SP D.3 – ERO modelling of erosion, migration in GyM and AUG

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Beneficiary: ENEA
Linked third parties: Politecnico di Milano, ISTP-CNR

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The framework: erosion/deposition simulations in GyM and AUG with ERO2.0

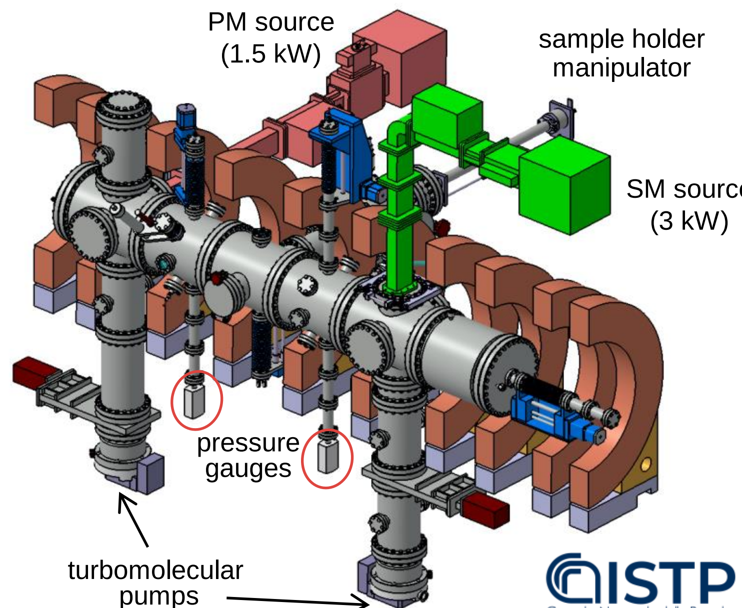
Aims of the work at PoliMi and ISTP-CNR in the context of WP PWIE – SP D3

- Study erosion and morphology evolution of model surfaces, varying roughness and incidence angle
- Couple SOLPS-ITER and ERO2.0 in linear device
- Study erosion and global migration in GyM
- Perform global simulations in AUG with existing SOLPS-ITER plasma background

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	n_e up to 10^{17} m^{-3} $T_e \approx 5$-10 eV
Ion flux on on target	up to 10^{21} m^{-2} s^{-1}
Fluence on target	up to 10^{25} m^{-2}

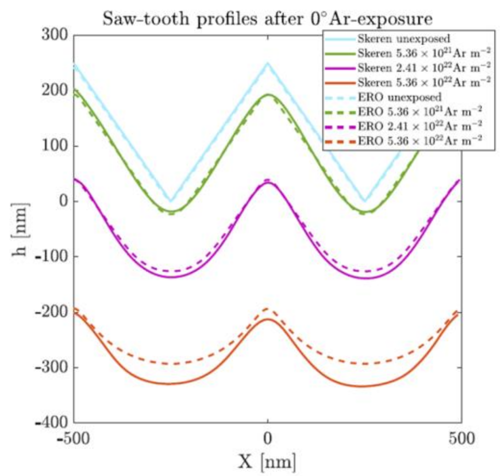
obtained working in **steady state** for 7 hours



ERO2.0 morphology evolution: capabilities

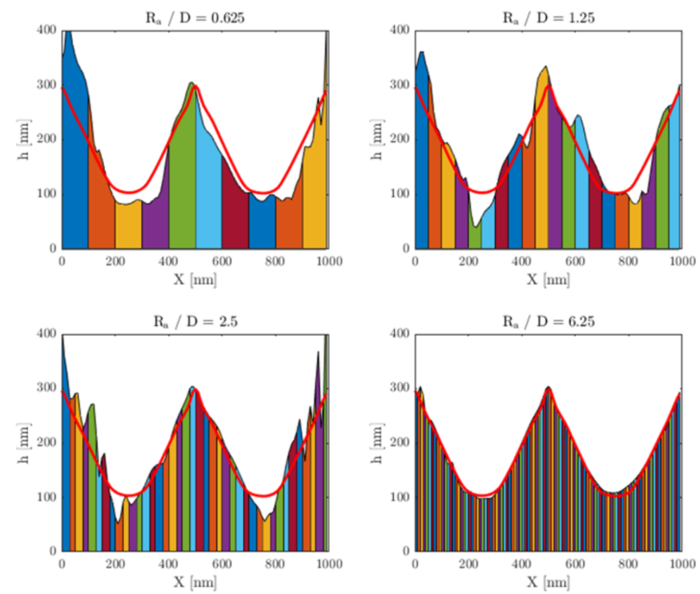
Comparison ERO2.0 / literature analytical models

