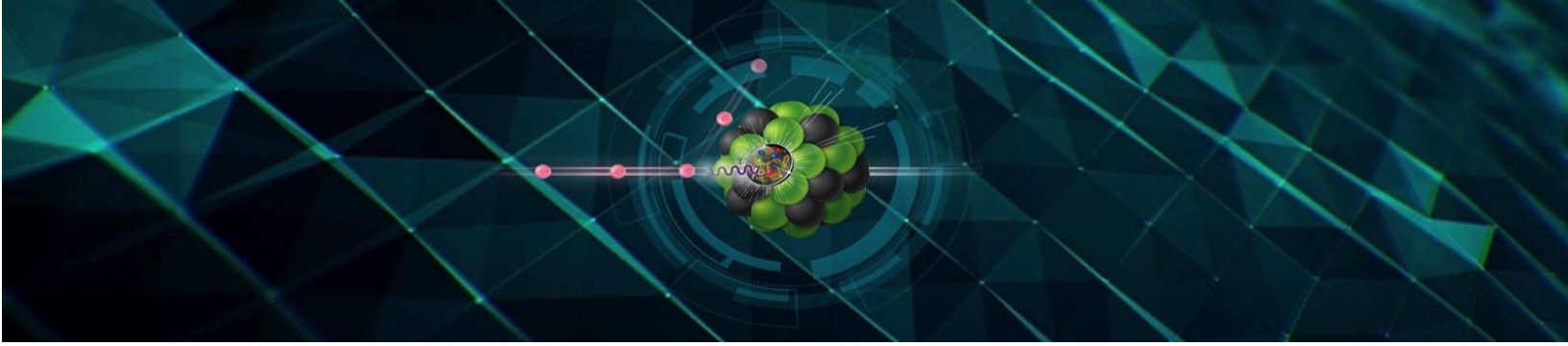

11 / 04 / 2021

Answers to Questions Asked by Collaboration Initiatives on

Call for Collaboration Proposals for Detectors at the Electron-Ion Collider

Answers to email from ECCE leadership Team 03/16/2021

Dear EIC PM:

First of all, we would like to express our gratitude for all the effort and work that went into crafting the call for proposals. Of course, we have some questions and some points on which we'd like to request some clarification.

- What are the budgetary constraints/guidance for the proposal? At the recent EIC@IP6 and EIC Calorimetry meetings slides were shown that suggest an on-project cost of ~$200M for the first detector and an assumption of ~$70M in-kind contributions. Should we take these as "official" guidelines in developing the proposal?

The cost for the reference detector was presented at the DOE CD-1 review. The total detector cost presented was $245M, not including contingency. The cost estimate includes project management, labor, overhead burden, escalation, and in-kind contributions of $93M.

- What level of costing is expected for the proposal? Will the project make the costing information used for the detector at CD-1 available?

The cost breakdown for the global detector systems is provided in the following table. The Project also intends to provide a costing template that provides costs on sub-detector technologies included in the Basis Of Estimate (BOE) information.

EIC Reference Detector Cost Estimate	
WBS	$M
Detector Management	7.4
Detector R&D	12.1
Tracking	31.1
PID	26.5
Electromagnetic Calorimetry	36.2
Hadronic Calorimetry	33.1
Magnets	29.7
Electronics	17.1
DAQ Computing	8.7
Detector Infrastructure	26.4
IR Integration & Auxiliary Detectors	8.1
Detector Pre-Ops & Commissioning	8.7
TOTAL	245.1

- Where can we find the EIC CD-0 'mission need' statement referred to in the call for proposals? Is this publicly available?

The EIC CD-0 ''mission need' statement is not publicly available. The call for detector proposals refers to the ''mission need' statement to make it clear that it was based on the requirements discussed in the EIC community White Paper and the National Academies of Science (NAS) 2018 report.

- The performance requirements are listed at multiple point in the call for proposals:
  - "... propose a system that meets the performance requirements described in the EIC CDR and EICUG YR…"
  - "... how the simulated performance compares to the requirements detailed in the YR…"

Individual detector requirements (as listed in the YR) may be more stringent when evaluated individually than is required for the physics performance of the combined detector system for a given physics observable. This leads to the question of exactly how the performance of detector proposal will be evaluated. Will proposals that don't meet ALL the individual resolution requirements defined by the YR be rejected, or will they be evaluated on the broad physics reach and performance for physics observables?

