Questions/guidance for the presenters are listed in order of the proposal number:

EICGENR&D2022_01 : CSGlass for hadron calorimetry at the EIC

Assuming the scintillating glass is shown to have the required properties, what would the configuration of a working hadronic calorimeter roughly look like?

Do the necessary waveform digitizing electronics for a working hadronic calorimeter exist, or are they currently in development, or will they require initiating an additional R&D effort?

When one combines the time needed for development of the glass, the waveform-digitizing electronics, and the design and construction and beam tests of a prototype calorimeter, how many years (optimistically) might it take for this technology to be ready so that a collaboration could commit to it as the basis for an EIC hadronic calorimeter design?

In the best-case scenario of ideal scintillating glass, off the shelf waveform-digitizing electronics, and no loss of Cerenkov vs Scint light timing discrimination due to the use of wavelength shifters, is there a basis from simulation suggesting that such a calorimeter could achieve the Yellow Report desired resolution of 35%/sqrt(E)?

What is the proposed density, refractive index and fluor of the material? Are there predictions on the wavelength spectrum, rise and decay times?

What is the expected separation of Cherenkov and Scintillation light? Following from this, what is the figure of merit for the pulse shape analysis and the resulting hadron/electron separation?

What PSD algorithms are considered? Will they be implemented into hardware or applied offline? What are the trade-off in terms of speed, required computing power, and figures of merit?

EICGENR&D2022_02 : A proposal for MPGD-based transition radiation detector/tracker

Please clarify what work was already partially addressed within eRD22, and what lines of R&D are new.

Can you detail the prototype of the field cage that is planned?

Why not buy the gain mapping device from a private company? (A lot of X-rays guns are available.)

There appears to be non-zero overlap in detector R&D prototypes with proposal #23: Development of Thin Gap MPGDs for EIC Trackers . (All received proposals can be found at https://www.jlab.org/research/eic_rd_prgm/receivedproposals .) If this is correct, and both proposals are funded, how would you exploit this potential synergy?

Travel costs are roughly ¼ of the budget request. Are all 6 people necessary for the tests at Fermilab?

EICGENR&D2022_03: Precise Timing with a Micro Pattern Gaseous Detector

Please elaborate on the role and potential advantages of using a PICOSEC detector for the EIC. Based on reasonable assumptions about the radiator/photocathode/gas gain structure, how would this technology compare to LGADs for use as an EIC TOF detector in terms of multiple scattering, heat generation, and services?

Please show a diagram of where the PICOSEC detector would be placed in the experiment.

Describe in detail the proposed scope of work for Year 1.

What generic R&D and achieved milestones would be sufficient to establish that this technology is a viable candidate for an EIC TOF detector? (Further refinements in the radiator, photocathode, and gas gain structures are inherently open ended, but a final configuration could be established using project R&D.)

Regarding labor: Can you detail the %FTE participation by other collaborators? Which part of the project could be accomplished without funding for a PhD student?

EICGENR&D2022_04: BeAGLE, a tool to refine IR and detector requirements for the EIC

Please provide a (possibly slightly revised) section 2.1 describing Proposed Work during FY2023 assuming this is the only year for which funding from the EIC-related generic R&D program will be available. Provide 100%, 80%, and 60% funding scenarios.

EICGENR&D2022_05: Continued Development and Evaluation of a Low-Power High-Density High Timing Precision Readout ASIC for AC-LGADs (HPSoC)

Historically, electronics work which is not strongly and directly coupled to an experiment has been of limited value given the specificity of needs for the experiment (geometry, power consumption, etc). Can you detail the steps your collaboration is taking to ensure that the ASIC you are developing will stay relevant?

In addition to the input stage, a full FEE system also requires configuration, calibration, data transport, and synchronization. Do these other stages of the FEE already exist, or are they currently in development, or will they require initiating an additional R&D effort? What is the strategy to implement a synchronization across a whole system on the level of 10ps, which is smaller than the transition jitter of many clock distribution systems?

On a longer time scale, what is the possibility to include interconnections for potentially smaller pitches in view of issues observed with first version of the chip? Ie, is less than 300 um feasible?

The chip and board design seems to be fully outsourced to a commercial company. What are the implications for collaborators in using the design/chips? Also for the longer term?

Which version of the chip should achieve the 10 ps timing?

It would be good to see a concept for interconnection and larger area detector.

The digital feature extraction is not yet well defined, some initial tests are envisaged for a FPGA implementation. What is the exact strategy to implement a feature extraction with lots of parameters inside the ASIC?

EICGENR&D2022_06: A new radiation tolerant low power Phase-Locked Loop IP block in a 65 nm technology for precision clocking in the EIC frontend electronics

What steps is this collaboration taking (or can it take) such that their low-jitter clock, if successfully developed, will then be incorporated by chip designers into the front end electronics of EIC detectors?

