ESS NEUTRINO SUPER BEAM
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5 MW Beam Power in the ESSnuSB Accumulator:

A way to manage foil stripping injection at 14Hz Linac pulse rate

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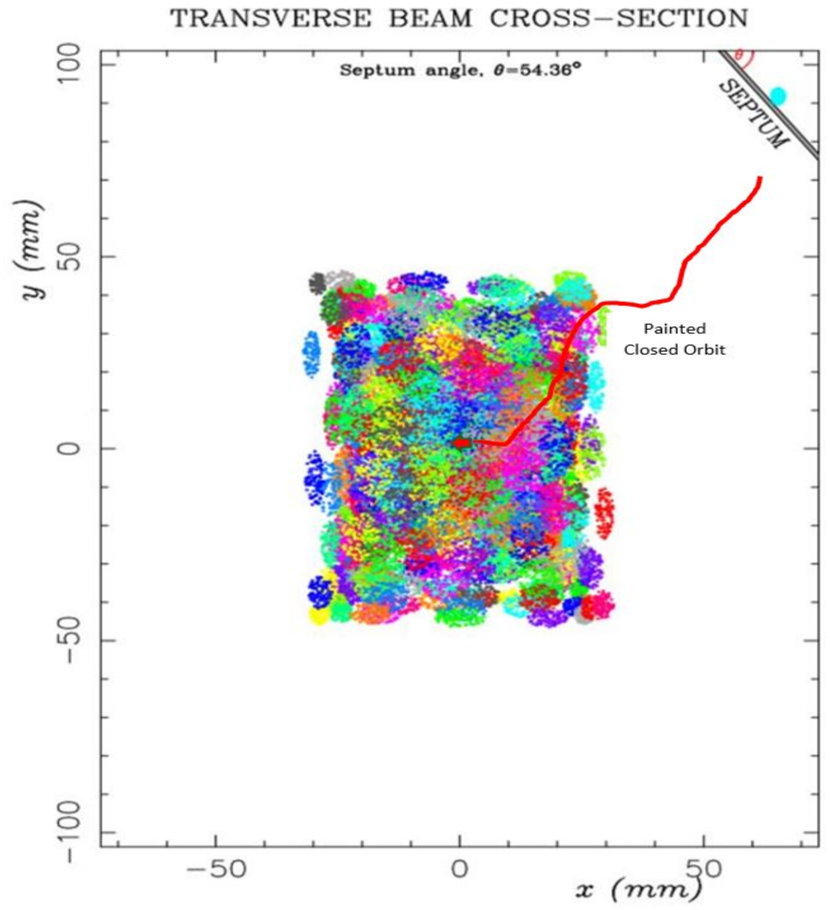
Abstract

- ESSnuSB is aiming to measure the leptonic charge-parity violation using a 5 MW H- beam in 2.86 ms long pulses from the ESS. For the millisecond long pulses, foil-based stripping must be used before laser stripping is common practice. In the past, the scenario consisted of splitting a linac pulse into 4 rings, or 3 or 4 intermediate pulses, and one ring. At present, the scenario, in view of ultimate laser stripping, consists of one ring, one pulse, split into four batches.
- Conventional stripping geometry would lead to foil evaporation under this beam load. On the other hand, the final emittances at extraction increased. This suggests replacing the standard corner foil with a single-edge foil, rotated to about 45º. The tilted foil allows moving the injection point together with the painting bumps along the foil edge, distributing the deposited beam power over a larger foil area. We present simulation results obtained with the same tools as in the past scenarios. They show peak foil temperatures, which compare with the best results obtained from the past scenarios with intermediate pulses