The proposals for Detector 1 and Detector 2 will be evaluated on their physics reach, depth and the detector performance for the science goals described in the EIC White Paper and National Academies of Science (NAS) 2018 report and beyond. Individual resolution requirements might differ, but as the Yellow Report physics requirements have been obtained through fast simulations integrating all subdetector performances at once, performances close to what is described in the Yellow Report will be needed to reach the performance goals.

- The call for proposals refers to the CDR for information about the IR configuration. What configuration should we assume for IP8, if the configuration with a 50mr crossing angle described in the Appendix to the CDR is no longer an option? ECCE is committed to a proposal for detector 1, but we want to make sure we don't miss an opportunity to optimize the far-forward physics program.

The current IP design considerations at IR-8 are discussed in the talk by V. Morozov at the IR2@EIC workshop, March 17-19, 2021
https://indico.bnl.gov/event/10677/contributions/45590/attachments/33159/53185/IR2_dev_status_18mar21.pptx. The major differences to the IR design at IP-6 are a larger crossing angle < 35 mrad and a secondary focus for the outgoing hadrons. The increased luminosity at lower √s shown in the talk can be implemented at both IRs.

- What defines a "collaboration" for the purposes of the call for proposals? Are there requirements on structure, bylaws, or member institution commitments?

A collaboration is defined in the same way as at RHIC, LHC, HERA and TEVATRON. It is a group of national and international university groups and laboratories, which define their rules and laws of how the different members interact in a collaboration roster. There are no requirements on structure, bylaws, or member institution commitments, and people are not required to be a member of the EICUG.

Dear EIC Detector Review Committee,

in response to your recent call for Detector Proposals for the EIC several groups are preparing proposals. These groups are focusing on how different technologies
in the central region could be used to reach the physics requirements set out in the yellow report. These technology choices do not have a strong bearing on the forward region.
Some of us are considering the possibility of preparing a separate forward proposal that would reach or exceed the requirements specified for the forward detectors.
Such a group could perhaps be more agile alone than as part of a larger structure. Of course, we would plan to merge with whichever concept is eventually selected for the
central detectors in each of the IR. Such a forward proposal would of course consider complimentary measurements that could be made at a second IR.

I would be very grateful for your feedback in this matter.
Thank you for the wonderful machine that you are building for our community

Michael Murray

The EIC physics program, in contrast to the LHC and RHIC, requires far forward detector measurements which are strongly coupled with the central detector. Groups working on far-forward detectors would benefit from working closely with a consortium optimizing the performance of the other sub-detectors and the integrated detector. In addition, collaboration between different collaborations/consortia to optimize complementarity is strongly encouraged.

Answers to Question during EIC Project – EIC SG-Proto Collaboration meeting July 1st:

ATHENA:
What is the timescale for EIC Project support for detector R&D needs?

The DAC report on R&D needs was received this week. The advice aligns reasonably well with the EIC project detector R&D plan. Final adjustments to the R&D plan will be made to address DAC recommendations and project R&D will commence by October 1. Plans will be presented and discussed with the proto-collaborations

and User group by the EIC-UG meeting. The continuation of the Generic R&D depends on securing funding, but if successful an October 1 start is also envisioned.

Could you please comment on the need to include costing for general detector support services such as control room / DAQ room and readout racks / platforms?

Yes, general detector support services need to be included, but as is discussed earlier re-use of equipment should be considered, as discussed in the "read-me" for costing please discuss details with the project POCs.

ECCE:

Can we get an update on the progress forming review committee and drafting its charge (both on the process and on current thoughts).

The co-chairs were recently defined and we are reviewing the draft charge and potential committee membership with the co-chairs.

Our experience is that a certain amount of "Project Management" needs to be embedded within the collaboration during R&D, development, and fabrication. Should that cost be included in our estimate? ECCE-level project management is needed to provide a single point of contact between EIC project management and "in the trenches" day-to-day information from the subsystems regarding cost tracking, milestone performance and local risk mitigation. Ultimately, this ECCE level of project management helps EIC project management satisfy 413.b requirements and thereby reduces overall project risk.

