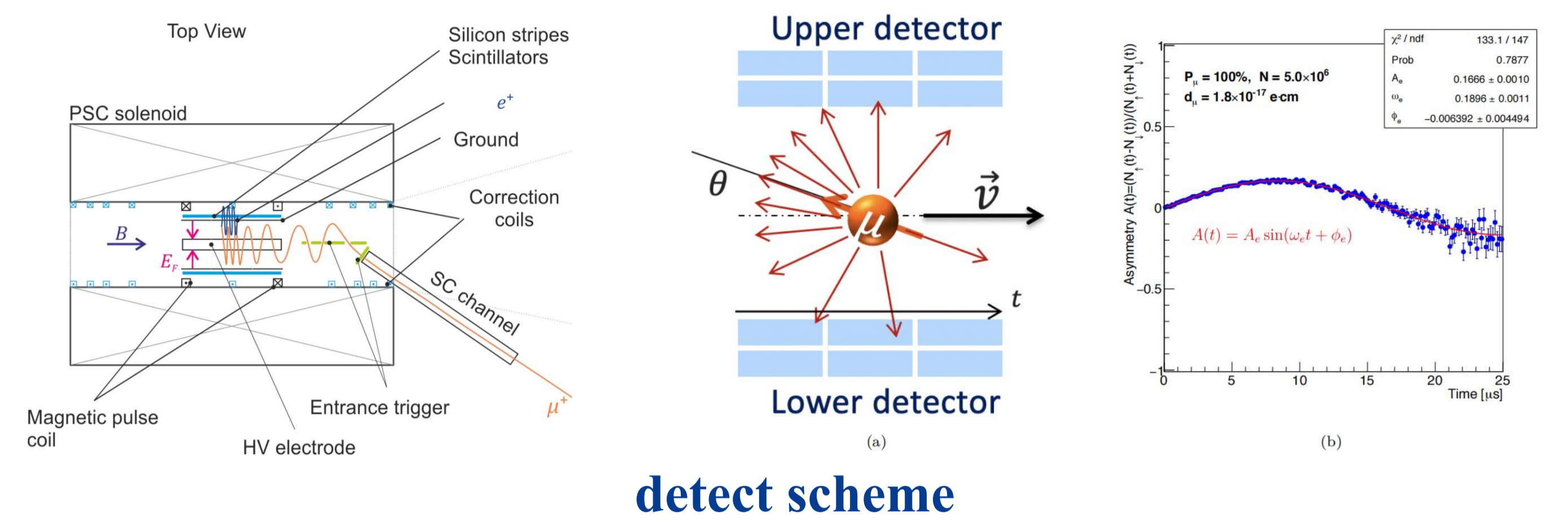


Motivation of the muEDM searches

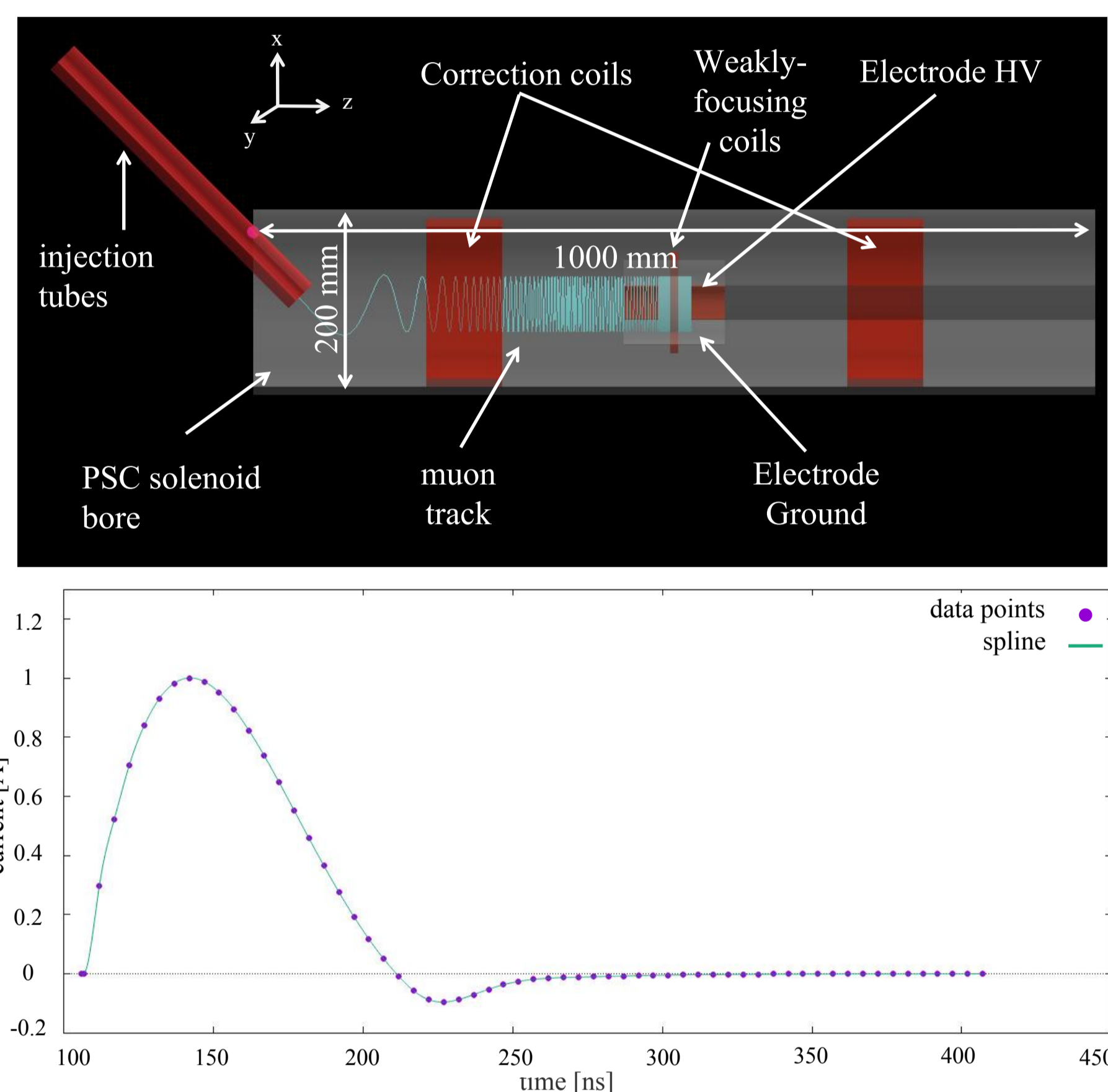
- EDM of elementary particles violate CP symmetry and they are sensitive probes of BSM physics.
- The current best direct limit is $d_\mu \leq 1.8 \times 10^{-19} e \cdot \text{cm}$, obtained by BNL[1].
- muEDM at PSI aims to reach a sensitivity of $6 \times 10^{-23} e \cdot \text{cm}$ using frozen-spin technique.

