Preliminary analysis of Runaway Electrons at JET

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Runaway electrons (RE) are electrons that undergo free fall acceleration of relativistic particles. The understanding of the RE generation processes and methods to suppress them is necessary to ensure safe and reliable operation of future tokamaks [1].

RE generation processes are studied at the JET facility using different diagnostics, in particular with the Gamma-ray Camera (GC). In 2016 two new detectors based on fast $CeBr_3$ scintillators were installed in channels 9 and 10, replacing those based on CsI crystals [2]. The new setup was tested during the experimental campaigns in July and November 2016. Experiment goals were to determine the efficiency of high Z impurity injection in a RE beam.

Dedicated software, JET_SHOT_PILEUP, created in C++ is language, was prepared to analyse data from JET shots. The flowchart of this program is shown in Fig. 1.

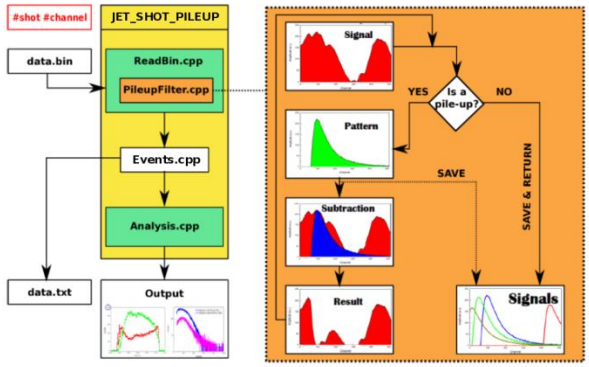

Fig. 1. Flowchart of the JET_SHOT_PILEUP program used for analysis of Runaway Electrons.

JET_SHOT_PILEUP consists of four classes: ReadBin, PileupFilter, Events and Analysis. The JET_SHOT_PILEUP program is analyses event-by-event and the returns time and shape of the signal.

The data acquisition (DAQ) time to start acquisition is provided by the JET absolute time with a precision of 1 MHz. The data file is composed of events and each event corresponds to an occurrence time and a pulse amplitude.

The class Events contains elements with time and amplitude of each signal. The object of this class is created by the readEventsFromBin() function called by the ReadBin class which is used to read a binary output file generated by the DAQ dedicated to GC. The PileupFilter class is used to unfold pile-up events. Pile-up events occur for high count rate measurements when the signal length is longer than the data acquisition time.

In the case of pile-up events, more than one signal is registered and a special formula is needed to obtain the time and amplitude of each component signal. The *Analysis* class is used to load an Events object. It builds an energy spectrum and calculates how many events were recorded during a shot.

Results from shots #91066 - #91081 and #92448 - #92461 were analysed with the JET_SHOT_PILEUP program.

As a result of the analysis we obtain a gamma-ray energy spectrum and a distribution of counts in time computed for two energy ranges, below and above 520 keV. The number of registered gamma-rays in the GC rises when the disruption happens, see the green line in Fig. 2. The start time of the JET plasma disruption obtained from theGC consistent with that obtained by other JET diagnostics.

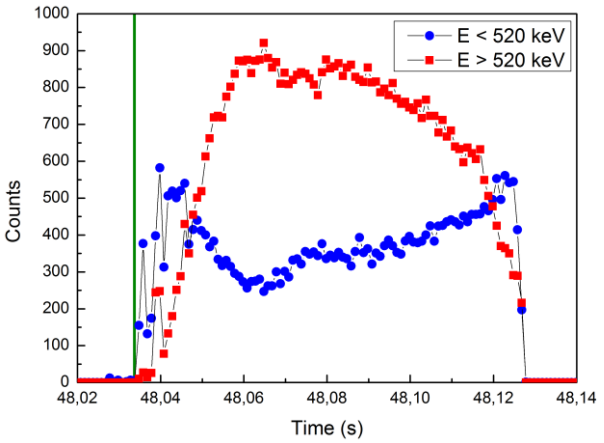

Fig. 2. Number of gamma photons registered with the $CeBr_3$ detector in the GC during shot #92449. The solid green line indicates the start of JET plasma disruption.

References

[1] C. Reux *et al.*, *Runaway electron beam generation and mitigation during disruptions at JET-ILW*, Nucl. Fusion 55 (2015) 093013.

[2] I. Zychor *et al.*, *High performance detectors for upgraded gamma ray diagnostics for JET DT campaigns*, Phys. Scr. 91 (2016) 064003.

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