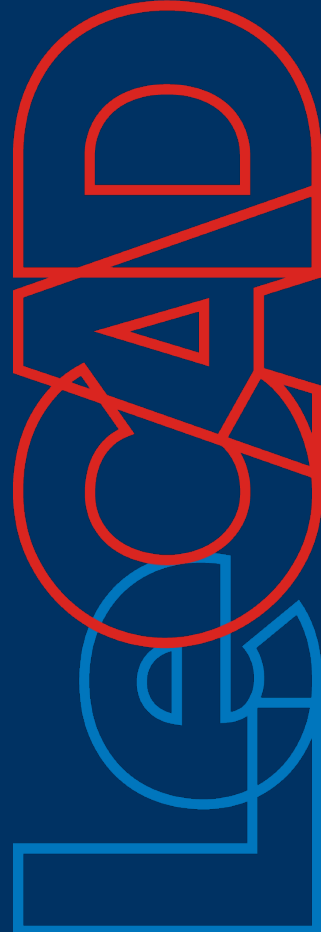




EUROfusion PWIE SPA 4 - D004

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

L. Kos, I. Vasileska, L. Bogdanović





SPA-D004 Deliverable 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

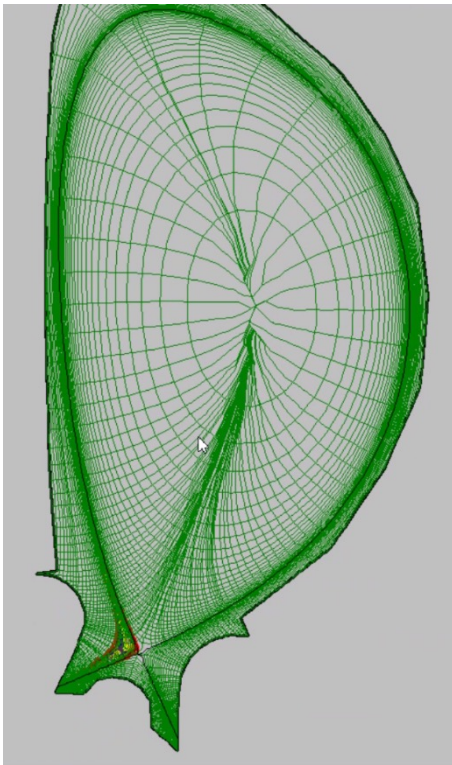
TOKES (“Tokamak Equilibrium and Surfaces”) code:

- 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**.

