COLD tracking for diagnostics

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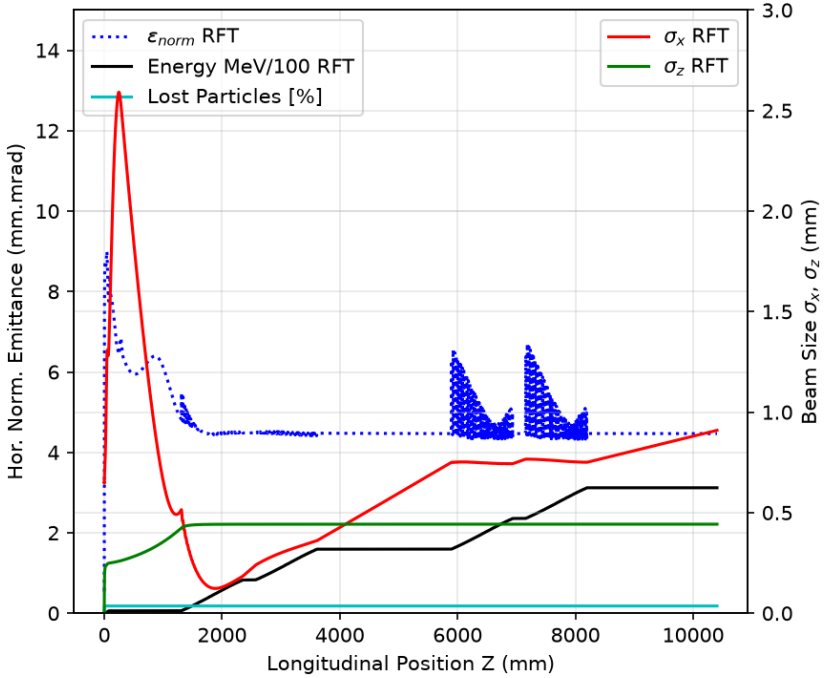
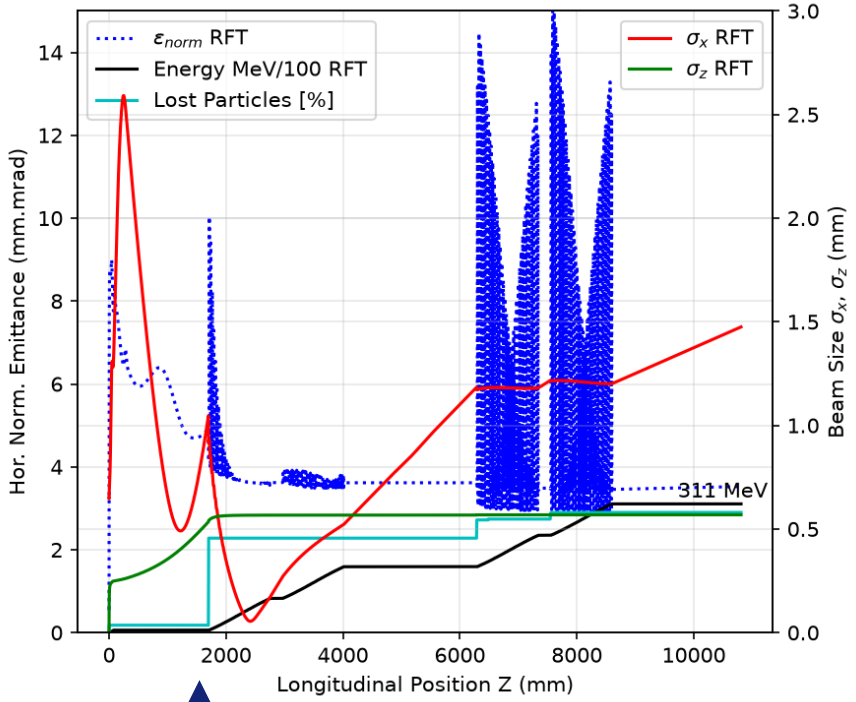
On behalf of the EBS Accelerator Team and the international collaboration:
SLAC, INFN, CERN, PSI, CORNELL

EFFECT OF THE DISTANCE GUN - FIRST STRUCTURE

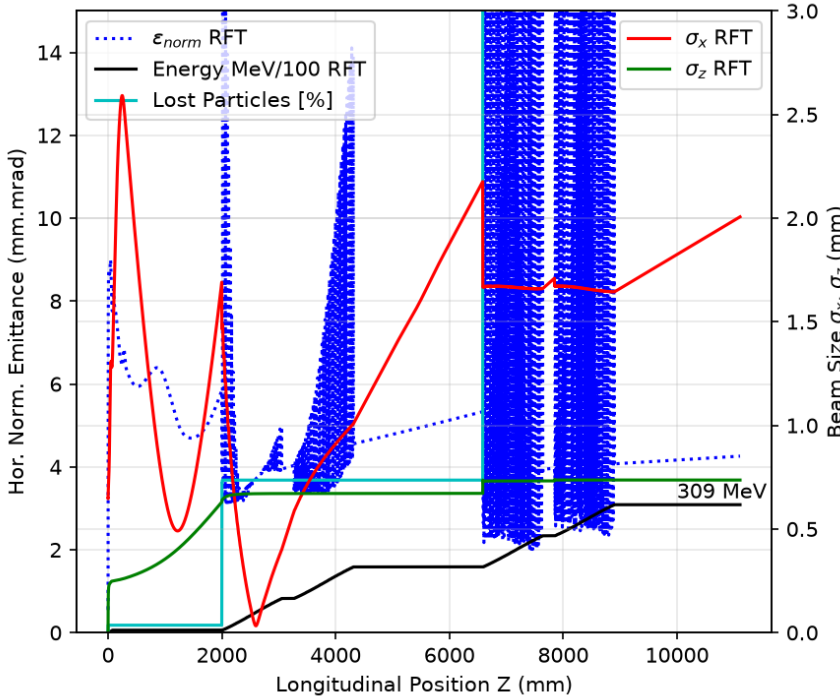


1.297 m



1.7 m

Value presently in the drawings



2.0 m

January 2026 settings

```
'Bz': 0.288306,
 'DriftGunStruct': 1.29731,
 'sigr': 0.6478,
 'sigt': 0.200,
```

