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Study on production and extraction of negative ion impurity ions in a Cesiated negative ion source

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The detection of a peak corresponding to a hydrogen bearing impurity species (mostly due to water vapour :H20) was reported many times in past while performing the Doppler shift spectroscopy (DSS) diagnostics in several neutral beam injectors based on positive ion sources. However, for the experiments based on negative ion sources, we are reporting the detection of this peak for the first time. This peak always appeared in DSS spectrum when the background pressure at the observation location is ~ 1x10-4 mbar and disappeared when the pressure at the observed location is ~1x10-5 mbar. For the present experiments, the negative ions of H2O can be formed by dissociative attachment of (H20-)* leading to the formation of H–, O– and OH– fragments. The dissociative attachment seems to be the cause of the formation of this negative ion species due to favourable conditions such as 5-10eV in driver region for vibrational excitation and 1-2eV near plasma grid. A detailed study on this peak using the DSS spectrum and the pressure traces obtained using Residual Gas Analyzer was carried out in ROBIN (RF Operated Beam source in India for Negative Ion research) test stand. Estimates of impurity content have been made using intensity ratio of fast hydrogen peak and hydrogen peak originating from the negative ion impurity. The extracted current of hydrogen neutrals originating from these impurities are estimated. To obtain this value, the Balmer-alpha excitation cross-section at low energies (~ 1.5 keV) were reviewed and few approximations were made since the published data is available only for the higher-energy ranges for such processes. These approximations are outlined in this paper. There is some evidence that the amount of impurity present in the ion source affects the ratio of the main species.

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