RD 2013-4 Forward RICH Detector (New proposal)
(Y. Qiang presenting)

Qiang gave an excellent talk.

The proposers presented a concept and R&D program for a Forward RICH involving dual radiators and a single radiator and various readout options. The goal of the proposal is to determine the detector technology and finish the conceptual design of the RICH detector in three years.

By using common readout a dual-radiator RICH detector has the advantage of a more compact size than two separate RICH detectors. Concepts of dual-radiator RICH detector for the EIC with focusing using a Fresnel lens and using proximity focusing are well-described as is a modular concept for aerogel RICH detectors where it is assumed that a separate gas RICH detector would provide high momentum hadron ID. Readout based on a LAPPD using an MCP is proposed. This would offer excellent timing resolution and would in principle significantly enhance PID capability. A GEM with a reflective photocathode film deposited on the uppermost surface as an alternative readout is also proposed.

Assuming successful completion of the work proposed, as a follow on project the proponents envisage producing prototypes of these RICH detectors for the EIC.

The proposal is well-structured. There are four related work programs.

Detector simulation and conceptual design

The detector simulations will be carried at Jefferson Lab and LANL using existing EIC simulation codes developed by other EIC projects, and focus on simulation of detector performance, optimization and optics design. The tasks include: modeling the aerogel, the lens, the strip or pixel readout, and to embed a detector in the EIC event environment, including tracking detectors, determine maximal pixel/strip size, maximum module size (for the modular concept), efficiency etc. and develop reconstruction software.

LAPPD photodetector evaluation

LAPPD samples and associated front-end electronics will be provided by the ANL group. Tests include single photon detection efficiency at different wavelengths, particularly between UV and green, Background noise level, gain as a function of input pulse rate, time and position resolution, radiation hardness, sensitivity to magnetic field, and lifetime Most of the performance tests will take place at Jefferson Lab.

Improvements to LAPPDs

Some characteristics of LAPPDs may need to be tuned in order to better match the EIC application. In addition to the good timing/position resolution and cost that the LAPPD collaboration is already pursuing the following areas have been identified: high rate capability, tolerance to a strong magnetic

field, a thinner glass window, readout ambiguity with high rate/alternative charge collection option. These developments and improvements will be mainly carried out at ANL.

GEM readout development for the Cherenkov detectors:

GEMs coated with CsI have been used to detect UV photons, but a GEM photocathode coating that is sensitive in the wavelength range appropriate for aerogel radiators (~ 300 – 500 nm) has not yet been realized on a large scale. The first phase of photosensitive GEM development will focus on optimizing photocathode deposition parameters and operating gases to give the highest possible effective quantum efficiency. CERN triple GEMs will be used for these studies that will take place at LANL. A suitable readout pattern will be developed in simulation, which can maximize ring resolution while minimizing channel count. This readout pattern will then be tested.

Aerogel development/characterization:

A variety of aerogel samples will be characterized to choose the best option for the EIC RICH. The work will be conducted at JLAb by personnel from both INFN and JLab, and some studies will be carried at LANL as well. The studies will include measurements of transmittance, absorption length and scattering length for different aerogel tiles, measurements of refractive index and chromatic dispersion, and high precision mapping of the tiles thickness.

Funding request

The proposal requests $359k. This supports post doctoral effort and some equipment and M&S across four institutions.

JLAB is responsible for the detector simulation, characterization of LAPPDs and conceptual design. Partial support for a postdoc is requested to perform these tasks as well as characterization of aerogel radiators under the supervision of INFN.

LANL will be responsible for GEM photocathode manufacture and testing, optimizing RICH readout design, and will simulate and optimize the proposed RICH detector in a realistic EIC environment. The labor funding will be used for partial support of a LANL postdoc for the project.

ANL is the home of the LAPPD collaboration. ANL will fabricate LAPPD samples for the project and also carry out the R&D of LAPPD needed to render it suitable for EIC RICH readout. The labor funding will be used to partial support an ANL postdoc for the project.

INFN will be responsible for characterization and selection of various aerogel samples. This work is conducted at JLAB where they provide partial supervision for the JLAB post doc requested above.

Recommendation

The proposal is very broad. Each of the four work programs would require many person years of development work. The proponents are highly accomplished and respected members of the

community with the relevant experience to execute the work proposed. The difficulty for the Committee is that the work proposed greatly exceeds the capacity of the personpower requested. Each proposing institution is a National Lab with significant technical resources and personpower, however the amount of personpower that can be assigned to carry out this work, beyond the personpower requested, is absent from the proposal. Without this information it is not possible to fully evaluate this proposal and so the Committee cannot recommend the proposal be funded at this time. However, with the addition of a full accounting of the personpower available to carry out the work proposed, the Committee would welcome a resubmission of this proposal.

RD 2013-5 10 Picosecond Time of Flight (New proposal)
(M. Chiu presenting)

This proposal seems to be well motivated and capitalizes on a critical and substantial development effort already in place for LAPPD devices. The Committee wants to encourage the proponents to continue to pursue this approach. The Committee suggests that the group reconsider and perhaps refocus its priorities here in light of two circumstances: a) the availability of components may be delayed with respect to their expectations and b) further optimization and considerations of characteristics and performance may result in a better targeted device relative to the EIC application. In particular

a) The Committee believes that an early focus on collider specific readout electronics, and fast timing, per se, may be premature. It is likely these aspects will become available in any case, as the technology develops further.
b) It is not clear that the devices sought for the early R&D will indeed be available on the timescale over which substantial funds are being requested
c) The configuration and characteristics may benefit from further optimization, some of which the proponents have already identified, and some which have been suggested by others:
    a. Optimization of wavelength response
    b. Pixelized versus Cartesian readout
    c. Area coverage of individual tiles
    d. Magnetic field effects

Given these recommendations and uncertainties the Committee recommends funding at a reduced level in order that the studies may be pursued, but also that more substantial funding e held to when it could be applied more decisively. In this regard the Committee would support the U-Mass post-doc in Year 1 but hold off on the proposed electronics work. The Year 1 milestones, other than the PSEC5 aspect, should be followed but augmented with the more general suggestions under item c).