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Polarized ^3He Target for JLab 12GeV Era

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Since most of the ^3He spin is carried by the unpaired neutron, polarized ^3He targets have been widely used as an effective polarized neutron target in electron scattering experiments to study the spin structure of neutron. Over the past a couple of decades, polarized ^3He targets had been successfully utilized in thirteen electron scattering experiments during JLab 6 GeV era. At JLab, a technique called Spin-Exchange Optical Pumping (SEOP) is used to polarize the ^3He target. For the past decade, several developments including Rb-K hybrid alkali system and high power narrow line-width diode lasers were implemented to the polarized ^3He target in order to reach higher ^3He polarization with world record luminosity. As JLab completed 12 GeV upgrade in 2017, there are seven upcoming approved polarized ^3He target experiments. Upgrade of the target with convection cell and Pulse Nuclear Magnetic Resonance (PNMR) polarimetry were completed for the first upcoming 12 GeV era experiment A_1^n (E12-06-110) with collaboration of d_2^n (E12-06-121) in JLab Hall C. For typical $10^{22}/\text{cm}^2$ high-density target used in this collaboration experiment, the maximum polarization reached over 50% under $30\mu\text{A}$ electron beam, thus the luminosity of $10^{36}/\text{cm}^2/\text{s}$ will be achieved.

Summary

During JLab 6 GeV era, the polarized ^3He target system were successfully implemented in to multiple electron scattering experiments with world-record luminosity. As JLab upgraded to 12 GeV, the upgrades of convection cell and Pulse Nuclear Magnetic Resonance polarimetry were done and the target system is ready for the upcoming A1n/d2n collaboration experiment in Hall C which will begin in November, 2019.

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