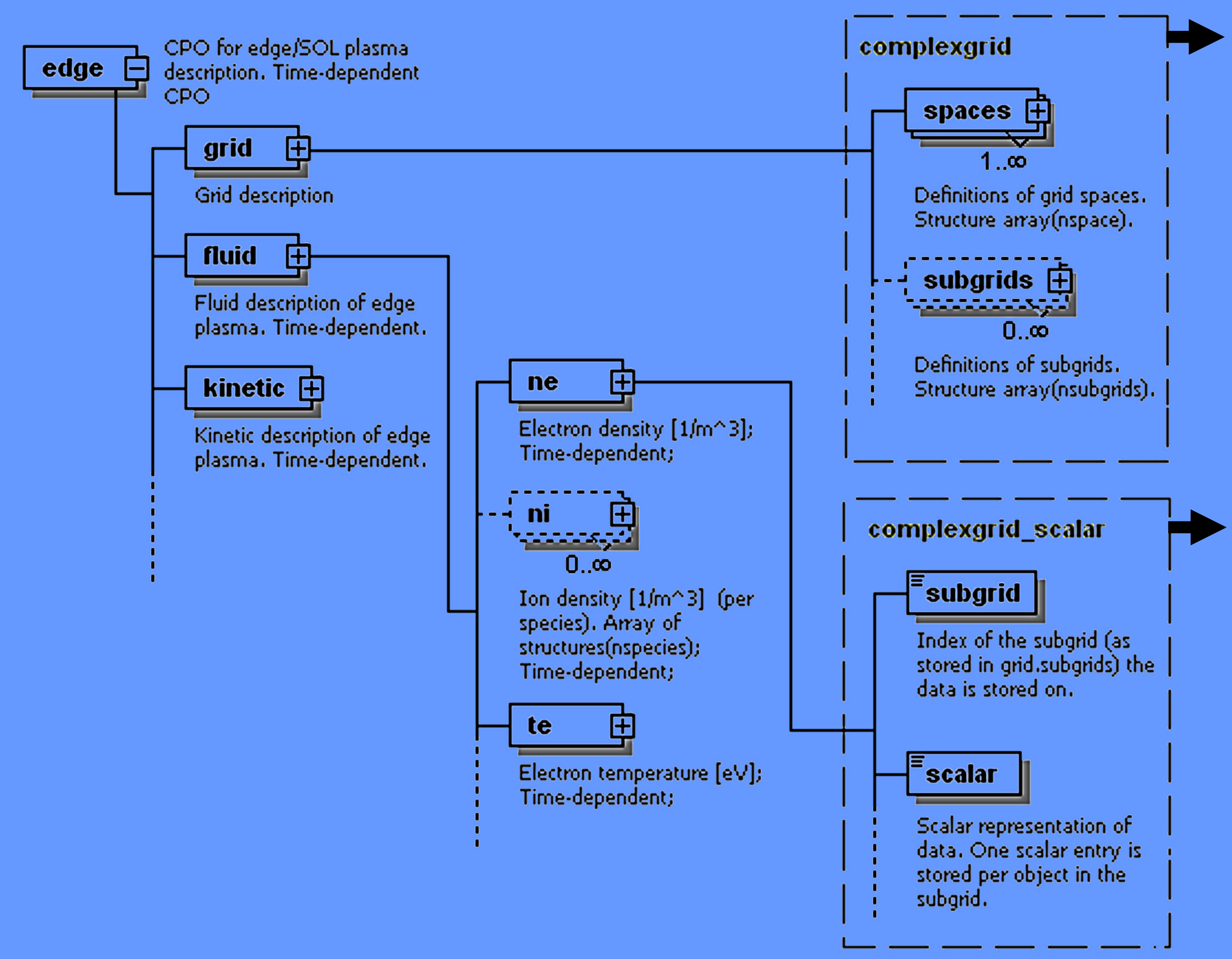
- **SOLPS**:
  - Can process data store in an EQUILIBRIUM CPO to generate a grid (CARRE component)
  - Can generate the output of the B2 component of SOLPS to the EDGE CPO
  - Can also use ITM-AMNS data
- **ASCOT, BIT1, ERO**:
  - Starting the implementation of CPOs

Next Steps

- ➢ Complete the use of CPOs in SOLPS
- ➢ Develop workflows coupling the edge codes (initially as A→B, but eventually as loops)
- ➢ Couple the Core & Edge

ITM General Grid Description

The problem of efficiently storing high-dimensional data on complicated geometries drove an effort to design the **ITM general grid description**: combining dedicated grid data structures with the CPO concept to separate the physics model from the discretization used by a specific code.