This approach is reasonable and should be explicitly addressed in the proposal. The costing for the embedded effort does not need to be included in the Project Management estimate.

We normally generate two sources of cost contingency as part of our cost analysis: Risk-based Contingency and Estimate Uncertainty. We understand risk-based cost contingency should not be presented as part of our detailed estimate. We plan to include a conservative estimate of labor and material to reflect Estimate Uncertainty. Is this acceptable?

Do not include Contingency or Estimate Uncertainty in your base estimates. The costing spreadsheet includes a column for the Basis of Estimate (BOE).

Please, provide any guidance concerning how to cost and what to generally include or not include in our IR integration, such as cost of design and construction of installation fixtures, assembly labor, services (cables) connection, on-site transport, etc.

Include all of the costs required to make a detector functional. As an example for the ZDC include: all design and construction labor, detector material, electronics, cables, the ZDC support structures, and the cooling system. In summary, everything required as for a detector in the main detector.

We intend to integrate the total R&D and show it in the requested summary spreadsheet, associated with each ECCE subsystem. Is this an acceptable approach? Please, clarify any types of R&D to include or not include in the estimate.

Yes, as long as it is clearly indicated if a certain task is R&D, PED or construction

Question from Barbara on 07/07/2021

Dear Elke and Rolf,

I'm writing to follow up on the very useful discussion last week between the EIC Project and the EICUG Steering Committee, regarding the mechanism for providing supplemental material to the EIC proposals. The page limit is rather small, so the committee may desire additional information or plots supporting statements made in the proposals. Consequently the collaborations seek guidance about how to make such additional materials available for committee members to consult should they choose to do so.

Please let us know how you would advise us to proceed.

thank you and best regards,
Barbara

Formally, from the call, "If possible, the proposal should not exceed 60 pages". This implies that the labs can only realistically expect the Detector Collaboration Proposals Advisory Panel members to read proposals of ~60 pages.

Therefore to provide supplemental documentation is a choice of the individual proto-collaborations, the same for the way it is provided. We think that most efficient is to have it on a web page (indico, wiki or so) and with links/references in the proposal. Of course it will be up to the panel members to choose if they want to look at the extra material.

Question from John, Tanja and Or on 07/24/2021

Hi,

As we discussed in the last meeting, we are sending you the FAQ questions about in-kind assumptions.

As discussed in the 2nd Joint EIC Project Management Team and EIC Proposal Teams meeting on 2 June 2021 the coordination and assumption of reuse of equipment is crucial. Can you provide us with formal guidelines on the exact details that should be provided for each reuse item? e.g. should we always name an alternative in case the item is eventually not available for reuse and/or quantify its impact on risk and cost? Should we evaluate ourselves the risk associated with the assumption we can indeed reuse said item?

As discussed in the 2nd Joint EIC Project Management Team and EIC Proposal Teams meeting on 2 June 2021 repurpose equipment can also contribute to in-kind contributions. Can you provide us with formal guidelines on the exact details that should be provided for such contributions? e.g. is a formal letter from the collaborator making the contribution required? If so, what level of commitment and/or declaration of intention is required at this stage?

Providing an alternative for the potential to be reused equipment, is exactly the correct approach.
The alternative should be costed the same way as if it would be the first option. This cost can be used to evaluate the fraction of in-kind the re-used equipment represents. A risk analysis is critical especially if the equipment needs significant refurbishment, which could impact the overall schedule of the project.

At this moment an email of the collaborator providing the equipment stating it is available for repurpose should be enough. The email should include a description of the condition of the equipment and when it is available

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Questions from Athena on 08/08/2021

Beampipe design (For far-forward areas): Do we have an engineering design, even preliminary design, to use for simulations?
A preliminary design exists and was blessed by Charles Hetzel. and is integrated in the GEANT simulations of ECCE and ATHENA. Updates will be made known to all collaborations as soon as they become available. In general step files are available at the SketchUp site: https://physdiv.jlab.org/EIC/Menagerie/John

Connected to question one: Off-Momentum detectors are located inside the beampipe (~20 sigma). Do we need to move them out during injection?
Yes, every roman pot like detector needs to be moveable to adjust optimally to the beam conditions, injection, different optics running and so on.

