Synchrotron Radiation from Runaway Electrons in COMPASS Tokamak

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Runaway electrons are an important part of the ongoing ITER-relevant studies on COMPASS, as runaway electrons could severely damage plasma facing components. Synchrotron radiation from highly energetic runaway electrons offers a valuable opportunity for measuring parameters of confined high-energy runaway electrons directly from the plasma core.

The infrared camera with wavelength range 7.5 – 13 µm was used for detection of synchrotron radiation in two dedicated runaway campaigns at the COMPASS tokamak. During these experiments, the infrared camera was installed at a midplane tangential port. The diameter of the observed area of the plasma cross-section was about 15 and 17 cm in the first and the second runaway campaign, respectively. Synchrotron radiation was successfully measured at low density discharges ($n_e \leq 2.5 \times 10^{19}$ m$^{-3}$). Even though the observed area was relatively large for monitoring the plasma core (COMPASS minor radius is 22 cm), it seems that majority of the observed synchrotron radiation come rather as a reflection from the vessel than directly from the inspected plasma volume. Nevertheless, it is presented that relevant information can be derived using an appropriate analysis.

It is demonstrated that relative intensity of the infrared radiation is correlated with critical energy for production of runaway electrons. Using the 0D-model \cite{Yu2013} for estimating the maximum energy of runaway electrons, importance of the synchrotron radiation is addressed. The main observations is how loss of runaway electrons is enhanced when the deceleration due to synchrotron radiation is significant. The model reported by Stahl \cite{Stahl2013} can be used for the comparison with the experiments, providing that the infrared camera is calibrated.

References