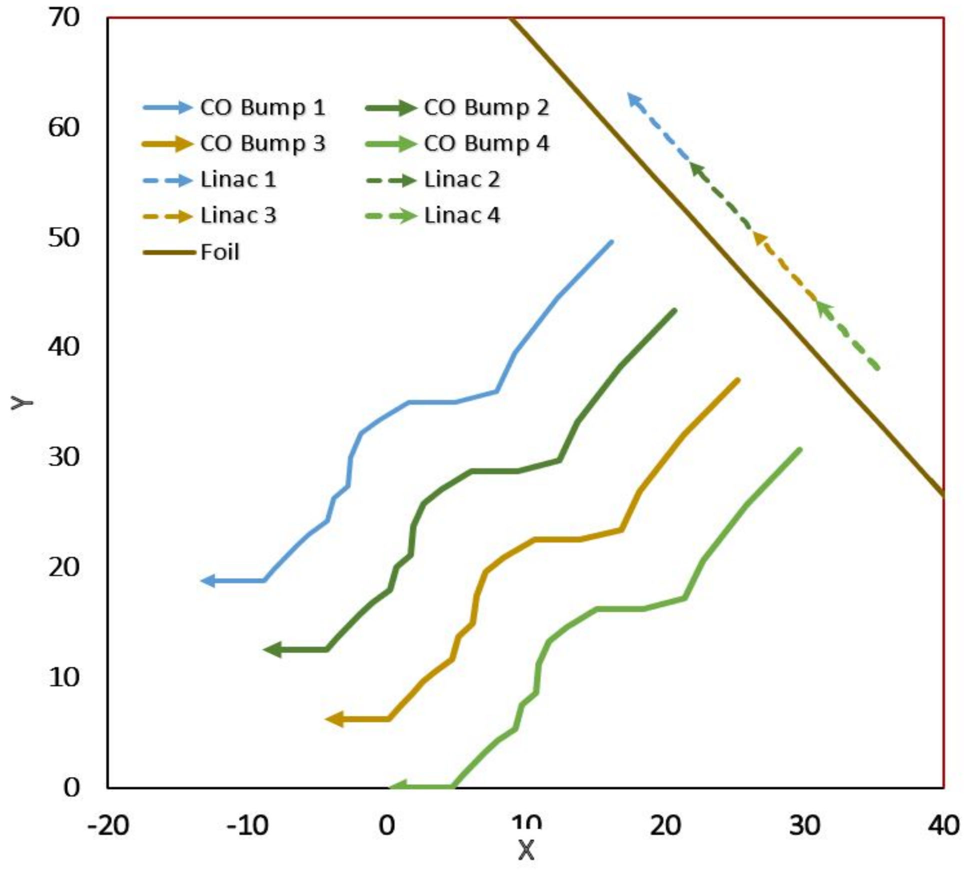
Ways out of the foil-heating dilemma

- Different ideas were proposed to distribute the load of the four consecutive batches:
  1. Move the injection point on the foil with simultaneous following of the painting orbit bump
  2. Use a different area of the foil for each batch
  3. A row of several thinner foils
- Ideas (i) and (ii) combined were studied for a final painted geometric emittance of 120 π mm mrad.
- Idea (iii) was studied for a final painted emittance of 60 π mm mrad (geom.)

