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Modelling of C wall Scenario 2 with SOLPS-ITER - status and plans

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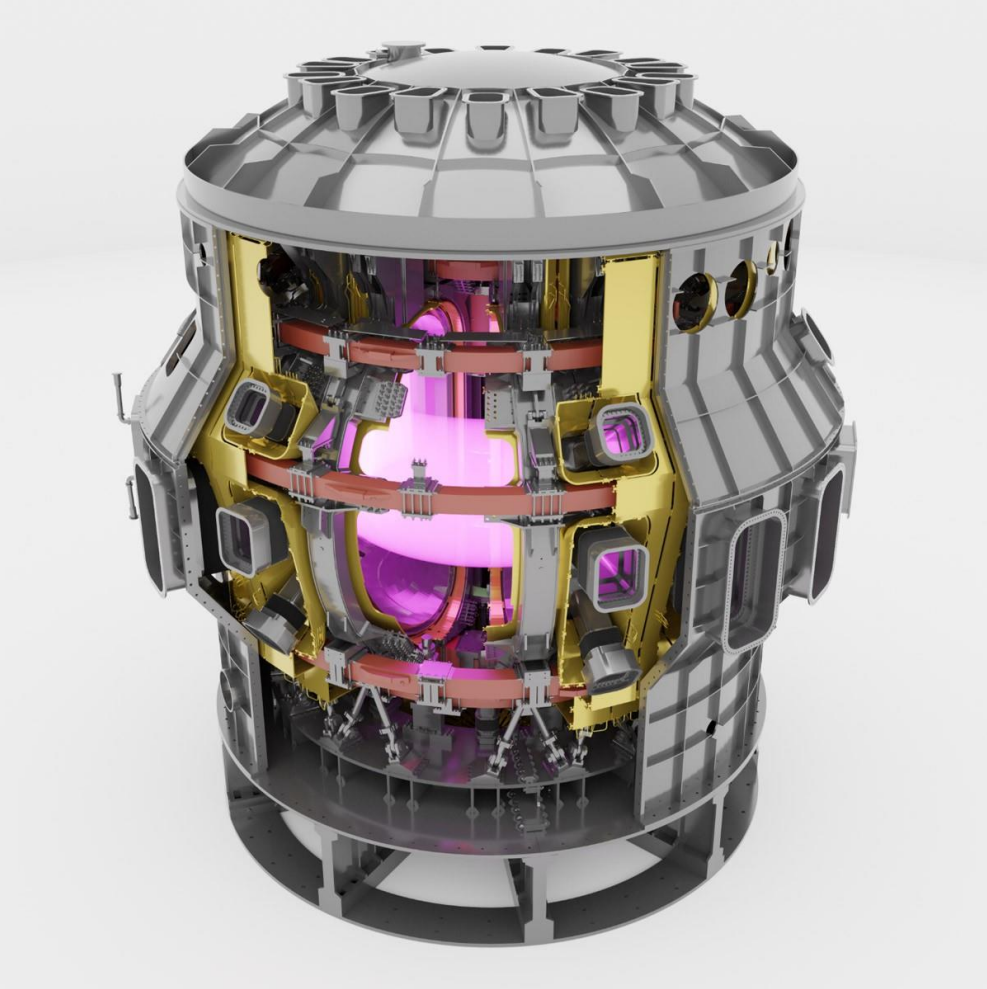
Modelling of C wall Scenario 2

