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P4.013 Effect of a magnetic cusp configuration on ion species ratio in a NBI ion source

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In arc discharge plasma, an ion species ratio depends on plasma density and ion confinement time. To increase an atomic ion species ratio in an NBI (neutral beam injector) ion source, various ion sources have been designed to have higher ratio of the plasma volume to the effective ion loss area so that the ion confinement time could be longer. For that reason, most of NBI ion sources have a large arc chamber with strong cusp magnetic field. KSTAR NBI ion source also has a large arc chamber with a strong azimuthal line cusp configuration but its atomic ion (D+) beam fraction is small because its normal operation power levels of the arc discharges are comparatively lower than those of other NBI ion sources. Particularly, the D2+ (H2+) ion beam fraction is relatively large at about 40%. This means that there are so many primary electrons in the beam extraction region. Through several Ele-orbit code simulations, it was found that some magnetic cusp configurations are very effective to prevent primary electrons from getting near the plasma grid. In order to reduce the molecular ion fraction in KSTAR NBI ion source and consequently increase its atomic ion fraction, we carried out the experiments applying several new magnetic cusp configurations to the arc chamber. The results show that the atomic ion fraction could increases up to 80% with the new magnetic cusp configuration despite the low arc operation power at KSTAR NBI ion source.

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