§5. Optimization of Diagnostic Neutral Beam Operating for the MSE Spectroscopy in CHS

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The H_α emission from the hydrogen neutral beam injected into a plasma has 15 components (8 lines of π and 7 lines of σ) due to the Motional Stark Effect (MSE). The wavelength shift of the π lines from the σ_0 line is proportional to the magnitude of Lorentz Electric Field, $\boldsymbol{v} \times \boldsymbol{B}$ ($\boldsymbol{v}$:beam velocity, $\boldsymbol{B}$:magnetic field) [1].

The diagnostic neutral beam (DNB) has been installed in the CHS for the MSE measurements. Line broadening caused by a finite beam divergence angle results in overlapping between the adjacent lines. Since S/N ratio is roughly proportional to the beam current, higher beam current and smaller beam divergence angle are desirable for the measurement.

Figure 1 shows the beam divergence angle as a function of the beam current for various acceleration voltages. The optimized beam current, I_b, where the beam divergence angle has the minimum value, depends on the acceleration voltage, V_b, as $I_b \propto V_b^{3/2}$. The minimum divergence angle is ~0.65 degree and dose not depend on the beam voltage. There are three H_α emissions with different Doppler shift depending on the three beam energy components. The H_α from full energy component, yielding larger $\boldsymbol{v}\times\boldsymbol{B}$, is used for the measurement. Figure 2 shows the energy ratio as a function of the optimized beam current. The proton ratio (the fraction of full energy component) is 0.4~0.57 and increases as the acceleration voltage increases. Therefore, the optimum operations of DNB achieved are V_b=45kV and I_b=3.5A.

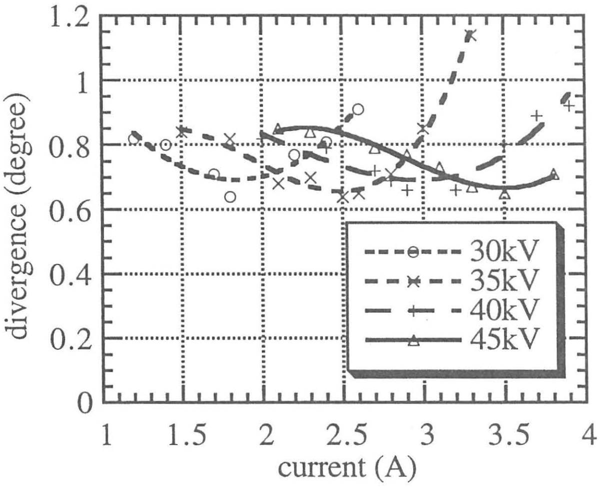

Fig.1 The beam divergence as a function of the beam current for various acceleration voltages

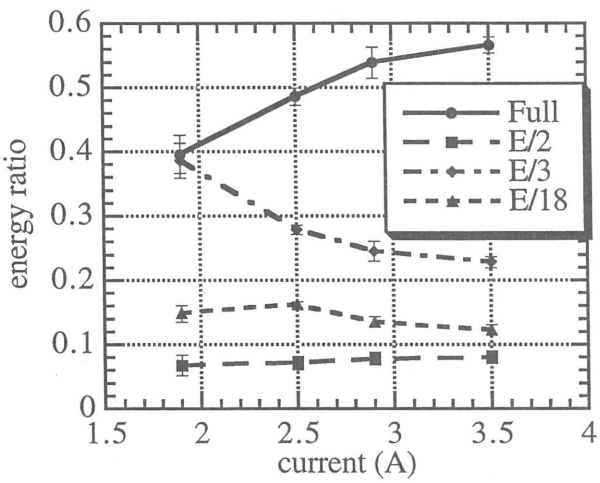

Fig.2 The energy ratio as a function of the optimized beam current

References
1)D.Wroblewski, K.H.Burrell, L.L.Lao, P.Politzer, W.P.West Rev.Sci.Instrum. **61** (1990) 3552