SolEdge-HDG plan 2026

On behalf of SolEdge-HDG team

Working plan

TSVV-B scientific proposal, SolEdge-HDG

- Mean-field simulations of TCV-X23 with reduced transport model:
  - Current status: Y. Kunimoto (PhD student) is testing new closures for reduced turbulent model on TCV-X21
  - 2026 plans:
    - How can we get TCV-X23 data?
    - We should compare reduced turbulent model results with turbulent codes
- Limiter configuration discharges on WEST to support ITER start-up:
  - Current status: full discharges are modelled + impurity radiation model + simplified transport + ERO2.0 simulation of erosion and impurity transport
  - 2026 plans:
    - Investigate in more details in steady state higher fidelity core models, reduced turbulent models, the impact of radiation profile, BC at grazing angles, flux limiters and validate against experiment
    - Study the impact on wall erosion

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- Implementation of impurity models and drifts
  - Current status: impurity radiation model tested, some artifacts of old drifts tests are in the code
  - 2026 plans:
    - Test whether or not impurity model is enough in limiter and diverted plasmas
    - Do X-point radiation simulations, scanning the cooling function
    - Start working with BgradB drift
- 3D simulations
  - Current status: M. Capasso (PhD student) runs 3D N-Gamma-neutral model in circular case, for WEST there are issues with memory (direct solver, size of the mesh)
  - 2026 plans:
    - Investigate iterative solvers
    - Do ripple simulations at least in circular geometry, but also in WEST and compare with exp
    - First attempts to implement advanced numerical approach to reduce condition number due to problem anisotropy

SolEdge-HDG longer terms

- Implementation of impurity transport, ExB drifts will require adding new complex equations
- Dealing with non-axisymmetric 3D wall geometry will require changing of code numerics (so far 2.5D with toroidal symmetry)
- Adding new physics will most probably require more refined meshes => memory issues
- At the current stage of the code adding new features and changing code basis is getting more and more cumbersome (legacy, documentation, readability issues)
- Also int32 implementation limits us memory-wise (pastix/petsc crashes for large meshes)

- At this moment we should consider rewriting the code from scratch if we want to have all the described capabilities
- At least a reduced version of the code solely for impurities/vorticity equation can be made and coupled
- The problem is the absence of permanent contract scientists working on the code
- Is EBC repository available?
- Help with impurity model and vorticity equation from SOLEDGE3X team?
- If budgets for 2027 are reduced there is a risk of staying with 2.5D, only impurity radiation and only BgradB drift