EICGENR&D2022_07: Refined Methods for Transfer Matrix Reconstruction Using Beamline Silicon Detectors for Exclusive Processes at the EIC

The problem seems well-suited for ML if suitable training samples can be obtained. This is in principle straightforward in simulation, but has thought been put into how to obtain such samples from data? For example, does the momentum resolution of the detectors match the precision on the momentum the proposed method provides? i.e. can you get from the detectors information useful for testing?

Will this work lead to specifications for measuring or constraining higher order multipoles in the magnets between the IR and the silicon detectors, or is this not expected to be an issue?

Is the maintenance of this code assured by the same team involved in this proposal?

How do you evaluate the risk of not delivering on time the proposed, tested code? Which aspects of the proposed work are mostly likely to introduce delays? (E.g., is the major uncertainty in the time needed to test machine learning techniques?)

This is nominally a 1 year project requesting support for 70% of a postdoc FTE. Is the plan then to divert an existing postdoc to this effort for most of one year?

EICGENR&D2022_11: Development of a Generic, Low-power and Multi-channel Frontend Readout ASIC for Precision Timing Measurements at EIC

Historically, electronics work which is not strongly and directly coupled to an experiment has been of limited value given the specificity of needs for the experiment (geometry, power consumption, etc). Can you detail the steps your collaboration is taking to ensure that the ASIC you are developing will stay relevant?

In addition to the input stage, a full FEE system also requires configuration, calibration, data transport, and synchronization. Do these other stages of the FEE already exist, or are they currently in development, or will they require initiating an additional R&D effort?

It would be good to see a concept for interconnection and larger area detector.

Can you show a schematics of the chip and the overall system with TDC and global synchronization?

What is the schedule and milestones to reach a full readout system?

What is the difference in performance, power consumption, and cost between a CFD and LED solution?

The costing for the ASIC development is quite vague. What does the cost entail?

EICGENR&D2022_12 : Development of a Novel Readout Concept for an EIC DIRC

How will the performance (in all respects) of the new geometry be assessed, relative to the baseline for Detector 1? Could you sketch out the cost-benefit analysis of how the pi/K separation power, smaller pixel array, SiPM usage, and impact on calorimetry (e.g. thinner bars) could be weighted in design choices? What cost reduction might be achieved in the best case scenario?

Can you sketch on Figure 2 the path of the Cerenkov photons along the midline of the bar? (The effect of the lens is not very obvious from the text.)

EICGENR&D2022_13 : Simulations of the physics impact of a solenoid-based compensation scheme for the field of the main detector solenoid in IR8

The connection with the EIC Project and the Detector 2 working group should be more emphasized, specifically if/how this affects the pre-TDR (closed orbit, spin precession/polarization lifetime).

To further pursue the point made above: any successful implementation of the findings of this study would require not only a great deal of optics design, but communication and negotiation between a wide range of stakeholders. Can you address the (perhaps unfounded) concern that devoting 1/3 of the requested funds to modification of the event generator software might be an unnecessary distraction?

EICGENR&D2022_14 : Tracking and PID with a GridPIX Detector

GridPIX post-processing to prevent discharges is not addressed. This is a critical item for the long-term use. Can you discuss any overhead and risks this might entail in an EIC detector?

Please detail the radiation length for the sPHENIX TPC (reportedly 1.5%), then do the same for the conceptual design for an EIC detector using the proposed technology (where 1% is said to be achievable).

What R&D will be needed after the FNAL beam test? That has not been clearly defined.

EICGENR&D2022_15 : Particle identification and tracking in real time using Machine Learning on FPGA

There appears to be overlap in the proposed research with the current DOE-funded project on FPGA-ML tracking/full event tagging for RHIC/EIC under DE-FOA-0002490 by LANL-MIT-FNAL-NJIT . Can you comment on how this proposal will complement that effort?

Can you make a clear case that the proposed R&D addresses problems that are currently projected to be bottlenecks for EIC Detector 2 or an upgrade of Detector 1? For example, is it a mere detail that Detector 1 tracking technology is based on silicon whereas this proposal would use GEMs? Are the noise and track reconstruction challenges similar? The EIC-related generic R&D program cannot support overly generic R&D.

Please discuss the reliability of the proposed methods, in particular for the following areas:

- What amount of by-passing data is required to study the systematic uncertainty on the acceptance efficiency for the proposed full event ML trigger/tagger?
- Please quantify the performance difference for the inference network between the training environment and FPGA implementation (e.g. via emulation with QONNX), as different numerical precisions are used in these two environments.
- Please comment on the following factors in the algorithm design: competence awareness, quantization aware training, and whether/how calibration is used.

