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Improving luminosity using optics tuning and data-driven methods

Wednesday 4 June 2025 16:00 (2 hours)

The results of Run 24 experiments at Relativistic Heavy Ion Collider (RHIC) for improving luminosity using optics tuning are presented in this study. In the first experiment, MADx matching was used to output magnet strengths corresponding to specific s star movements around Interaction Region 8 (IR8). The corresponding Zero Degree Calorimeter (ZDC) signal was measured in place of luminosity, and Bayesian Optimization aids search of optimal movements. It was found that values retrieved from matching were inaccurate, resulting in negative feedback loops. The second experiment focused on calculating accurate s star movements. The matching method was replaced with a linear sensitivity matrix, directly relating optics to power supply, and its null space was used to fit constraints such as hysteresis effects. At the experiment, beam losses were observed at collimators around boundary of IR8, which were fixed for the third experiment. Dynamic mode decomposition was also introduced to improve quality of turn-by-turn (TBT) data as well as accuracy and consistency of optics measurements at IR8. These improvements will be tested in the experiment of next RHIC run for luminosity optimization.

Footnotes

Paper preparation format

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Author: FUNG, William (Facility for Rare Isotope Beams)

Co-authors: ROBERT-DEMOLAIZE, Guillaume (Brookhaven National Laboratory); QIANG, Ji (Lawrence Berkeley National Laboratory); GU, Xiaofeng (Brookhaven National Laboratory); HAO, Yue (Facility for Rare Isotope Beams)

Presenter: FUNG, William (Facility for Rare Isotope Beams)

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