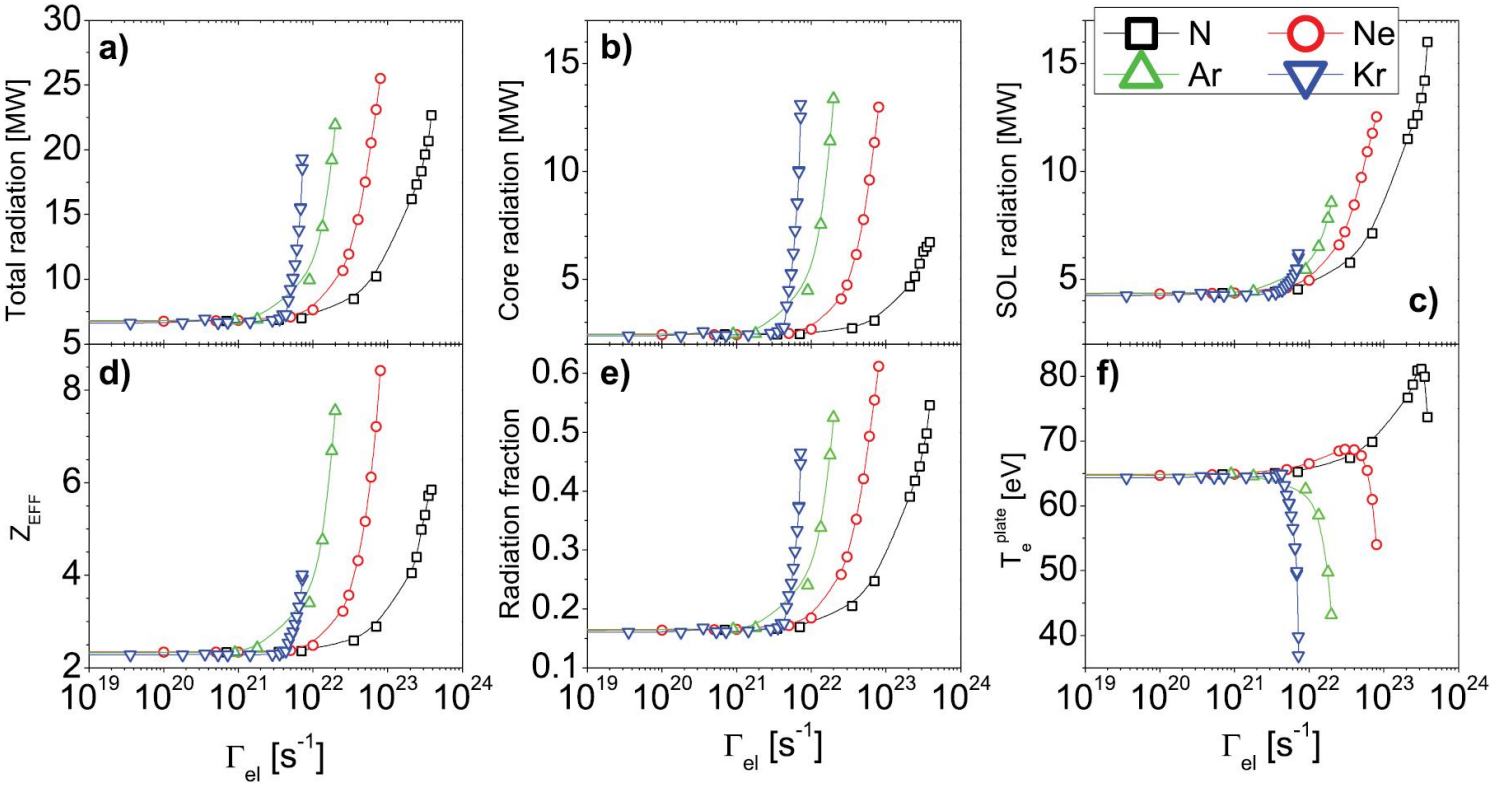
- Introduction
- Modelling assumptions
- Simulations results
- Summary
- Plans



Introduction

Studies performer in this project are a continuation of the plasma simulations for JT-60SA made in former WP with the COERDIV code which couples the central and SOL plasma

COREDIV simulations of SCN#2 with Ne/Ar/Kr seeding



R. Zagórski et al., NF 2016; K. Gałązka et al., 2018.

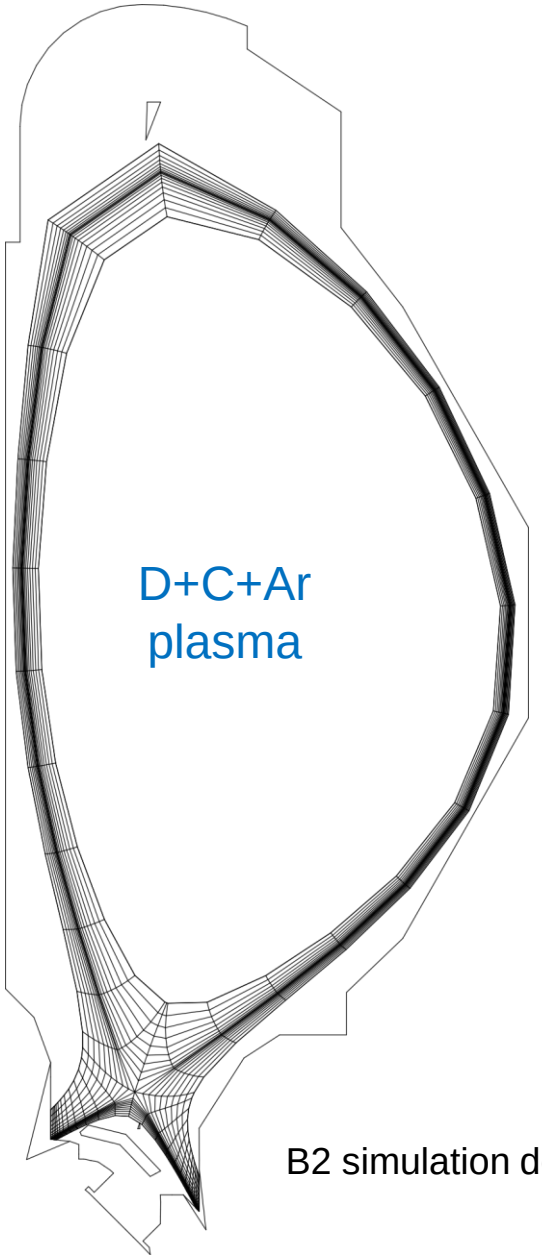
Introduction

Motivations

- Studies of the power exhaust problem with seeded impurities
- JT-60SA auxiliary heating in scn#2: 41 MW
- maximum power density to target: 10 MW/m^2
- need to radiate out about 20-30 MW