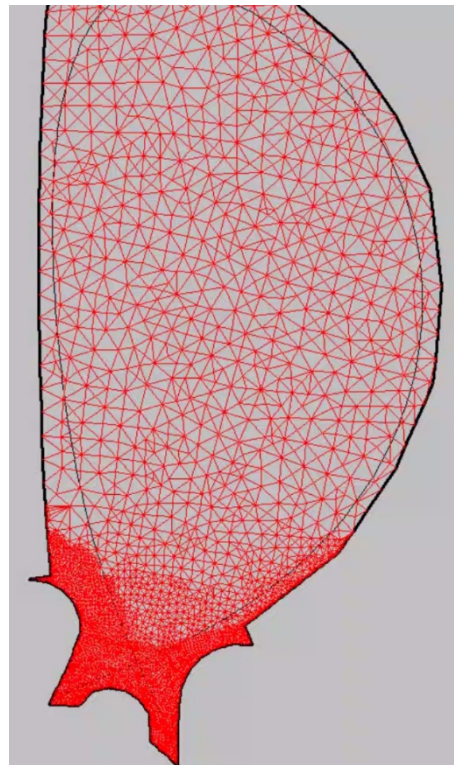


TOKES: Calculation principles

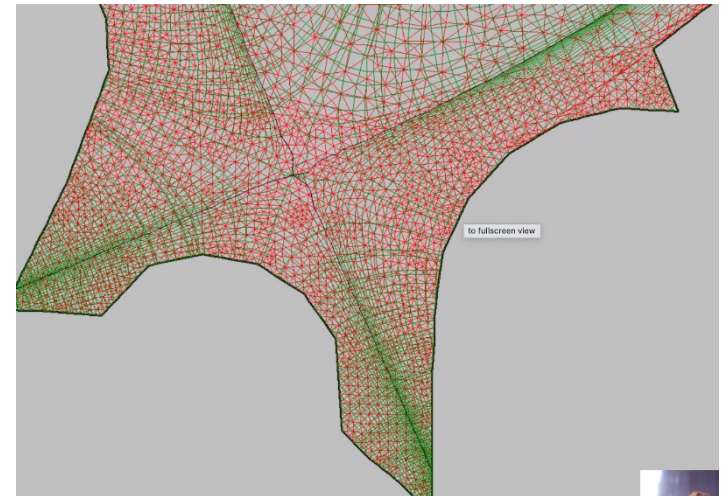
Calculation grid and mesh



Calculation grid



Magnetic potential mesh

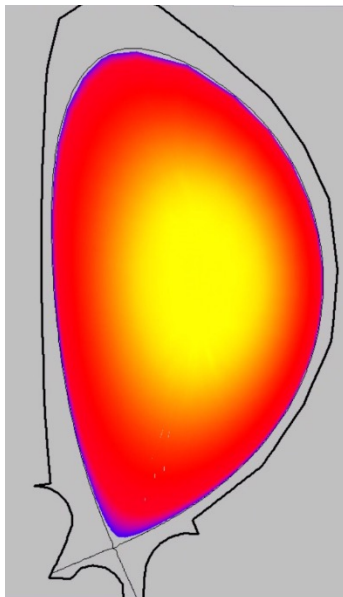


Combining grids

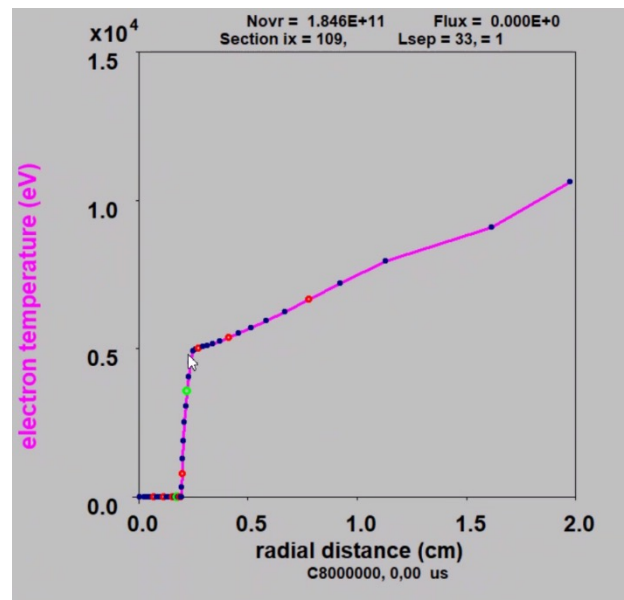


TOKES: GUI Capabilities

- 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



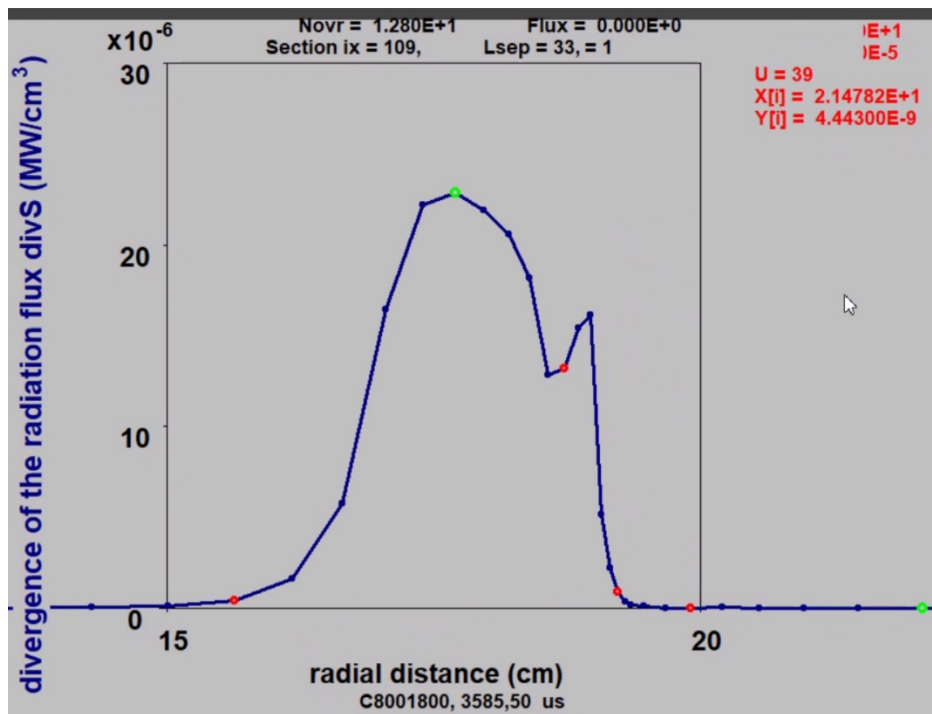
Electron temperature profile

- 0 - Coordinate cross
- 1 - Wall parameters
- 2 - Electron temperature
- 3 - W density
- 4 - D+T density
- 6 - not density
- 7 - Vz velocity
- 8 - Ion temperature
- 9 - Electron density
- 10 - Electron density in log scale
- 11 - Vxy velocity
- 12 - Bxy magnetic field
- 13 - Radiation fluxes
