Contribution ID: **19** Type: **Oral**

Impact of plasma scenario on W erosion and migration: comparison between WEST experiments and SOLEDGE3X-ERO2.0 simulations

Wednesday 29 October 2025 11:15 (20 minutes)

A major issue for next step devices is the control of plasma wall interaction, both for keeping the material erosion at reasonable level as well as for avoiding core contamination by high Z impurities and consequently the reduction of plasma performances. In this respect, WEST experiments supported by numerical modeling are particularly relevant to progress in the physical understanding of the complex interplay between erosion patterns, impurity migration and efficiency of plasma screening. In this contribution we will review main results from the comparison between WEST experimental data and SOLEDGE-ERO2.0 numerical modeling, both in 2D and 3D.
First, we will present results concerning the high fluence campaign with attached plasma conditions that was conducted in WEST to expose the ITER-grade actively-cooled divertor to ITER-relevant deuterium fluences. The same plasma discharge of 60s long was repeated hundreds of times, accumulating about 10,000 seconds of plasma with a maximum of 6×10^(26) part.m−2 of fluence measured by divertor Langmuir probes (LP). Impurities have been tracked by visible spectroscopy (VS), showing high content of nitrogen and boron all along the campaign, with oxygen and carbon also present. The estimation of W gross and net erosion is estimated both considering analysis LP and VS experimental data and simulation results, and finally compared with post mortem analysis. Numerical simulations are particularly helpful in determining the concentration of light impurities necessary for explaining the measured net erosion as well as the impact of ExB drifts on the asymmetries between inner and outer strike point with a quite important level of deposits at the inner strike point.
In order to reduce W sources and core contamination that have been found in attached plasma, X-Point Radiator (XPR) and detached regimes are particularly attractive. In WEST, XPR have been obtained with nitrogen seeding for discharges of more than 30 seconds long. Very low level of W erosion at the strike points is measured during these discharges using visible spectroscopy, as previously predicted with SOLEDGE-ERO2.0 simulations for equivalent target conditions. Moreover, thanks to the movable VUV spectrometer, we have recently measured strong reduction of W low ionized states around the X-point during XPR with respect to attached conditions. These measurements provide important information on the migration of the eroded W and are particularly valuable to validate the predictions of SOLEDGE-ERO2.0, encouraging the development of such scenario for improving control strategies on W erosion and core contamination for future experiments.
Finally, we will present the results of SOLEDGE-ERO2.0 simulations considering both 3D wall and magnetic geometries. In particular the impact of magnetic ripple on the modulation of the plasma outflow on the divertor target has been compared with experimental data. Its impact on W erosion and migration estimated with ERO2.0 is ongoing and it will be also presented.

Speaker's title

Mr

Speaker's Affiliation

CEA IRFM, Saint Paul Lez Durance

Member State or IGO

France

Author: CIRAOLO, Guido (CEA, IRFM)

Co-authors: Mr HUART, Alexis (CEA IRFM); DESGRANGES, Corinne (CEA/IRFM); SALES DE OLIVEIRA, Diego (EPFL - Swiss Plasma Center); SERRE, Eric (CNRS); YANG, Hao (Aix-Marseille Univ., CNRS, Centrale Med, M2P2); BUFFERAND, Hugo (CEA); KUDASHEV, Ivan (Aix-Marseille Univ., CNRS, Centrale Med, M2P2); GUNN, James Paul (CEA Cadarache); ROMAZANOV, Juri (Forschungszentrum Jülich GmbH); Mr PASQUALE, Marco (IRFM CEA); VARADARAJAN, Naren; FEDORCZAK, Nicolas (IRFM/CEA); RIVALS, Nicolas (CEA); TAMAIN, Patrick (CEA Cadarache); Dr DULL, Raffael (AMU); BREZINSEK, Sebastijan (Forschungszentrum Jülich); WEST TEAM (CEA-IRFM Saint Paul lez durance); CORRE, yann (FrCEAIRFM)

Presenter: CIRAOLO, Guido (CEA, IRFM)

Session Classification: X-point and other Radiator Regimes

Track Classification: X-point and other Radiator Regimes