

Expression of Interest for Lepton Polarimetry

Note that many of the institutions interested in contributing to lepton polarimetry at EIC will discuss their planned contributions in institution-specific EOIs. This document is intended to collate these contributions in a single place.

Please indicate the name of the contact person for this submission:

ECIUG Polarimetry Working Group: Elke Aschenauer (elke@bnl.gov) and Dave Gaskell (gaskell@jlab.org) Conveners

Please indicate all institutions collectively involved in this submission of interest:

Argonne National Lab, Brookhaven National Lab, Jefferson Lab, Stony Brook University, University of Kansas, University of Manitoba, University of Massachusetts, Amherst, University of Virginia

Please indicate the items of interest for potential equipment cooperation:

This EOI covers components of the Compton polarimeters required at the EIC. The components covered in this EOI include the laser system, calorimeter, and position sensitive detectors needed for both the photon and electron detectors. Other efforts covered in this EOI include simulations, systematic studies, and development of detector readout electronics.

University of Manitoba will contribute to the EIC lepton polarimetry effort through fast and full simulations, and to the development of the electron detector system. While we are open to any applicable technology, we have experience with HV-MAPS detectors which we are evaluating for polarimetry applications in MOLLER and SuperKEKB.

UMass-Amherst will contribute to the development of the EIC polarimeters via simulations, studies of potential systematic errors and possibly photon or electron detector and readout development.

Stony Brook University would like to collaborate towards the development of the EIC polarimeters via simulations, design of the interaction region as well as R&D related to the design and construction of a laser system that will meet the high precision goals of the polarimeter. We will seek additional non-DOE (local University, State and private) funding sources as they become available.

University of Kansas has expertise with TOTEM Roman pots, diamond and Large Gain Avalanche Diode detector and fast readout electronics which could be applied to the electron detector readout. We will seek additional non-DOE funding for this.

Argonne National Laboratory will be developing superconducting nanowire particle detectors for applications at the EIC. With the encouragement of the EIC Detector R&D Committee, we will leverage the detector capabilities for detecting electrons in a Compton polarimeter.

University of Virginia will contribute to the development of the laser system required to meet high precision requirement and to simulation studies of measurement techniques and possible sources of systematic errors.

Please indicate what the level of potential contributions are for each item of interest:

University of Manitoba: About 40 hours of PI research time per month will be allocated to lepton polarimetry at the EIC by W. Deconinck, M. Gericke, J. Mammei (in some overlap with SuperKEKB polarimetry). We have requested support for 1 M.Sc. student from NSERC, starting September 2021, to work exclusively on lepton polarimetry for the EIC, with a focus on the lepton detector system of a Compton polarimeter. We have (through U.Victoria) also requested support 1 M.Sc. student from NSERC, starting September 2021, to work on Compton polarimetry for the polarized SuperKEKB upgrade, and we anticipate significant synergy in simulation software. In terms of unique facilities, we have a refurbished 30 keV proton accelerator for some detector tests and we have access to Compute Canada resources (with a total pool of about 250k cores).

UMass-Amherst: On the items of interest listed in the previous question we propose to contribute 0.25 FTE postdoc effort starting 2023 with the potential to ramp up to 0.5 FTE postdoc effort in later years.

Stony Brook University will provide in-kind labor contributions and make existing facilities available towards the design, construction, commissioning, and maintenance of various components related to the Compton polarimeter (see table for details on labor).

University of Kansas will loan existing readout electronics for beam test and help in design of the final system. University of Kansas will also provide expertise with impedance reduction of the device similar to what was done for LHC TOTEM.

Argonne National Laboratory can leverage the fabrication facilities and expertise needed to produce superconducting nanowire detectors. The facilities include the Center for Nanoscale Materials (CNM) and expertise and fabrication from the Materials Science Division (MSD).

University of Virginia intends to contribute person power for this work. 0.25 FTE postdoc effort starting in 2021 toward this effort, along with a fraction of PI effort. In 2022 and beyond UVa expects to also contribute up to 0.5 FTE of a graduate student for several years of development and implementation.

Please indicate what, if any, assumptions you made as coming from the EIC Project or the labs for your items of interest:

As host institutions, Brookhaven National Laboratory and Jefferson Lab are able to provide expertise and support in several areas:

Brookhaven will provide support for integration of the polarimeters in the collider and has capabilities for supporting DAQ development and deployment.

Jefferson Lab is able to provide expertise and advice in the areas of laser development, strip detectors, and RF simulations. In addition, the existing Compton polarimeters in Halls A and C at Jefferson Lab can possibly be used as test-beds (depending on the Jefferson Lab experimental schedule and requirements).

