SP D1 - Modelling of background plasmas: GyM

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Beneficiary: ENEA
Linked third parties: Politecnico di Milano

General aim of the work at PoliMi in the context of WP PWIE - SP D1

‣ **Production of plasma backgrounds** to be used as input for global ERO2.0 simulations to assess the erosion and redeposition in linear machines taking GyM as reference.

‣ Plasma simulations are performed using **SOLPS-ITER code**

The linear plasma device GyM @ISTP-CNR, Milano

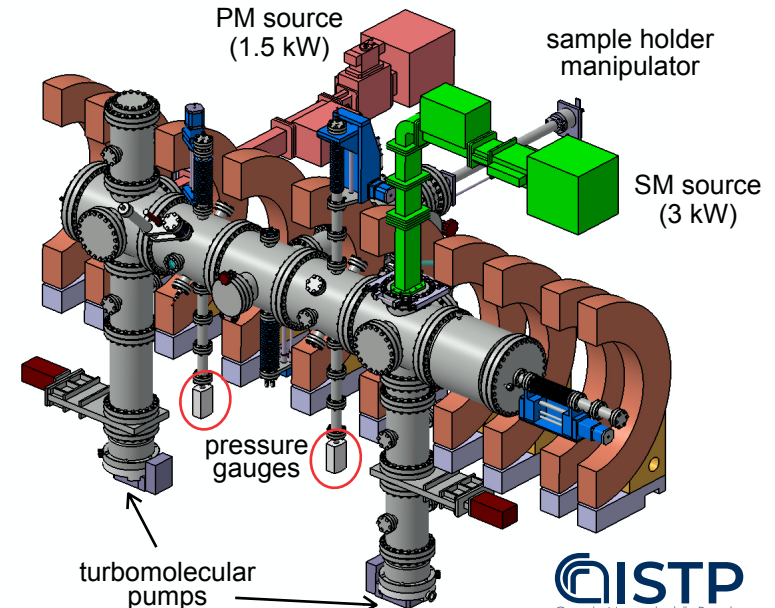|	
Working pressure	up to 10^{-3} mbar
Magnetic field	$B_{max} \approx 0.13$ T I = 600 A
Microwave source power	$P_{max} = 4.5$ kW
Plasma characteristics	up to 10^{17} m^{-3} $T_e \approx 5\text{-}10$ eV
Ion flux on target	up to 10^{21} m^{-2} s^{-1}
Fluence on target	up to 10^{25} m^{-2} obtained working in **steady state** for 7 hours

PM source (1.5 kW)

sample holder manipulator

SM source (3 kW)

pressure gauges

turbomolecular pumps

Background plasma modelling: capabilities

1. Procedure developed to more easily implement linear geometry in SOLPS *(report recently uploaded on ITER share-point)*

2. Validated argon plasma simulation in GyM, with SOLPS-ITER:

   - assessment of the effect of diffusion coefficients, input power and neutral background pressure

   - comparison with experimental data
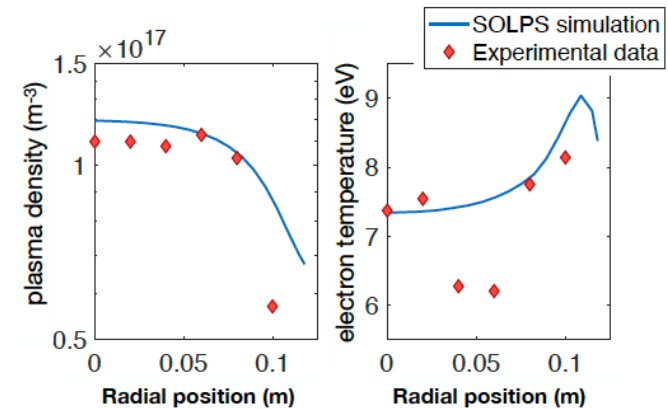
   Related publication: M Sala et al 2020 Plasma Phys. Control. Fusion 62 055005

3. Global 0D model to help interpretation of SOLPS-ITER simulations:

   - application to investigate helium plasma simulations in GyM

   - comparison between the global model and SOLPS-ITER results

   - comparison with experimental data
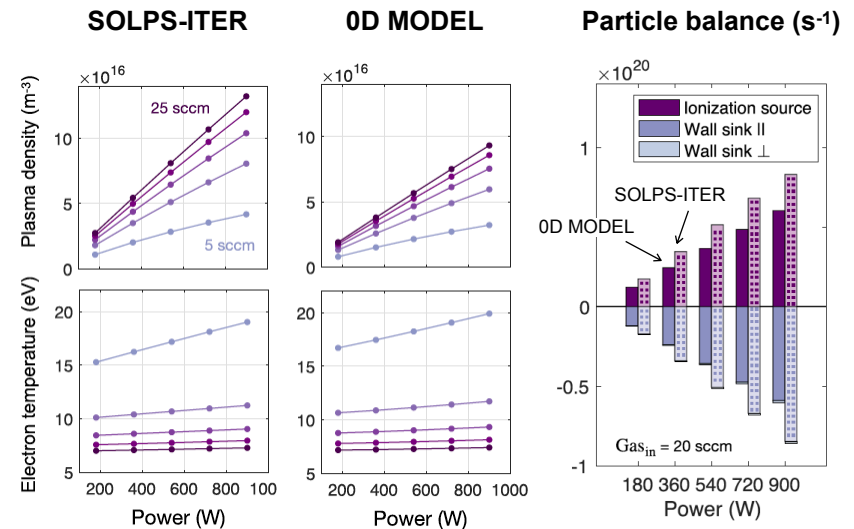
   Related publication: E. Tonello et al 2021 Nucl. Fusion 61 066036

Planned activities 2021

1. **Non-hydrogen reactions and database in EIRENE:**

   (i) Investigation of discrepancies found in SOLPS-ITER simulations of pure helium plasmas using different atomic databases.

