# Development of a Spin-Light Polarimeter for the EIC: an Update

June 26, 2014

Polarized electrons and ion beams are an essential part of the EIC program. The entire EIC program, especially the parity-violating electroweak program, will place stringent requirements on the precision polarimetry of the electron beam. The determination of the polarization of the electron beam is one of the dominant systematic uncertainties for this program. We propose to develop a novel continuous non-invasive polarimeter based on the spin dependence of synchrotron radiation (SR), referred to as "spin-light". The proposed polarimeter requires a position sensitive hard X-ray detector. We will develop a pair of split-plane differential ionization chambers as position sensitive X-ray detectors.

We had submitted a revised proposal to develop the detectors for such a polarimeter to the committee in December 2013. In its report on our proposal the committee had asked us to work with either (or preferably both) the MEIC or eRHIC accelerator teams to determine a definitive lattice location and convincingly address the various questions raised on systematics, precision and accuracy by this extremely challenging measurement. We have been consulting with the MEIC accelerator team and we have found a definitive lattice location for a spin-light polarimeter near the interaction region. V. Morozov, F. Lin and P. Nadel-Turonski from the MEIC design team have joined the proposal are helping study the feasibility of the spin-light polarimeter.

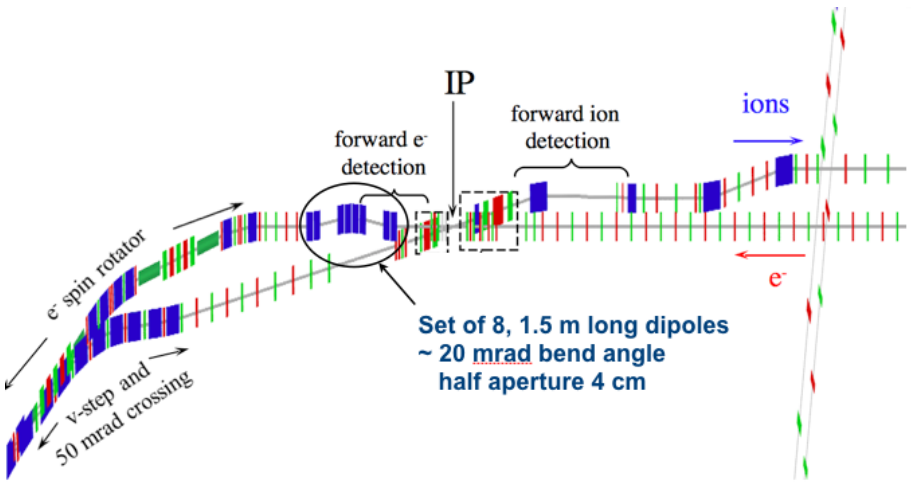


Figure 1: A possible location for a spin-light polarimeter. The set of 8 dipoles indicated will be used as the source of Synchrotron radiation instead of a 3-pole wiggler.

The set of 8 dipole magnets, just after the interaction region, as shown in Fig. 1, would be an ideal source for the spin-light polarimeter. These magnets would be used instead of the 3-pole wiggler magnet. Although the field strength of the dipole magnets is significantly lower than what we had

proposed in our original designs (0.55 T compared to 4.0 T), they have a larger bend angle (20 mrad compared to 10 mrad in the original design), much larger pole lengths (1.5 m compared to 0.2 m) and are much more widely spaced (4 m compared to 1 m). All of these factors contribute towards the feasibility of a spin-light polarimeter that utilizes the dipole magnets that are already a part of the lattice design. However, the size of the actual asymmetry in this new configuration is smaller than those in our original design (see Fig. 2), making the measurement even more challenging.