- Therefore, there is need of the detailed studies of the power mitigation in the SOL and plasma deposition at the target plates
- Studies with boundary plasma code have been started (the SOLPS-ITER code package)

Modelling assumptions

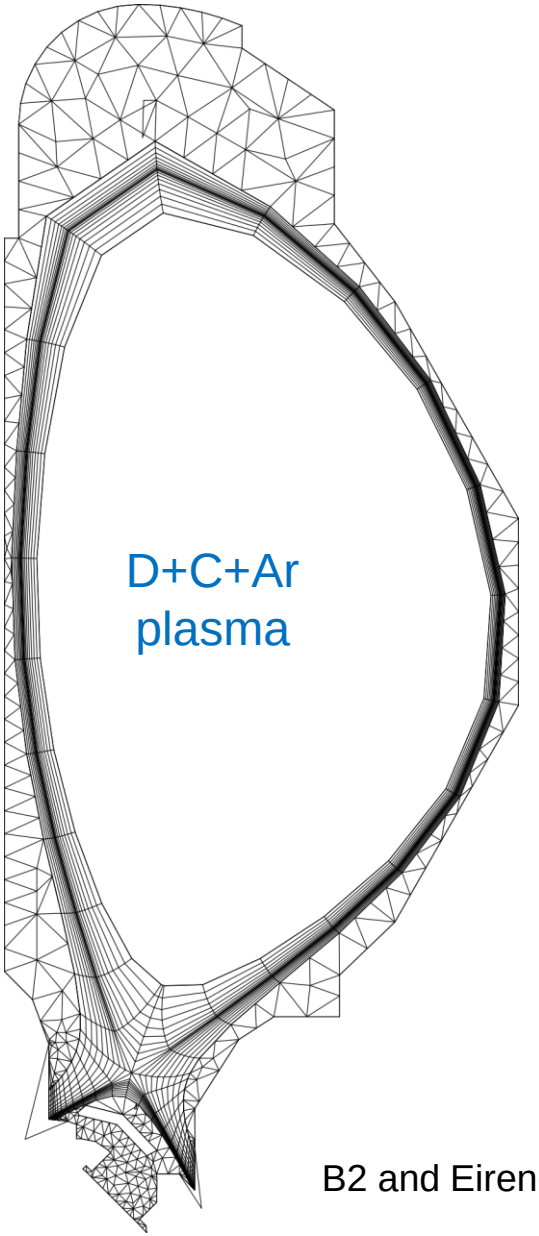


B2 simulation domain

- Simulations have been performed with SOLPS-ITER (multifluid B2 code coupled with Eirene MC code)

- Scn#2 is under consideration
- B2 numerical mesh consists of 50 x 36 cells (2021)
- Deuterium plasma with argon impurity
- Carbon divertor targets
- With physical sputtering of carbon targets
- No chemical sputtering

