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# Global 3D Modelling of Plasma-Wall Interactions in Fusion Devices: Applications and Data Needs in View of ITER and DEMO

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Plasma-wall interactions (PWI) in fusion devices pose significant challenges, including erosion of plasma-facing components (PFC), fuel retention, and plasma contamination by impurities. Accurate modelling of these interactions is crucial for the design and operation of future fusion devices. This talk presents recent advancements in 3D modeling of PWI, highlighting the capabilities and applications of the Monte Carlo code ERO2.0, as well as specific data needs for ITER and DEMO.
ERO2.0 facilitates simulations of PWI with realistic PFC geometries and plasma backgrounds from codes such as SOLPS-ITER and EMC3-EIRENE. Its massive parallelization allows for comprehensive modeling of the entire plasma boundary, including wall material erosion, impurity transport and re-deposition. The code employs a kinetic approach to trace eroded impurities, incorporating atomic and molecular processes such as ionization, recombination, and collisions.
Recent developments in ERO2.0 include handling spatially inhomogeneous multi-species plasma backgrounds and implementing thermal force corrections. These enhancements are critical for simulating erosion and re-deposition. For ITER, ERO2.0 predictions have provided valuable insights into wall lifetime and impurity behavior [1]. The code's application to DEMO highlights the challenges of extrapolating plasma parameters to the first wall, as well as the role of charge-exchange neutrals (CXN) in first wall erosion [2].
The presentation will introduce the code, discuss validation efforts in contemporary devices, and present predictive studies for ITER and DEMO. In particular, it will detail the importance of energy- and angular-resolved CXN distributions in erosion simulations for DEMO. Finally, the role of ERO2.0 modelling in the integral approach to PWI in DEMO within EUROfusion activities will be outlined [3].
[1] J. Romazanov et al., Nucl. Fusion 62 (2022) 036011
[2] C. Baumann et al., presented at PSI-26 conference in Marseille, France (May 2024)
[3] D. Matveev et al., presented at 29th IAEA FEC in London, UK (October 2023)

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