Univerza v Ljubljani
Fakulteta za strojništvo

EUROfusion PWIE SPA 4 - D004

Code Development to examine specific engineering use cases for transient heat flux analysis on ITER and/or DEMO (JSI)

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SPA-D004 Deliverble objective

- Code development by refactoring TOKES code to be provided for new users (resolve IPR, portability, Git, CI testing)
- Documentation of the code internals
- Selected ITER and/or DEMO transient benchmarks to be prepared as tutorials
- Specific engineering use cases to be prepared

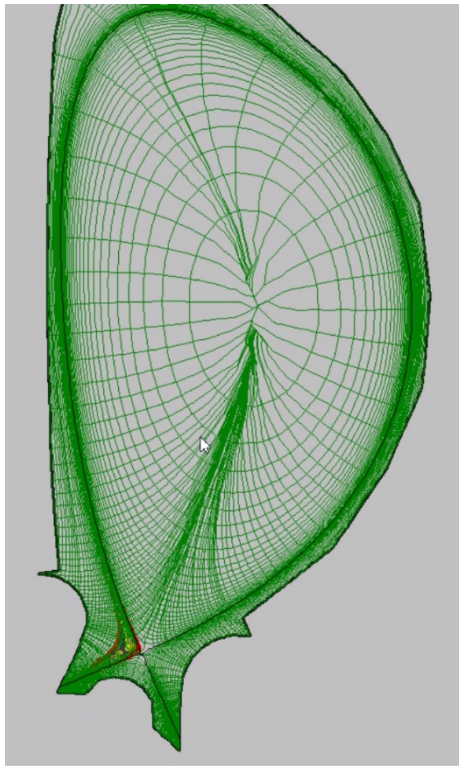
Introduction

TOKES (“Tokamak Equilibrium and Surfaces”) code:

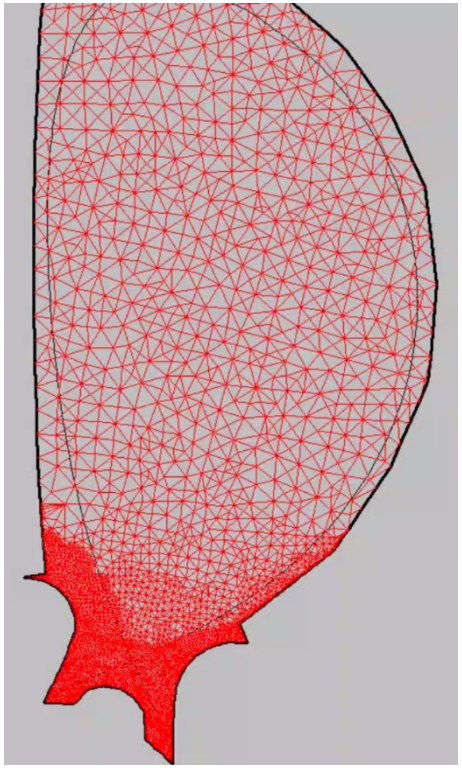
- comprehensive, parallelized tokamak fluid plasma description, particularly suited to the **simulation of fast transient heat loads on plasma-facing components (PFC)** for engineering and physics studies
- computes **multi-fluid processes** (including impurities and neutrals) **in the core and SOL plasmas**, accounting for the dynamics of magnetic fields and currents in the plasma and in the tokamak poloidal field coils
- features a **numerical meshing out to all wall surfaces** with the possibility of spatially variable grid resolution on the mesh
- includes **standard surface interactions** such as **sputtering**, but also **surface vaporization** and, importantly, **a vapour shielding module.**