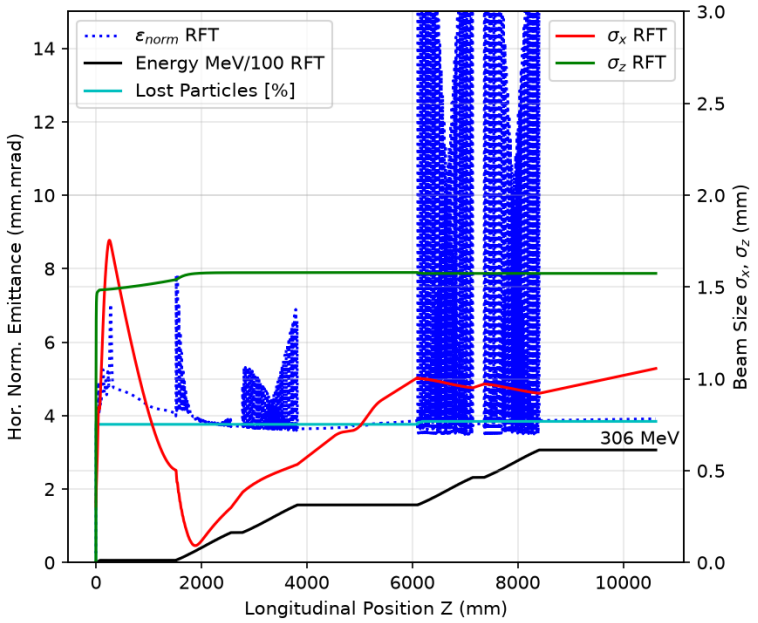
Lost particles at structure entrance

More emittance oscillation in structures

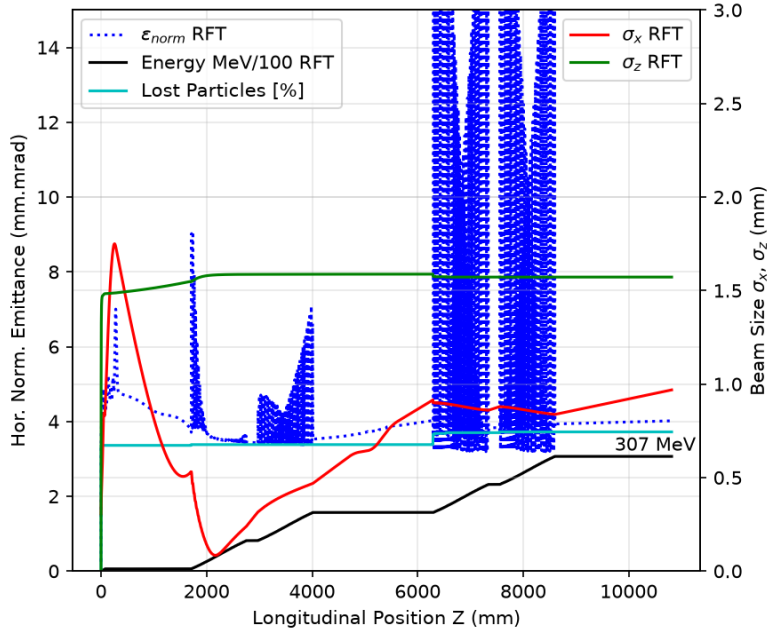
Longer bunch

/Users/liuzzo/Desktop/LINAC/COLD_Phase2_January2026restored/RFT_EMIT_SIGMA_50000.png

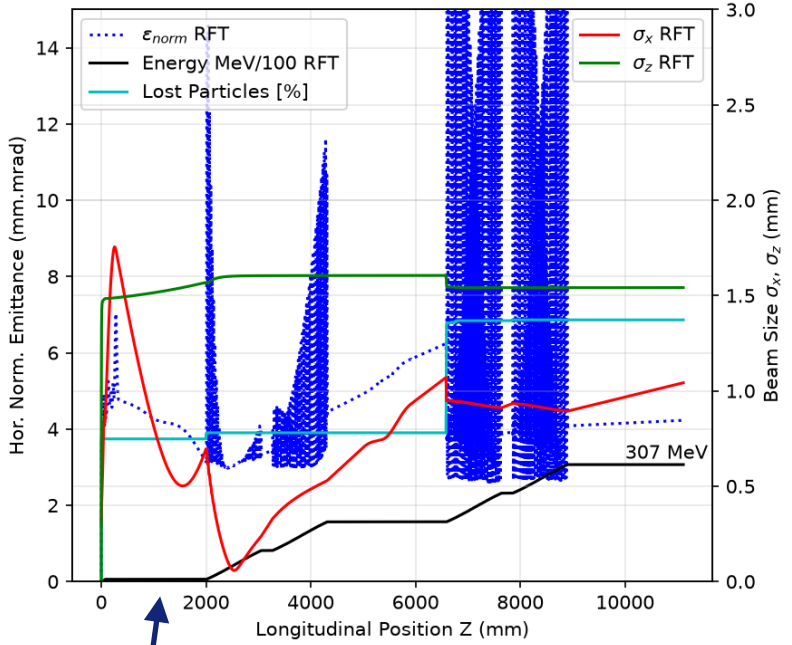
EFFECT OF THE DISTANCE GUN - FIRST STRUCTURE



