

LhARA: Meeting

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October 15, 2020

Ideal Distribution

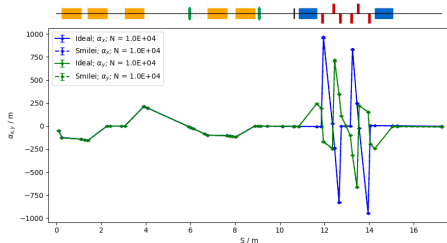
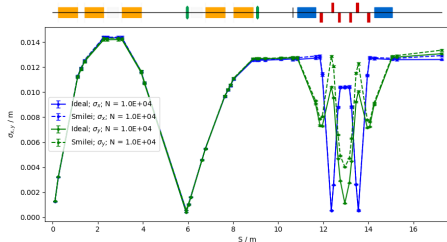


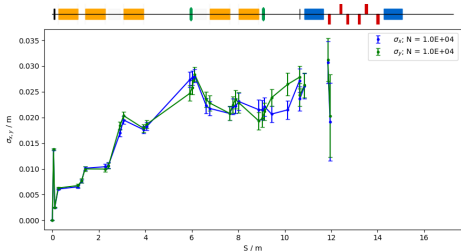
Figure: Sigma plot (top) and Alpha plot (bottom).

Comparable results between the ideal distribution and the fitted Twiss distribution.

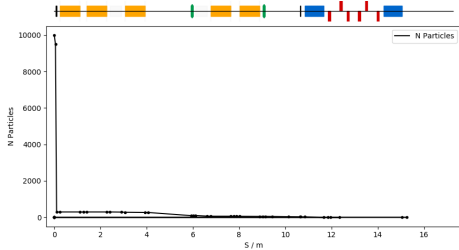
Generated Distribution – No Cut

Using sampled SMILEI simulation results with no cuts (Cartesian smear):
(Assumed collimator at nozzle to have arbitrary radius of 5 mm and space charge not included)

Sigma Plot



Number of Particles

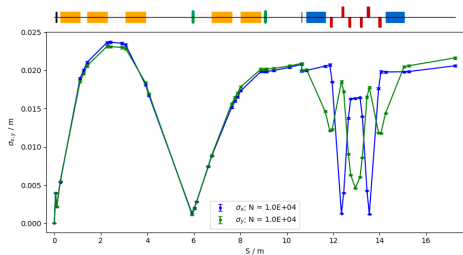


97% particles lost due to vacuum collimator, then remainder are lost in beampipe.
Particles that pass collimator are very low energy.

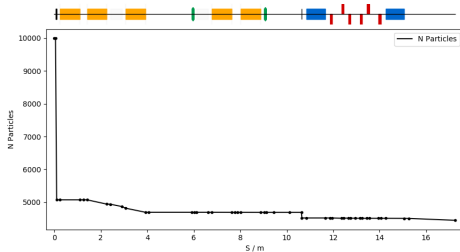
Generated Distribution – 15 MeV \pm 2% centred

Using sampled SMILEI simulation but with sampled KE within range of 15 MeV \pm 2%, momentum rotated, and position centred to emulate rotating the target:

Sigma Plot



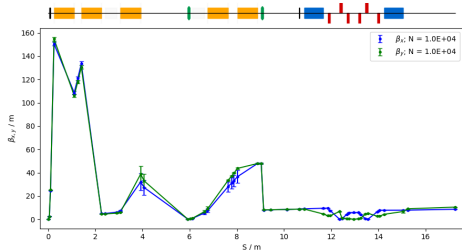
Number of Particles



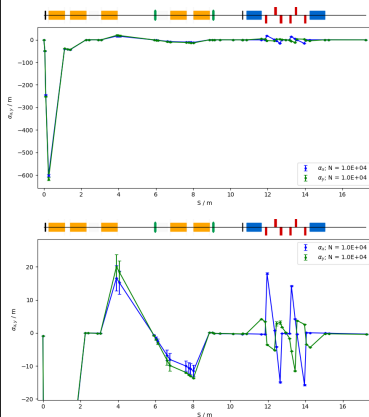
Generated Distribution – 15 MeV \pm 2% centred