TOKES: Calculation principles

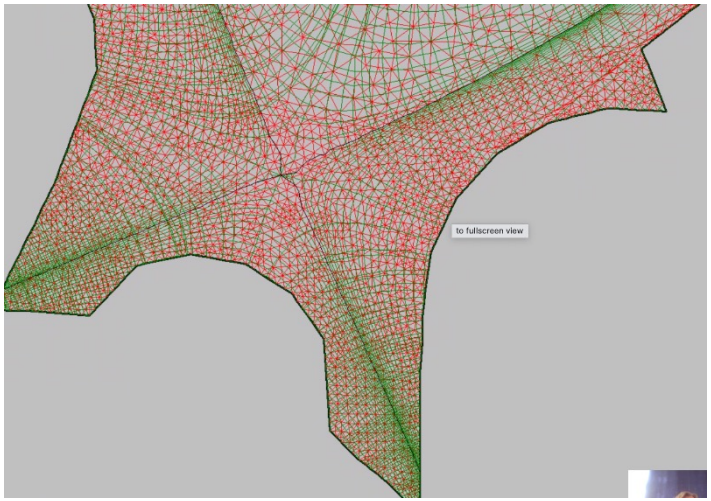
Calculation grid and mesh



Calculation grid



Magnetic potential mesh

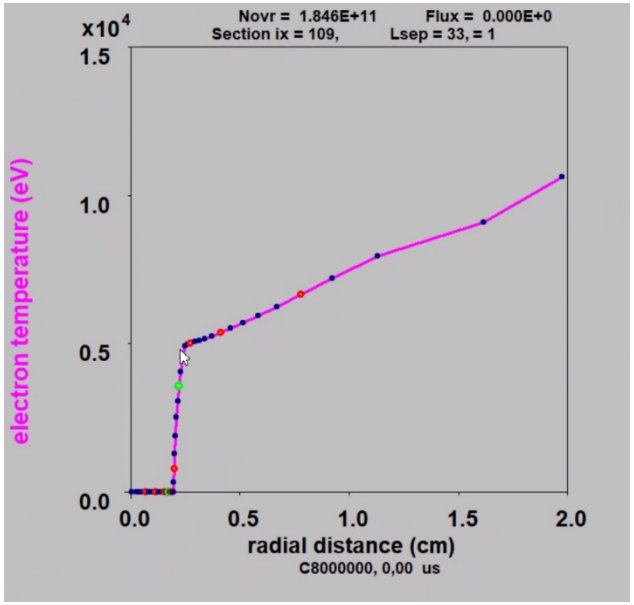


Combining grids

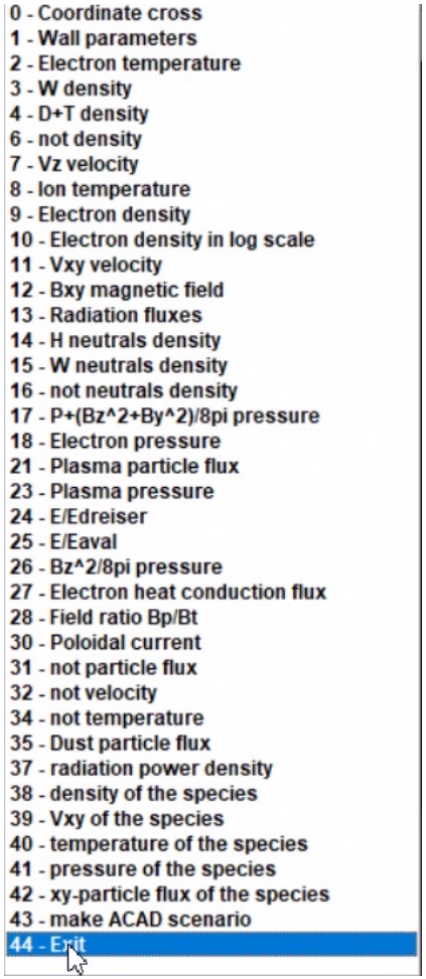
TOKES: GUI Capabilities

- preparing or preprocessing of the input data (boundary, triangle grid, plasma toroidal currents, magnetic layers)
- several calculation options, visualization of input data and calculated results

