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Xuan Li (LANL), Nilanga Liyanage (UVA), Cristiano Fanelli (MIT)

Paper overview

- Near final paper draft implemented in the overleaf link. Thank Peter, Ken and Douglas for the nice setup.

Design and Simulated Performance of Tracking Systems for the ECCE Detector at the Electron Ion Collider

J. K. Adkins[35], Y. Akiba[52], A. Albataineh[68], M. Amaryan[46], I. C. Arsene[72], J. Bae[60], X. Bai[77], M. Bashkanov[86], R. Bellwied[66], F. Benmokhtar[14], J. C. Bernauer[54,55,56], F. Bock[48], W. Boeglin[16], M. Borysova[82], E. Brash[10], P. Brindza[27], W. J. Briscoe[20], M. Brooks[31], S. Bueltmann[46], M. H. S. Bukhari[26], A. Bylinkin[68], R. Capobianco[65], W.-C. Chang[2], Y. Cheon[58], K. Chen[7], K.-F. Chen[45], K.-Y. Cheng[39], M. Chiu[4], T. Chujo[75], Z. Citron[1], E. Cline[54,55], E. Cohen[43], T. Cormier[48], Y. Corrales Morales[31], C. Cotton[77], C. Crawford[69], S. Creekmore[48], C.Cuevas[27], J. Cunningham[48], G. David[4], C. T. Dean[31], M. Demarteau[48], S. Diehl[65], N. Doshita[84], R. Dupré[23], J. M. Durham[31], R. Dzhygadlo[19], R. Ehlers[48], L. El Fassi[37], A. Emmert[77], R. Ent[27], C. Fanelli[36], R. Fatemi[69], S. Fegan[86], M. Finger[8], M. Finger Jr.[8], J. Frantz[47], M. Friedman[22], I. Friscic[87], D. Gangadharan[66], S. Gardner[18], K. Gates[18], F. Geurts[31], R. Gilman[53], D. Glazier[18], E. Glimos[48], Y. Goto[52], N. Grau[3], S. V. Greene[78], A. Q. Guo[24], L. Guo[16], S. K. Ha[85], J. Haggerty[4], T. Hayward[65], X. He[17], O. Hen[36], D. W. Higinbotham[27], M. Hoballah[23], P.-h. J. Hsu[44], J. Huang[4], G. Huber[73], A. Hutson[66], K. Y. Hwang[85], C. Hyde[46], M. Inaba[63], T. Iwata[84], H.-S. Jo[30], K. Joo[65], N. Kalantarians[80], K. Kawade[59], S. Kay[73], A. Kim[65], B. Kim[60], C. Kim[50], M. Kim[52], Y. Kim[50], Y. Kim[58], E. Kistenev[4], V. Klimenko[65], S. H. Ko[57], I. Korover[36], W. Korsch[69], G. Krintiras[68], S. Kuhn[46], C.-M. Kuo[39], T. Kutz[36], J. Lajoie[25], D. Lawrence[27], S. Lebedev[25], J. S. H. Lee[57], S. W. Lee[30], Y.-J. Lee[36], W. Li[51], W. Li[54,55,83], X. Li[9], X. Li[31], Y. T. Liang[24], S. Lim[50], C.-h. Lin[2], D. X. Lin[24], K. Liu[31], M. X. Liu[31], K. Livingston[18], N. Liyanage[77], W. J. Llope[81], C. Loizides[48], E. Long[71], R.-S. Lu[45], Z. Lu[9], W. Lynch[86], D. Marchand[23], M. Marcisovsky[13], P. Markowitz[16], P. McGaughey[31], M. Mihovilovic[70], R. G. Milner[36], A. Milov[82], Y. Miyachi[84], P. Monaghan[10], R. Montgomery[18], D. Morrison[4], C. Munoz Camacho[23], M. Murray[68], K. Nagai[31], J. Nagle[64], I. Nakagawa[52], C. Nattrass[76], D. Nguyen[27], S. Niccolai[23], R. Nouicer[4], G. Nukazuka[52], M. Nycz[77], V. A. Okorokov[42], S. Orešić[73], J.D. Osborn[48], C. O'Shaughnessy[31], S. Paganis[45], Z Papandreou[73], S. Pate[41], M. Patel[25], C. Paus[36], G. Penman[18], M. G. Perdekamp[67], D. V. Perepelitsa[64], H. Periera da Costa[31], K. Peters[19], W. Phelps[10], E. Piasetzky[61], C. Pinkenburg[4], I. Prochazka[8], T. Protzman[33], M. Purschke[4], J. Putschke[81], J. R. Pybus[36], R. Rajput-Ghoshal[27], J. Rasson[48], B. Raue[16], K. Read[48], K. Røed[72], R. Reed[33], J. Reinhold[16], E. L. Renner[31], J. Richards[65], C. Riedl[67], T. Rinn[4], J. Roche[47], G. M. Roland[36], G. Ron[22], M. Rosati[25], C. Royon[68], J. Ryu[50], S. Salur[53], N. Santiesteban[36], R. Santos[65], M. Sarsour[17], J. Schambach[48], A. Schmidt[20], N. Schmidt[48], C. Schwarz[19], J. Schwiening[19], R. Seidl[52], A. Sickles[67], P. Simmerling[65], S. Sirca[70], D. Sharma[17], Z. Shi[31], T.-A. Shibata[40], C.-W. Shih[39], S. Shimizu[52], U. Shrestha[65], K. Slifer[71], K. Smith[31], R. Soltz[34], W. Sondheim[31], J. Song[9], J. Song[50], I. I. Strakovsky[20], P. Steinberg[4], J. Stevens[83], J. Strube[49], P. Sun[9], X. Sun[7], K. Suresh[73], W.-C. Tang[39], S. Tapia Araya[25], S. Tarafdar[78], L. Teodorescu[5], A. Timmins[66], L. Tomasek[13], N. Trotta[65], T. S. Tveter[72], E. Umaka[25], A. Usman[73], H. W. van Hecke[31], J. Velkovska[78], E. Voutier[23], P.K. Wang[23], Q. Wang[68], Y. Wang[7], Y. Wang[62], D. P. Watts[86], L. Weinstein[46], M. Williams[36], C.-P. Wong[31], L. Wood[49], M. H. Wood[6], C. Woody[4], B. Wyslouch[36], Z. Xiao[62], Y. Yamazaki[29], Y. Yang[38], Z. Ye[62], H. D. Yoo[85], M. Yurov[31], N. Zachariou[86], W.A. Zajc[11], J. Zhang[77], Y. Zhang[62], Y. X. Zhao[24], X. Zheng[77], P. Zhuang[62]

