A High-energy DC Electron Cooler for Staged Beam Cooling in JLEIC

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Attaining the design luminosity of the Jefferson Lab Electron-Ion Collider (JLEIC) requires beam cooling both during beam preparation and collision. During collision runs, the high-energy booster accumulates and stores a new, separate beam that can quickly replace the beam in the ion collider ring when needed. While the ion collider ring will include a bunched-beam high-energy cooler, the time overhead caused by injecting a new beam has to be minimized by pre-cooling the beam in the booster, leveraging the performance of conventional DC electron cooling technology to the full extent possible.

The energy dependence of the cooling rate, intra-beam scattering, and space-charge tune shift results in different trade-offs depending on the choice of energy ramp and bunch parameters in the booster. We show the feasibility of the staged cooling approach with cooling simulations for different beam transport scenarios. Because of the relatively high energy equaling or surpassing that of the Fermilab recycler cooler, the design options pertaining to high voltage, magnetization, and beam optics have to be evaluated carefully. We present the current state of our design effort.

Acknowledgements:

This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics under contract DE-AC05-06OR23177.

References:

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