PROJECT INFORMATION

Project number:	43227
Administrative institution:	University of Regina
Project title:	Solenoidal Large Intensity Device (SoLID) Heavy Gas Cherenkov Detector
Team leaders:	Garth Huber
Meeting date:	January 9 and 10, 2023

SUMMARY OF ASSESSMENT

Research or technology development

EX ☐ SA ☑ SW ☐ PS ☐ NS ☐

Team expertise

EX ☐ SA ☑ SW ☐ PS ☐ NS ☐

Team composition

EX ☐ SA ☐ SW ☑ PS ☐ NS ☐

Infrastructure

EX ☐ SA ☑ SW ☐ PS ☐ NS ☐

Sustainability

EX ☐ SA ☑ SW ☐ PS ☐ NS ☐

Benefits

EX ☐ SA ☐ SW ☑ PS ☐ NS ☐

Rating scale

EX	SA	SW	PS	NS
The proposal satisfies and significantly exceeds the criterion standard.	The proposal satisfies the criterion standard.	The proposal satisfies the criterion standard, but has a few minor weaknesses.	The proposal partially satisfies the criterion standard and has some significant weaknesses.	The proposal does not satisfy the criterion standard due to major weaknesses.

RESEARCH OR TECHNOLOGY DEVELOPMENT

Criterion standard: The research or technology development program(s) are innovative, feasible and internationally competitive.

EX ☐ SA ☑ SW ☐ PS ☐ NS ☐

Context

One of the central problems of modern physics research concerns our understanding of the building blocks of the atomic nucleus -- the protons, neutrons, and other particles (mesons) that bind them. Notable discoveries have indicated that these particles consist of yet more fundamental constituents, the quarks and gluons. While Quantum Chromo Dynamics (QCD) is able to describe accurately how quarks and gluons interact at extremely high energies (or, equivalently, when the quarks are very close together), it has been very difficult to apply QCD to lower energy (longer distance) phenomena. The proposed research program will further study the inner workings of QCD.

The Solenoidial Large Intensity Device (SoLID), located at the Thomas Jefferson National Accelerator Facility Lab (JLab) in the United States, will use the latest detector and readout technology to enable an increase in luminosity by a factor of 10-100 compared to existing detectors.

In the 2022–2026 Canadian Subatomic Physics Long-Range Plan, SoLID is identified as a new experiment that will help to shed light on nucleon structure and hadron properties.

Strengths

The research program is well described and of high quality and relevance. It exploits the unique beam properties of the hosting facility and is internationally competitive.

Canada has a strong track record in this area. Involvement in the SoLID experiment is the continuation of a long-term program of Canadian participation in leading JLab experiments.

Canada is making a major contribution to the SoLID collaboration. Some preliminary work has already been completed indicating that several critical technical questions have already been addressed mitigating risk, while other technology decisions are yet to be made. Specifically, for the HGC detector, suitable feasibility studies have been conducted.

Weaknesses

None.

Summary and comments

The research program is innovative, feasible and internationally competitive.

TEAM EXPERTISE

Criterion standard: The team comprises the breadth of experience and expertise needed to conduct the proposed research program(s).

EX ☐ SA ☑ SW ☐ PS ☐ NS ☐

Context

The SoLID collaboration has approximately 300 members from more than 70 institutions in 13 countries.

For this proposal, the team consists of two researchers from Canadian institutions and six members from the United States. They have previous experience conducting physics data analyses for JLab experiments. Members' expertise covers a variety of areas and include prior work on large detector research and development projects.

Strengths

The proposed work will be executed by an experienced team of researchers whose complementary skills are well-matched to the expertise required to conduct the project successfully. The team is strong, with prominent scientists from both the University of Regina and several American institutions, and has the solid leadership needed to deliver on the project.

The history of previous scientific collaboration (mainly in the context of other joint projects at JLab) supports ongoing successful cooperation and collaboration amongst members of the team on large experimental projects in nuclear/particle physics, and with the administrative and physical environment of the hosting institution.

Team leader Huber has extensive experience building particle physics detectors while the others cover the needed mix of hardware and software competencies. Whereas most of the team listed physics outputs in their publications, some also listed relevant instrumentation papers.

The team has a demonstrated track record of attracting funding for detector development which lends additional confidence about the team's capabilities.

Weaknesses

None.

Summary and comments

The proposal satisfies the criterion standard.

TEAM COMPOSITION

Criterion standard: Principles of equity and diversity were considered in the team composition including in its leadership. There is a commitment to create an inclusive environment where all team members are fully integrated and supported in the research team.

EX ☐ SA ☐ SW ☑ PS ☐ NS ☐

Context

The proposal points to inequitable recruitment, selection, retention, and bias as specific challenges that could prevent individuals from underrepresented groups from participating equitably within the team.