[1]*A. Alikhanyan National Laboratory, Yerevan, Armenia*
[2]*Institute of Physics, Academia Sinica, Taipei, Taiwan*
[3]*Augustana University, , Sioux Falls, , SD, USA*
[4]*Brookhaven National Laboratory, , Upton, 11973, NY, USA*
[5]*Brunel University London, , Uxbridge, , UK*
[6]*Canisius College, , Buffalo, , NY, USA*
[7]*Central China Normal University, Wuhan, China*
[8]*Charles University, Prague, Czech Republic*
[9]*China Institute of Atomic Energy, Fangshan, Beijing, China*
[10]*Christopher Newport University, , Newport News, , VA, USA*
[11]*Columbia University, , New York, , NY, USA*
[12]*Catholic University of America, 620 Michigan Ave., Washington DC, 20064, USA*
[13]*Czech Technical University, , Prague, Czech Republic*
[14]*Duquesne University, , Pittsburgh, , PA, USA*
[15]*Duke University, , , , NC, USA*
[16]*Florida International University, , Miami, , FL, USA*
[17]*Georgia State University, , Atlanta, , GA, USA*
[18]*University of Glasgow, , Glasgow, , UK*
[19]*GSI Helmholtzzentrum fuer Schwerionenforschung, , Darmstadt, , Germany*
[20]*The George Washington University, , Washington, DC, , USA*
[21]*Hampton University, , Hampton, , VA, USA*
[22]*Hebrew University, , Jerusalem, , Isreal*
[23]*Universite Paris-Saclay, CNRS/IN2P3, IJCLab, Orsay, France*
[24]*Chinese Academy of Sciences, , Lanzhou, , , China*
[25]*Iowa State University, , , , IA, USA*
[26]*Jazan University, Jazan, Sadui Arabia*
[27]*Thomas Jefferson National Accelerator Facility, 12000 Jefferson Ave., Newport News, 24450, VA, USA*

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-3.5 to 3.5 with full azimuthal coverage. Key tracking performances, which include the tracking momentum resolutions, transverse Distance of Closet Approach (DCA_{2D}) resolutions, angular resolutions projected at the particle identification detectors will be presented.

