

§32. Trial Production of a Simple Neutral Particle Analyzer

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We investigated a simple type of neutral particle analyzer in order to measure both pitch angle and energy of the charge exchanged neutral particle caused by the ion trapped in the open and closed systems.

Ionization efficiency was estimated in the following two cases, that is, a carbon thin film with the thickness of 25 Å was used to ionize the charge exchanged neutral particle, and the other method was a gas stripping type. As an example, in case of the hydrogen atom with the energy of 5 keV, the ionization efficiency is about ten times as compared with using the gas stripping type, however the full width at half maximum of the scattering angle profile is about ten degrees in case of perpendicular injection. We calculated the detection efficiency of the charge exchanged neutral particle in conjunction with the toroidal type of energy analyzer having 5 channel detectors as shown in Fig.1.

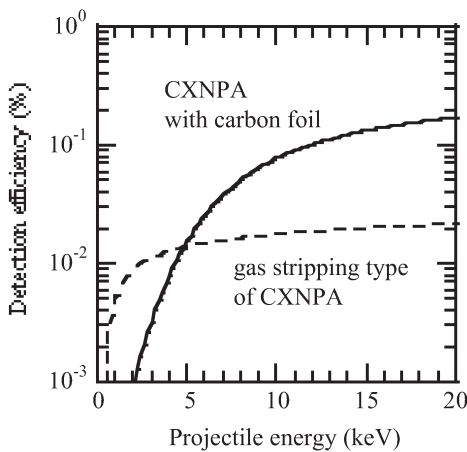


Fig.1. Detection efficiency of the charge exchanged neutral particle. The toroidal type of energy analyzer is used in the calculation.

The carbon thin film is better than the gas stripping type for the neutral particle with higher energy more than about 5 keV. The radius of the main path is 90 mm in the toroidal analyzer, the deflection angle is 155 degrees and

the azimuthal angle is spread to 35 degrees.

As the other method, we applied the gas stripping type of energy analyzer to the neutral particle detection with lower energy than about 5 keV. The cylindrical type of electrostatic energy analyzer was adopted, which had the deflection angle of 63.6 degrees and a wide entrance aperture. The analyzer has the useful characteristics of energy resolution for the parallel incident ions passing through the wide entrance aperture. The micro-channel plate is used as the ion detector and three channels are inserted behind the exit slit as shown in Fig.2.

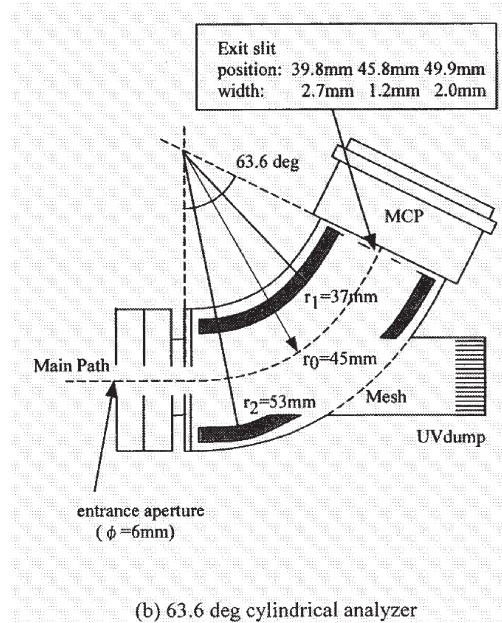


Fig.2. Cylindrical type of neutral particle analyzer with the deflection angle of 63.6 degrees.

The radius of the main path is 45 mm, the maximum of the analyzing energy is about 10 keV. We set the analyzer near the inner mirror throat of the plug/barrier cell in the tandem mirror with a pitch angle adjuster, and measured both pitch angle and energy of the charge exchanged neutral particles due to the bounced ions by the plug potential and the mirror throat of the plug/barrier cell.1) This type of analyzer is available to other magnetic confinement devices.

Reference

- 1) Ishii, K., et al.: Rev. Sci. Instrum. **75**, No.10 (2004) 3619.