1.5 m



1.7 m



2.0 m

August 2026 settings

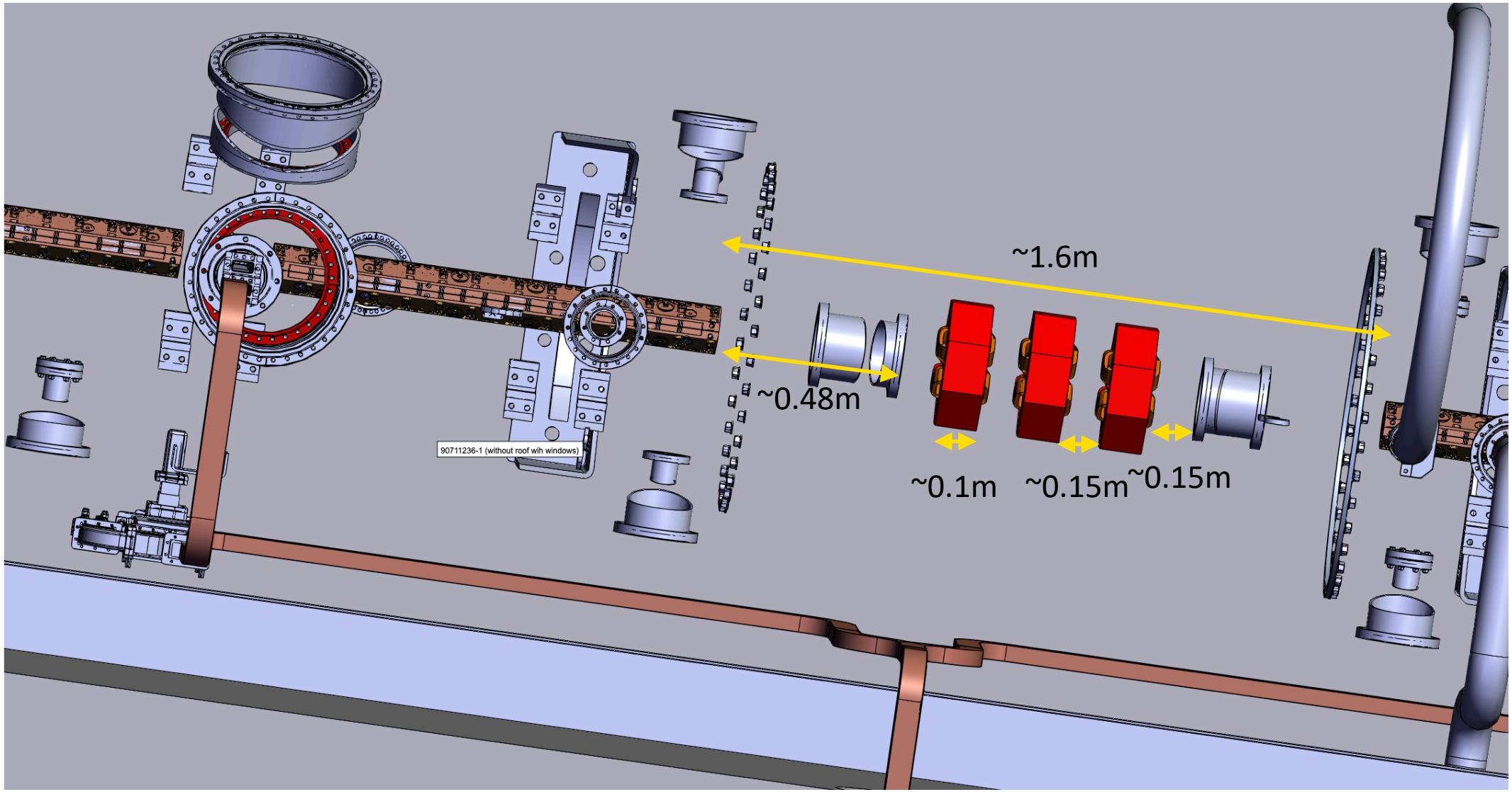
```
'Bz': 0.288306,
 'DriftGunStruct': 1.5,
 'sigr': 0.3,
 'sigt': 2.12, (5 ps FWHM)
```

Looks ok

Few more lost particles at structure entrance
More emittance oscillation in structures