Keywords: ECCE, Electron Ion Collider, Tracking

Contents

1. ECCE tracking detector overview

The ECCE central detector[1] is a cylindrical detector covering $|\eta| \leq 3.5$ and the full azimuth angle. It is designed to reuse the former BaBar superconducting solenoid to contain a barrel tracking system, one hadron endcap tracking subsystem and one electron endcap tracking subsystem.

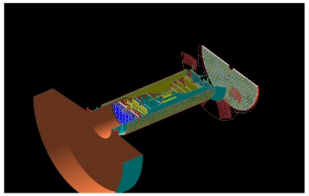

Figure 1: ECCE tracking detector side view in GEANT4 simulation.

As shown in Figure 1, the primary components of the ECCE tracking detector reference design are as follows.

Silicon Tracking system The Monolithic Active Pixel Sensor (MAPS) based silicon vertex/tracking system consists of three components:

Silicon Barrel The silicon barrel detector consists of three vertex layers close to the beam pipe, two middle layers to provide the central track sagitta measurements. All layers use the ITS-3 type of sensors with pixel pitch at 10 μm and the average material budget per layer is 0.05%X_0. The detector mechanical stricture design will be imported from the EIC eRD104 and eRD111 studies.

Siliocn Hadron Endcap The silicon hadron endcap detector consists of 5 disks, which provide precisely measured space points for charged particle tracking in the forward pseudorapidity region. This detector will enhance the capability to determine the decay vertex of long decayed particles and measure the majority of charged particle in the asymmetric $e+p$ and $e+A$ collisions. The technology for the silicon disk assembly is ITS-3 silicon sensor with pixel pitch at 10 μm. The detector mechanical stricture design will be imported from the EIC eRD104 and eRD111 studies.

Silicon Electron Endcap The silicon electron endcap detector consists of 4 disks, which provide precise measurements of charged tracks especially electron tracks in the backward pseduarapidity region. The reduction of number of disks in the electron endcap is to accommodate the integration needs from the electron electromagnetic calorimeter. The technology for the silicon disk assembly is ITS-3 silicon sensor with pixel pitch at 10 μm. The detector mechanical stricture design will be imported from the EIC eRD104 and eRD111 studies.

Gas Tracking system All gas tracking layers in ECCE will be based on μRwell technology. μRWELL is a single-stage amplification Micro Pattern Gaseous Detector (MPGD) that is a derivative of the Gas Electron Multiplier (GEM) technology. It features a single kapton foil with GEM-like conical holes that are closed off at the bottom by gluing the kapton foil to a readout structure to form a microscopic *well* structure. The technology shares similar performances with a GEM detector in term of rate capability, while providing a better spacial resolution than GEM. Furthermore, compared to GEMs, μRWELL presents the advantages of flexibility, more convenient fabrication and lower production cost that makes it the ideal candidate for large detectors. Large area μRwell foils have been developed and manufactured at CERN. The Korean collaboration will acquire this technology under a technology transfer agreement from CERN and will manufacture the μRwell foils for ECCE gas detectors. The same Korean collaboration has experience in large area micro pattern gas detector foil fabrication, having worked successfully with CERN to manufacture GEM foils for CMS GEM detectors.

In ECCE μRwell layers will form three barrel tracking layers further out from the beam-pipe than the silicon layers. The barrel gas tracker layers include Two inner barrel μRwell layers, as well as a single outer barrel μRwell layer. All μRwell detectors will have 2D strip based readout. The strip pitch for all 3 layers will be 400 μm.

Paper outline and status

- The paper consist of 16 figures and 9 pages.
- Paper outline:
  - ECCE tracking detector overview (polished)
  - Detector design and Tracking Performance (under polishing)
  - Summary and Outlook (will work on)
  - Acknowledgements (will work on)
- We plan to release the 1st paper draft around the 1st week of April for consortium review.