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High Intensity Polarized Electron Source Development for the EIC

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The Electron Ion Collider (EIC) is a new Nuclear Physics Facility that will use collisions between polarized Ions and polarized electrons to study the inner structure of the Nucleon. The EIC will be sited at Brookhaven National Laboratory (BNL) and is designed in collaboration with JLab to address profound questions about nucleons. For this purpose, the EIC takes advantage of the entire existing Relativistic Heavy Ion Collider (RHIC) facility with the addition of an Electron Storage Ring (ESR) inside the present RHIC tunnel providing polarized electron beams up to 18 GeV for collisions with polarized protons or heavy ions with Center-of-mass energy of 20 to 140 GeV. Polarized electrons are injected into the ESR from a Rapid Cycling Synchrotron (RCS) Injector Ring with a Pre-Injector comprised of a 300keV polarized photoelectron source and a 400 MeV linear accelerator with bunch stretching and longitudinal phase space rotation capabilities. The high voltage and high bunch charge requirements for the EIC polarized gun are challenging. We present results of the EIC polarized electron source built using an inverted high voltage direct current (HVDC) photoemission gun design with a large cathode that thus far meets or exceeds all EIC operational requirements with a bunch charge of up to 16 nC at a stable operating gap voltage of 300 kV. We present the polarized e-gun design, conditioning history, accelerated life testing and operating performance. Thus far, our gun conditioned without the use of an inert gas up to 350 kV with no field emission in less than a day, has achieved an e-beam current of 37 uA without decay, while biasing the anode significantly increases lifetime which appears to be limited only be the vacuum rise from the Faraday cup in our beam stop. We will present near term plans to introduce and characterize the performance of highly polarized photocathodes along with enhanced Faraday cup vacuum isolation and beam halo studies.

Category

Polarized Sources

Primary author: SKARITKA, John (Brookhaven National Laboratory)

Co-authors: WANG, Erdong; RAHMAN, Omer; LAMBIASE, Robert; LIU, Wei; BISWAS, Jyoti; DEGEN, Christopher; INACKER, Patrick; PANICCIA, Matthew

Presenter: SKARITKA, John (Brookhaven National Laboratory)

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