   (ii) Assessment of the correct treatment of electron heat loss due to radiative collisions with neutral helium atoms.

   (iii) Definition of the set of default reactions for EIRENE in the case of "purely non-hydrogen plasmas", e.g. helium or argon.
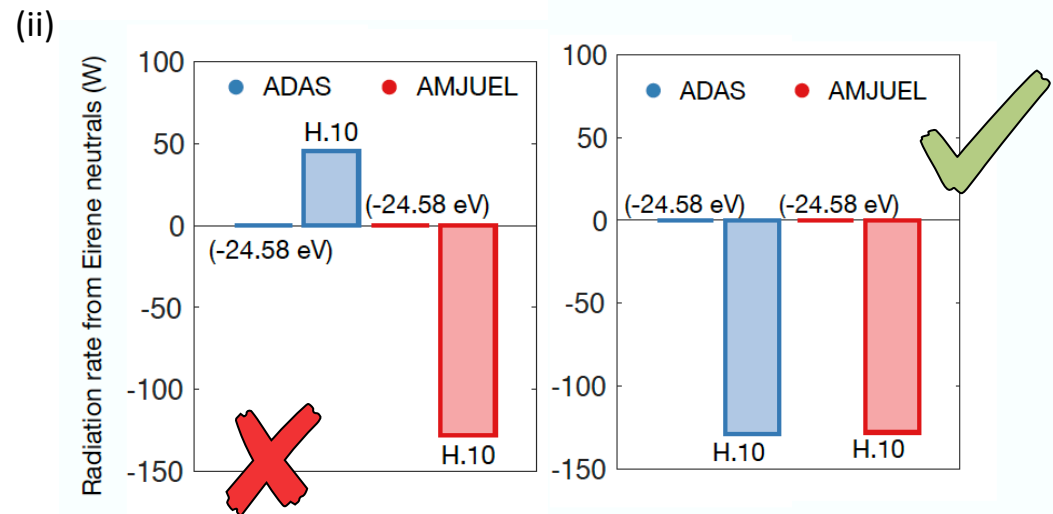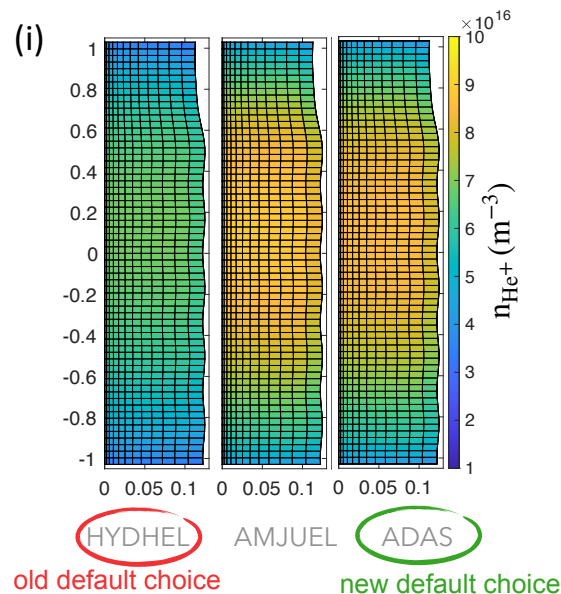
Some of these aspects have been considered in the latest SOLPS-ITER release.

Planned activities 2021

2. *Production of helium background plasmas for ERO2.0*:

   (i) **Full machine configuration:**

- production of helium plasma background with SOLPS-ITER
- conversion SOLPS-ITER output into ERO2.0 input
- first global ERO2.0 simulations   *(See also M. Passoni SP D3 presentation)*
- experimental plasma characterization is on going aiming at the validation of simulation results

   (ii) **Sample holder configuration**: the sample holder is inserted radially into the plasma when erosion experiments are performed in GyM.

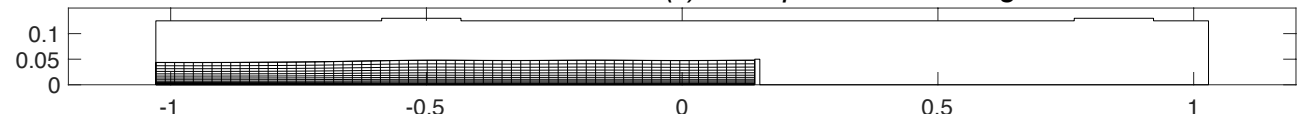Address the following **open issues:**
- partial loss of axis symmetry
- present SOLPS-ITER capabilities do not allow to have solid objects into the plasma
- assess how realistic are results obtained considering only the plasma in front of the sample holder, more experimental characterization needed

(i) Full machine configuration: B2.5 mesh
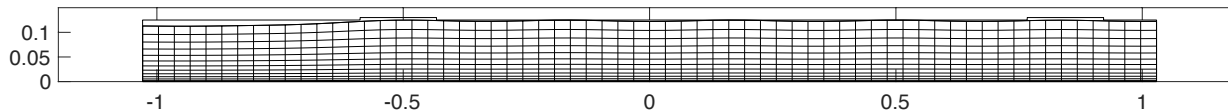
(ii) Sample holder configuration: B2.5 mesh

Thank you!