A list of concrete practices to overcome the challenges is included:

- Individual adherence to a user group code of conduct
- EDI training and an EDI committee
- Social activities to support inclusion
- Continued outreach to the public to promote STEM to all groups
- Remote access for those unable to attend in person due to travel restrictions, family responsibilities, etc.

Strengths

The proposal appropriately describes specific challenges and systemic barriers which exist in the research field regarding the inclusion of equity-deserving groups. Concrete practices which have already been adopted to overcome these challenges are named, both on the institutional level and on the collaboration level.

Access to the facility remotely for those unable to attend in person is commendable.

Weaknesses

Some of the active measures described to promote inclusion are more akin to team building and the majority, though well-intentioned, are not inclusive (e.g., hikes, walks, activities outside normal working hours) suggesting a lack of understanding of some of the more fundamental EDI issues.

The solutions proposed to encourage EDI overlook an opportunity to develop equitable opportunities at the team membership or team leadership level (e.g., participation of early career researchers).

Summary and comments

There is a commitment to create an inclusive environment, but it is not yet fully reflected in the team composition.

INFRASTRUCTURE

Criterion standard: The requested infrastructure is necessary and appropriate to conduct the proposed research program(s) and optimally enhances existing capacity.

EX ☐ SA ☑ SW ☐ PS ☐ NS ☐

Context

The proposal is requesting funds to develop a key component of SoLID: the Heavy Gas Cherenkov detector.

The requested infrastructure includes:

- Vessel and front thin windows
  - Fabrication, including materials and machining costs ($860k)
  - Assembly and pressure testing ($140k)
  - Shipping ($20k)
- Contributions from international partners ($4M)

Strengths

The requested infrastructure is necessary and appropriate. It is critical to the scientific program and an integral part of the Heavy Gas Cherenkov detector unit for the SoLID facility.

Requirements and benefits of the Heavy Gas Cherenkov detector are clearly laid out for selected parts of the physics program for which this detector component is vital.

The mature design and rather detailed available physics studies were obtained based on previous funding, also via CFI funding which supported prototyping work.

The engineering work for the Heavy Gas Cherenkov concept has successfully undergone engineering review through JLab, and a comprehensive Request for Tender procedure for the fabrication, assembly, and essential quality verification steps has been conducted by the University of Regina group. This places the budget estimate on a firm and reliable basis.

Weaknesses

None.

Summary and comments

The requested infrastructure is necessary and appropriate. It builds existing capacity in Canada and at JLab.

SUSTAINABILITY

Criterion standard: The infrastructure will be optimally used and maintained over its useful life through tangible commitments.

EX ☐ SA ☑ SW ☐ PS ☐ NS ☐

Context

Management of the infrastructure will be overseen through the existing SoLID Collaboration structure.

Operation and maintenance costs are expected to be covered through support from JLab and the various funding agencies represented in the SoLID Collaboration. It will be maintained by the SoLID Collaboration.

An operation and maintenance budget specific to this proposal of $1.3M over five years is presented: $420 in personnel and $25k in supplies.

Strengths

The management and governance structures proposed are typical of large collaborative projects and in this case, appropriate. They are largely defined by the hosting facility and its administrative organization. The structures appear commensurate to fulfill this function and to move forward with further planning, construction, commissioning and finally operation of the infrastructure.

It is noteworthy that the SoLID facility intends to reuse parts of concluded (and partly already dismantled) experiments such as CLEO-II and, possibly, MOLLER. This would not only allow savings on procurement costs for some large components of the detector, but also put scientific infrastructure to which CFI has already contributed funds in the past to longer-term use.

The operation and maintenance budget is appropriate.

Weaknesses

None.

Summary and comments

The proposal satisfies the criterion standard.

BENEFITS

Criterion standard: The team and its partners have a well-defined plan to transfer the results of the research or technology development program(s). The results are likely to lead to social, economic, health or environmental benefits for Canadians.

EX ☐ SA ☐ SW ☑ PS ☐ NS ☐

Context

Postdocs and graduate students have been, or will be, hired at many of the participating Canadian institutes using NSERC project grant funding. The SoLID research carried out by highly qualified personnel will include the application of creative problem solving through the process of calibration, evaluation of systematic uncertainties, and event reconstruction using machine learning techniques that will be applied to the data acquired by this project.

Cherenkov effect has application in the fields of medical physics and biological research (e.g., radiotherapy dose calibration.

Strengths

The proposal describes appropriate prospects for technology transfer to applications which could be beneficial to society.

The proposed project provides a good training ground for HQP. It provides a wide range of exposure from physics question and detector concept studies, numerical simulation and optimization, to construction, commissioning, calibration and physics analysis methods. Such acquired skills make graduates of the project good hires for employment in academia or industry.

Weaknesses

The technology transfer plan is unclear.

There is limited information on the number of highly qualified personnel that could be trained over the duration of the project.

Summary and comments

The results are likely to lead to benefits, but the technology transfer plan is unclear.

MEMBERSHIP

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