/Users/liuzzo/Desktop/LINAC/COLD_Phase2_August2026/RFT_EMIT_SIGMA_50000_1.5m.png

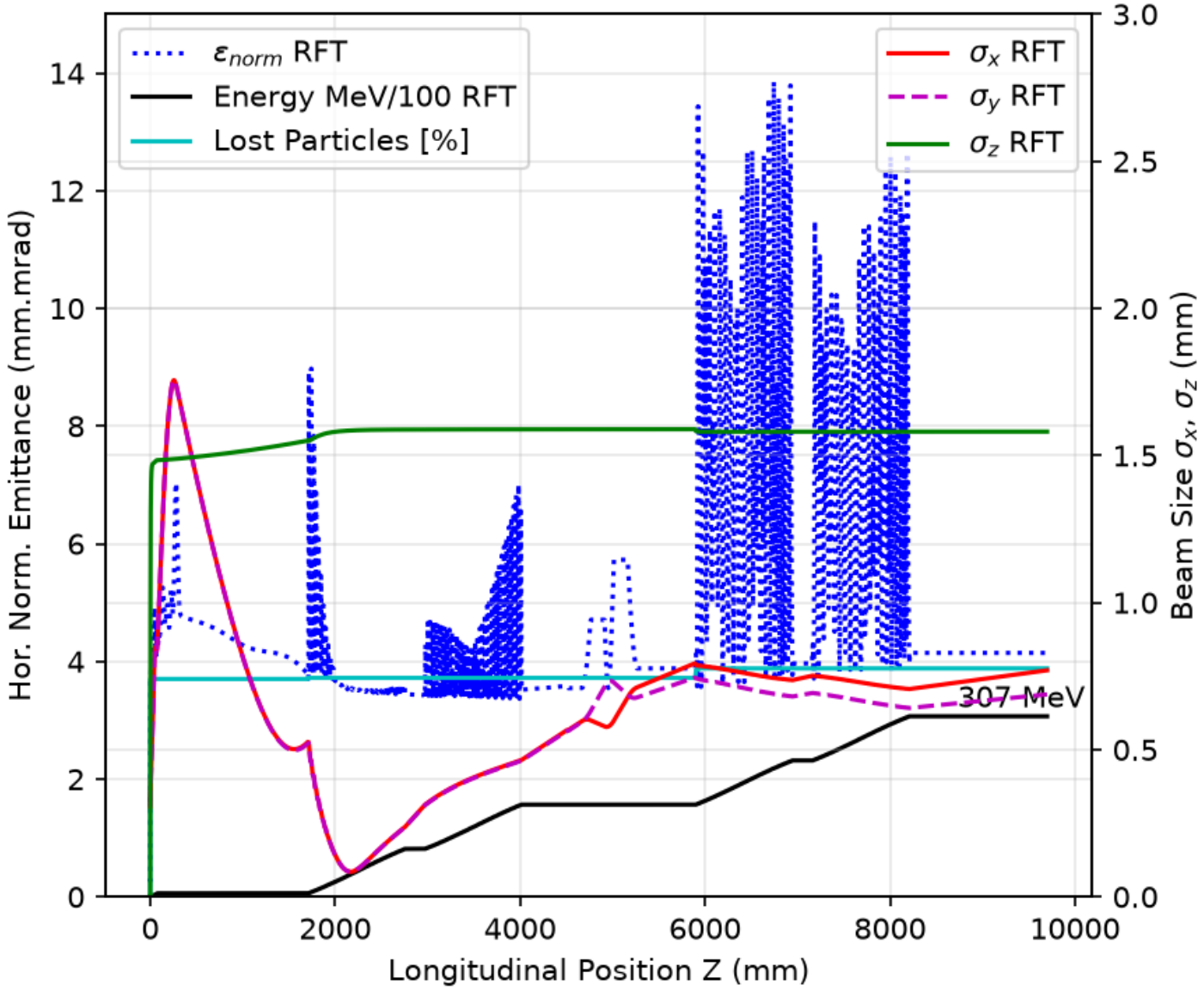
TRIPLET LAYOUT



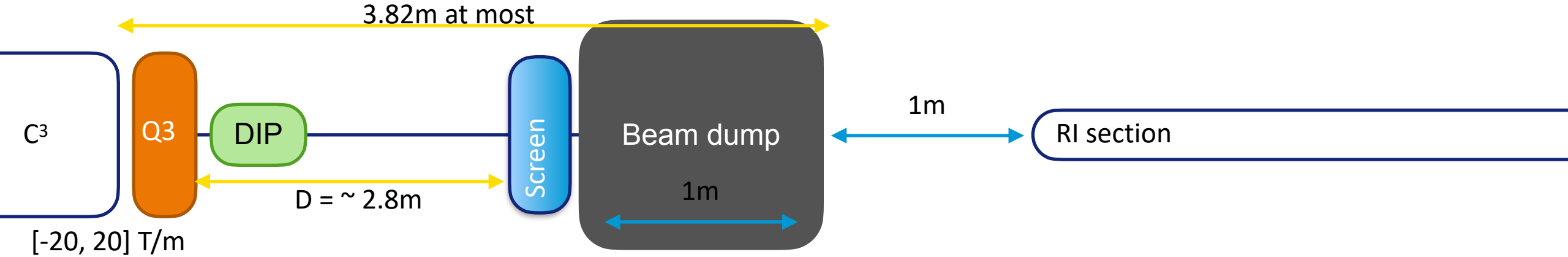
TRIPLET WITH APPROXIMATE LAYOUT FROM DRAWINGS

August 2026 settings

```
'Bz': 0.288306,
 'DriftGunStruct': 1.7,
 'sigr': 0.3,
 'sigt': 2.12, (5 ps FWHM)
K1L −3T/m,
K2L=6T/m
```



POSSIBLE LINEAR LAYOUT FOR DIAGNOSTIC SECTION FOR ENERGY OR EMITTANCE MEASUREMENT

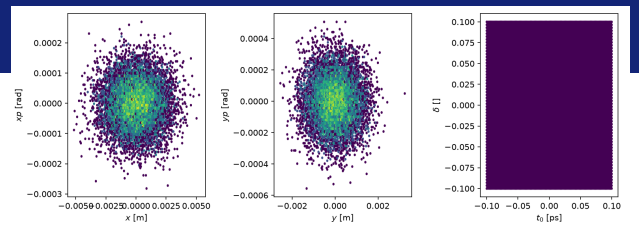


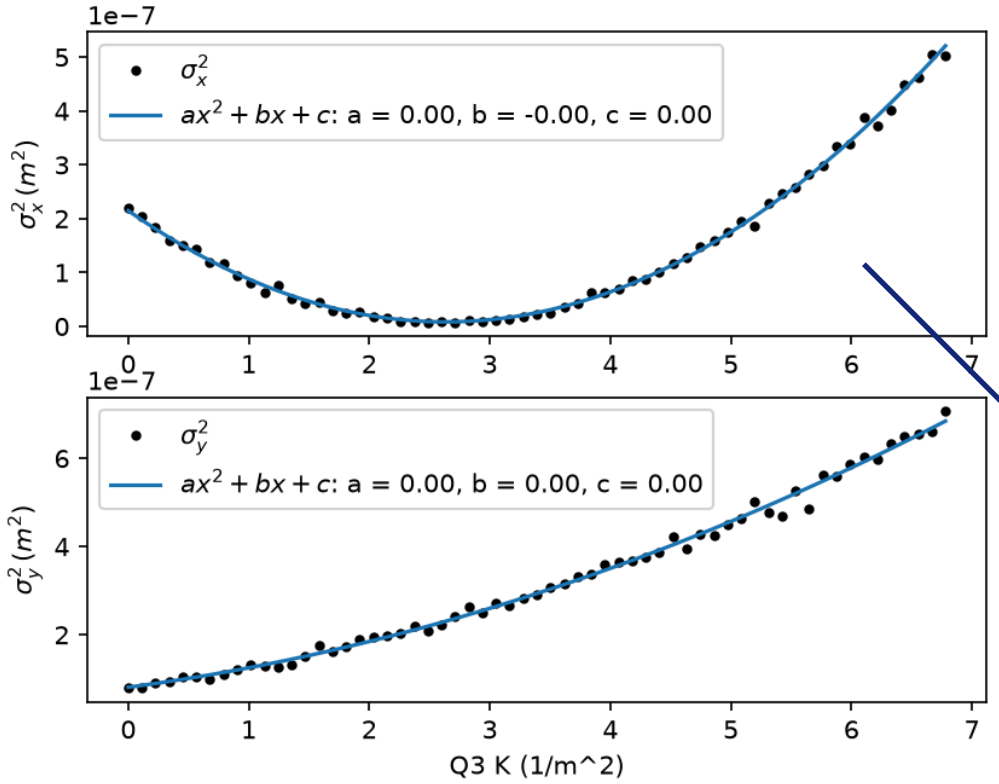
To measure emittance: quadrupole SCAN, dipole/corrector set to zero.

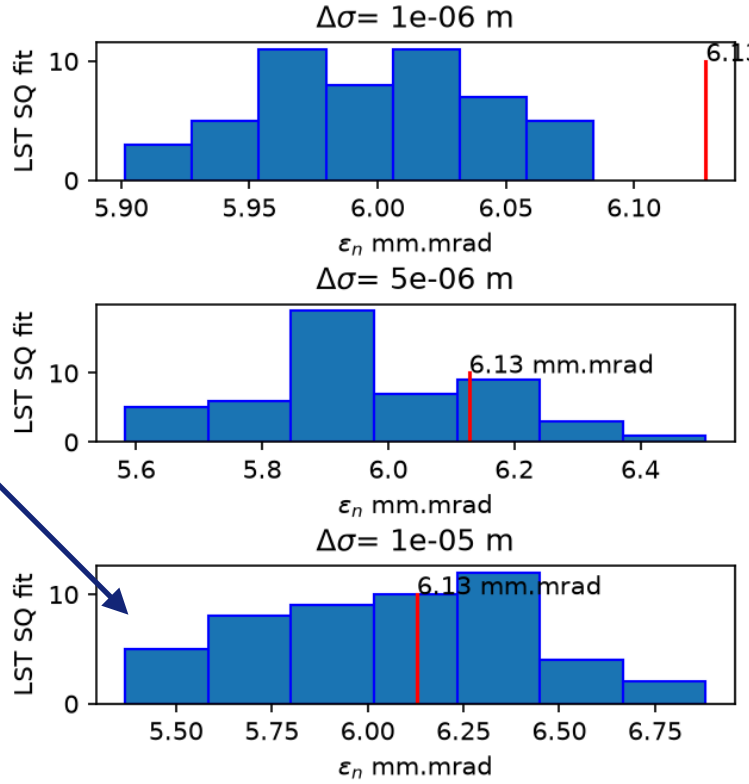
To measure energy: fix quadrupole and power DIPOLE to measure displacement on the screen (within Dump aperture)

