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Helium doped plasmas on FTU

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The possibility to exploit the properties of medium and light impurities in contaminating plasmas is explored in many tokamaks devices [2-5]; since is crucial to fix the conditions that favor a strong increase of particle confinement while minimizing the amount of impurities needed, as well as to favor the so called "plasma detachment". The light doping action represents a good method to increase the core electron density, often without any undesirable central impurity accumulation; meanwhile the amount of impurities, and the relative edge radiation, have to be kept below the threshold where a disruptive MHD activity is generated.
In order to complete experimental observations regarding the electron density peaking in doped plasma referred in FTU [4], a series of experimental sessions have been performed in the last two campaigns by injecting Helium on the L-mode plasma scenarios. As first results reported in this work, it has been revealed that not only the total amount of inflated Helium, but also speed of injection, as well as edge conditioning, can influence the impurity effects. Examples are exposed in the figure 1.
VUV spectroscopy measurements help to evaluate the Helium presence, that triggers the particles inflow; indeed, only a small fraction of electrons could be attributed to the ones stripped by Helium ionization in the total contribution of the electron density rise. In the same phase, the attempt to interpret the radiation losses and effective charge traces, in respect to concurrent different impurities, is treated too. Further observations regard the behavior of the temperature profiles, also in comparison with previous works in which Neon impurity was used [4,6]. Generally, these plasmas, as consequence of the Helium injection, frequently excite some instabilities, such as MARFEs and MHD, that affect measurements and provoke strong perturbations, in some cases they appear simultaneously.
Considerable results have been achieved in the search of the best conditions to obtain a very high electron density peaking, by reaching the value of 5, all are detailed in this document.
A JETTO analysis adds interesting considerations about particle transport and improvement in confinement. Furthermore, a set of different scenarios has been experimentally performed. One of them, consisting in a scan of plasma current (principal parameters: I_p=250-500 kA, B_T=5.3 T, n_{e_0}=0.2-1 10^{20} m^{-3}, T_{e0}=1-4 keV), has confirmed that the highest peaking is reached at low current. Another one explores the relationship between the increase of the electron density and the plasma position inside of the wall chamber, by varying plasma shape and magnetic configuration.

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