MEMOS-U modelling of AUG tungsten leading edge exposures
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When ELMy or disrupting plasmas interact with plasma-facing components (PFC), the wetted areas typically range from one/few to few tens of cm² on each PFC [1-3] so that for metallic surfaces and sufficiently energetic transients, any liquid pools forming as a result of the interaction will likely be surrounded by cold(er) solid surface. This imposes a drastic temperature gradient once the hot liquid rolls onto the adjacent surface, which facilitates efficient heat conduction. If the liquid displacement is of the order of the pool size, as is in fact observed in the post-mortem analysis of melted tungsten (W) samples from AUG and JET [1-3], melt dynamics will be governed by a delicate balance between prompt re-solidification and the supply of moving melt, to produce the final damage profile. This highlights the fact that convective heat transfer and deformation of the heat conduction domain are crucial in realistic modelling of such phenomena.

Here we present simulation results of an AUG W leading edge (LE) experiment (shots #33504, #33508, #33509) [2] obtained with MEMOS-U, a newly upgraded [4,5] version of the original code MEMOS [6]. The heat loads received by the LE are recovered from measurements on a separate sloped sample in discharge #33511 and constitute the code input. The comparison is carried out between the final erosion profile of the exposed lamella and simulated sample post-exposure geometry as well as between simulated and experimental profilometry results normal to the exposed LE.

Sensitivity of the results to boundary conditions, in particular to the individual nature of ELMs, is discussed. We also elucidate the fact that only a negligible, < 1%, fraction of the energy absorbed by the LE in each exposure, is expended for the melt production. Most of the absorbed energy contributes to heating of the sample before reaching the melting point. This signifies that we are dealing with a threshold scenario: minimal, well below experimental uncertainty, variations in the energy input yield drastic changes in the liquid volume.