UMass-Amherst: R&D and simulations that we plan to contribute could potentially come from operating grants. UMass-Amherst has the required laboratory facilities to carry out the needed R&D efforts. However, any equipment for the polarimeters will need to be supported by the Project.

University of Manitoba: While we anticipate that operating grants will support all personnel and travel to EIC UG workshops, this may not cover in-person project review meetings.

Opportunistic Compton polarimeter access to test HV-MAPS technology during or around SBS running through a modified detector can in Hall A at Jefferson Lab would be very valuable.

Stony Brook University: We expect support from the EIC project for design and engineering in addition to supplies and materials needed for the different polarimeter components.

Argonne National Lab: We assume that the next two years will be funded through various sources at Argonne. After that, we assume future support will come from the EIC project R&D funding.

University of Virginia: We anticipate that funding for the postdoc contribution will be made with support of CFNS under a Joint Postdoctoral position. Future activities are assumed to be funded from continuing grant research funding.

Please indicate the labor contribution for the EIC experimental equipment activities:

The time commitment of groups participating in Lepton Polarimetry Efforts as described in this EoI is anticipated to be as follows:

Institution Name	Professor	Research Professor	Staff Scientist	Postdoc	Graduate Student	Undergrad. student	Engineer	Designer	Technician	Total Sum
Argonne			0.4	0.8			0.1			1.3
University of Manitoba	0.17				0.5	0.3 ^{summer}				0.67
	0.13					0.3 ^{summer}				0.43
	0.10				0.25 ^{KEK}					0.35
UMass-Amherst	0.05			0.25					0.3	
SBU	0.125			1	0.5	0.6				2.225
		0.4		0.6	0.3	0.4				1.70
University of Virginia	0.1			0.25	0.5					0.85

NOTE: FTE in the above table represents the annual fractional full time equivalent (FTE).

NOTE: for a professor, full-time equivalent research time may be limited to 25% max, for a research professor (or a sabbatical) or a staff scientist limited to 50% max, for a postdoc maybe 100%, and for a grad. student perhaps 50% (on average). For an undergraduate student research time (on average) is limited to 20% max.

University of Manitoba: This level of effort will start on April 1, 2020, and continue for 2 years. After that time, we anticipate that future grants will include equal or higher levels of effort.

Stony Brook University plans to sustain the level of contribution for the duration of the project and if needed into operations for the commissioning and operating of the built polarimeter components.

UMass-Amherst plans to make EIC polarimetry development an activity in the next grant cycle beginning in 2023. It is anticipated that at least this level of effort will be sustained for the duration of the Project and into commissioning and operation of the polarimeter.

Argonne National Lab: The level of effort indicated is for the next year and will be supported by programmatic funding at Argonne. Future effort is dependent on R&D interest and project funding.

University of Virginia: The level of effort for 2021 is expected to be 0.25FTE postdoc, with additional PI and graduate student effort in year 2022 and beyond. The future effort is contingent on DOE support under the continuing research grant.

Please indicate if there are timing constraints to your submission:

University of Manitoba: The Canadian funding cycles are aligned to the financial years, starting on April 1. We are currently on 2 year grant cycles, reflecting the ramp-up in EIC efforts. This allows us, with some frequency, to adjust and increase requests. The Manitoba group has a significant role in MOLLER, which may reduce our additional availability during the running of that experiment.

Stony Brook University: We expect to not have any significant time constraints.

Argonne National Lab: We expect to not have any significant time constraints.

Please indicate any other information you feel will be helpful:

UMass-Amherst: Extensive experience in fixed target electron scattering asymmetry measurements both for hardware and analysis, including electron beam polarimetry.

University of Manitoba: Experience with the Hall A and Hall C Compton polarimeters, both in the electron and photon detection channels.

Stony Brook University: In addition to the resources described above SBU has significant laboratory space which could be used to deploy, test different polarimeter components.

University of Manitoba: In addition to operating funds from NSERC described above, we can request infrastructure funds through other programs (NSERC RTI and CFI). These will typically require an in-kind or financial contribution match from other parties, which could be the EIC project or other international collaborators. For the entire EIC project (excluding accelerator support from TRIUMF) we anticipate a range from CA\$1.5M to CA\$6M in CFI support, which is comparable in scope to the GlueX barrel calorimeter or MOLLER main detector system.

University of Virginia: Experience with high precision Compton polarimetry in Jefferson Lab in Halls A and C, including laser development, operation, analysis and studies of potential systematic errors.