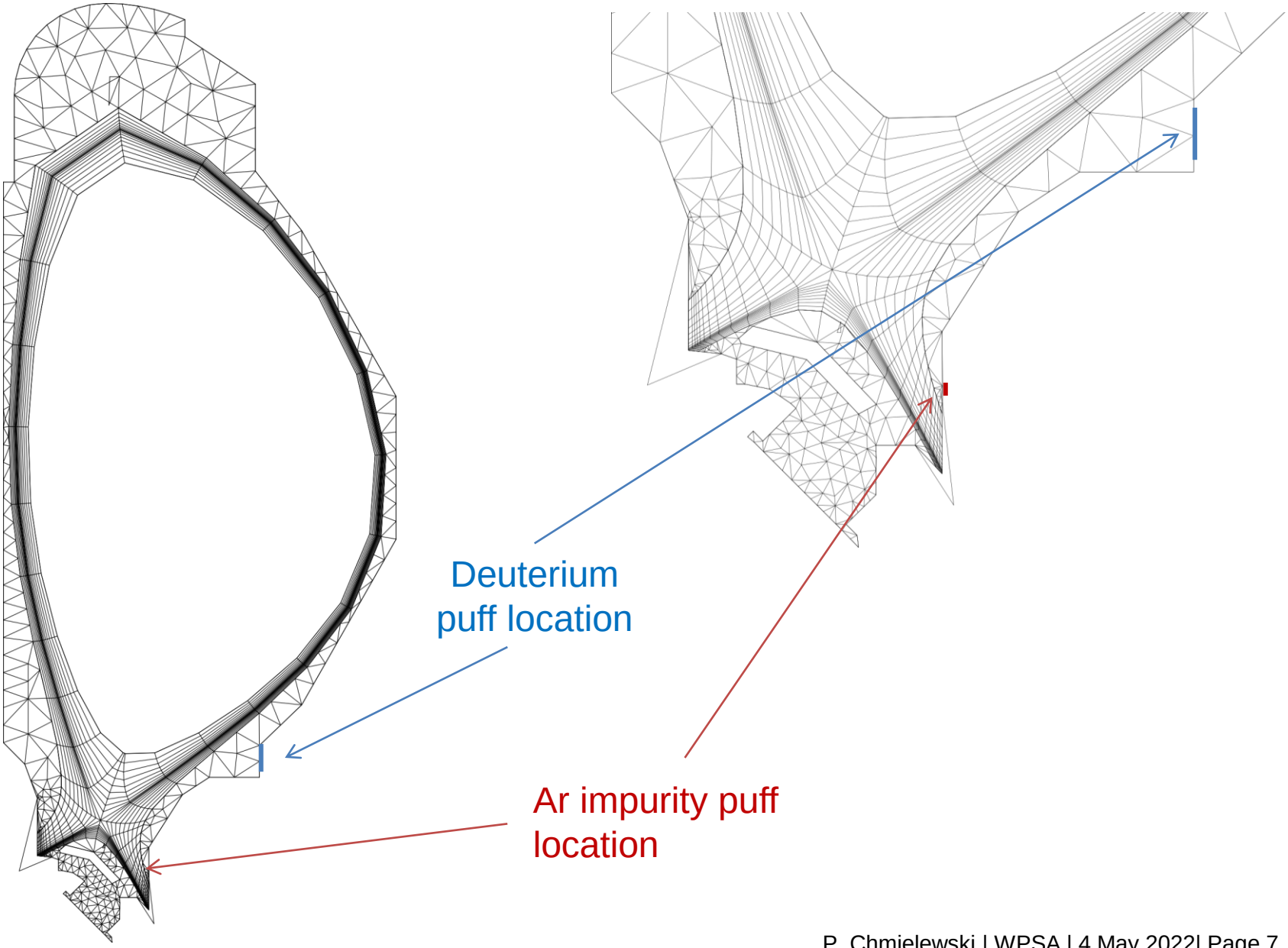
Modelling assumptions



B2 and Eirene mesh

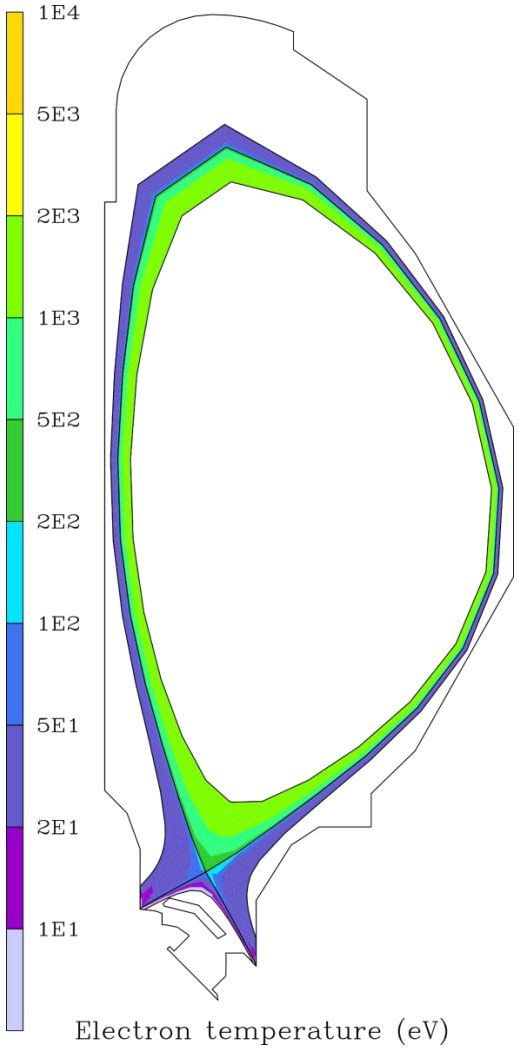
- Applyed core-SOL boundary conditions:
  - P_{IN} = 21 MW (divided equally into electrons and ions)
  - density boundary condition: specified inner electron density equal to 3×10^{19} m^{-3}
- Gas puffing:
  - Deuterium gas puff (outer valve)
  - Ar seeding above the outer divertor