Optimisation without Space Charge

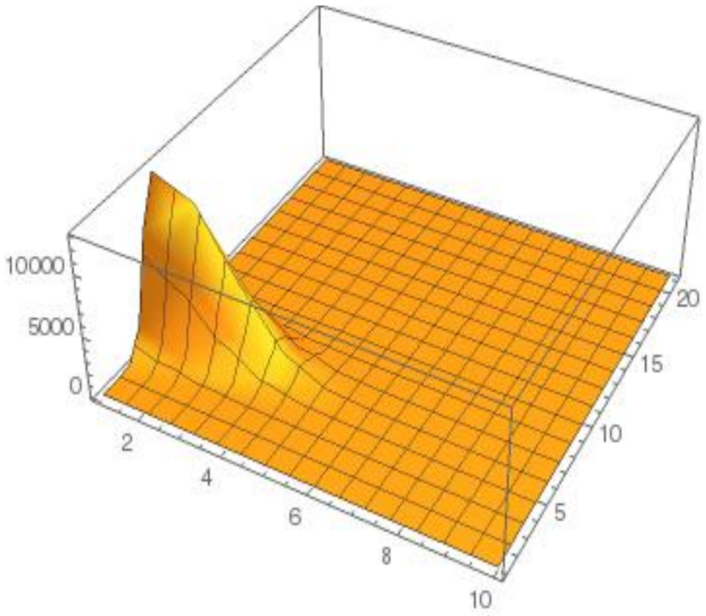


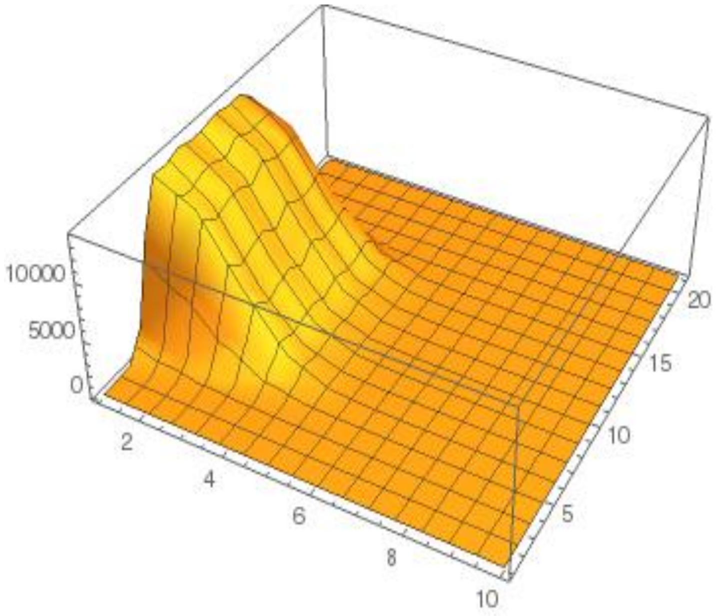
The final x-y distribution of 480 injected turns. It shows the painting orbit bump, coming down to zero



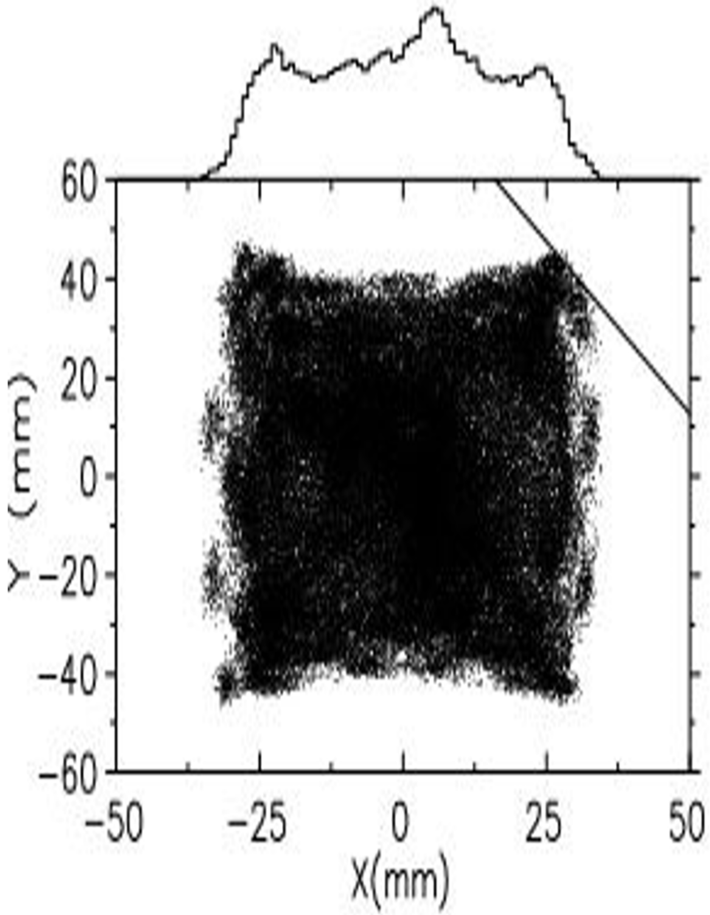
Geometry of the combined strategies (i) and (ii)

