

Closeout Presentation of Detector Advisory Committee Review October 21, 2022

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Thanks to Elke Aschenauer, Rolf Ent, Patrizia Rossi, Thomas Ullrich, and Anna Mendez!

Thanks to ePIC collaboration and all the groups and presenters!

Charge to DAC

For the October 2022 DAC meeting we welcome your guidance and advice on the following topics:

- The status and progress of the EIC Project.
- The status and progress of the EPIC detector and collaboration following the consolidation and optimization process after the DPAP.
- The status, progress and plans for the EIC project detector R&D that has been initiated recently (eRD101-105, eRD108, eRD110-112).
- The plans for the EIC project detector R&D that have not been started yet, for various reasons (eRD106-107, eRD109, and the new eRD113)
- Further planning for the outyears of the EIC Project detector R&D as documented in the “Assessment of R&D Needs for an EIC Detector” (EIC Detector R&D) document.
- What do you see as priorities for the proposed EIC-related Project detector R&D?

Status of EIC Project

- Focus at this review was experiment at IP6 (Ref Detector 1)
- Strongly moving forward towards CD2/3a Milestone
- Attention to long lead items important for 3a commitment
- Making strong use of funds made recently available
- Providing important technical and engineering resources to ePIC
- Overall, appear on-track with planned timeline

Status of EPIC Detector and Collaboration

- Congratulations on rapid consolidation of EIC experimentalist efforts and creation of a new vibrant collaboration
- Enormous progress is developing a coherent design for detector to carry out EIC research goals, with well defined open questions
- Critical creation of common simulation environment with October Simulation Campaign
- Impressive Progress in integration of readout software/framework at early stage
- Recommend close monitoring of manpower and commitment to EIC
- Overall, appear mostly on-track with planned timeline

Review of *recently* initiated R&D Projects

- Understood by committee that funding and COVID related issues have delayed FY22 progress
- Nonetheless, the committee was impressed with progress that was in fact made in this short time; indicative of strong commitments of the collaborating institutes and EIC project management

Tracking: eRD104/eRD111/(eRD113) -Silicon

- Large effort with progress on many fronts, including tools to study impact of design choices on physics capabilities
- Strong in-kind contributions by many institutes of consortium
- Development of working design for the MAPS barrel and disk trackers
- Strongly tied to ITS3/ALICE R&D; ties to foundry seem intact
- ITS2 appears to be close to no longer being a fallback solution (development effort commensurate with ITS3)
- Necessary progress appears achievable by CD2
- Recommend continued efforts to become more deeply involved in ALICE/CERN ITS3 development with attention to EIC specific needs
- Recommend study of reliability/stability of new 65nm MAPS

Tracking: eRD108

- Development of μ RWELL barrel tracker to mitigate risk
- Optimization of readout from micromegas barrel
- Exploration of μ RWELL in μ TPC mode, thin gap GEM- μ RWELL
- Study μ RWELL ASIC performance
- Good progress in μ RWELL barrel development
- Is more R&D needed to finalize MicroMegas tracker design and test this size cylindrical tracker (e.g. discharge issues)?
- Suggest that μ TPC mode, thin gap GEM- μ RWELL studies fall more under generic R&D efforts

PID: eRD101 - mRICH

- Development of Modular RICH detector
- Test beam study carried out at JLab
- Data show mRICH performance with pattern matching as function of position on aperture
- Simulation needs to be done with realistic particle fluxes as soon as possible to confirm that performance meets requirements.
- Single photon angle resolution needs to be measured soon
- Open question of photosensor choice (eRD110)
- Need for additional person power to increase speed of R&D to be compatible with project timeline

PID: eRD102 - dRICH

- Successful test of dRICH in test beam
- Broad efforts, important to focus on critical design choices
- Characterization of low index aerogel properties
- Important to continue study impact of pressurized gas vessel
- Recommend continued study of mirror vendors
- Recommend continued active investigation of aerogel from different vendors
- Recommend revisiting with new simulation tools and ePIC design the expected neutron fluence on photon detector side (SiPM)
- Open question on photosensor (eRD110) choice

PID: eRD103 - hpDIRC

- Impressive development of good test facilities at SBU and Jlab
- Good Collaboration with PANDA DIRC effort
- Excellent communication/involvement BABAR DIRC developers
- Performance of bar at Hall D promising
- Recommend starting process of opening/studying DIRC bars as soon as possible to meet project timeline, especially in case of significant problems
- Recommend strong effort to develop streaming readout with UH and Nalu

PID: eRD112 – AC-LGADs

- Large effort on many fronts to understand/develop AC-LGADs
- Successful test beam studies
- Significant progress in readout electronics development
- Recommend continued study of sensor production options
- Recommend study of optimization for ePIC needs: time resolution vs spatial resolution, especially forward vs central regions
- Continue to study impact of cooling/readout on performance
- Appears possible to achieve project timeline goals

Calorimetry: eRD105 – SciGlass

- Important production of 40cm blocks, progress in manufacturing process
- Characterization of longitudinal light transmission, radiation tolerance
- Successful beam tests with 20cm and 40cm block test counter
- Recommend study of details of uniformity of density/index/scintillation along/across blocks using eg transverse transmission
- Recommend study of transverse position resolution (simulation and measurement)
- Recommend of study of optimization of block size relative to Moliere radius
- Recommend study of production times both for uniformly shaped blocks and those with projective geometry shapes.
- Important to understand impact of using external foundry for production

Calorimetry: eRD106/eRD107 – Forward Calorimeters

- ePIC choice of WSciFi for EM cal
 - Focus on optimization of sensor/fiber connection to increase uniformity and efficiency
 - In addition to study of proposed scheme, recommend study of possibly simpler alternatives
- Development of Hadron Cal modules especially production
 - Good collaboration with CALICE
 - Testing of injection molding tiles
 - Recommend study with prototype and incorporation of performance parameters in ePIC simulation
 - Some of tasks are more project engineering than R&D

Sensors: eRD110 – LAPPD/SiPM

- Critical component to overall EPIC realization
- Strongly coupled to ASIC development
- Good programs to characterize LAPPD performance with test beams as well
- Proposed program addresses important open questions
- Understand if alternate LAPPD vendor options
- Recommend conservative estimation of fluences (10^{10})
- Annealing process seems promising for SiPM
- What will impact of annealing services/infrastructure be on global performance?
- Some longtime experience from STAR calo annealing, but single photon needs may be more stringent

Sensors: eRD109 – ASIC/Readout efforts

- Active program for many detector sensor/systems
- All require compatible with streaming read out
- Important for collaboration to focus on details of full readout system (I.e. detector to electronics hut)
- Overlapping efforts should mitigate risk and lead to synergy in R&D
- Recommend careful attention to ASIC development cycles with vendors to keep to project timeline, possibly too optimistic. Historically development time has been significantly under-estimated.

Global Recommendations

- Again, congratulations to all on enormous progress in short time!
- Continue workshops to have good communication between overlapping development efforts
- Many projects are at test beam stage; overall coordination might be very useful
- At next review important to hear how R&D is being used in development of final design, especially critical design choices
- Aggressive effort needed to keep to project timeline
- Important to move from R&D activities to detector specific design
- Important to expand manpower as soon as possible to keep on track
- Recommend more direction of effort towards final detector development for CD2/3a