

Charting a course to the 2nd Detector

—
—
—
March 31, 2022

DPAP Report on 2nd Detector

Section 3 : Physics Impact of a second detector

- “A strong case for *two complementary general-purpose detectors* has been made during the panel review, in line with the arguments given in chapter 12 of the Yellow Report.”
- “...it is *essential to have two detectors with a sufficient degree of complementarity* in layout and detector technologies. This requires a well-chosen balance between optimization as general-purpose detector versus partial specialization and the ability to cross check the other detector for a broad range of measurements. The design of a second detector should be chosen with these criteria in mind.”
- “The time required for its design and construction may offer *opportunities for benefiting from technological progress.*”
- “As laid out in the *section 2.1* on physics performance, *an IR with a secondary focus can significantly broaden the physics scope and output of the EIC.*”

DPAP Report on 2nd Detector

Section 2.1 :

“The CORE proposal makes a convincing case for the *significant gain in physics reach* achievable with a secondary focus:

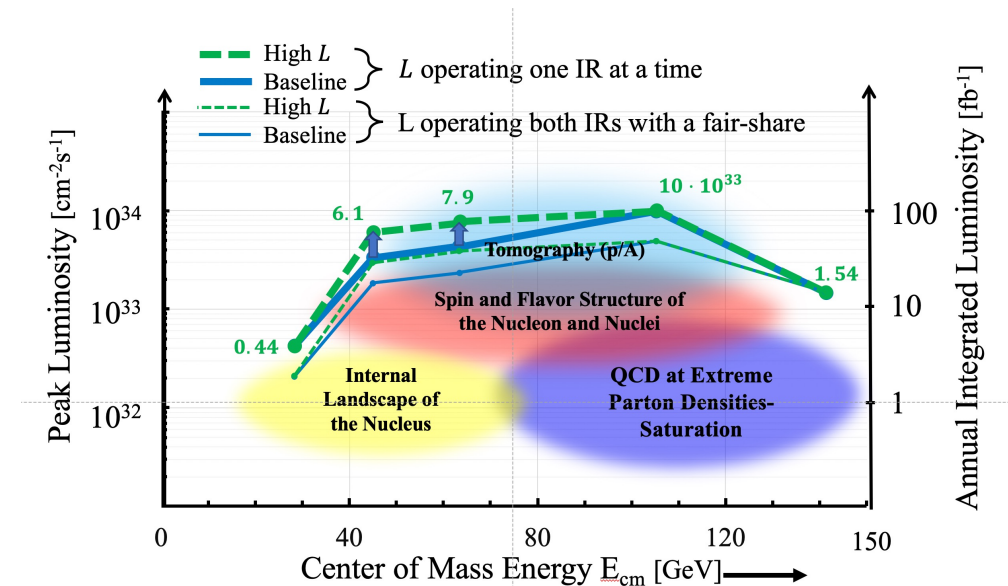
- increased acceptance in the invariant momentum transfer t of the scattered proton in ep collisions, which directly translates into an increased resolution power for imaging partons in the transverse plane,
- significantly improved abilities to detect nuclear breakup in exclusive and diffractive scattering on light and heavy nuclei. The distinction between coherent and incoherent scattering is essential for the physics interpretation of these processes.
- prospects for a program of low-background γ gamma spectroscopy with rare isotopes in the beam fragments.”

Section 4

“*There is significant support in the community and from the panel for a second general-purpose detector system* to be installed in IR8 when resources are available. This detector should take advantage of the delayed start to explore opportunities for some complementarity in the physics reach and/or in the technologies used.”

Mandate is clear – now how to get there?

- Started a series of meetings between the project leadership, ATHENA, CORE and ECCE leaders and the steering committee chair and vice chair.
- Unanimous support from all parties in the room – everyone agrees a 2nd detector, on a delayed timeline, is the best course of action for the EIC science and the community.
- Define the boundary conditions
 - Include a secondary focus
 - [DPAP talk](#) *most recent!*
 - [arxiv 2105.13564](#)
 - Crossing angle 35 mrad
 - Accelerator free space -4.5 m to +5 m
 - Luminosity as on the plot (dashed lines)
- Developed four essential focus areas
 - details in next slides ...



I. Complementarity to Project Detector

- Impossible to do before the DPAP Review
- As the project detector is defined, it becomes more natural to develop points of complementarity
- Magnetic Field – do we want 1.5 or more? Small or large bore?
- Consider fixed thin target program?
- Use the time it takes for the project detector to come into focus for R&D and technology development.

II. Refine physics case for secondary focus

- Perhaps the most obvious and natural starting point for complementarity.
- Propose to kick-start 2nd detector process around secondary focus
- EICUG hosted workshops, utilizing CNFS and EIC2 resources, to define path forward.
- Goal will be to develop concrete complementarity

III. Define a generic R&D Program

- Build on successful R&D program history
- Emphasize complementarity in physics reach and new or future detector technologies: LAPPDs, barrel pfRICH, ECal and HCal technologies, MPGDs
- Start generic R&D program in phase with Detector-1 Project R&D program – promising signs from DOE/NP for generic detector R&D program.

IV. Build and Engage the Community

- Need to evaluate and understand the existing workforce dedicated to a 2nd detector. Important to be sensitive to possible fragmentation and/or overload of groups involved in project detector.
- Cultivate groups for whom the prospects and timeline of a 2nd detector/IR (Detector-2) may be of interest.
- Spearhead a 2nd Detector campaign to build and engage the international community that has not been deeply involved to date.
- To that end the steering committee developed the EIC Users Group 2nd Detector/IR Brochure – see near final version on indico.
 - Builds on previous mandate from the Users Group, spearheaded by Richard Milner and Rolf Ent.
 - Aimed to garner support from high level, international funding agencies
 - Discusses the scientific benefits of two detectors, the unique opportunity afforded by the RHIC/EIC layout to facilitate two detectors and the long-term benefits provided to a country by pursuing the technological innovation that accompanies such efforts.
 - Brochure is eight pages, folds in input from 10 external readers from around the globe, some with ties to international agencies
 - Final version is ready to be printed, working on copyright issues



The Electron-Ion Collider (EIC) is a transformational and unique accelerator that will enable studies of nuclear matter with unprecedented precision. The EIC is required to address fundamental open questions in physics, such as the origin of mass and spin of protons and neutrons, the details of the "glue" that binds them, and the nature of very dense gluon systems in nuclei. This ambitious collider could

not deliver physics results without powerful "cameras" capable of taking the most detailed snapshots of the collisions produced at the EIC. Novel particle detectors must be designed and constructed to capitalize on the investment made on the accelerator side, so that the deepest secrets of the building blocks of matter in our visible universe may be unlocked.

Charting a course to the 2nd Detector

- The statement from DPAP that *“There is significant support in the community and from the panel for a second general-purpose detector system to be installed in IR8 when resources are available”* is the best possible outcome for the 2nd Detector effort.
- This sentiment is fully endorsed by the steering committee as well as the project and proposal leadership.
- The case for complementarity can only be fully developed as the project detector comes into focus – proceed in tandem.
- Plan to resume 2nd detector discussions in full at summer EICUG meeting, starting with focus on complementarity brought by the secondary focus.