Introducing Space Charge



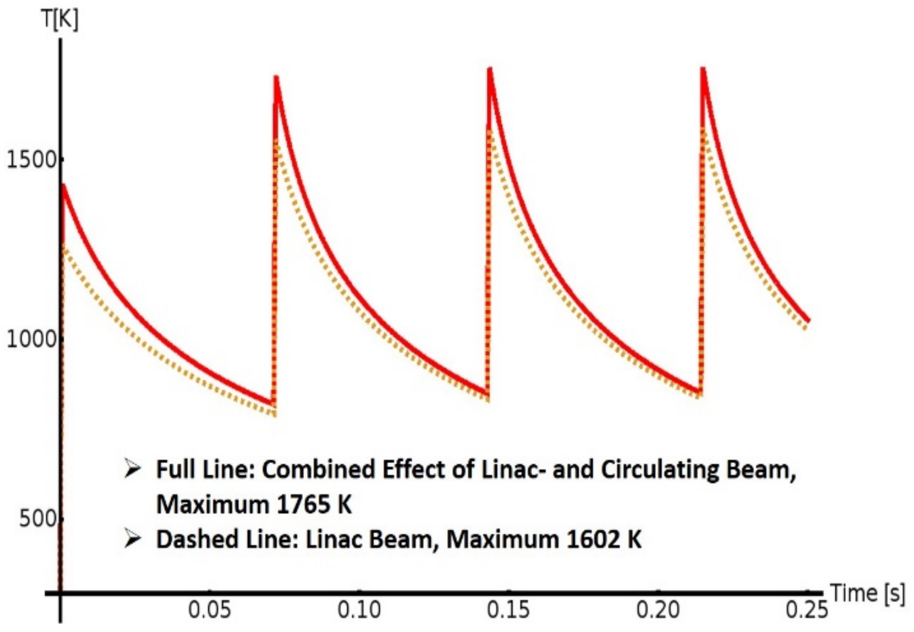


Distributions of foil hits

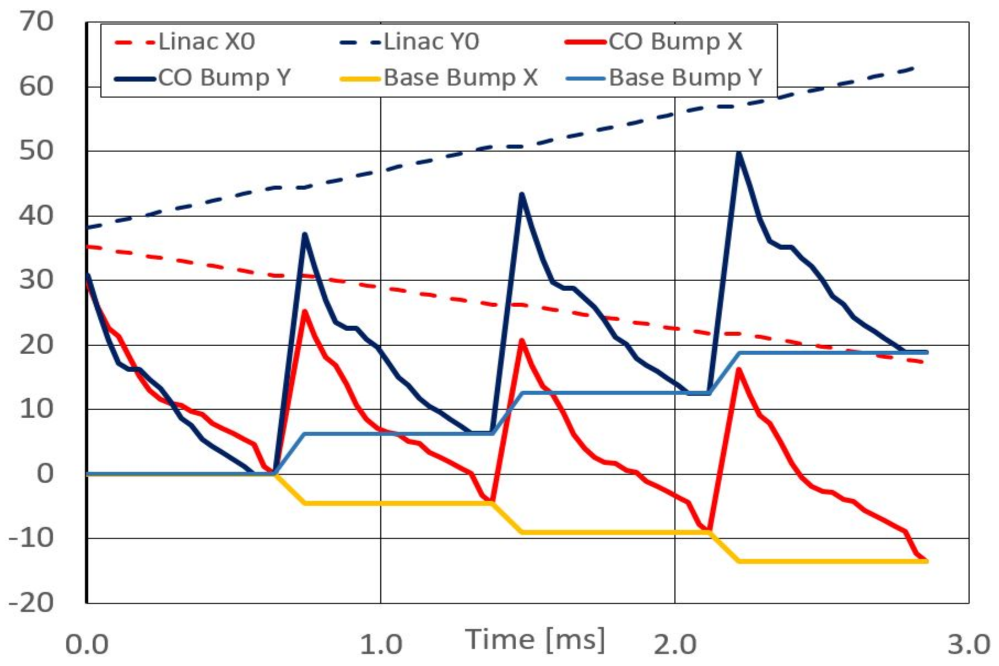


Final x-y distribution calculated with ACCSIM including space charge

Foil temperature and conclusion



Foil temperatures for 4 batches



The different bump amplitudes as a function of time

Moving injection point is a very promising way to manage foil stripping injection for 5 MW beam power. Further studies are ongoing.