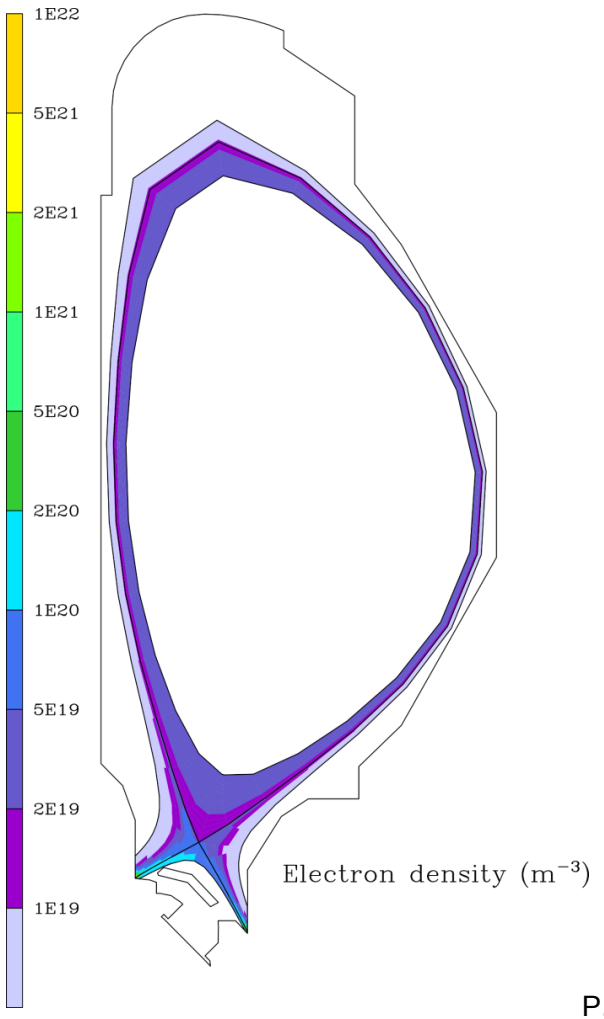
Modelling assumptions

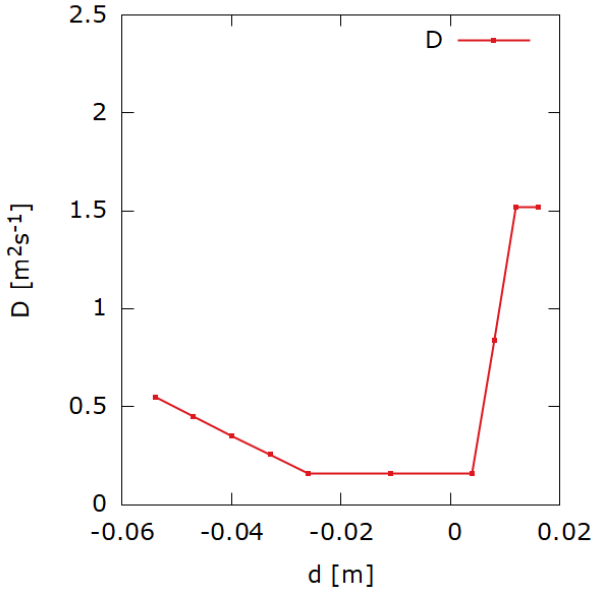


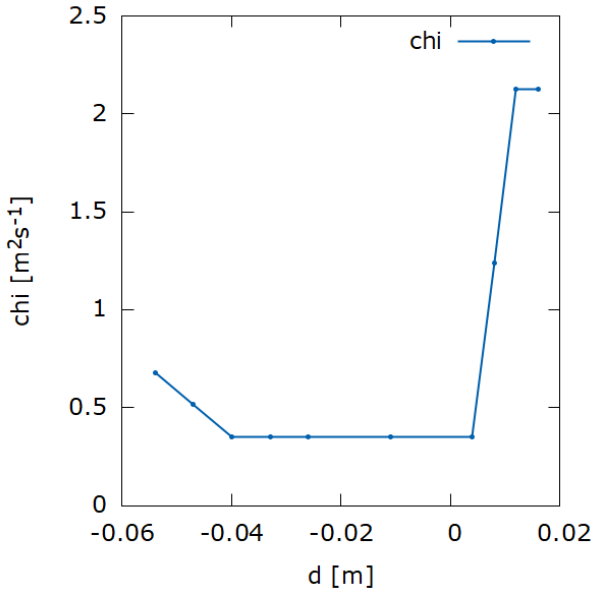
Diffusivity profiles

Radial profiles of the particle density diffusivity and electron heat diffusivity have been assumed on the basis of the L. Balbinot studies of JET discharges