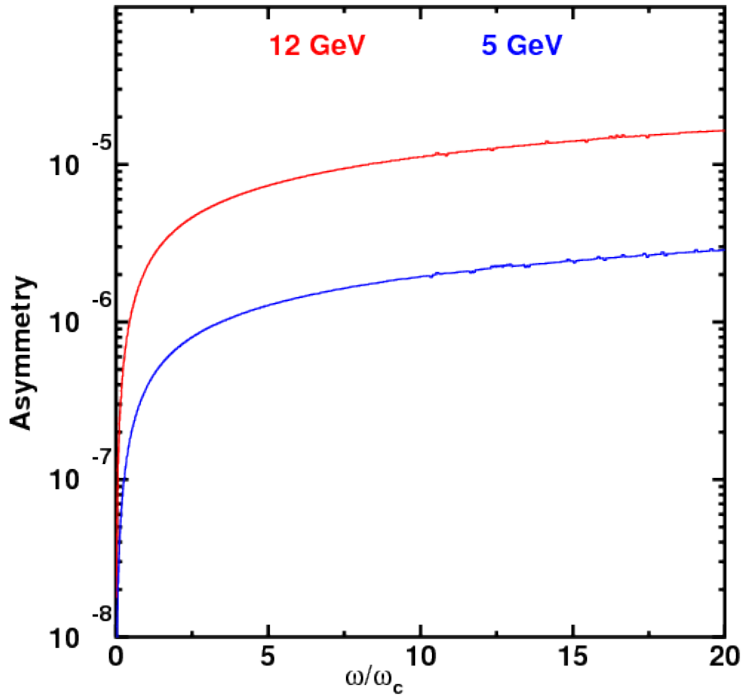


Figure 2: The spin light asymmetry using the dipole magnets that are already part of the lattice design.

In order to study the feasibility of measuring the small asymmetry and to estimate the various systematics, we have simulated the polarimeter in the new configuration using a Geant4 model. Some of the results of the simulation are shown in Fig. 3. We have also determined that because of the large separation between the dipoles and their relatively large apertures, the slits and collimators required to separate the fans of Synchrotron light from the various magnet poles is relatively easier in this new configuration and they should not interfere with the machine operations. We are continuing to simulate and rigorously investigate the feasibility of the polarimeter in consultation with the MEIC machine experts.

Over the next few months we will be consulting the eRHIC accelerator team and determine if a suitable lattice location can be identified in the eRHIC design. Once we have identified a suitable location in the eRHIC design we will perform simulate for the eRHIC configuration and present a comprehensive proposal that will compare and contrast the feasibility of the spin light polarimeter at MEIC and eRHIC. At this time we are just submitting an update on the work completed so far.

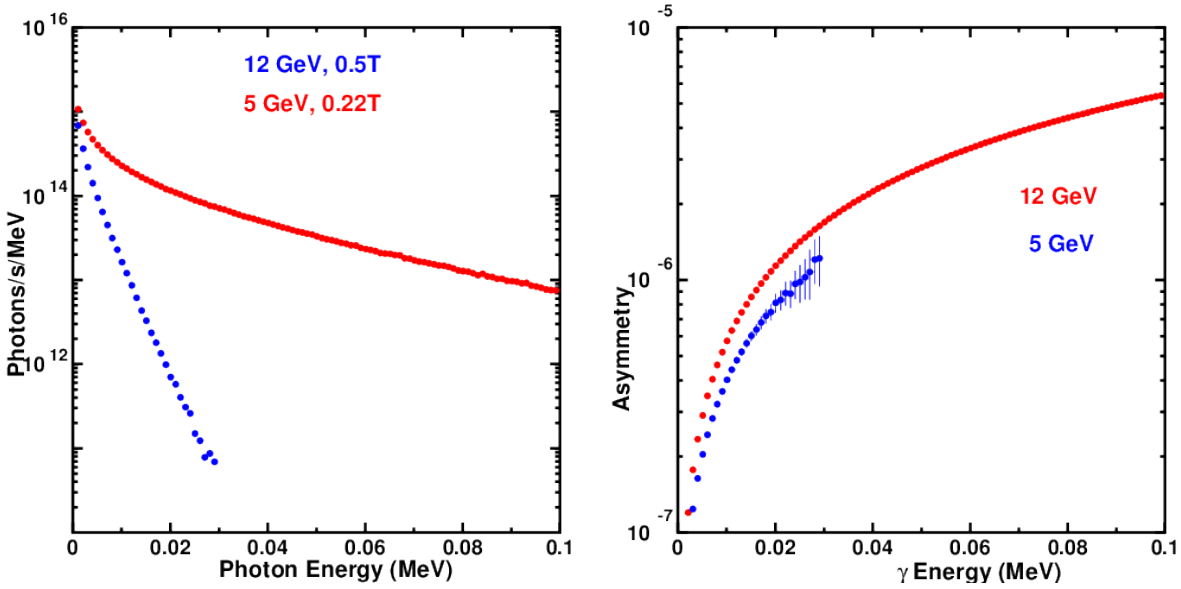


Figure 3: Preliminary results from a Geant4 simulation of the spin light polarimeter in the MEIC configuration. (left) The SR spectrum and (right) the spin light asymmetry using the dipole magnets that are already part of the lattice design.