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## Precision absolute polarimeter development for the ${}^3\text{He}^{++}$ ion beam at 5.0-6.0 MeV energy

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We have previously developed a concept for a polarized  ${}^3\text{He}$  ion source based on the existing Electron Beam Ionization Source (EBIS) at Brookhaven National Laboratory (BNL). Successful tests of polarizing  ${}^3\text{He}$  in a high magnetic field have led to the development of the Extended EBIS upgrade. The spin-rotator and  ${}^3\text{He}^{++}$  beam polarimetry development is also in progress in collaboration with MIT.

There is a unique opportunity for precision measurements of the absolute  ${}^3\text{He}^{++}$  polarization at beam energies 5.0-6.0 MeV after the EBIS Linac. It was shown in Ref. [1], that the analyzing power for the elastic scattering of spin-1/2 particles ( ${}^3\text{He}$ ) on spin-0 particles ( ${}^4\text{He}$ ) can reach the maximum theoretical value  $|P| = 1$  at some point (Ebeam,  $\theta_{\text{CM}}$ ). Using the experimental data [2], several such points were established for  ${}^3\text{He}+{}^4\text{He}$  elastic scattering including the  $P = +1$  at beam  $E \approx 5.3$  MeV and  $\theta$  (center of mass)  $\approx 91^\circ$ . Therefore, the main effort of this R@D will be development of precision absolute polarimeter for the measurements of the  ${}^3\text{He}^{++}$  beam polarization produced in the EBIS as a reference for the further polarization measurements (and possible polarization losses) along accelerator chain.

The polarimeter vacuum system is integrated in the spin-rotator transport line. The  ${}^3\text{He}^{++}$  ion beam will enter the scattering chamber through the thin window to minimize beam energy losses. The scattering chamber is filled with  ${}^4\text{He}$  gas at  $\sim 5$  torr pressure. The silicon strip detectors will be used for energy and TOF measurements of the scattered  ${}^3\text{He}$  and recoil  ${}^4\text{He}$  nuclei (in coincidence) for the identification of the scattering kinematics with analyzing power  $AN \sim 1$ . Two sets of detectors will measure both nuclei and left-right asymmetry at the spin-flip.

The status of polarimeter development (vacuum system, scattering chamber, thin window, Si-strip detectors and WFD- based DAQ) will be presented.

[1] R. J. Spiger and T. A. Tombrello. Scattering of  $\text{He}^3$  by  $\text{He}^4$  and of  $\text{He}^4$  by Tritium". In: Phys. Rev. 163 (4 1967), pp. 964{984.

[2] G.R. Plattner and A.D. Bacher. "Absolute calibration of spin 1/2 polarization". Physics Letters Volume 36B, number 3 (1971), pp. 211-214

### Summary

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