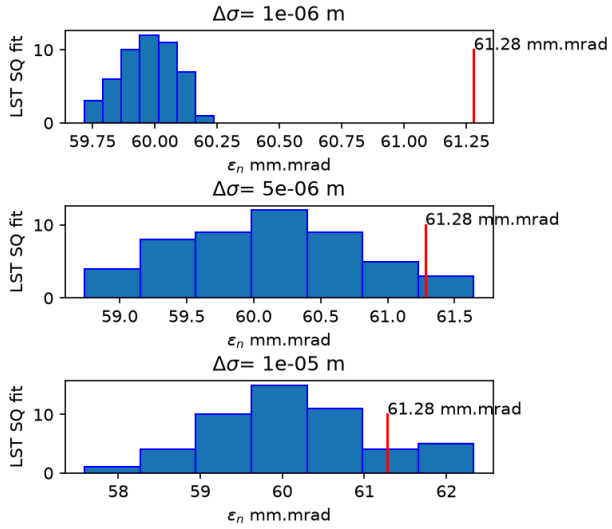
To measure bunch length: ?

PYAT SIMULATIONS









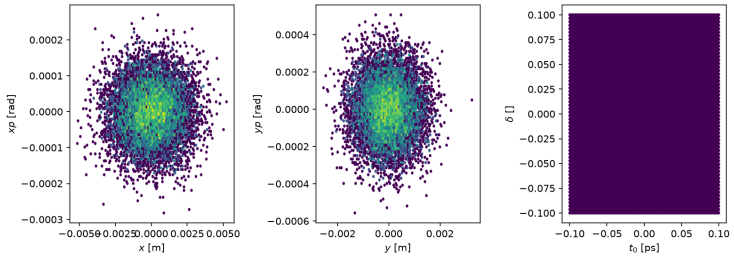
PyAT gaussian beam is working
Works for any input emittance and for realistic errors
There is a small systematic error

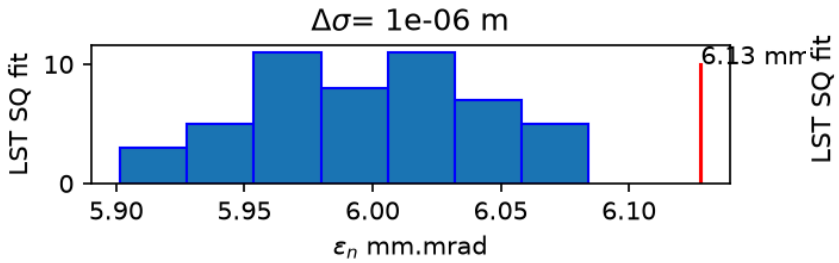
A FACTOR /2 in emittance computation is introduced empirically to get this results

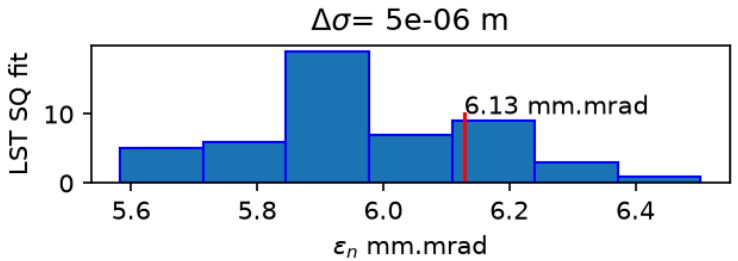
/Users/liuzzo/Desktop/LINAC/COLD_Phase2_August2026/diag_studies_emittance_V17_AT_vsemit.py

