

Development of a new E//B neutral particle analyzer and its first commissioning on HL-3

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An E parallel B type neutral particle analyzer (E//B NPA) could simultaneously provide the energy and mass resolution of ions in magnetic confined fusion devices [1, 2]. It is a powerful tool for fast ion physics study in nowadays machines [3], and could provide the D/T fuel ratio in future device like ITER[4]. Recently a new E//B NPA has been developed for HL-3 tokamak. Components of this NPA is shown in figure 1(a) and the photo is shown in figure 1(b). He gas is adopted as stripping material to avoid angle scattering, energy loss and part replacement which might be brought about by a solid foil. The analysis unit is made of an NdFeB permanent magnet and two oxygen-free copper plates. The magnet and electric plates are designed with COMSOL software which could simulate both the fields and the particle orbits at the same time. LYSO scintillators combined with silicon photomultipliers (SiPM) are adopted as the particle detector. There are two rows of detector with 16 detectors in each row, as shown in figure 1(c). The analysis unit and detector array are calibrated with a 50 keV ECR ion source and a 300 keV H/D accelerator, respectively.

This NPA was connected to HL-3 in 2023 campaign. As shown in figure 2, 16-41 keV deuterium neutrals are detected in discharge 3347 [5]. The beam is D and the plasma working gas is also D, so there is only count number on D channel. There might be a small fraction of H in the plasma but its energy should be low compared with the lower energy limit (29.3keV) of the H channel. More experimental detail will be presented in this meeting.

References

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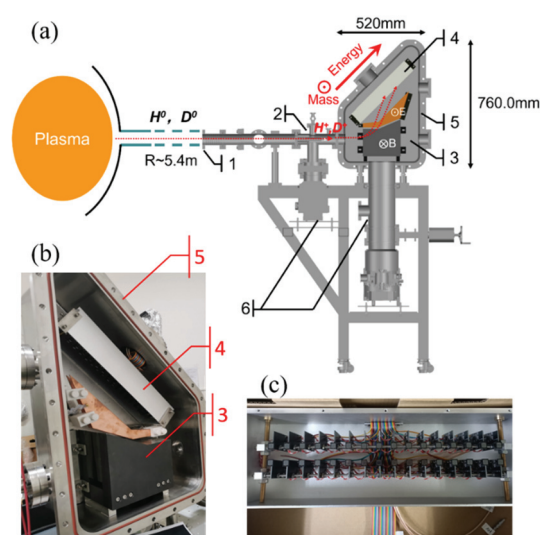


Figure 1 (a) Components of the analyzer; (b) Photo of the E//B NPA structure; (c) Photo of the detector array. 1 collimation diaphragm; 2 stripping cell; 3 analyzer unit; 4 detector; 5 chamber; 6 pumping system.

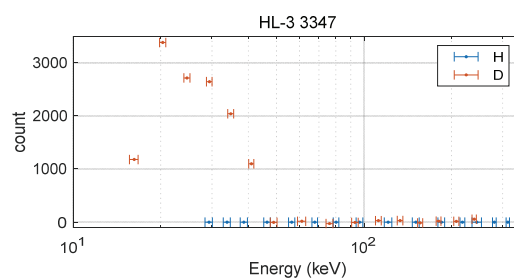


Figure 2 Dependence of neutral counts on the energy in discharge 3347 in HL-3. The width of the error bar stands for the energy range measured by the detector.