Please detail the planned work and deliverables from the electrical engineer, and how they fit into the current budget of 0.05+0.1 FTEs.

Why implement the algorithms immediately in an FPGA board and not test it beforehand with existing data in a CPU? Of course this is much slower but will show how good the algorithms work.

Regarding labor: How can a PhD student salary be cut by -20% or -40%? Is it planned to hire the student later? But then the problem is just shifted.

Please clarify to what extent the collaboration plans to be users of ML software vs developers. It sounds like the generic software/firmware work is essentially done by hls4ml (and others, but this one is mentioned specifically). But in the proposal, it seemed they would also be doing some development.

EICGENR&D2022_16 : Development of High Precision and Eco-friendly MRPC TOF Detector for EIC

Please respond to the observation that the emphasis of this proposal is on simulations and gas optimizations while the proponents have not demonstrated that they have a scalable electronics readout solution that can deliver the performance that they need.

Can you make a rough comparison of the radiation length of MRPCs vs AC-LGAD's? (Include services such as cooling infrastructure if possible.)

Can you also roughly compare the cost for instrumenting the same area with MRPCs vs AC-LGAD's?

What is the expected <u>position</u> resolution of the MRPCs in this proposal?

EICGENR&D2022_17 : Machine Learning for Detection of Low-Energy Photons in the EIC ZDC

How suboptimal is the baseline setup (ie, without these ML studies)?

Some description of the transverse segmentation would be of interest. (A diagram is given for the ZDC in Figure 2, with emphasis on the longitudinal segmentation of the device and the composition of the various segments.)

The description of the proposed AI/ML work is rather rudimentary and should be elaborated during a formal presentation.

Naively, the primary challenge would be obtaining realistic samples of beam/neutron backgrounds to train the algorithms. This aspect is not discussed in any detail in the proposal and should be clarified.

A simple plot showing a sample event containing routine expected background hits and event hits for a typical event of interest would be of interest, more so if it showed the transverse energy deposition in the EM and Hadronic compartments. This would let the reader obtain some idea of the inherent spatial resolution of the device's response, which underlies any analysis of the response as proposed by the group. Stated simply, can the device spatially resolve the particles of interest or not? For example, show an event with a boosted 2.6 MeV photon from 208Pb de-excitation together with a hit from a spectator neutron. Can the eye see the photon(s) or not?

EICGENR&D2022_18 : Superconducting Nanowire Detectors for the EIC

The presentation should spend significant time on the detector concepts discussed in Section 3.3 . Despite the low level of technical readiness, the proposal identifies potential EIC applications where this technology might find a unique niche provided that rad-hardness can be demonstrated. Please provide some idea of the infrastructure that would be needed to cool the detectors to superconducting temperatures without interfering with the primary beam.

The reset time was presented as being O(10)ns in the context of single photon detection. For charged particles, is the reset time expected to be longer (given the several orders of magnitude larger local heat deposition)?

EICGENR&D2022_19 : EIC KLM R&D Proposal

Since EPIC has now decided on all parts of the software framework, how does the migration affect the proposed studies and timeline?

The collaboration between the Multipurpose KLM and KLM-type HCAL is not specified at all. What are the benefits for this combined proposal?

What, exactly, is going to be prototyped? The proposal would be helped by a few drawings of what might be prototyped. For example, Leo Piilonen's talk at DPF 2015 on the BELLE-II KLM upgrade was quite illuminating.

Given the limited amount of time for the presentations, and the complexity of this proposal (the reviewers are struggling to extract a coherent work plan), the talk should focus entirely on Year 1 and should de-emphasize discussion of the electronics improvements. (These subjects may come up during the question period however.) In our preliminary opinion, the current work needs to focus on single slat readout, which can be done with simple electronics available in many of the labs. Once some proof-of-principle for the readout technique is established, a future proposal for customized readout electronics could very well make sense.

Reduced funding scales both detector parts equally. Have other options been considered, e.g. focusing primarily on one part?

EICGENR&D2022_22 : Injection Molding of Large Plastic Scintillator Tiles at Optical Quality

The performance criteria for optical quality and crosstalk were not quantified. This should come from experience or simulation. What are the allowable specifications? How does this relate to the main physics cases for the detector systems at EIC?

What optical quality has been reached so far at ORNL?

Is there a reasonable limit on the size of these devices, and how does that match the production and development? Explain the interplay of the size of tile, size of SiPM, optics, cross talk, and physics requirements.

Different examples are presented, how will the decision on which type to take forward be made?

The work plan looks very aggressive/ambitious to fit within one year. What steps for evaluation and process improvement are planned? What is the expected feedback mechanism?