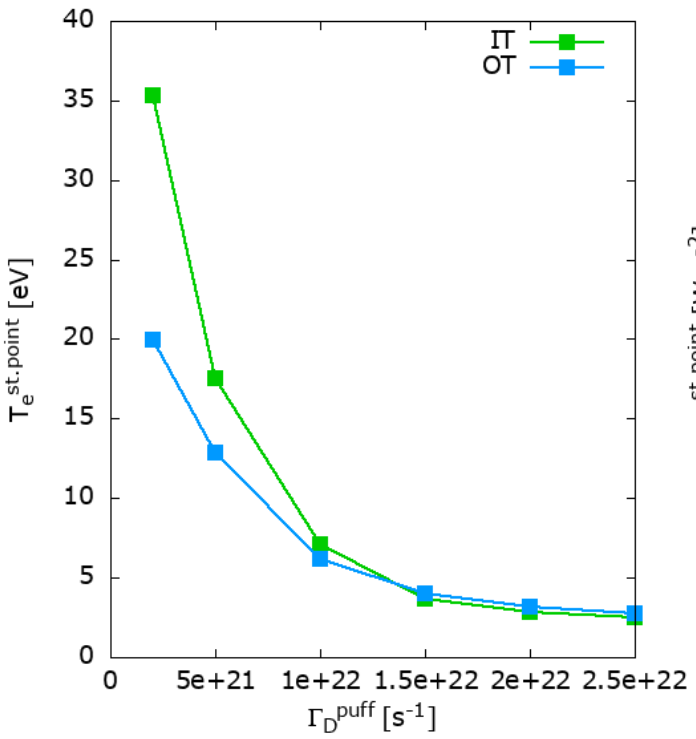


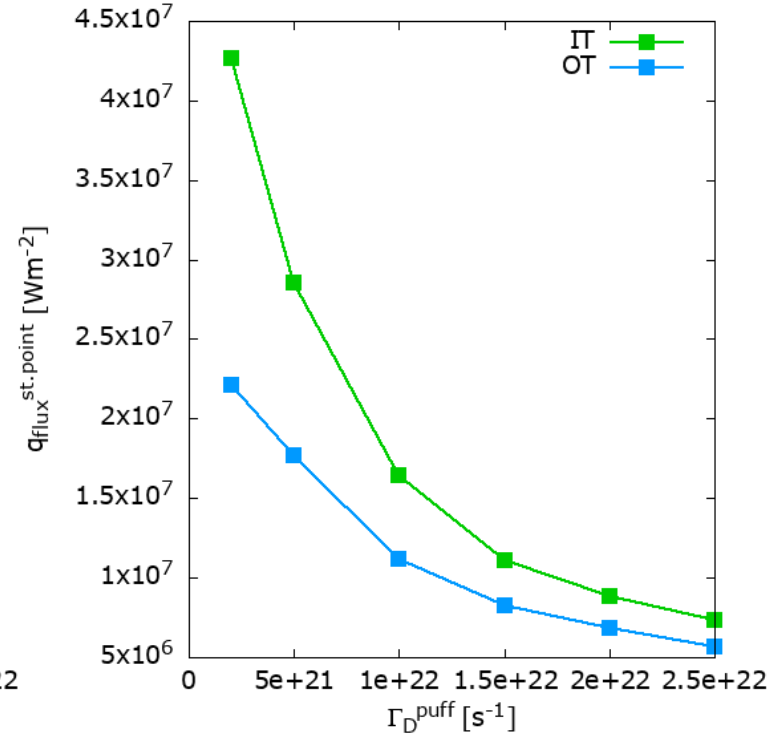




Simulations results

Scans over the electron density at separatrix with low Ar concentration have been done





- Increase of the upstream electron density with raise of the deuterium puff has been observed
- Low values of the electron temperature at the strike point
- Drop of T_e at the strike point with increase of the upstream density (inner and outer targets)

