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Beam-Beam Limitation Toward 10^34 cm^−2 s^−1 Luminosity for Electron-Ion Collider

Tuesday 12 August 2025 16:00 (2 hours)

Achieving the design luminosity of 10^{34} $\mathrm{cm}^{-2}\mathrm{s}^{-1}$ in the Electron-Ion Collider (EIC) requires a deep understanding of beam-beam interaction limits in a weak-strong collision regime with flat hadron beams. This contribution presents recent studies of synchro-betatron resonances — particularly the coupling resonance 2*nux*-2nuy+p*nuz=0 — that can induce emittance transfer between the horizontal and vertical planes and limit luminosity performance. We identify the hourglass effect, caused by the proton bunch length being comparable to the vertical beta functions of both beams at the interaction point (IP), as the dominant source driving this resonance. We further investigate how physical noise, such as intra-beam scattering and fluctuations in the electron orbit and beam size, couples with the beam-beam interaction to amplify emittance growth and reduce luminosity. A theoretical model is developed to explain the underlying mechanism. Mitigation strategies, including working point optimization and sextupole correction to suppress resonance driving terms, are also discussed. These studies provide important guidance for future EIC operation and inform strategies for potential upgrades.

Please consider my poster for contributed oral presentation

Yes

Would you like to submit this poster in student poster session on Sunday (August 10th)

No

Footnotes

Funding Agency

I have read and accept the Privacy Policy Statement

Yes

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