Scientific results of the collaboration on tokamak pedestal physics between Europe and the Asia-Pacific region (2018 PPCF Dendy Award)

Hajime Urano[1], Costanza Maggi[2], Ohjin Kwon[3], Samuli Saarelma[2]

[1]*National Institutes for Quantum Radiological Science and Technology, Naka Fusion Institute, Naka, 311-0193 Japan*
[2]*CCFE, Culham Science Centre, Abingdon, OX14 3DB, UK*
[3]*Daegu University, 201 Daegudaero,Gyeongsan, Gyeongbuk, 38453 Republic of Korea*

The collaboration has expanded the understanding of tokamak pedestal physics through multimachine experiments, in particular JET and JT-60U, and theoretical analysis. The issues considered were plasma shape (including X-point location), neutrals, global plasma beta, TF ripple and edge rotation. The work has led to more accurate models for predicting ITER and DEMO pedestals.

In both JET and JT-60U a robust correlation was found between total and pedestal thermal stored energy and improved edge stability was correlated with increasing total poloidal normalized pressure [1]. Despite their similar plasma size, the plasma performance of the two tokamaks can be different, which arises from machine-related aspects, such as shape, aspect ratio, TF ripple. The effects of TF ripple and edge rotation on the pedestal structure were investigated by the collaboration between the two tokamaks [2]. The effect of plasma shape on the pedestal width was examined focusing on the different operational areas of JET and JT-60U [3]. The effects of plasma triangularity, global beta and neutrals on pedestal confinement and stability were investigated in JET with the Be/W ITER-like wall [4]. On the theoretical side, the collaboration initially focussed on the effect of the X-point on pedestal stability. The X-point, depending on its poloidal location, can have opposite effects on peeling and ballooning modes, the two instabilities that govern linear MHD pedestal stability [5]. Analysis of simulated ITER plasmas has shown that, unlike most currently operating tokamaks that are limited by coupled peeling-ballooning modes, ITER pedestals are likely to be limited by low-n peeling modes due to very low collisionality and, consequently, high bootstrap current [6]. Pedestal predictions for the European DEMO have indicated that the beneficial effect of triangularity on pedestal stability saturates at a certain triangularity value, giving an upper limit for system studies for the maximum pedestal that can be achieved by plasma shaping alone.

The Award recipients feel privileged that their collaborative work was highly recognized.

[1] CF Maggi et al., Nucl. Fusion **47** (2007) 535; [2] H Urano et al., Nucl. Fusion **51** (2011) 113004; [3] H Urano, S Saarelma et al., Proc. IAEA FEC 2016, Kyoto, EX/3-4.; [4] CF Maggi et al., Nucl. Fusion **55** (2015) 113031; [5] S Saarelma, OJ Kwon et al., Plasma Phys. Control. Fusion **53** (2011) 025011; [6] S Saarelma et al., Nucl. Fusion **52** (2012) 103020.