Type: Talk

Development of absolute polarimeter for the low energy ³He⁺⁺ ion beam

Monday, 29 June 2020 11:00 (30 minutes)

For the Electron-Ion Collider, a polarized ${}^{3}\text{He}^{++}$ ion source is being constructed at the Electron Beam Ionization Source (EBIS) of the Brookhaven National Laboratory. For precision determination of the ${}^{3}\text{He}$ polarization, the ${}^{3}\text{He}$ beam, after acceleration to 6 MeV at EBIS, will be elastically scattered off a gas ${}^{4}\text{He}$ target. For such a scattering, the analyzing power $A_{\rm N}(E_{\rm beam}, \theta_{\rm CM})$ can reach absolute, 100%, maximum at some points in the beam energy / center of mass scattering angle plane [1]. Several such points were found in Refs. [2, 3] including ($E_{\rm beam} = 5.3 \,\mathrm{MeV}, \theta_{\rm CM} = 91^{\circ}$).

The vertically polarized $6 \text{ MeV}^{3}\text{He}^{++}$ ion beam will enter, through a thin window (to minimize the energy loss of the beam), to the scattering chamber filled with ⁴He gas at a pressure of $\sim 5 \text{ Torr}$. Two left-right symmetric Si strip detectors (with vertically oriented strips) will be used to detect both scattered ³He and recoil ⁴He particles in every event. Good energy and time resolution of the detectors will allow us to recognize ³He and ⁴He signals and to eliminate background events. A spin rotator will provide the beam spin-flip to suppress the acceptance and intensity related systematic errors.

For the polarimeter calibration, we plan to scan the ³He energy (by variation the entrance window thickness) and to measure the spin-correlated asymmetry dependence on scattering angle $\theta_{\rm CM}$. Analyzing power $A_{\rm N} = 100\%$ can be attributed to the absolute maximum found in these measurements.

G. Plattner et al., "Absolute calibration of spin – 1/2 polarization", Phys. Lett. B 36, 211 (1971)
D.M. Hardy et al., "Polarization in ³He + ⁴He elastic scattering", Phys. Lett. B 31, 355 (1970)
W.R. Boykin, S.D. Baker, D.M. Hardy, "Scattering of ³He and ⁴He from polarized ³He between 4 and 10 MeV", Nucl. Phys. A 195, 241 (1972)

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