2019 Workshop on Polarized Sources, Targets, and Polarimetry



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## Precision absolute polarimeter development for the 3He++ ion beam at 5.0-6.0 MeV energy

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

There is a unique opportunity for precision measurements of the absolute 3He++ 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 (3He) on spin-0 particles (4He) can reach the maximum theoretical value |P| = 1 at some point (Ebeam,  $\theta$ CM). Using the experimental data [2], several such points were established for 3He+4He elastic scattering including the P= +1 at beam E  $\approx$  5.3 MeV and  $\theta$  (center of mass)  $\approx$  91°. Therefore, the main effort of this R@D will be development of precision absolute polarimeter for the measurements of the 3He++ 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 3He++ ion beam will enter the scattering chamber through the thin window to minimize beam energy losses. The scattering chamber is filled with 4He gas at ~ 5 torr pressure. The silicon strip detectors will be used for energy and TOF measurements of the scattered 3He and recoil 4He nuclei (in coincidence) for the identification of the scattering kinematics with analyzing power AN ~ 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 He3 by He4 and of He4 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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