Using sampled SMILEI simulation but with sampled KE within range of 15 MeV \pm 2%, momentum rotated, and position centred to emulate rotating the target:

Beta Plot



Alpha Plot



Ideal vs Generated Distribution Twiss Parameters

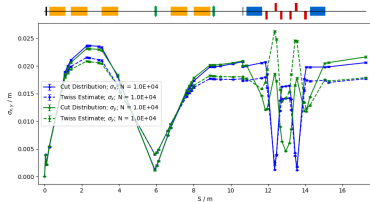
Twiss parameter approximations for distributions both **10 cm after target**:
(Ideal distribution does not include collimator)

| Parameter | Ideal | Generated (15 MeV \pm 2% and centred) |
|-----------------------------|------------------------|---|
| β_x [m] | 4.82 | 24.53 |
| β_y [m] | 4.97 | 25.24 |
| α_x | -49.43 | -245.27 |
| α_y | -51 | -252.29 |
| ϵ_x [π m rad] | 3.277×10^{-7} | 1.86×10^{-7} |
| ϵ_y [π m rad] | 3.256×10^{-7} | 1.91×10^{-7} |
| σ_E | 1.77×10^{-4} | 9.74×10^{-4} |

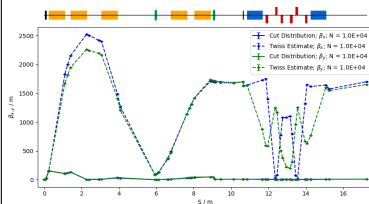
Generated Distribution – 15 MeV \pm 2% centred

Comparing generated distribution with estimated Twiss parameters starting at 10 cm:

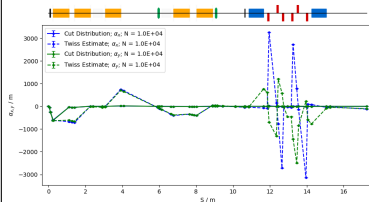
Sigma Plot



Beta Plot



Alpha Plot



No cut distribution with same momentum rotation

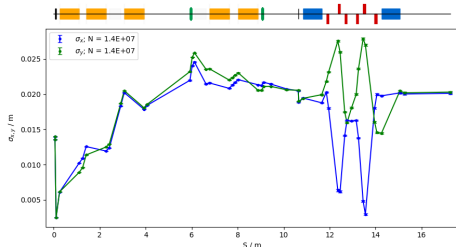


Figure: Sigma plot.

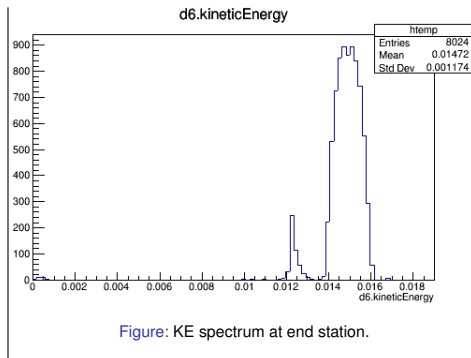
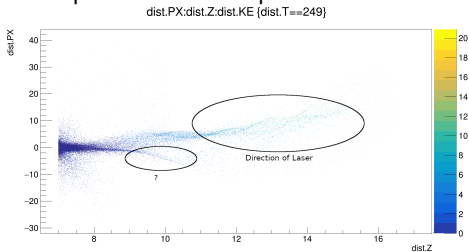


Figure: KE spectrum at end station.

- Of an initial beam of 15,000,000 protons, about 250,000 pass through collimator (1.7%)
 - Initial beam has 6384 protons with $(14.7 < KE < 15.3)$ MeV, 3195 pass collimator, 2779 at end station.

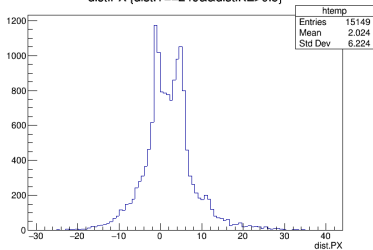
Double peak feature in transverse momentum

Two peak structure of protons at 249 ns.



SMILEI

dist.PX (dist.T==249&&dist.KE>0.5)



Old EPOCH (unknown timestep)

dist.PX (dist.KE>0.5)