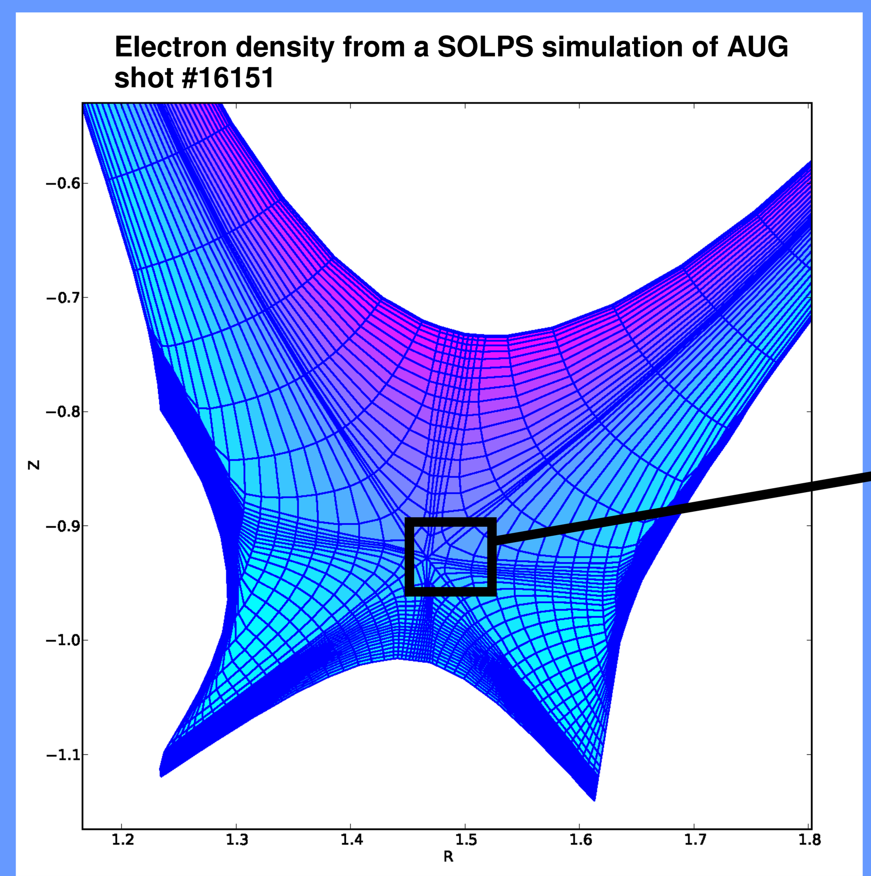
Grid description structure (for this CPO):

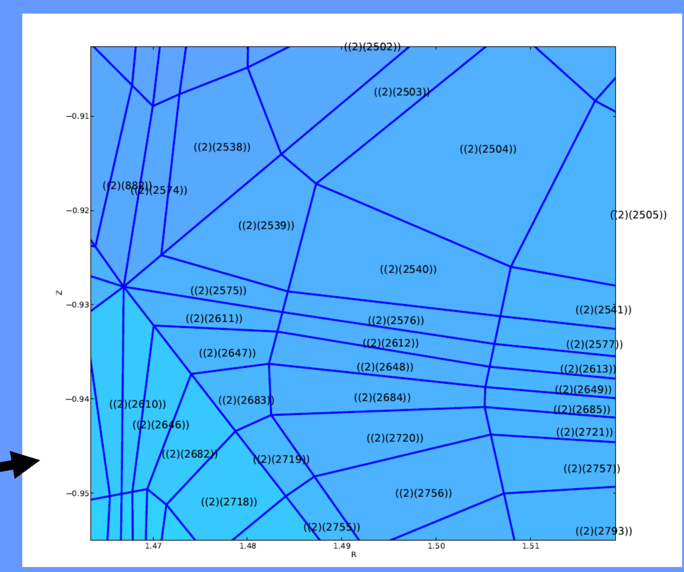
- defines grid geometry, connectivity & metrics
- defines subgrids (for data storage and domain identification)

Scalar data field structure:

- Associates data with a specific subgrid
- holds data (in possibly complex data representation)

➔ Generic data types: used in multiple CPOs, enable construction of general tools for data processing and visualization



