Effects of pellets and impurity injection on runaway control experiments on FTU

A.Romano[1], G. Apruzzese[1], F.Bombarda[1], L.Boncagni[1], P. Buratti[1], D.Carnevale[2], S. Ceccuzzi[1], F. Cordella[1], C. Di Troia[1], G. Ferrò[2], L.Gabellieri[1], E. Giovannozzi[1], M. Gospodarczyk[2], G. Ramogida[1], S. Sibio[1], B.Tilia[1], O. Tudisco[1] and the FTU team*

[1]*ENEA, Fusion and Nuclear Safety Department, C. R. Frascati, Via E. Fermi 45, 00044 Frascati (Roma), Italy*

[2]*Dip. di Ing. Civile ed Informatica, Università di Roma "Tor Vergata", Italy*

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Generation of runaway (RE) beams following disruptions is a serious concern in tokamak devices. FTU is conducting an extensive program aimed at controlling and mitigating the purposely generated RE beams (natural and induced disruptions) [1, 2]. During the last experimental campaign different mitigation techniques have been tested, which involved injection of impurity gas (Neon), of multiple Deuterium pellets ($1\text{-}2\cdot10^{20}$ atoms), and of Laser Blow Off metal impurities (Tungsten, Molybdenum, Iron and Zirconium). The injections have been performed both during the plasma current flat top with seed REs embedded in a hot plasma and after current quench with current mainly carried by REs. The experimental results point to a complex picture where MHD effects, impurity transport and radiation, temperature and density variation all play different roles depending on the target plasma condition.

As far as the LBO is concerned, the element providing the most useful information was Fe. Injections during the plasma current flat-top in RE discharges show up in the spectroscopic diagnostics, bolometry and Soft X-ray. The signal time correlations appear to be related to the amount of RE electrons in the plasma, qualitatively estimated from the ratio of the (neutron+gamma)/neutron signals. Pellets injected during this phase caused an increase of plasma density; the effects on the RE beams were analyzed. LBO injections performed on the RE beam formed after the current quench do not produce any effects on any diagnostics nor on the beam itself, possibly because of the very low electron temperatures.

Deuterium pellets injected into a RE beam display complex behaviors. When injected in the early phase of the beam the pellet is ablated but ionization does not take place, presumably because the background plasma is too cold; the electron density surprisingly diminishes in this case. When the pellets are injected a later time into a warmer plasma and a less energetic RE beam, they are ionized increasing the electron density.

[1] D. Carnevale, et al., Runaway Electron Beam Control, EPS 2018.

[2] B Esposito et al 2017 Plasma Phys. Control. Fusion **59** 014044.