If we have two RP stations at IP8, what would be the impact on impedance (and on the beam lifetime)?
This has not been simulated in detail. Roman Pots if positioned correctly cannot have an impact on lifetime as they are not the limiting aperture, if they would the detector would not last. The impedance question needs detailed simulations by an accelerator expert, and the overall impedance budget can of course affect stable beam conditions.

Can we simulate/estimate the impact on the background coming from the electron "top-up" injection?
Technically we are not running in a "top-up" mode but replace two electron bunches every 1s. There should be no background for the experiment as the idea is to shave off the electron tails beyond 6 sigma in the transfer line. If one injects on orbit and on energy (with reasonable errors) in one sigma also to keep the protons happy, a 6 s beam would always be well within the apertures of 13/23 s.

In the matrix of the proposal where we have to indicate who does what and which resources can be provided, how do we deal with groups who are working for more than one proposal? It can result in a double counting of resources and manpower.
This question is similar as the one for assumed reuse of equipment.
The answer is the same, we feel the only way to deal with this is to be transparent, and all proto-collaborations should indicate clearly if groups have responsibilities in more than one EIC proto-collaboration, and if such responsibilities are separate or inclusive. In addition, it will be important to indicate the magnitude of the responsibility.

Questions from CORE on 08/08/2021

Could we have a report on the engineering/safety review/feasibility-study of a 2 atm (gauge) Ar vessel as an alternative to heavy fluorocarbon for the Dual
A pressurized RICH is possible if all the rules of the pressurized vessel code (details: DOE 10CFR851 and backup) are followed. This will result in a material heavy vessel, which seems the opposite of what one wants in a collider detector. There has been no engineering/safety review/feasibility-study as this needs a concrete design specifying volume, shape, wall thickness, window thickness, what materials are used, etc.

In September could we have some discussion of requirements for vacuum bake-out of the beam-pipe (in-situ, not in-situ, Si detector in place, not in place)

We will answer this a bit more general as Si detector in place is a composite question. See https://www.dropbox.com/s/npoul675le70aah/4thMeeting.August_v2.pptx?dl=0.

Questions from ECCE on 08/08/2021

How should proto collaborations go about defining costs and in-kind contributions for the polarimetry and luminosity detectors? Are these considered part of the IR, or part of the detector?
We had suggested to form consortia/overarching working groups on May 9th.
The polarimeters need not to be costed as part of the proposal as this may become too difficult given their varied locations. If there are groups who are interested to contribute, please direct them to Dave Gaskell and Elke. The luminosity monitor is local w.r.t. the detector/IR so can/could be costed as part of the proposal starting including anything that comes behind the conversion/exit window.

What is the dividing line between costs assigned to the IR and costs assigned to the detector?
We think this was addressed in an earlier meeting: You should include all the costs required to make a sub-detector functional. As an example, for the ZDC include all design and construction labor, all detector material, electronics, cables, the ZDC support structures, and the cooling system. In summary, everything that is required for a sub-detector system as part of the main detector.
In contrast: beam-pipes, pumps, valves, etc., are part of the accelerator IR scope. The project overall is still defining all interfaces between different systems.

What is the process the proto collaborations should follow to work with the EIC project for costing of Detector Infrastructure and IR Integration?
We assume the question means: which scope is included in WBS 6.10.10 Detector Infrastructure. The collaborations should make sure they are aware what assumptions of re-use of equipment and infrastructure of the existing halls has been made --> talk to your POC.
In general, the WBS contains all support structures for subdetectors, rails systems to move detectors, labor to construct the detector, the cradle for the central detector, electronic platforms and any other equipment to build an EIC detector as a whole.

Questions from 09/02/2021

Please provide a set of initial running conditions for proposals:
- beam energies in year 1
- luminosity ramp in years 1-3
- polarizations in years 1-3

Given the project threshold and objective Key Performance Parameters for CD4 (see backup) the most likely answers are:
- 10 GeV electrons on 250 GeV protons (or 100 GeV/u heavy ions)
- objective is to start with 1 x 10^{33} and to grow beyond
- objective is to start with 60% (50%) proton (electron) polarization

Should proposals address plans for both p and A beams in years 1 and 2?
The call states “Experiments must address the EIC White Paper and NAS report science case”, this includes both p and A beams. The call for proposals does not include a request for a year-by-year plan.

