Production of Helium and Helium-Hydrogen Positive Ion Beams for the Alpha Particle Measurement

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It is very important to measure the behavior of alpha particles which contribute for the continuous plasma burning in nuclear fusion reactor of deuterium-tritium reaction. In order to measure the spatial and velocity profiles of alpha particles, injection of permeable helium neutral beam of ~1 MeV to the burning plasma has been considered. The helium neutral (H^0) beam exchanges charges with helium ions (alpha particles), and produced high-energy helium neutral particles are measured by the energy analyzer.

In order to produce diagnostic H^0 beam, a following method is being considered. Helium ion (He^+) beam of ~20 keV is converted to negative helium ion (He^-) through the alkali gas cell, and accelerated to ~1 MeV, then He^- of ~1 MeV spontaneously becomes H^0 by passing through a reasonable length. In this system, it is important to produce focused high-current-density ion beam in order to pass through small apertures of alkali gas cell with an enough signal level. We will report about our ion source system in which we already have obtained He^+ beam with sufficient focusing characteristics and high-current-density. Another method which can give a simple way to realize the 1 MeV H^0 beam is to use the helium-hydrogen ion (HeH^+) beam of ~20 keV. This beam can be accelerated to ~1 MeV, and neutralized through the gas cell with sufficient probability. However, conditions producing HeH^+ beam has not been investigated in detail as yet. We will also report the results on optimized conditions for obtaining the HeH^+ beam with an ampere order of current.