Correcting Coils in IP8: An Alternative to Skewed Quadrupoles to Correct Beamline Distortion

Ruthie Gu Yale University, Second-Year Undergraduate

Collaborators: Wenliang (Bill) Li, Abhay Deshpande, Paul Brindza, Charles Hyde, Pawel Nadel-Turonski, Vasiliy Morozov

EIC Early Career Workshop | July 24, 2022

an overlooked problem: beamline distortion caused by the main solenoid

IP6 Far Forward Region



image credit: Wenliang (Bill) Li

proton beam y positions vs. relative rigidity at low energies (41 GeV)



figure credits: Brynna Moran, Barak Schmookler



animation credit: Brookhaven National Laboratory

Detector Proposal for IP8: CORE



Detector Proposal for IP8: CORE



Baseline Configuration



Correcting Coil Configuration



Possibility of Increasing Quadrupole Apertures



image credit: Randika Gamage

Increased Quadrupole Apertures → Increased Acceptance

ZDC Acceptance with Baseline Quadrupole Apertures ZDC Acceptance with Increased Quadrupole Apertures ZDC XY ZDC XY 50E 50 Y (cm) Y (cm) 15862 Entries Entries 17227 Mean x 13.41 Mean x 12.43 40 F Mean y -0.0703 Mean y 0.008452 10% Std Dev x 18.15 Std Dev x 19.11 30 30 Std Dev y 8.524 Std Dev y 9.329 35 20 20 -30 10 0 -10 30 10 25 oF ~5.7 mrad ~7.1 mrad 25 20 20 -10 15 15 -20 -2010 10 -30 -305 5 -40-40 80 100 60 80 100 20 60 20 X (cm) X (cm)

Skewed Quadrupoles

Quadrupoles with Increased Apertures

Increased Quadrupole Apertures → Increased Acceptance



Increased Quadrupole Apertures → Increased Acceptance



Other Benefits of the Correcting Coils

 \rightarrow Compensates for transverse betatron coupling, works for particles of all momenta (unlike skewed quads)

 \rightarrow Compensates for the rotation of the crabbing plane, caused by the main solenoid

 \rightarrow Corrects for electron spin polarization, caused by the main solenoid

Final Remarks, Future Outlook

→ Create an optimized design for IP8 incorporating this "correcting coil"
→ Implement optimized design into simulation framework
→ Physics studies for DVCS on the proton and coherent diffraction on medium and heavy nuclei to benchmark design performance

COmpact detectoR for Eic (CORE)



image credit: Charles Hyde, Pawel Nadel-Turonski

IP8 Far Forward Region



image credit: Wenliang (Bill) Li