EICGENR&D2022_23 : Development of Thin Gap MPGDs for EIC Trackers

Is the efficiency expected to decrease as the ionization gas gap thickness is reduced?

How is the dE/dx response expected to change as the ionization gas gap thickness is reduced?

EICGENR&D2022_24 : Simplified LGAD structure with fine pixelation

Given the tight time constraints of the review meeting, be sure to highlight the proposed work in Section 5: A novel LGAD structure, for which the major new features are improved position resolution and simplified fabrication. (Other topics are fair game during the question period however.)

Please discuss potential challenges in the new, nominally simplified fabrication process.

Please discuss the effects of the pixelization and weighting fields on the time resolution and readout segmentation. In particular how does the readout pitch/thickness of the device affect the pulse shapes and rise times?

Can you describe what the work plan would look like for the 12-14 month period?

EICGENR&D2022_25 : Imaging Calorimetry for the Electron-Ion Collider

Please discuss considerations of lifetime and magnetic field resistance for the alternative photosensors (MCP-PMT and LAPPD in particular). For example:

- how many Coulombs of charge are expected annually?
- What will be the maximum transverse magnetic field this option can handle?

In the scintillation fiber layers, to what extent would multi-cluster separation in the same azimuthal sector be possible, e.g. by using timing and digital layer matching? Does this complicate reconstruction of high local density measurements, such as in jet substructure?

What is the light collection uniformity in the scintillation fiber layers? Does it lead to any position dependent energy uniformity and extra constant term in this proposed calorimeter?

How confident is the collaboration in the hadron rejection simulation? Is it possible to verify it with test beam data in FY23?

Can you provide an update on NASA's plan to make AstroPix sensors commercially available?

Please summarize the prototyping and beam test plan with the Astropix sensor layers.

Please provide an outline of the readout for the Astropix sensor layers. For example:

- What is the expected zero-suppression energy threshold applied to the pixels, and what is the dark noise rate using that threshold?
- What is the ADC bit precision and sampling speed? What is the timing precision?
- What is the path for the signals from the Astropix chip to the DAQ?

Update the availability of VME readout boards.

EICGENR&D2022_26 Section 1: Silicon Tracking and Vertexing Consortium: Embedded Monolithic Active Pixel Sensor R&D

Have initial thermal model studies already been done to explore feasibility and the need for thermal vias?

Please summarize current vendor capabilities and work needed to accomplish the goals.

EICGENR&D2022_26 Section 2: Silicon Tracking and Vertexing Consortium: Aluminum Flexible Circuit Manufacturing Capability

Please update the situation regarding the lack of domestic manufacturers. Have you talked to existing AL PCB vendors? The market may be expanding due to quantum needs.

EICGENR&D2022_26 Section 3: Silicon Tracking and Vertexing Consortium: Functional Verification Model of EIC Tracking and Vertexing Detectors R&D

How does the full tracker design integrate with upstream ITS3 chip design and foundry?

Please sketch out the proposed design flow and how the existing tools are supplemented.

EICGENR&D2022_26 Section 4: Silicon Tracking and Vertexing Consortium: Ultra-fast Timing Monolithic Active Pixel Sensors

What is the physics case for an ultra-fast MAPS beyond the existing RICH and LGAD technology?

What is the effective fill factor of the SPAD array - how closely can they be packed?

Dark noise control - do they have to be cooled? How much material and power would this use?

Charge sharing - how would multiply hit SPADs affect the transmission line scheme?

Regarding the TDC: A low power, psec TDC is very difficult to design, hence will probably dominate the power. Will the power consumption become problematic when a realistic TDC is considered?

EICGENR&D2022_27 : Combined design of a projective tracker and PID system for the EIC Detector-1 with the assistance of Artificial Intelligence

This proposal appears to be highly optimized to finalize details of project Detector 1. How would you respond to the statement that, from the point of view of EIC-related generic R&D, the usefulness of this technology has been demonstrated and the review committee should expect a proposal for its application to the design of Detector 2 in the coming years?

The close connection to the detector working group is emphasized. Is there convergence/support for the projective tracker layout?

How will the work be affected by migration of the EPIC software framework?

The entire budget in Table 2 is for the fully loaded cost of a postdoc. As stated in the proposal guidelines, "Limited support for postdoctoral fellows will be considered. There is tension between the desire for proponents to support postdocs with the hope of renewal, and the review committee's desire to flexibly channel each year's limited funds to the most promising new proposals." If only 50% of the fully loaded cost of a postdoc were available from this program, is there some cost-sharing arrangement with another group with a different funding source (or faculty start-up funds) that could be quickly arranged?

~~Regarding the budget in Table 2, does the $52K request for postdoc funding correspond to some fraction of the fully loaded cost, with the remainder of the salary and overhead coming from another source?~~