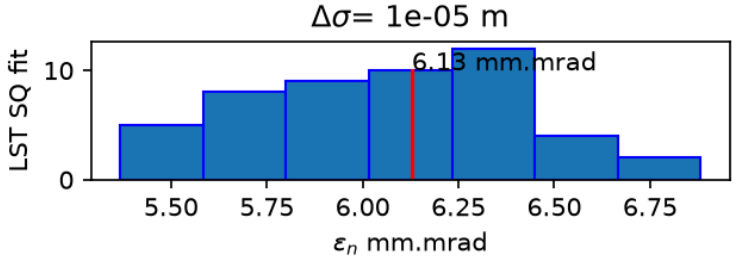
PYAT SIMULATIONS, INPUT BEAM FROM RF-TRACK TRACKING

IDEAL BEAM

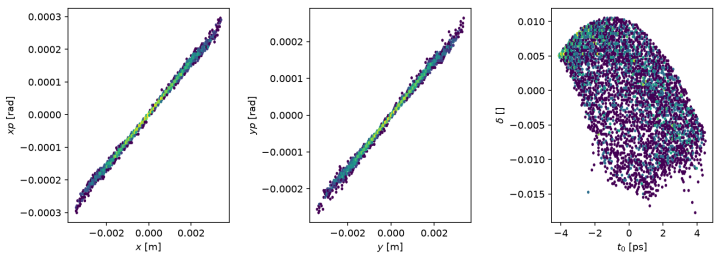


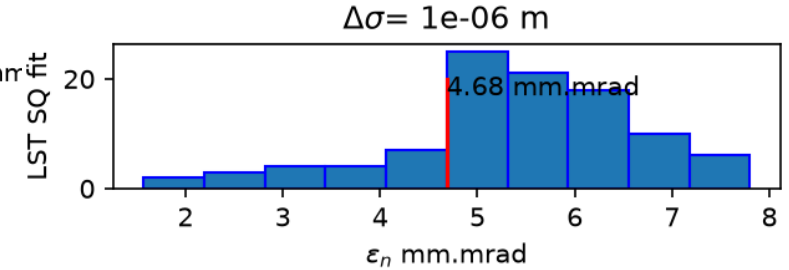


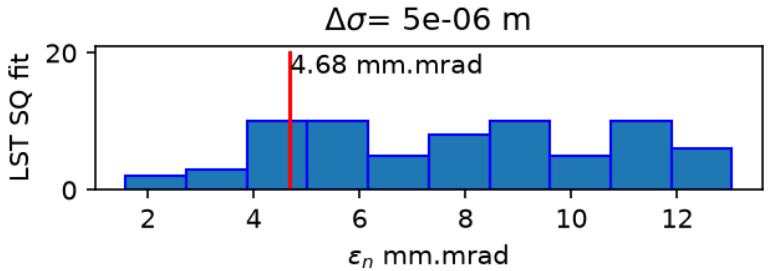


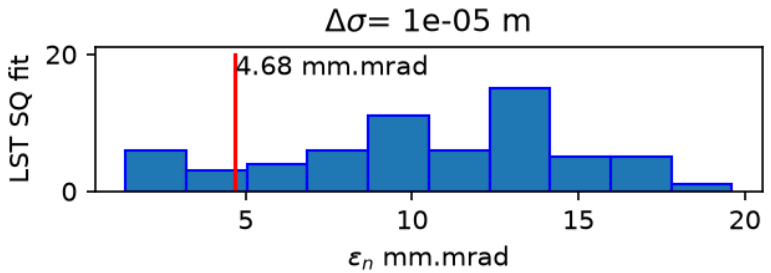


Realistic beam (RF-Track) SHORT

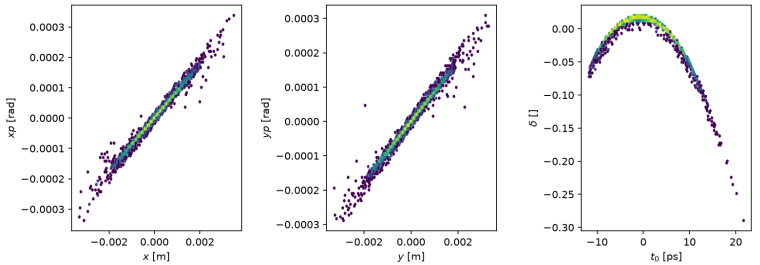


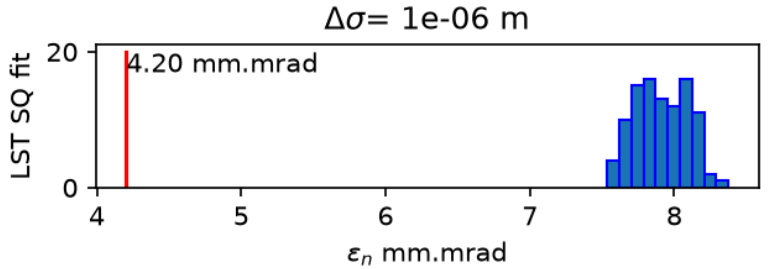


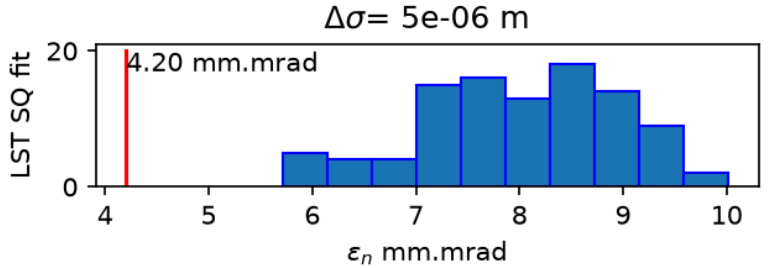


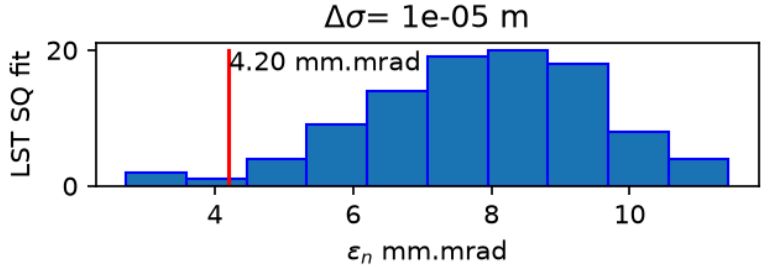


Realistic beam (RF-Track) LONG



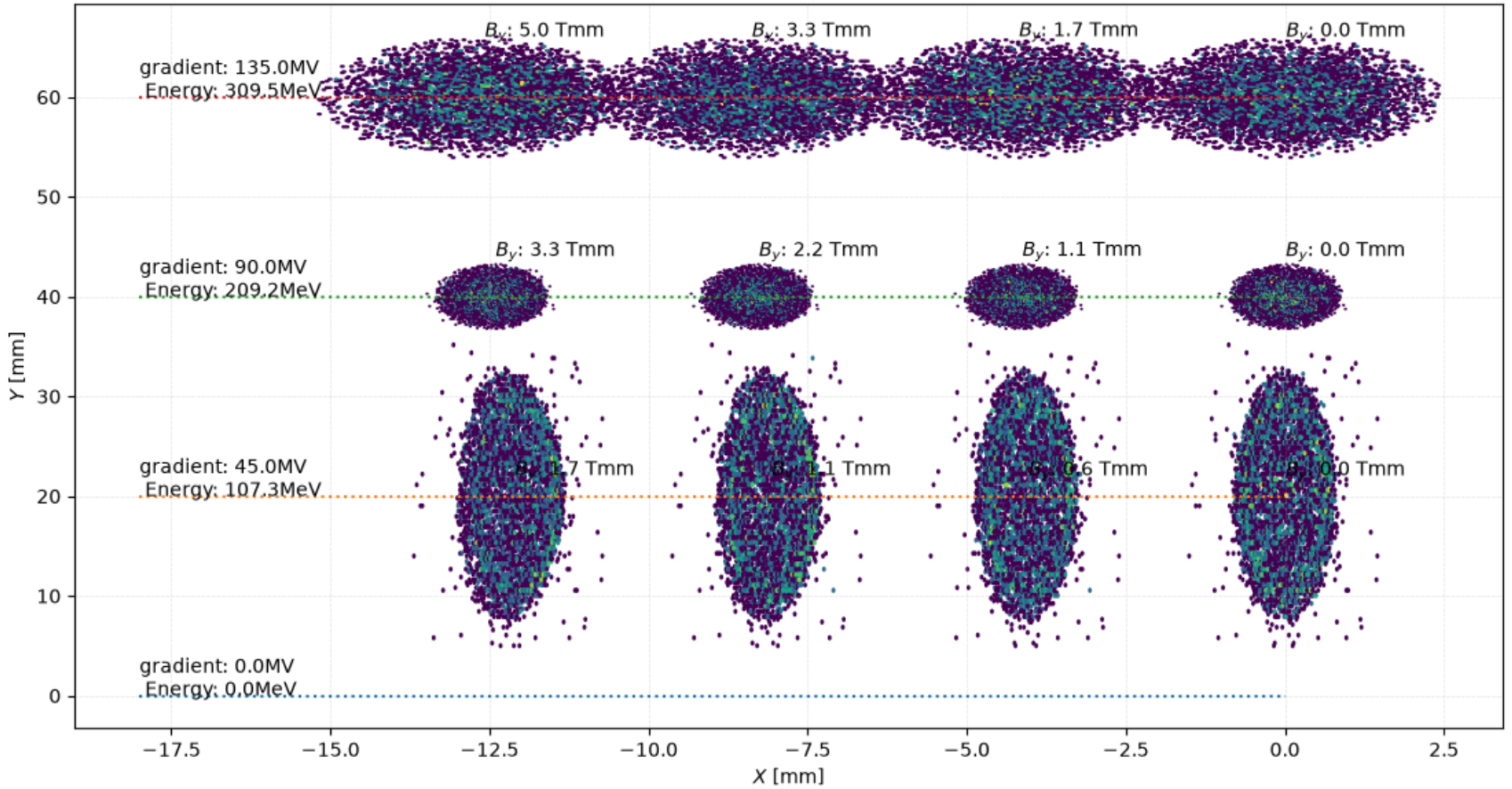






Slice emittance would work like the ideal case.

ENERGY MEASUREMENT WITH DIPOLE/CORRECTOR



Measurement error:
- centroid error
- Magnetic field error
- Minimum field

Energy = C B/x

If we can detect changes in position by dx = 10um, then we know the energy with 0.1% precision (0.3MeV for 300MeV).

