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P2.130 Armoring the Wendelstein 7-X divertor observation immersion tubes against NBI orbit losses

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The first neutral beam injector (NBI) experiments of the Wendelstein 7-X stellarator will start in summer 2018. The modelling of the fast ion production and slowing down processes [1,2] predicts losses of the NBI fast ions to the first wall on the order of 15%. One location receiving a high load (possibly peaking at several MW/m²) is the immersion tube for optical and infrared monitoring of the divertor targets. In the present design, the cooling of each tube is only meant to remove the heating by plasma radiation as well as the heating from the cameras inside the tube. The stainless steel face of the tube has three vacuum windows, which are sensitive to temperature gradients and overheating. To protect the windows from damage caused by the fast ions, different heat load mitigation techniques were investigated. Given the available time and resources until the first NBI experiments, a protective collar mounted at the front of the immersion tubes is regarded the most realistic solution. This contribution describes the fast ion modelling of the loads, the new design, thermal modelling of the design, and finally experimental experience with the protective collar. The fast ion heat loads have been assessed with the ASCOT code [3], the thermal loads with field line diffusion calculations [4] and the thermal response with the COMSOL multiphysics FEM code.

[1] Drevlak et al 2014 Nucl. Fusion 54 073002

[2] Äkäslompolo et al Nucl. Fusion (Under review, Proceedings of the 15th IAEA TM on energetic particles)

[3] Hirvijoki et al, CPC 185 (2014) 1310–1321

[4] Bozhenkov et al FusEngDes 88 (2013) 2997–3006

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