Initial state temperature

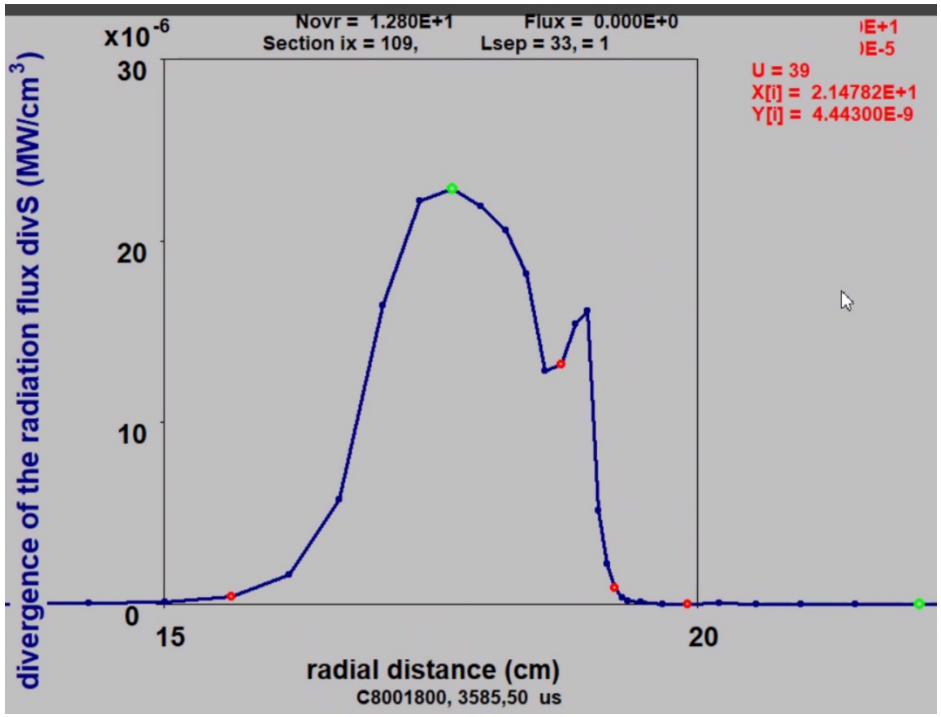


Electron temperature profile

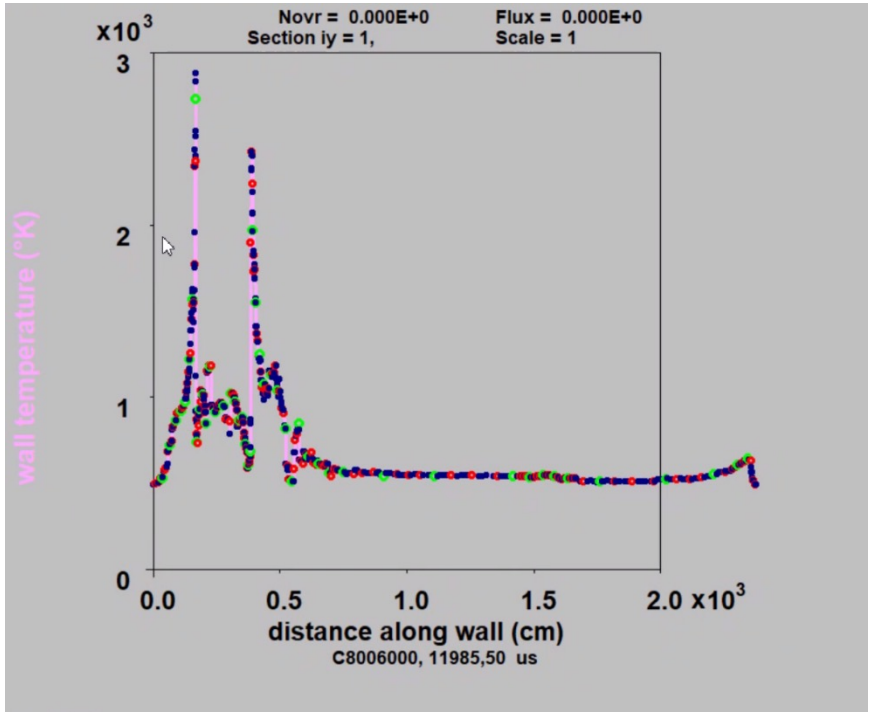


TOKES: GUI Capabilities (2)

