

### §3. Doppler Shift Spectra of H $\alpha$ Lines from Negative Ion Based Neutral Beams

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The velocity spectra of the negative ion based neutral beams with doppler-shifted H $\alpha$  spectroscopy, as well as the effectiveness of the spectroscopy <sup>1)</sup> has been studied / collaborated. In the 8<sup>th</sup> experimental cycle, the spectra from beam-line-1, BL-1 in addition to BL-2 and BL-3 have been newly measured to study the differences probably reflected by the ion source design and the operation conditions.

An internal mirror (Fig.1) was mounted inside the vacuum vessel of BL-1 to keep the same angle of line of sight as those in BL-2 and BL-3. We conducted systematic observations of the velocity distribution profiles in standard LHD-NBI injection (Fig.2), the spectra over the course of 70 ~ 128s long-pulsed beams with reduced power, and the behavior of negative ion beam stripping in the accelerator. Almost all of the transmitted beam power (Fig.2) was found to be at approximately the full acceleration energy (170keV). A very low energy peak due to beam particles stripped in the extractor gap (at ~8keV) is observed. It was observed that the similar spectrum profiles were repeatedly reproduced throughout the day, while the operating condition for the neutral beam was kept constant with a high power level of ~4.5MW/2.

H- ion uniformity (Fig.3) in an LHD-ion source along the long direction of ~125cm was deduced by the full energy component coming from five vertically arrayed grid sectors <sup>1)</sup>. It was found that the H- ion current is fairly uniform, and that there is still the prospect of increasing the H- current throughput by about 15% at the optimum perveance, if the uniformity is improved.

For long beam pulses, the magnitude of the full energy peak gradually declined as the beam pulse duration increased. When conductively cooled plasma grid was used, the spectra did not change for a longer time compared to those with a standard (i.e., a thermally isolated-) plasma grid.

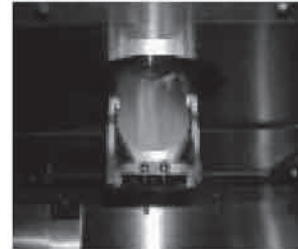


Fig. 1 Mirror system in-side the vacuum vessel.

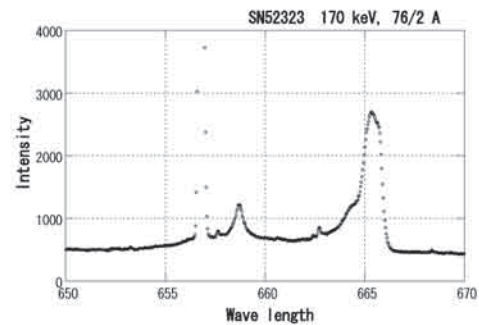


Fig.2 Spectrum in beam line-1 from negative ion based neutral beam.

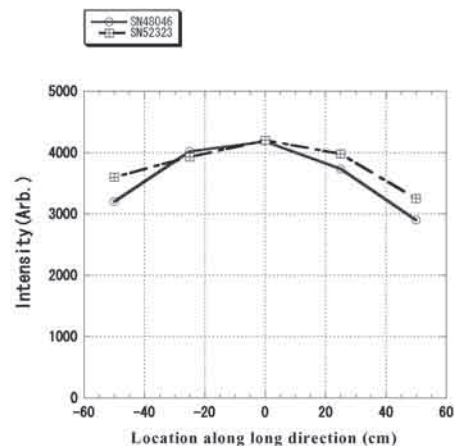


Fig.3 H- ion distribution along long direction in LHD H- ion source.

#### Reference

- 1) Y. Oka et al., Rev. Sci. Instrum. **75**, (2004)1803.