- 14 - H neutrals density
- 15 - W neutrals density
- 16 - not neutrals density
- 17 - $P+(B_z^2+B_y^2)/8\pi$ pressure
- 18 - Electron pressure
- 21 - Plasma particle flux
- 23 - Plasma pressure
- 24 - E/Edreiser
- 25 - E/Eaval
- 26 - $B_z^2/8\pi$ pressure
- 27 - Electron heat conduction flux
- 28 - Field ratio Bp/Bt
- 30 - Poloidal current
- 31 - not particle flux
- 32 - not velocity
- 34 - not temperature
- 35 - Dust particle flux
- 37 - radiation power density
- 38 - density of the species
- 39 - Vxy of the species
- 40 - temperature of the species
- 41 - pressure of the species
- 42 - xy-particle flux of the species
- 43 - make ACAD scenario
- 44 - Erit

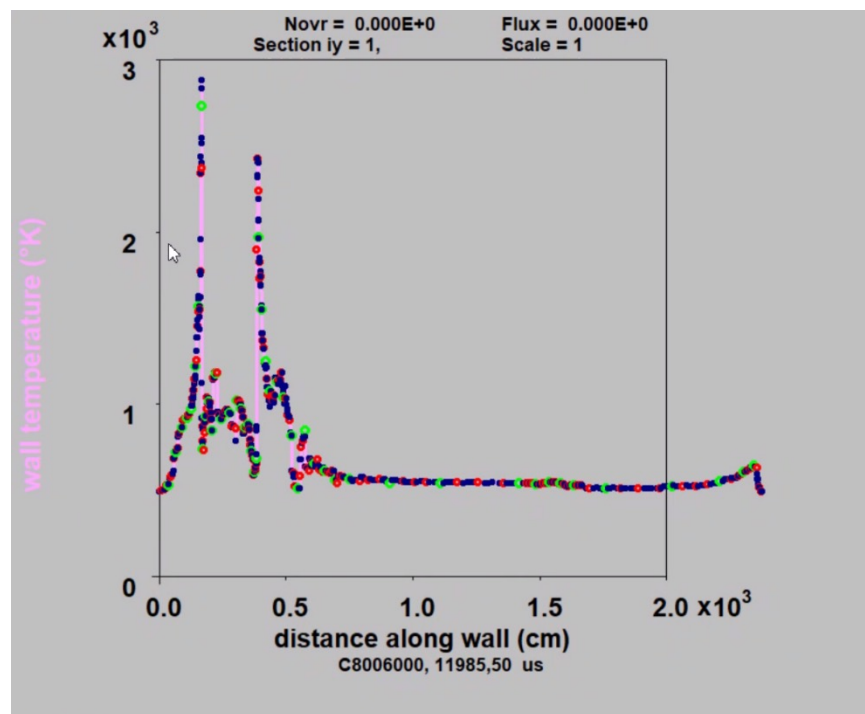


TOKES: GUI Capabilities (2)