For estimating integrated luminosities, what guidance can the project give about collision availability (fraction up time and run length) for years 1 - 3?
The integrated luminosity performance of an EIC that has been used for guidance is 100 fb^{-1} per year. One should likely assume a fraction of this at year-one of EIC operations beyond CD-4. The typical number used for guidance has been 10 fb^{-1} per year. This is consistent with the assumptions of the Yellow Report exercise (see for example page 408).

Questions from ATHENA 10/15/2021

We would like to ask the EIC project about the timeline to get a (final) estimate for the new magnet cost, as it has implications on the total estimate for our detector. Alternatively, should we just use the initial estimate (in the costing file) if the answer comes too late?
The more detailed estimate for the new magnet cost is part of the baselining at CD-2 which is roughly expected around Spring 2023. The best estimate we have for a new 3T magnet, folding in some minor updates to correct for oversights for vendor visits and mapping, and better estimates for the cryo can and cryo flex line are as follows:

Total cost Summary	
Magnet cost (M$)	23.92
Vendor visit (M$)	0.45
Cryo-flex line and cryo can (M$)	0.5
Labour hours (M$)	3.82
Total system cost	**28.69**

This is without contingency. Based on the 30% preliminary design that is near-completed for the new magnet, the expected stored energy is similar as we had assumed before, so costs are close to the previous estimate. The magnet cost is mainly based on a parametric calculation based on stored energy, and compared to actuals of other solenoids. We can also provide a more detailed spreadsheet to outline the Basis Of Estimate, as needed.

It is understood that contingency estimates are not part of the costing exercise currently performed by each proposal effort. Those estimates are provided by the EIC project. Can we have access to the algorithm and / or determine otherwise these estimates? We feel that it is essential to make a statement about contingency during the review process. What is the guidance from the EIC project about addressing contingency in the proposal and during the review process?
There is no unique algorithm to give access to. Contingency has in general two components, an estimate uncertainty that assigns a fixed contingency, and a risk-based uncertainty that follows a risk matrix and estimated cost, schedule and technical impacts. The contingency will soon be based on a Monte Carlo approach, folding in likelihoods of various such impacts. A table with various contingency categories of the estimate uncertainty is included in the costing spreadsheet we provided. However neither this nor the risk matrix will give a clear quantitative algorithm to easily describe the final contingency of 40% as applying to DOE scope.

Questions from CORE 11/02/2021

Dear Elke and Rolf,

We are currently preparing the cost estimates for the CORE proposal, However, while the guidance for subsystem (and with your input, solenoid) costing is straightforward, for some items included in the YR summary for which it is not clear that a bottom-up costing will produce a reliable result.

In particular, there is a $26.4M item for detector infrastructure. It would be very helpful to know how to estimate this for or scale it to CORE.

Also, there are two items
$7.4M for detector management, and
$8.7M for detector pre-ops & commissioning
which seem rather generic. Should we include them as is?

Yes, please include management and pre-ops as is.
The infrastructure scope includes both items that are generic to **any** detector (such as general need for cryogenics to the Hall, space for gas handling systems, racks, grounding, etc.) and items that directly are related to the **specific** detector proposal (support structures, cradle, specific gas handling systems, etc.). For the latter, in-kind contributions such as those through non-DOE contributions and re-use of equipment may be relevant.

And finally, it would be helpful to have a better understanding of what should be included in electronics and DAQ computing. For instance, is the latter just a level 3 trigger farm, or does it include FELIX DAQ boards (computer side), slow-control interfaces, etc - or is that part of the electronics? And how do you consistently project cost of computing? “Flops” today are presumably much more expensive than they will be in 2030 - but how do you extrapolate it?

The infrastructure scope includes both items that are generic to **any** detector (such as general need for cryogenics to the Hall, space for gas handling systems, racks, grounding, etc.) and items that are specific for a certain detector proposal (support structures, cradle, specific gas handling systems, etc.). For the latter, in-kind contributions such as those through non-DOE contributions and re-use of equipment may be relevant and can be used to offset the cost.

The electronics and computing scope was discussed twice with representatives from all proto-collaborations, Gary was invited and participated for CORE. FELIX DAQ cards, slow controls all
will be part if project scope. An online L3 farm would also be. The offline computing as well as offline software is not part of the project.

Thank you very much and Best Regards,
Pawel and Charles,