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Development of a Polarized H/D atom Source for the EicC Project

The Electron-Ion Collider in China (EicC) is a proposed high-intensity facility designed to explore the partonic structure of nucleons and nuclei, particularly in the sea quark region, with unprecedented precision. Its physics program aims to uncover the origin of nucleon mass and spin, image the three-dimensional landscape of partons, study quark-gluon dynamics in nuclei, and search for exotic hadronic states. These ambitious objectives demand high-luminosity collisions involving polarized beams with both high intensity and polarization, making advanced polarized source development a crucial step.

A polarized hydrogen and deuterium (H/D) ion source is currently under development at the Institute of Modern Physics, following the Atomic Beam Polarized Ion Source (ABPIS) scheme. The target performance is a beam polarization above 0.8 and an ion beam intensity exceeding 1 mA. The system incorporates two sets of sextupole magnets and three radiofrequency transition (RFT) units, which have been carefully designed and optimized for high polarization efficiency.

So far, an H atomic beam flux exceeding 3×10^{16} atoms/s has been measured by a hot cathode ion gauge. When the weak field transition (WFT) unit placed between two sets of sextupole magnets is turned on, the atomic beam flux decreases by about 50% compared to when the WFT is turned off, indicating the occurrence of effective spin state transitions. Further RFT tests and beamline optimization are ongoing.

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