Visualization of some results



Radiation flux

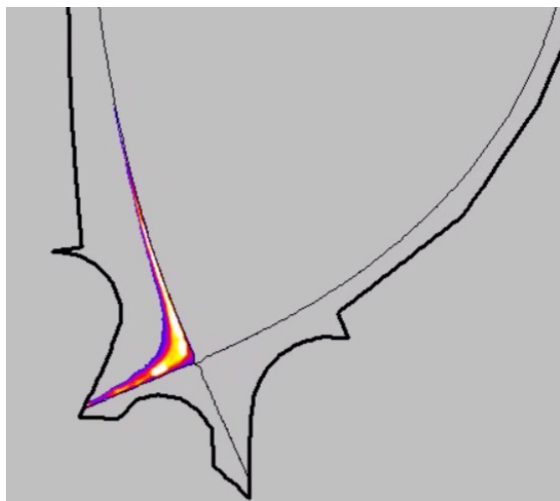


Wall temperature

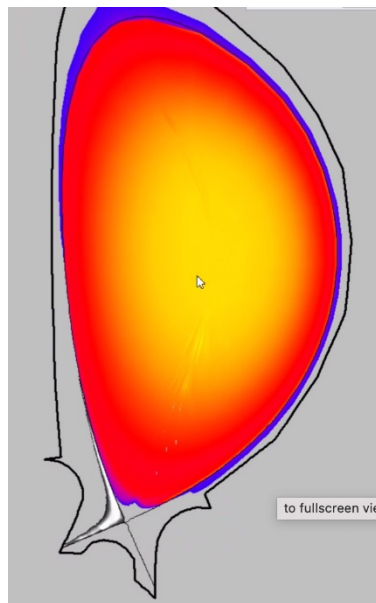


TOKES: Case example

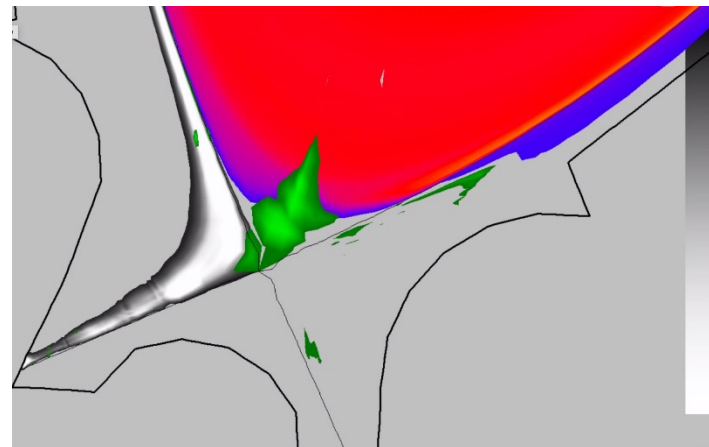
Surface vaporization calculation



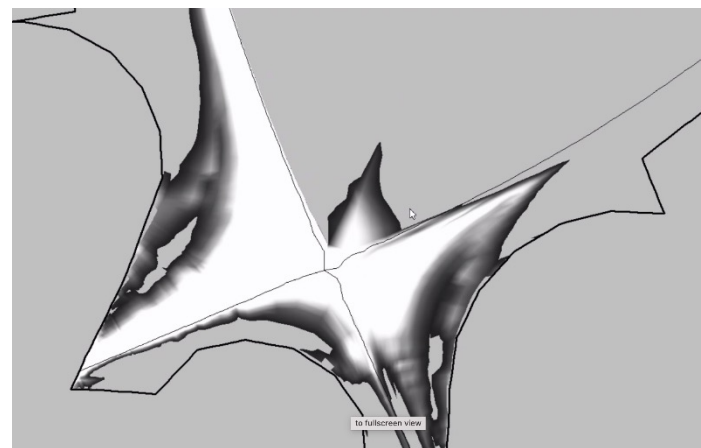
Density of vaporized material



Ionized tungsten plasma
along the fieldlines



Green spots: radiation power density



Some density inside the core