Overview of the muEDM experiment



Beam injection and storage study

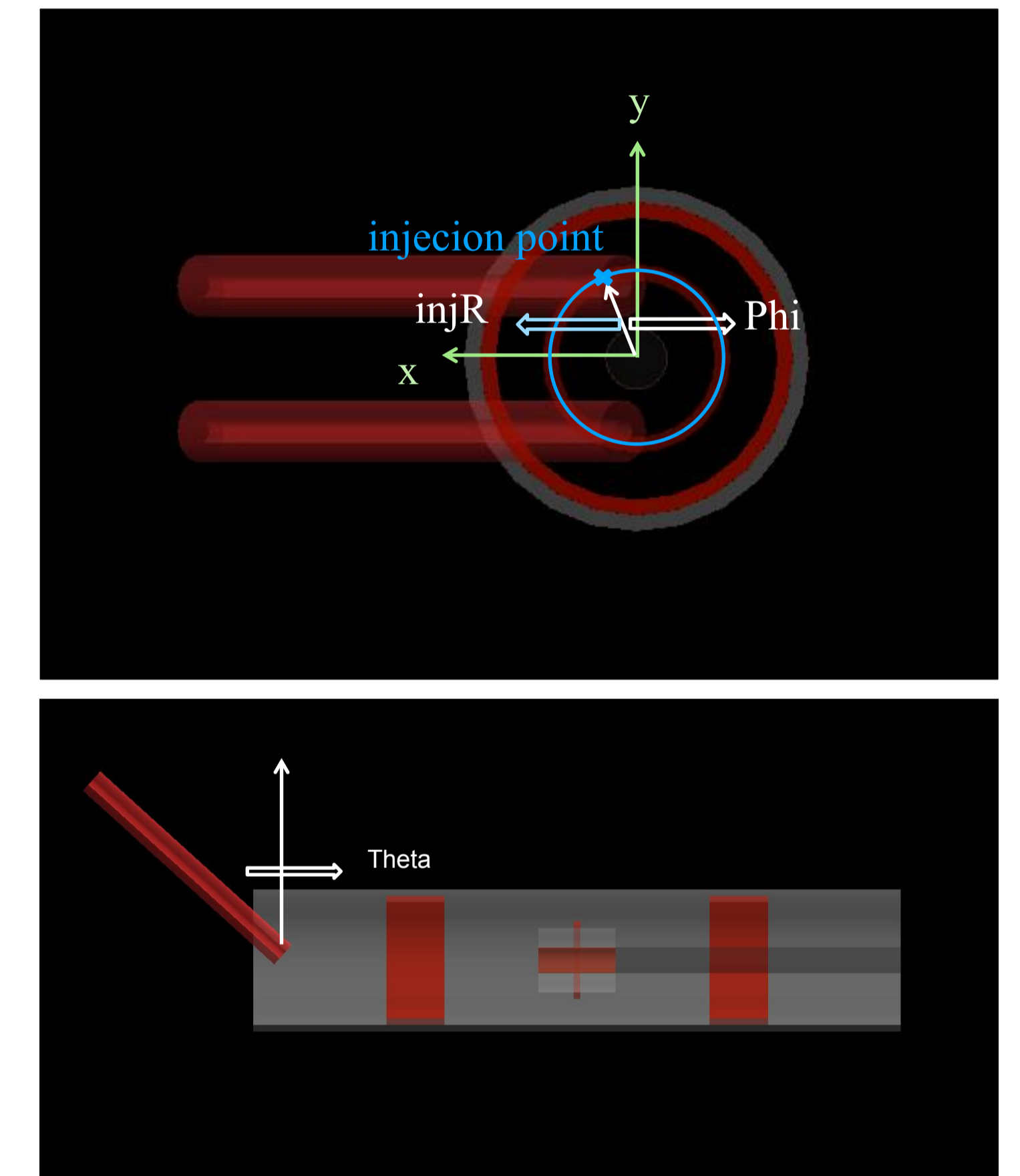
G4Beamline simulation and pulse field



optimized parameters_v1

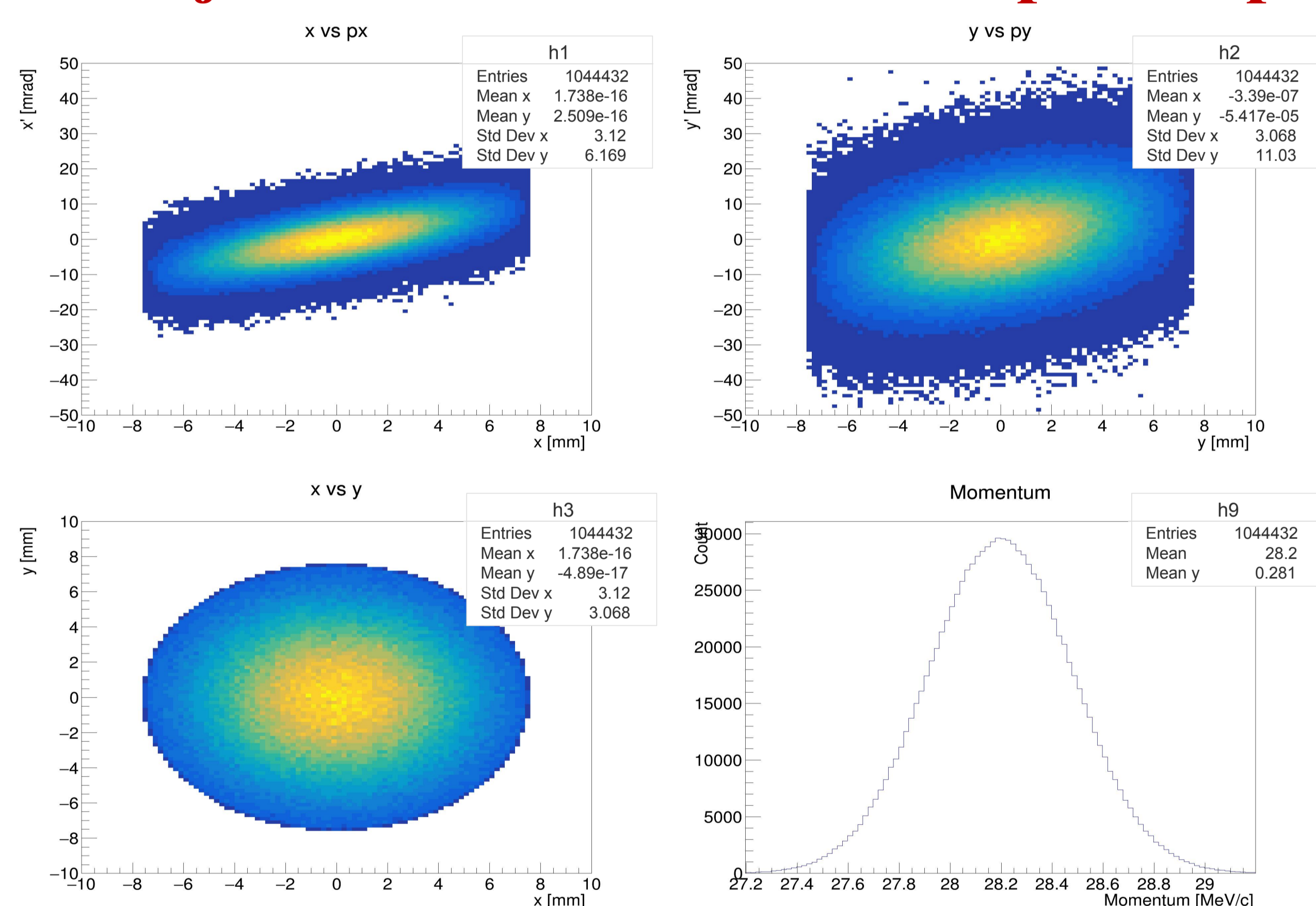
| Parameter Symbol | Description | Value |
|-------------------|-----------------------------------|-----------------------|
| Theta | Injection angle | -45.022° |
| Phi | Transverse angle | 9.244° |
| InjR | Injection radius | 45.561 mm |
| Z | Longitudinal injection coordinate | -443.836 mm |
| A _{Weak} | weak coil current | 1.5 A/mm ² |
| A _{CC} | correction coil current | 2.5 A/mm ² |