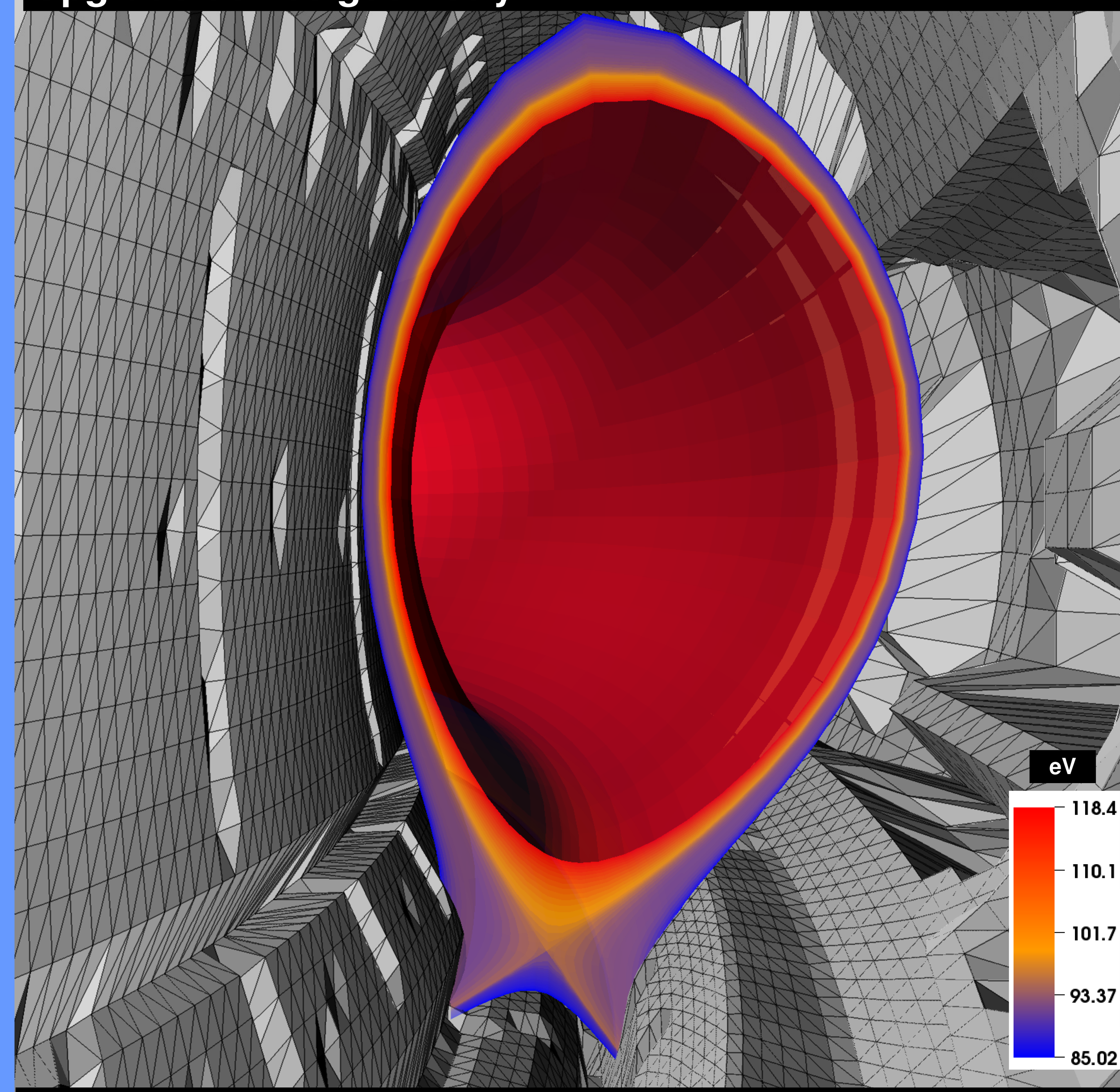


A plasma solution stored in the edge CPO on a 2d unstructured quadrilateral grid.

Left: grid & data in the divertor region.

Top: grid around at the X-point with cells labeled with their *object descriptor*, which is used to uniquely identify objects or classes of objects in the grid.

An electron temperature solution in the Scrape-Off Layer computed by SOLPS and visualized in the ASDEX Upgrade device geometry.



The raw geometry data was provided by MPI-IPP Garching (T. Lunt), conversion to the general grid description was done at Aalto University Helsinki (T. Kuoskela), and the combined plot was created with VisIt at MPI-IPP Garching (H.-J. Klingshirn), using the VisIt-UAL connector (part of the grid service library).

ITM Grid Service Library

The general grid description is a complex concept, designed to support a broad range of discretization and use cases.

To support users in using it, a set of general tools is provided in form of the **ITM grid service library.**

Key features:

- Multi-language (currently Fortran & Python, C++ planned)
- High-level interface for typical standard discretizations (n-dimensional structured grids, simple unstructured grids)
- Low-level interface for accessing discretization properties

Visualization:

- Integration with VisIt enables data visualization directly from the ITM UAL database system (see top-right figure)

EFDA ITM-TF Expo "The European Integrated Modelling effort : challenges and achievements" – 38th EPS 2011

D. Coster, IPP, D. Tskhakaya, F. Subba, ENEA, H.-J. Klingshirn, IPP, R. Wieggers, FOM, R. Stankiewicz, IPPLM, M. Airila, TEKES, L. Aho-Mantila, TEKES, X. Bonnin, CEA, D. Borodin, FZJ, G. Pereverzev, IPP, T. Koskela, TEKES, T. Lunt, IPP, and ITM-TF contributors