The magnet needs to be able to reach 5Tmm (for 300MeV beam)

~~The magnet needs to be tunable with precision at low field (steps of <0.01 Tmm between 0.0 and 0.1Tmm) for 6MeV beam measurements.~~

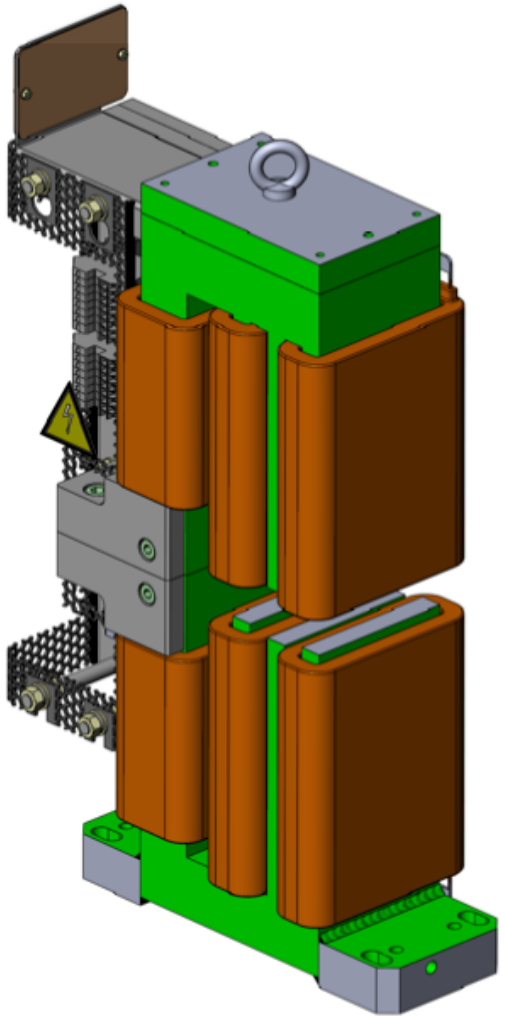
~~The remanent field for 0 current should be as low as possible and if possible lower than 0.01 Tmm.~~

POSSIBLE CORRECTOR MAGNET: EBS SPARE CORRECTORS

This corrector can produce an integrated field of up to **10 T·mm** at a current of **2 A**.

The yoke length in the beam direction is **100 mm**, and the total length, including the coils and protective grid, is approximately **150 mm**.

We have spare units of this corrector available, and we can make one or two of them available to you for an extended period.

