

This Beam Use Request from CeC collaboration (including CeC BNL group, Stony Brook University, SLAC and JLab) aims towards experimental demonstration of CeC based on plasma-cascade microbunching amplifier – PCA-based CeC. Demonstration of FEL-based CeC was attempted but not completed during Run-18 because (as was shown by the subsequent studies) of the excessive high-frequency (~10 THz) noise in the electron beam. After determining the cause of this problem, we had developed a CeC accelerator lattice with low (natural) shot noise in the electron beam. Last week we started the experiment to demonstrate this mode of operation.

The CeC FEL section had a transverse aperture insufficient for the BES-II program and has been removed. We designed a novel CeC scheme based on a plasma-cascade microbunching amplifier fully compatible with low energy RHIC operation. We installed the corresponding vacuum system at RHIC IP2 and procured the solenoids required for this CeC scheme. We also submitted an LDRD proposal to pursue a CeC demonstration in two steps: the commissioning of the new CeC system during Run 20 and the CeC demonstration experiments during Runs 21 and 22.

During Run 20 we propose to commission the accelerator, propagate the CW electron beam through the CeC section and to the beam dump, demonstrate the plasma-cascade microbunching amplifier, establish the interaction of the electron and ion beams, and demonstrate plasma-cascade amplification of the ion’s imprint on the electron beam. While most of the preparations can be realized in parallel with regular RHIC physics runs, a small portion of the CeC program requires dedicated time with 26.5 GeV/u ion beam¹. We request 24 8-hrs shifts (8 calendar days) of dedicated CeC operations with the following distributions:

Establish low loss propagation of CW electron beam through the CeC	4 shifts
Demonstration of demonstrate plasma-cascade amplifier	4 shifts
Develop lattice and orbit for 26.5 GeV/u ion beam	3 shifts
Establish interaction of electron and ion beams	3 shifts
Demonstrate plasma-cascade amplification of ion’s imprint	6 shifts
Contingency	4 shifts

Total	24 shifts

During Run 21 we propose to demonstrate longitudinal ion beam cooling using the PCA-based CeC. We plan to re-establish the Run 20 mode of operation and spend most of Run 21 for the CeC demonstration experiment. Again, while the most of preparations can be realized in parallel with regular RHIC physics runs, a significant portion of the CeC program requires dedicated time with 26.5 GeV/u ion beam. We request 42 8-hrs shifts (2 weeks) of dedicated CeC operations with following distributions:

Re-establish Run-20 operation	6 shifts
Re-establish and optimize imprint amplification	6 shifts
Demonstrate longitudinal ion beam with CeC	25 shifts
Contingency	5 shifts

Total	42 shifts

During Run 22 we propose to continue CeC experiment and to demonstrate simultaneous longitudinal and transverse (3D) cooling of the ion beam.

¹ As was demonstrated during Run 18, most of the time the 26.5 GeV/u ion beam can be used either for collisions or fix target physics program without any negative impact on the CeC experiment.