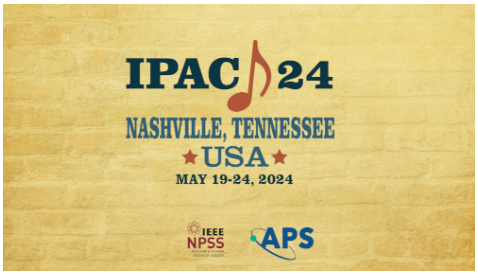

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Enhancing CERN-SPS slow extraction efficiency: meta bayesian optimization in crystal shadowing

Monday, 20 May 2024 16:00 (2 hours)

The Super Proton Synchrotron at CERN serves the fixed-target experiments of the North Area, providing protons and ions via slow extraction, and employs the crystal shadowing technique to significantly minimize losses. Over the past three operational years, the use of a crystal, positioned upstream of the electrostatic septum to shadow its blade, has allowed to achieve a 25% reduction in losses. Additionally, a novel non-local shadowing technique, utilizing a different crystal location, has successfully halved these losses. While using a single crystal in this location resulted in a temporary 50% reduction in slow extraction losses at nominal intensity, this effect was not sustainable beyond a few hours. This limitation is primarily attributed to the magnetic non-reproducibility and hysteresis inherent to the SPS main dipoles and quadrupoles. In this paper, we introduce the application of the Rank-Weighted Gaussian Process Ensemble to the setup of shadowing. We demonstrate its superior efficiency and effectiveness in comparison to traditional Bayesian optimization and other numerical methods, particularly in managing the complex dynamics of local and non-local shadowing.

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