Contribution ID: **3591** Type: **not specified**

P5.1051 Cold background plasma characterization during Runaway Electron mitigation experiments in the JET tokamak

Friday, 12 July 2019 14:00 (2 hours)

See full abstract here http://ocs.ciemat.es/EPS2019ABS/pdf/P5.1051.pdf

Disruptions are a major threat to future tokamaks like ITER and beyond. In addition to heat and electromagnetic (EM) loads, disruptions also generate runaway electron (RE), tens of MeVs electron beams which may damage plasma facing. The current ITER disruption mitigation strategy is first to mitigate disruption heat/EM loads and then mitigate the RE beam using Shattered Pellet Injection (SPI) systems.
During the past JET experiments, the ineffectiveness of Massive Gas Injection (MGI) to mitigate RE beam was observed[a]. This poor efficiency is suspected to be caused by the shallow penetration of MGI due to the presence of a cold dense background (BG) plasma. The characteristics of the BG plasma are poorly known as most of the conventional diagnostics cannot measure low electron temperature during post-disruption phase. Assuming a parabolic electron temperature profile of BG plasma, the profile parameters are estimated using VUV spectroscopy with the help of a synthetic spectrum constructed from ADAS Photon-Emissivity Coefficient[b] (PEC) data. For various BG plasma electron densities (1.10^18 - 3.10^19 m-^2) and runaway currents (0.4-1.11 MA), temperature profiles retain similar shape and the peak value lies between 5-20 eV. This is hotter than on smaller machines (1-2 eV in DIII-D[c]) and may explain the poor efficiency of MGI on RE beam mitigation at JET. No obvious increase or decrease of the temperature during the RE beam phase for a given pulse is clearly observed. A decrease of temperature with increasing maximum runaway current IRE is observed for a given flat-top plasma current. Higher electron temperatures are only observed in lower density BG plasmas and higher density plasmas tend to have lower Te.
By making a power balance of RE beam and BG plasma system, a 0D model based on experimental data will be proposed to explain the interaction of RE beam with the BG plasma.

References

[a] Reux, C. et al. 59th meeting of the APS Division of Plasma Physics October 2017
[b] Summers, H. P. (2004) The ADAS User Manual, version 2.6 http://www.adas.ac.uk
[c] Hollmann et al, Nuclear Fusion 2013

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Session Classification: Poster P5