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Improve Beam Brightness with Bayesian Optimization at the AGS Booster Injection at BNL

Alternating Gradient Synchrotron (AGS) and its Booster serve as part of the injector compound for RHIC and the future EIC at Brookhaven National Laboratory. Injection and early acceleration processes set maximum beam brightness for the collider rings. Such processes have many control parameters and are traditionally optimized empirically by operators. In an effort to streamline the injection processes with machine learning (ML) techniques, we develop and test a Bayesian Optimization (BO) algorithm to automatically tune the Linac to Booster (LtB) transfer line magnets to maximize beam brightness after injection into the Booster. We present experimental results that demonstrate BO can be applied to optimize Booster injection efficiency. Beam studies also indicate transverse coupling in LtB, which has been difficult to quantify due to instrument limitations. We plan to develop further studies to investigate the coupling effect.

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