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

January 18, 2015

In consultation 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.

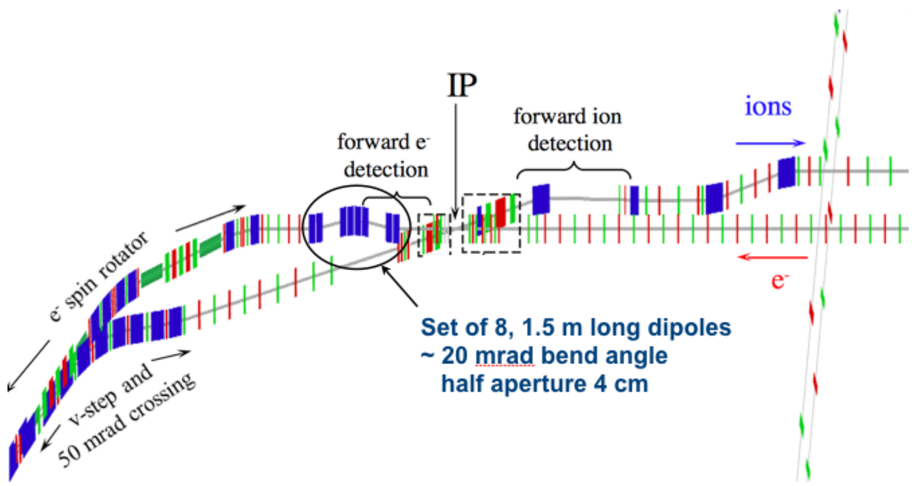

Figure 1: A possible location for a spin-light polarimeter. The set of 8 dipoles indicated will be used as the source of Synchrotron radiation instead of a 3-pole wiggler.

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.

The energy of the SR radiation using the interaction region magnets is lower compared to the original proposal. This would allow the use of high resolution X-ray CCD detectors. We have looked at both the CCD based detector and position sensitive ionization chambers. Based on our simulations we have concluded that the asymmetry is too small to be measured precisely using the existing detector technology.

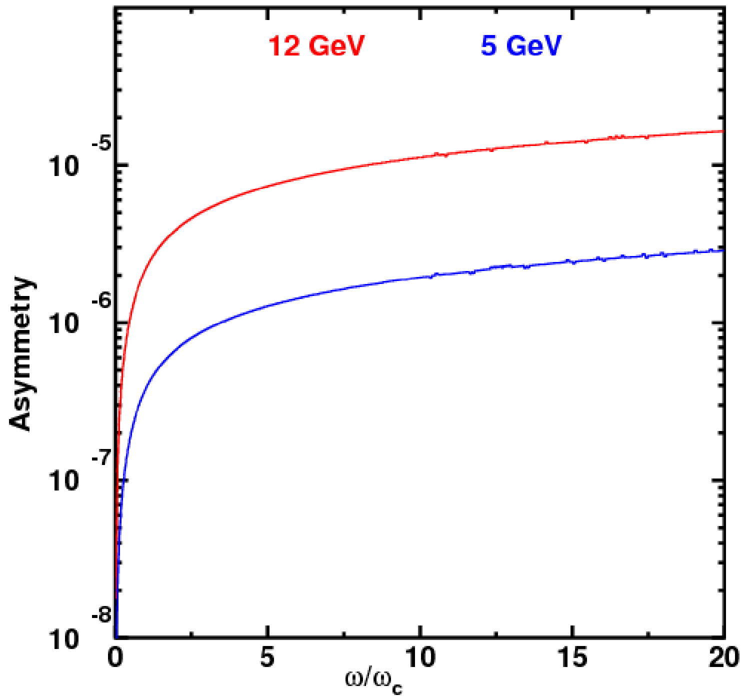

Figure 2: The spin light asymmetry using the dipole magnets that are already part of the lattice design.

We have also consulted with the eRHIC accelerator team and looked at the electron lattice. We have determined that there is no suitable set of magnets that can be used in the eRHIC lattice.

We conclude that a longitudinal polarimeter is not feasible for either the current MEIC or the eRHIC lattice designs.

In consultation with the MEIC accelerator team we have examined the feasibility of measuring the transverse polarization in the MEIC ring. The feasibility of transverse polarimetry using spin-light was demonstrated in the 1980s. For the MEIC lattice the ring is made of 5.5 m long dipoles with a field of 0.36T at 12 GeV. The spin-light asymmetry for transversely polarized electrons is shown in Fig. 3. The asymmetry for the transversely polarized electrons is at least an orders of magnitude larger than the asymmetry for the longitudinally polarized electrons. Moreover, this is an asymmetry of the total SR power emitted, and hence does not require a position sensitive detector. A regular ion chamber can be used to measure the asymmetry. We conclude that a transverse spin light polarimeter is feasible for the MEIC design.

We are continuing to examine the feasibility of a similar transverse polarimeter for the eRHIC design.

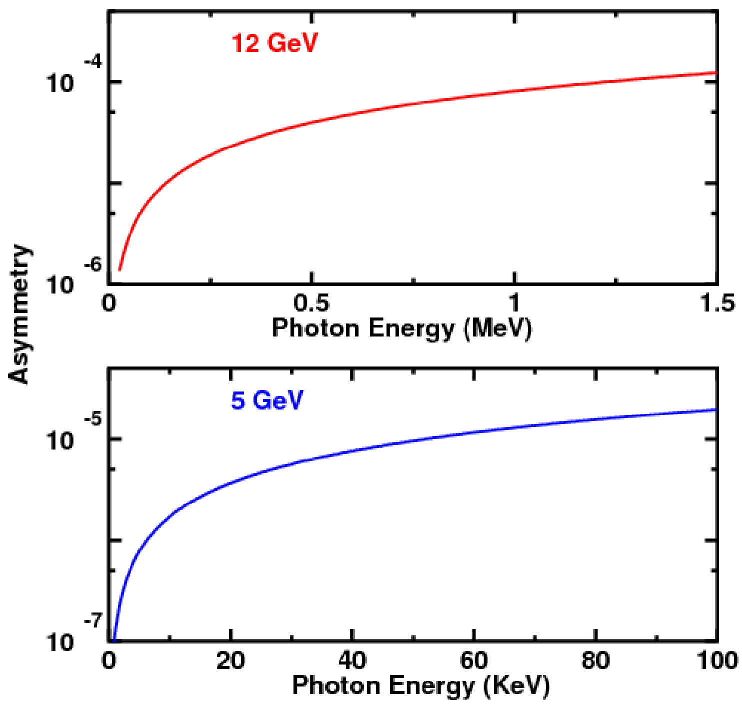

Figure 3: The spin light asymmetry for transversely polarized electrons in the MEIC ring for 12 and 5 GeV electrons..