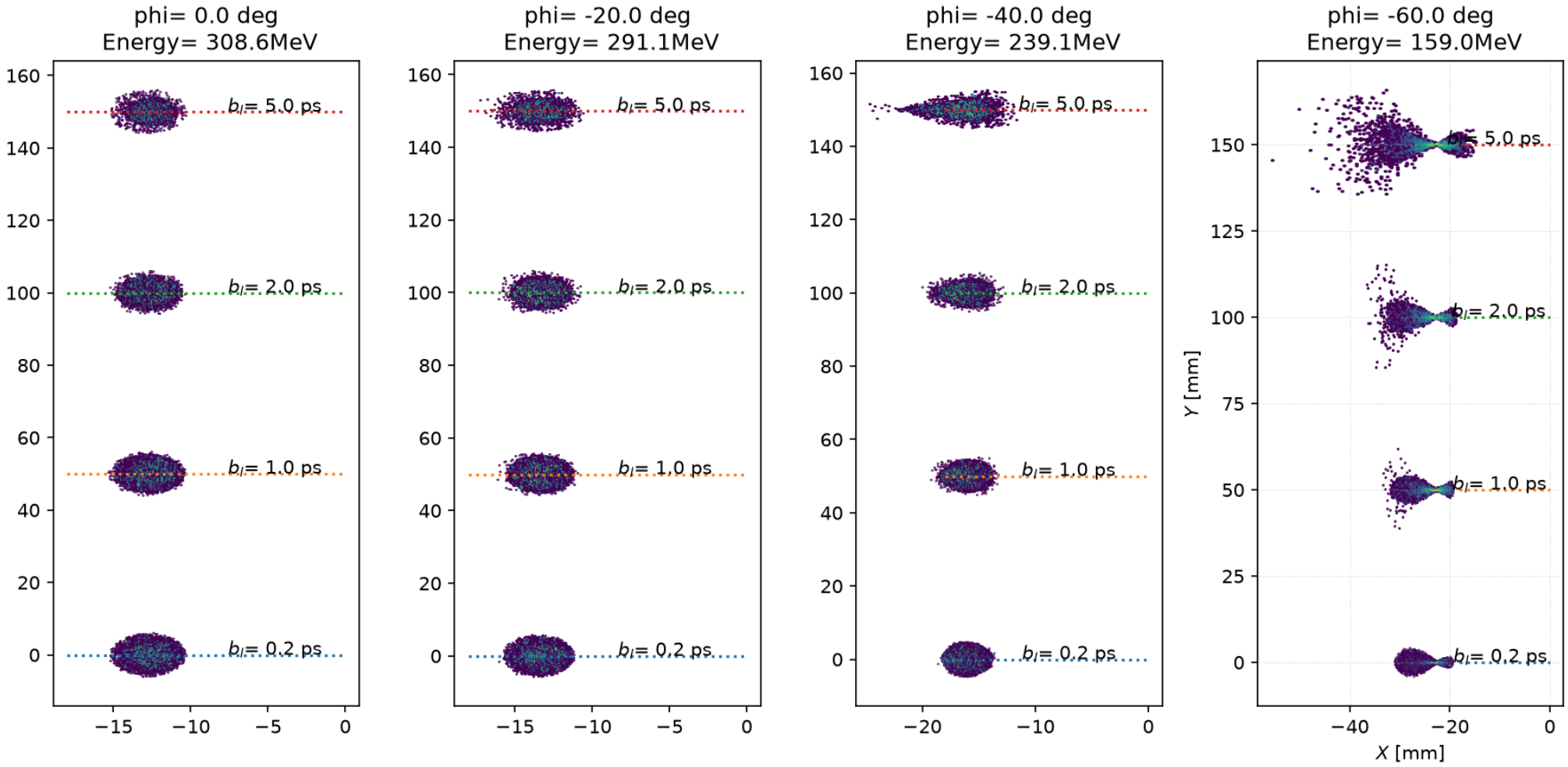


BUNCH LENGTH

Off crest operation (phase of accelerating structures)

Lower energy, but correlation of energy with longitudinal position in the bunch (late particles have lower energy)

Dispersive Image on the screen with dipole (corrector) on (5 Tmm).

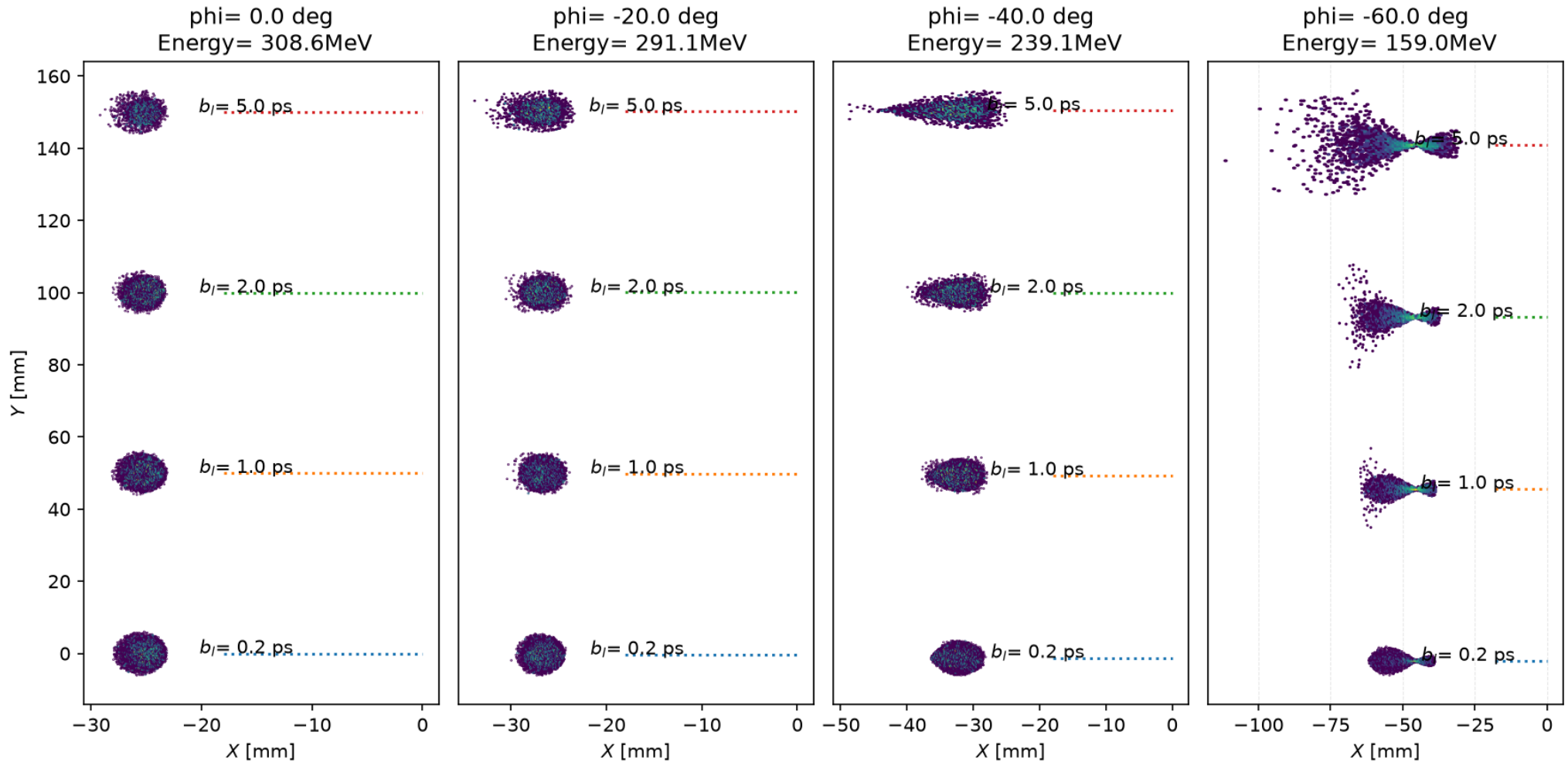


BUNCH LENGTH

Off crest operation (phase of accelerating structures)

Lower energy, but correlation of energy with longitudinal position in the bunch (late particles have lower energy)

Dispersive Image on the screen with dipole (corrector) on (10 Tmm).



CONCLUSION