Summary

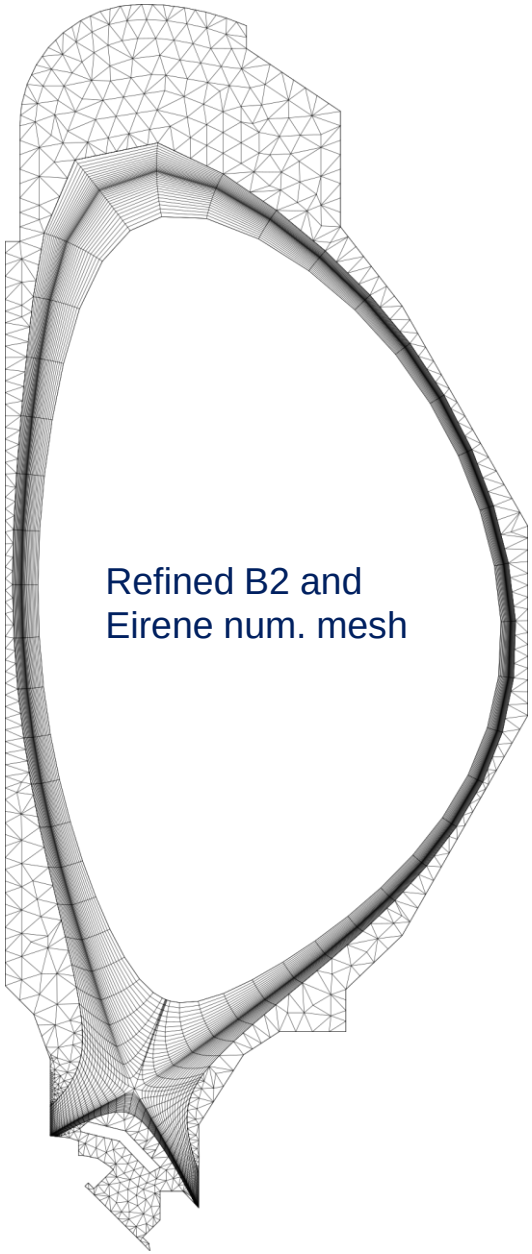
Activities in 2021

- Numerical model for JT-60SA SCN#2 with carbon wall and deuterium plasma seeded with argon impurity have been prepared
- Scan over the upstream electron density at low Ar puff have been done

Activities done in 2022

- Corrections to the numerical model have been added
  - corrected radial transport profile
  - the inner core boundary have been changed from constant density to constant particle flux condition
- Resolution of the numerical mesh have been increased (100x36 cells)
- Ongoing studies with new model conditions for different values of the argon concentartion and the separatrix density

Plans



Plans for 2022

The aim is to analyse the effect of the argon seeding

- on the heat load mitigation,
- on efficiency of the argon and carbon radiation,
- on the carbon sputtering

➢ Scans for different argon concentrations and for different values of the separatrix density will be performed

➢ Limited investigations of the plasma detachment in JT-60SA for various argon concentrations will be done

