Runaway Electron Beam Control

D. Carnevale[1] for the FTU team[2], the EUROfusion MST1 team[3] and JET Contributors[4]

[1] *Dip. di Ing. Civile ed Informatica, Università di Roma Tor Vergata, Italy*
[2] *See the author list of " G. Pucella et al., Proc. 25th IAEA FEC 2014"*
[3] *See the author list of "Meyer et al. 2017, Nucl. Fusion **57** 102014"*
[4] *See the author list of " X. Litaudon et al 2017 Nucl. Fusion **57** 102001"*

Post-disruption runaway electrons (RE) beam mitigation is one of the main concerns for ITER operations. RE beam control algorithms (Tore-Supra [1], DIII-D [2], FTU [3] and TCV [4]) for stabilization and current reduction can be combined with SPI/MGI and provide redundancy and backup in case of SPI/MGI failure. DINA simulations have shown that RE beam control could be effective for Current Quenches (CQ) below 4 MA in ITER. In the first part of the work the RE Control (REC) architecture to stabilize the RE beam position and ramp down its current is presented and experimental results on FTU and TCV are discussed. REC effectiveness is demonstrated by analyzing Hard X-ray (HXR) monitors and the Runaway Electrons Imaging and Spectroscopy (REIS) system. An estimation technique to retrieve the RE energy distribution function from REIS is proposed. RE beam instabilities and their correlation with toroidal electric field and density are discussed. Further, experimental results will be presented from FTU on deuterium pellet and heavy particle injection into steady-state flat-top discharges with runaway electrons and on RE beams. Analyzed data from the fast scanning CO_2-CO interferometer and spectroscopy diagnostics are also reported to help understanding the particle interaction with the RE beam to possibly extrapolate information for ITER predictions. Finally, the REC installation at JET to improve the RE beam stabilization will be introduced.

Acknowledgement: This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

References

[1] Saint-Laurent F. et al., Proc. 38th EPS Conf. Plasma Physics O3 118, 2011

[2] Hollmann E. M. et al., NF **53** 083004, 2013

[3] Esposito B. et al, PPCF, ISSN: 0741-3335, Vol 59, 2016

[4] Carnevale D. et al., 44th EPS, P 1.152, 2017