Contribution ID: **112** Type: **Oral**

Modeling transient edge plasma processes with dynamic wall recycling

Tuesday, 8 November 2022 09:35 (20 minutes)

A self-consistent 2D model is presented for transport in boundary plasma and plasma-facing material walls. Plasma dynamics in the domain is represented by a 2D collisional plasma fluid model in the edge-plasma code UEDGE [1], and transport of hydrogen and heat in the wall material is represented by a system of 1D (into the wall) reaction-diffusion equations solved in the code FACE [2]. To account for variation of parameters along the wall, in the coupled model multiple instances of the FACE code run in parallel. The coupled model provides a tool for investigating a range of dynamic plasma-material interactions phenomena in 2D. For studies of edge plasma with active wall, two applications are considered here: (i) strike-point sweeping, and (ii) ELM-pulse simulation.For strike-point sweeping, coupled calculations are applied to investigation of the impact of heat and hydrogen transport in the material wall on the divertor plasma and target heat load during sweeping of the target strike-point for parameters of high-power tokamak operation [3]. The modeling shows that for realistic sweep parameters frequency 10 Hz and amplitude 10 cm, the temperature on the plate can be maintained below 1500 K. However, sputtering of a target plate when sweeping without plasma detachment remains an unresolved problem under the conditions investigated. For ELM simulations, release of hydrogen from the wall can trigger transition to detachment in divertor [4]. During an ELM strike when the divertor plasma is attached, hydrogen is released from the target plate near the strike point and absorbed in the far SOL wall regions. On the other hand, for semi-detached divertor plasma, hydrogen is absorbed by the divertor plate during the ELM strike and released afterwards. During an ELM strike, hydrogen retention is affected up to the depth ~1 μm, while the plate is heated through ~100 μm. Overall, self-consistent simulations of edge plasma with an active wall add a new important modeling capability for systems with long pulses such as a tokamak-based fusion reactor.

[1] T.D. Rognlien et al., J. Nuc. Mat. 196, 347–123 (1992); [2] R.D. Smirnov et al., Fusion Sci. Technol. 71 (2017) 75; [3] M.V. Umansky et al., Contr. Plasma Physics (2022) doi: 10.1002/ctpp.202100156; [4] R.D. Smirnov et al., Phys. Plasmas 27 (2020) 032503.

*Work supported by US DoE contract DE-AC52-07NA27344 at LLNL and award DE- SC0018302 at UCSD as part of SciDAC-PSI.

Speaker's Affiliation

Lawrence Livermore National Laboratory, Livermore, USA

Member State or IGO

United States of America

Primary authors: Dr UMANSKY, Maxim (Lawrence Livermore National Lab); Dr SMIRNOV, Roman (University of California, San Diego); Prof. KRASHENINNIKOV, Sergei (University of California, San Diego)

Presenter: Dr UMANSKY, Maxim (Lawrence Livermore National Lab)

Session Classification: SOL

Track Classification: Scrape-off Layer and Divertor Physics