➢ Power scan is under consideration

❖ Planned publication at the PET conference

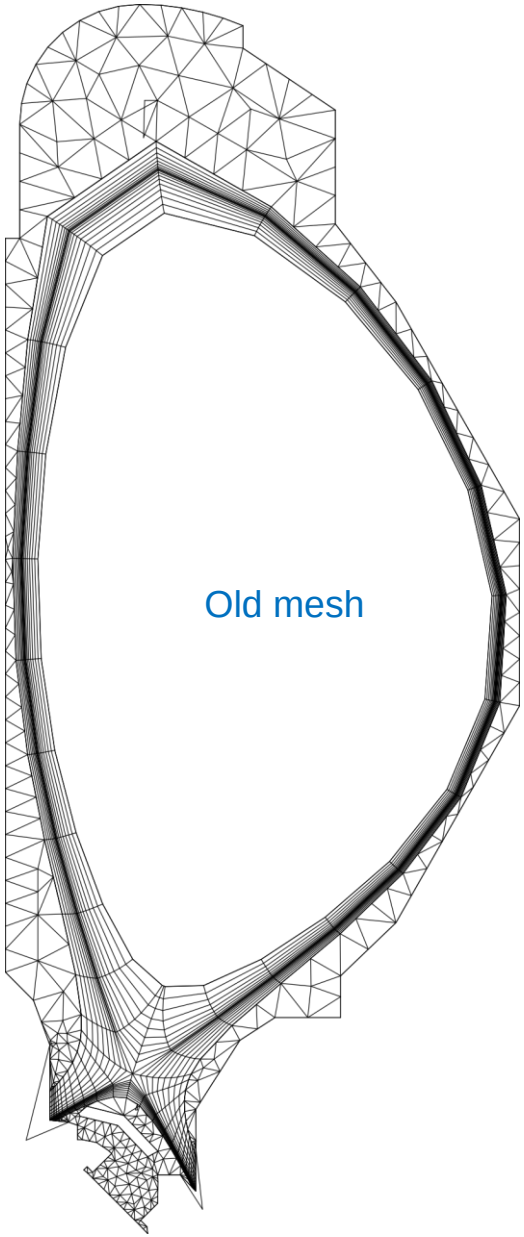
Plans

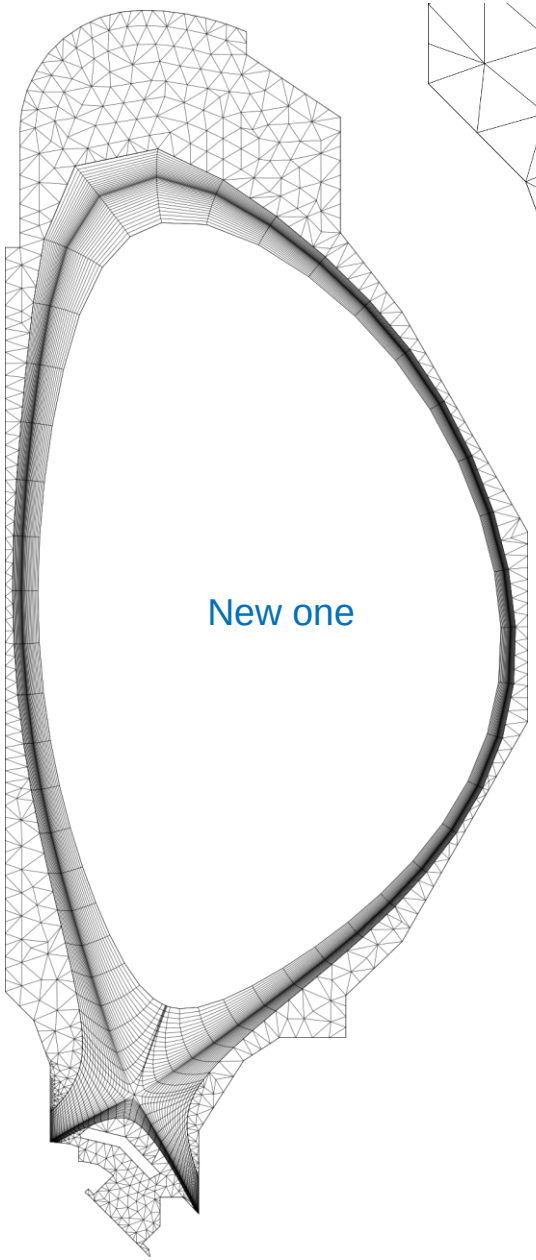
Thank you very much for attention!

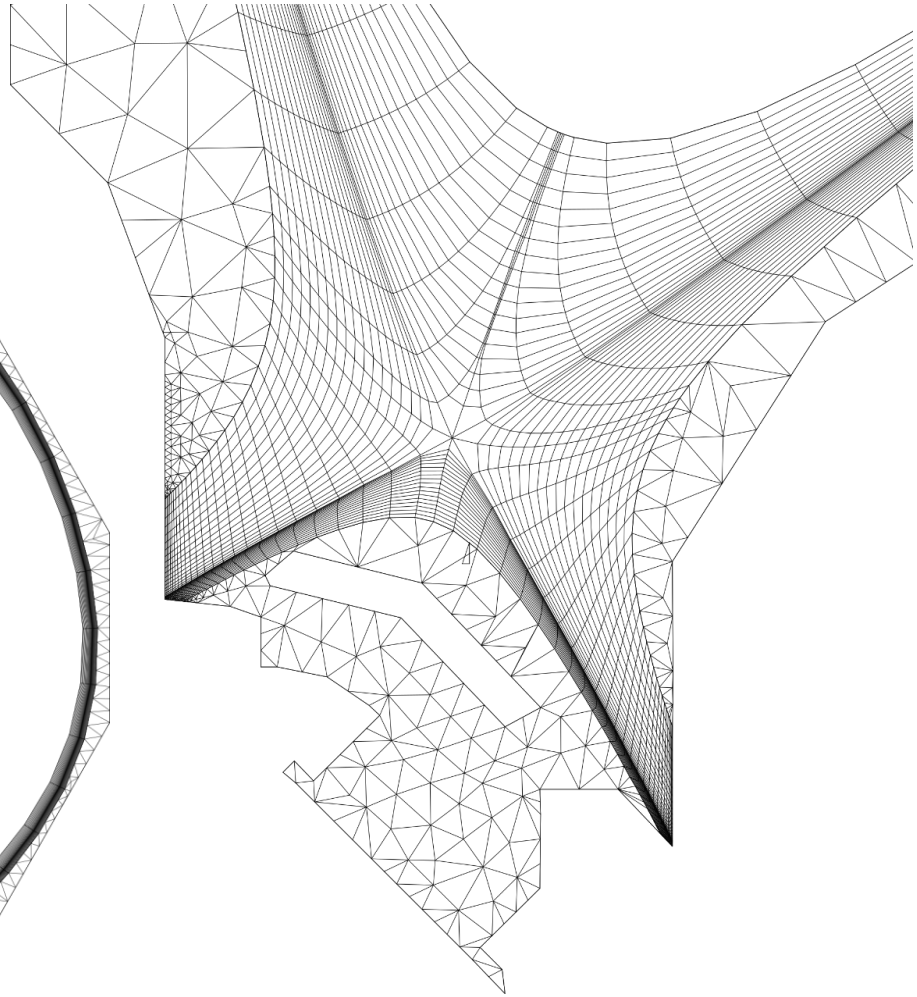
Plans

Backup slides

Simulations results







Simulations results

Spatial distribution of the electron temperature and electron density