Visualization of some results



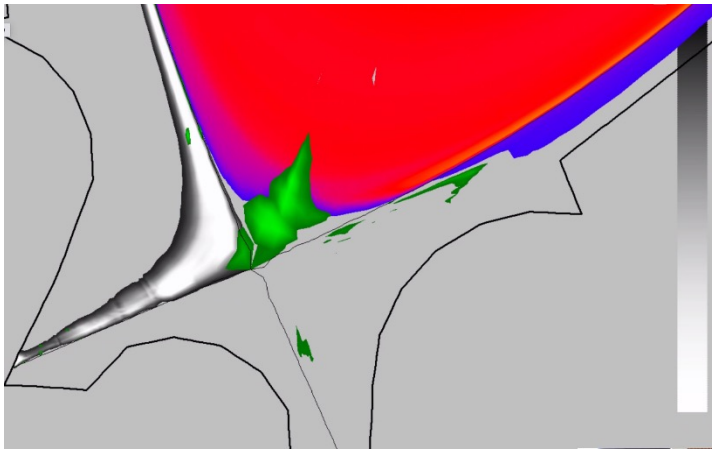
Radiation flux



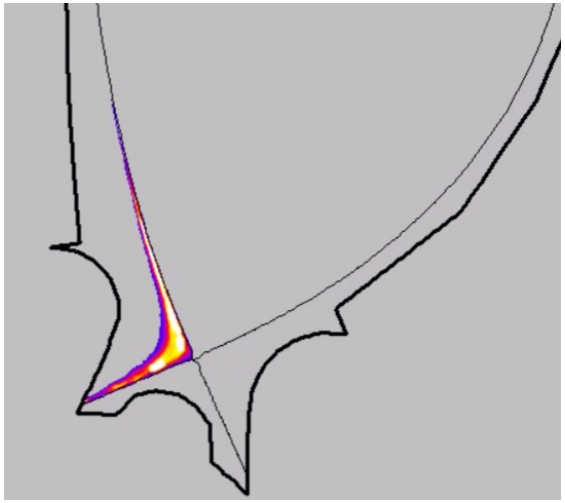
Wall temperature

TOKES: Case example

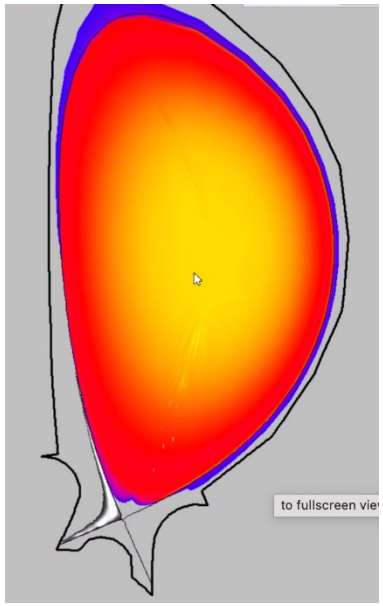
Surface vaporization calculation



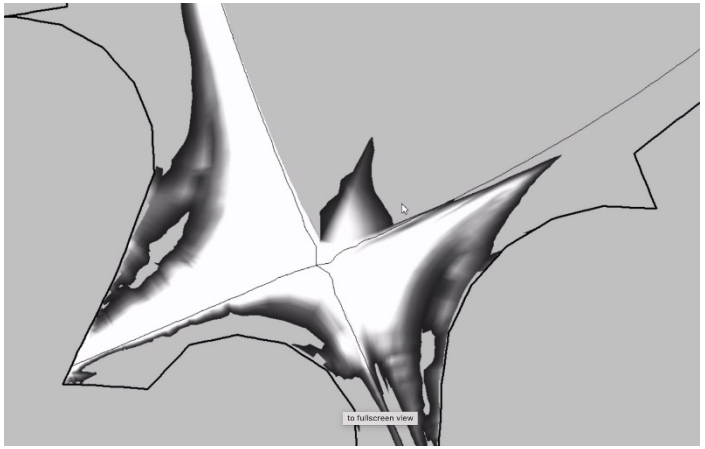
Green spots: radiation power density



Density of vaporized material



Ionized tungsten plasma along the fieldlines



Some density inside the core