- Motivation: considering aspects not included in ERO2.0, e.g. crystalline orientation
- Simulations performed with initial sawtooth morphology and Ar plasma
- Good agreement at low fluences (single crystal case)
- Assessed the influence of randomly oriented grains



Evolution of realistic experimental surfaces

- AFM-generated input morphology
- Assessed role of sheath-tracing on erosion rate
- Need for further code improvements



Related publications
G. Alberti et al 2021 Nucl. Fusion 61 066039
G. Alberti et al 2021, PFMC-18 conference

ERO2.0 morphology evolution: plans for 2021

- Support towards further development of ERO2.0
  - ➡ put in evidence the relevant physics to be introduced in ERO, e.g. crystallinity, in collaboration with code developers (J. Romazanov, A. Kirschner)
- Study of erosion and morphology evolution at the nanoscale
  - ➡ assess the dependence of erosion on roughness and incidence angle
  - ➡ preparatory work for comparison between ERO2.0 simulations and model samples exposed in GyM

ERO2.0 global migration in GyM: plans for 2021

SOLPS-ITER coupling with ERO2.0 in linear device

- Production of ERO2.0 inputs from SOLPS-ITER solution

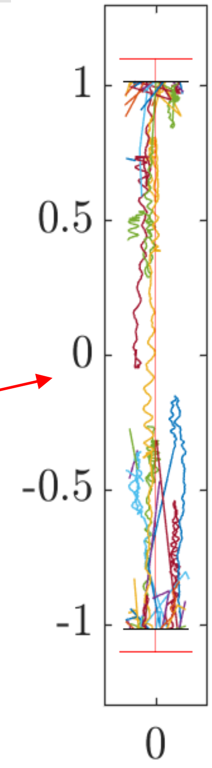
  ➡ from 2D plasma background to 3D volume: specific issues in a linear device

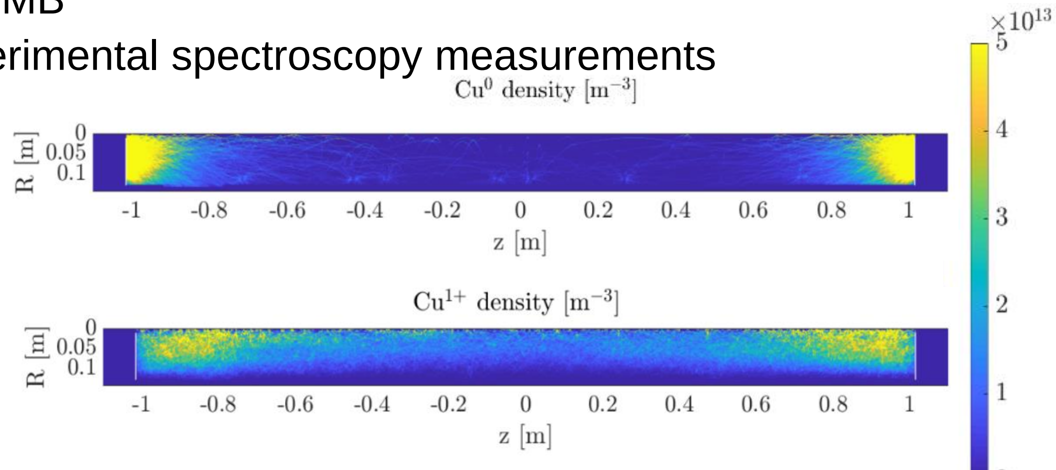
- Use of He-plasma background from SOLPS-ITER simulations in GyM:

  ➡ **Full machine configuration**
  Study of erosion/deposition on GyM wall and migration, changing wall material (Cu, Be, W). NO yields available on ERO repository for He plasma on Fe

  ➡ **Sample holder configuration**
  Erosion and global transport from exposed samples, to find optimal position for catch-up plates / QMB

  ➡ Possible comparison with experimental spectroscopy measurements in GyM (after 2021)





ERO2.0 global migration in AUG: plans for 2021

- As preliminarily discussed in WP TE, ERO2.0 simulations of erosion/deposition experiments and migration in AUG
  - ⇨ L-mode D-plasma, starting from already existing SOLPS plasma background produced under MST1-19-T10-AUG
  - ⇨ Comparison with VTT ERO simulations
  - ⇨ assess the role of main chamber sources and flows on divertor markers erosion/deposition experiments. Need for AUG 3D geometry

Thank you!