Analysis of the synchrotron radiation images of runaway electron beams in JET: island-like patterns and partial collapse of runaway electron beams.

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New wide angle, high-speed, visible light and mid-wave infrared (IR) cameras has been installed on JET in preparation of Deuterium-Tritium operations [1]. The new cameras have enabled fast imaging of synchrotron radiation from runaway electron (RE) beams in JET for the first time, during disruption & RE mitigation experiments in the JET 2018-2020 experimental campaigns. A first analysis of the high-speed IR and visible light videos of post-disruptive RE beams shows the presence of island-like dark and bright patterns in the synchrotron radiation with distinguishable poloidal mode number in ~61% of the visible RE beams. Multiple dynamics have been observed for these synchrotron island-like structures such as rotation, radial movement, growth and decay. In addition, dark island patterns characterised by an m=4 poloidal mode have been observed as precursors of RE beam current collapse. A first characterisation of the island-like patterns and their motion has been obtained using the JET Video Particle Tracker, which is a computer vision code developed for tracking bright structures visible in JET camera videos [2]. As an example, analyses conducted on an m=5 island-like structure visible in Pulse 95775 estimates its initial position at approximately 0.72 of the edge radius, while its final position is located at 0.45 of the edge radius. The pattern size associated with the island is estimated to be between 5 and 20cm. The rotation frequency of the structure is found not to be constant, instead showing periods of acceleration followed by sharp deceleration. In addition, a comparison of the island-like precursors, and the activity visible during the RE beam current collapse of pulses 95775 and 95776, is reported in the present work.

[1] J. Figueiredo et al., Rev. Sci. Inst., vol. 87, p. 11D443, 2016

[2] C. Sommariva et al., 8th REM Meeting, Goteborg, Sweden, 2020