parameters sketch map

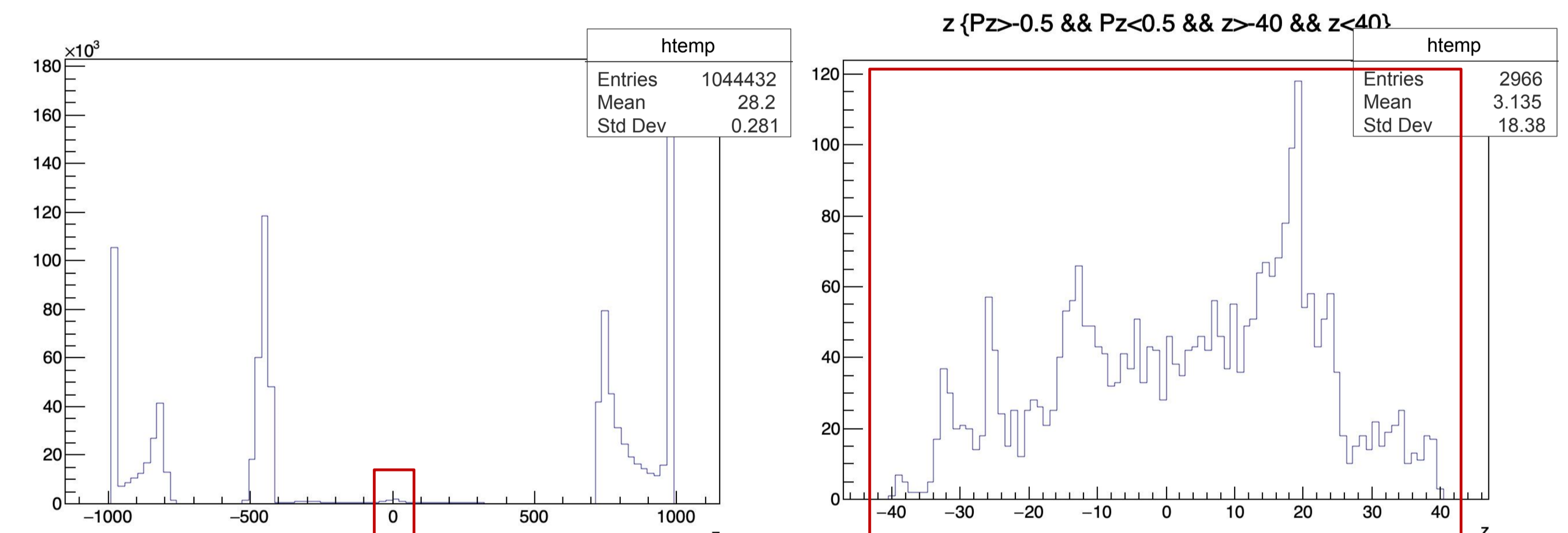


Storage efficiency: $N_{\text{stored}}/N_{\text{injected}} \sim 0.30\%$

muon injection beam distribution phase space



stored muons

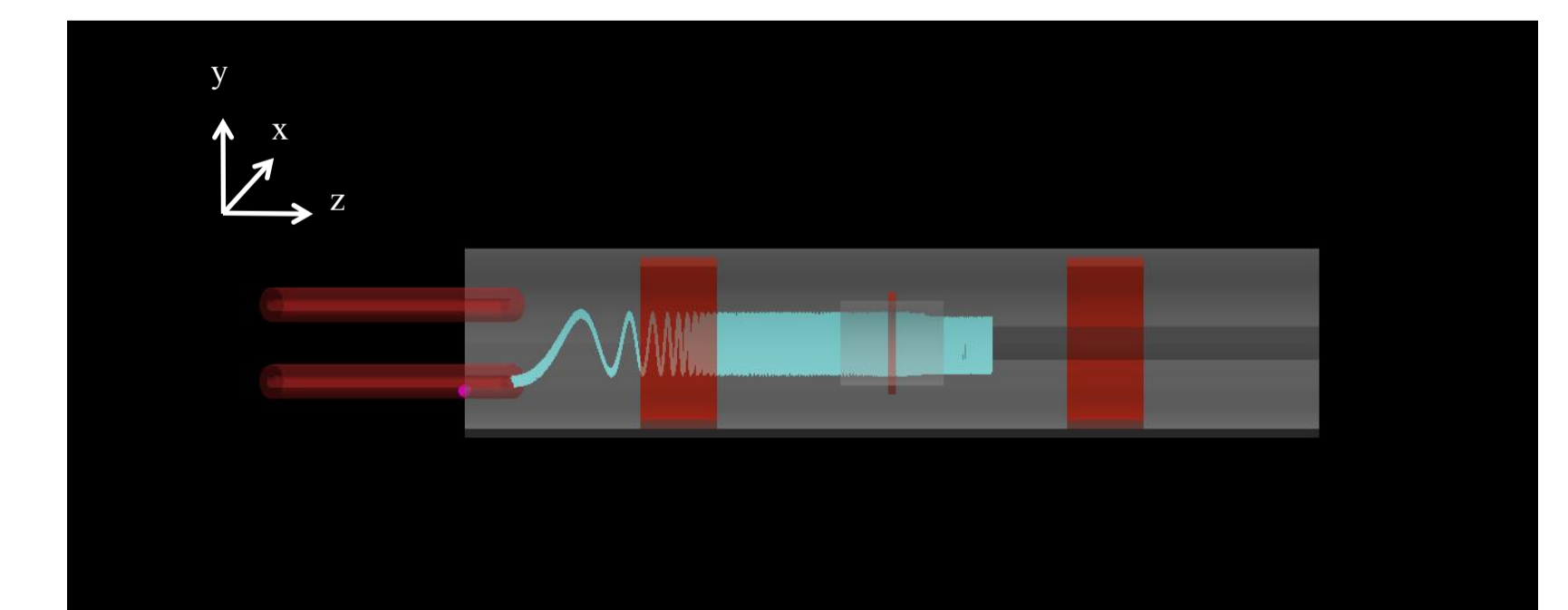


definition of stored muons:

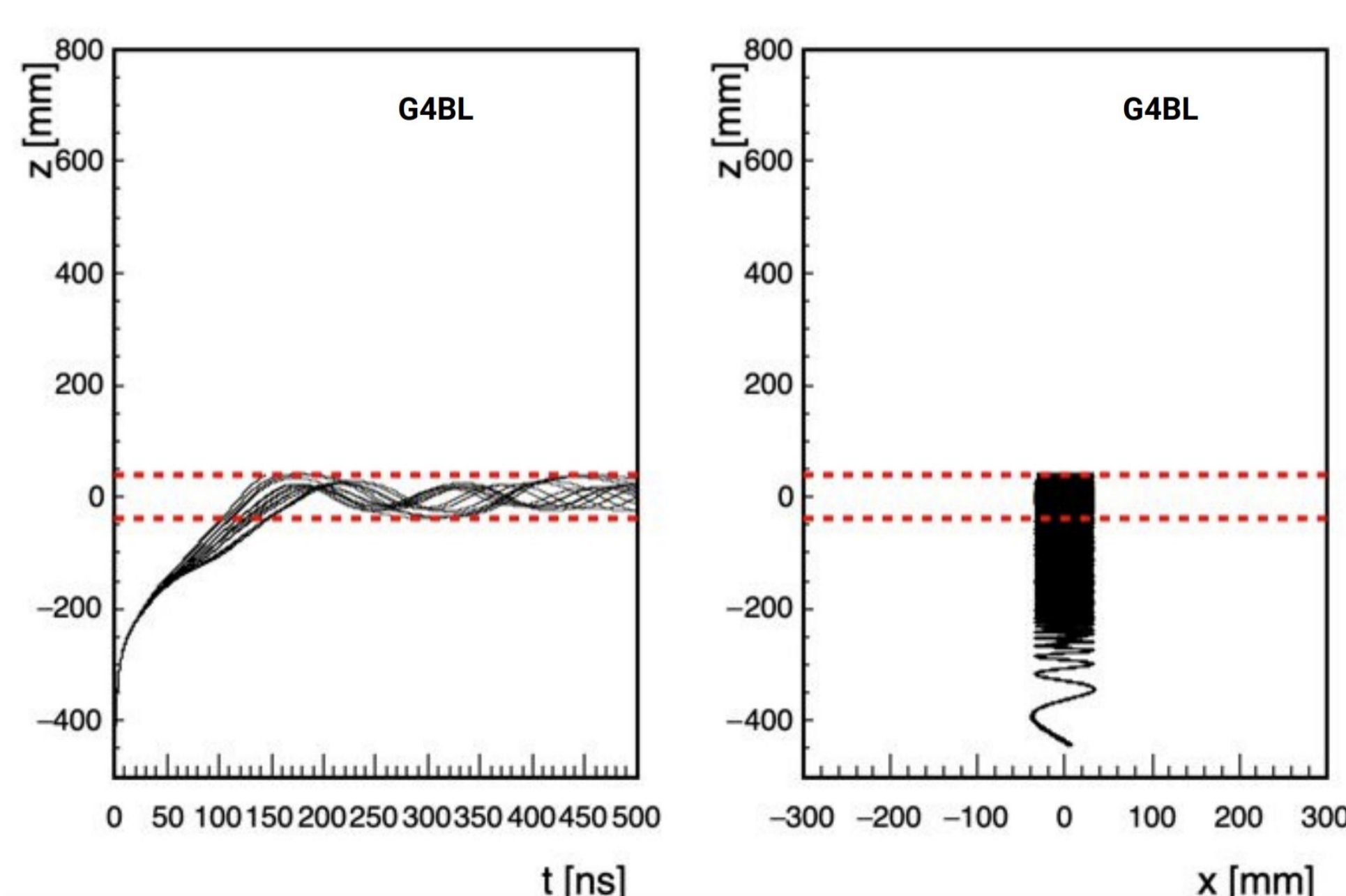
$$-40 < z < 40(\text{mm})$$

$$\text{and}$$

$$-0.5 < P_z < 0.5(\text{MeV})$$



stored muons' trajectory:



red dotted line highlight the storage region

Conclusion

- We have set up a G4beamline-based muon beam injection and storage study for the muEDM experiment.
- All the magnetic and electric field maps are incorporated into the simulation.
- Preliminary optimization indicated a storage efficiency of 0.30%.
- Future optimizations will be performed using the Bayesian optimization technique.

References

- [1] G. W. Bennett, *et al.*, Phys. Rev. D 80, 052008 (2009)
- [2] E. Brochu, *et al.*, arXiv:1012.2599
- [3] Chenran Xu, *et al.*, Phys. Rev. Accel. Beams 26, 034601 (2023)