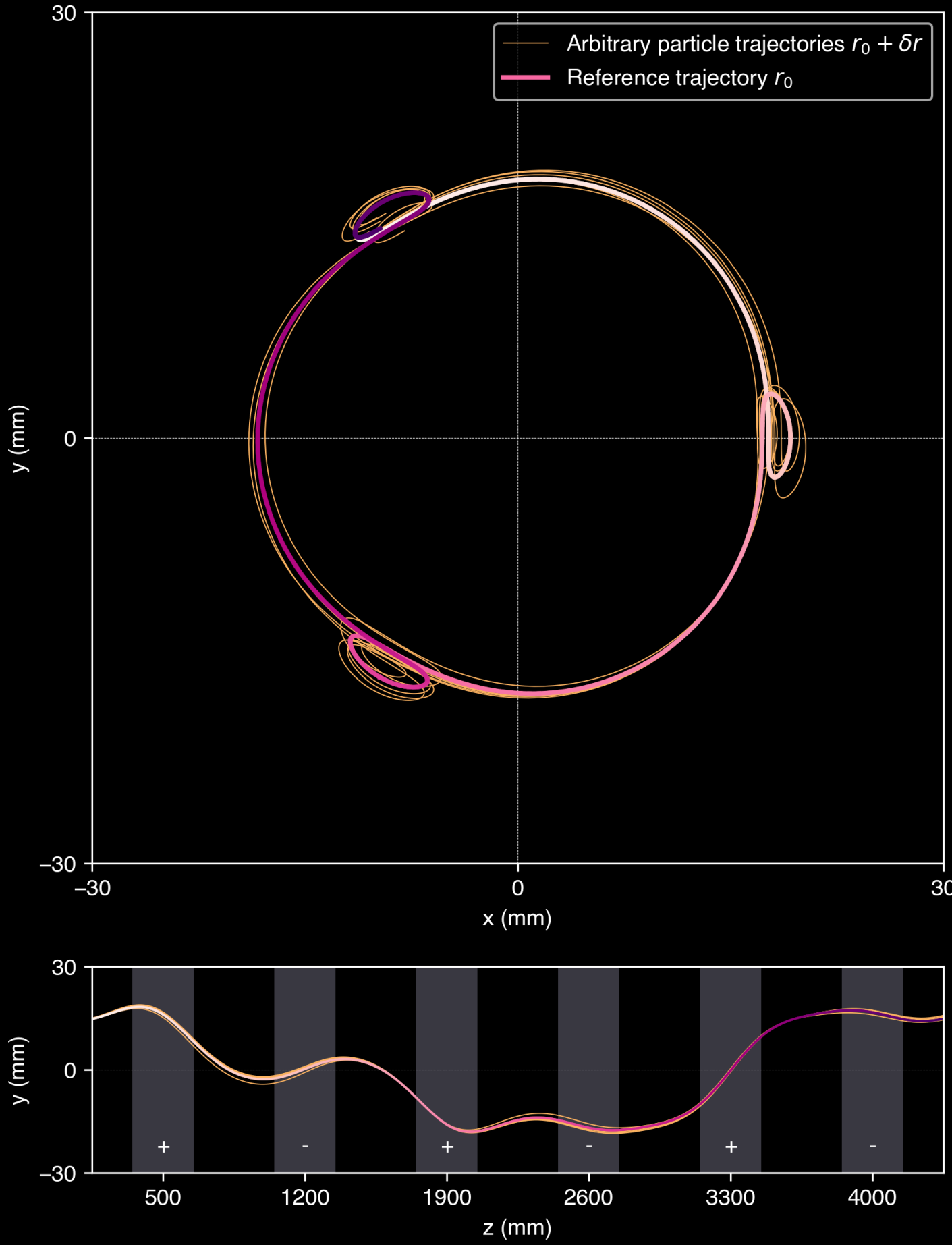
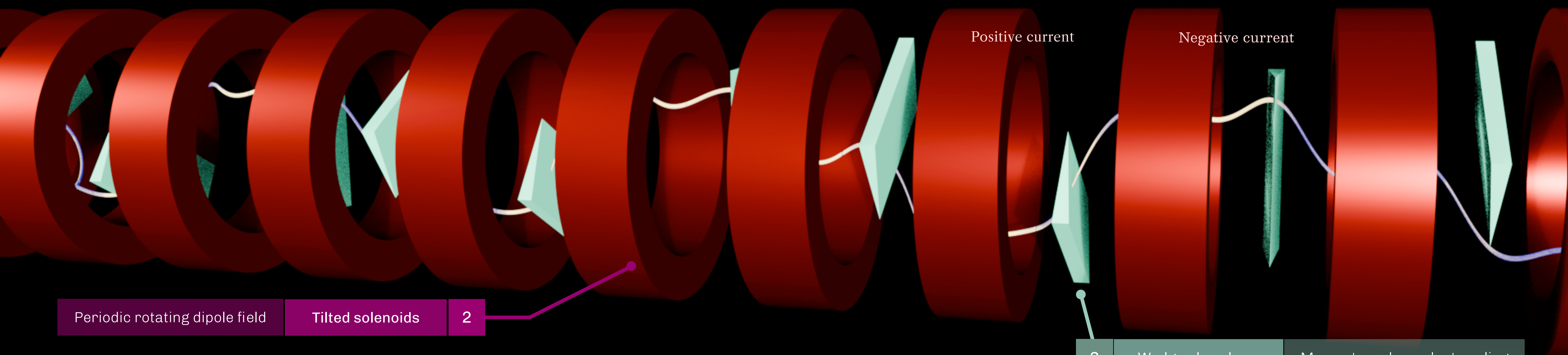


Beam Matching for the HFOFO Snake 6D Cooling Channel

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The helical FOFO snake is a design for initial muon cooling. It operates on three main principles:



The tilting of solenoids about their axes breaks the azimuthal symmetry of the magnetic field, and generates multipole components that form a periodically rotating dipole field. This gives rise to the defining feature of the channel: the helical beam trajectory.

The periodicity of the rotating field allows both muons and antimuons to take the same path, offset longitudinally, making the channel truly charge-agnostic.

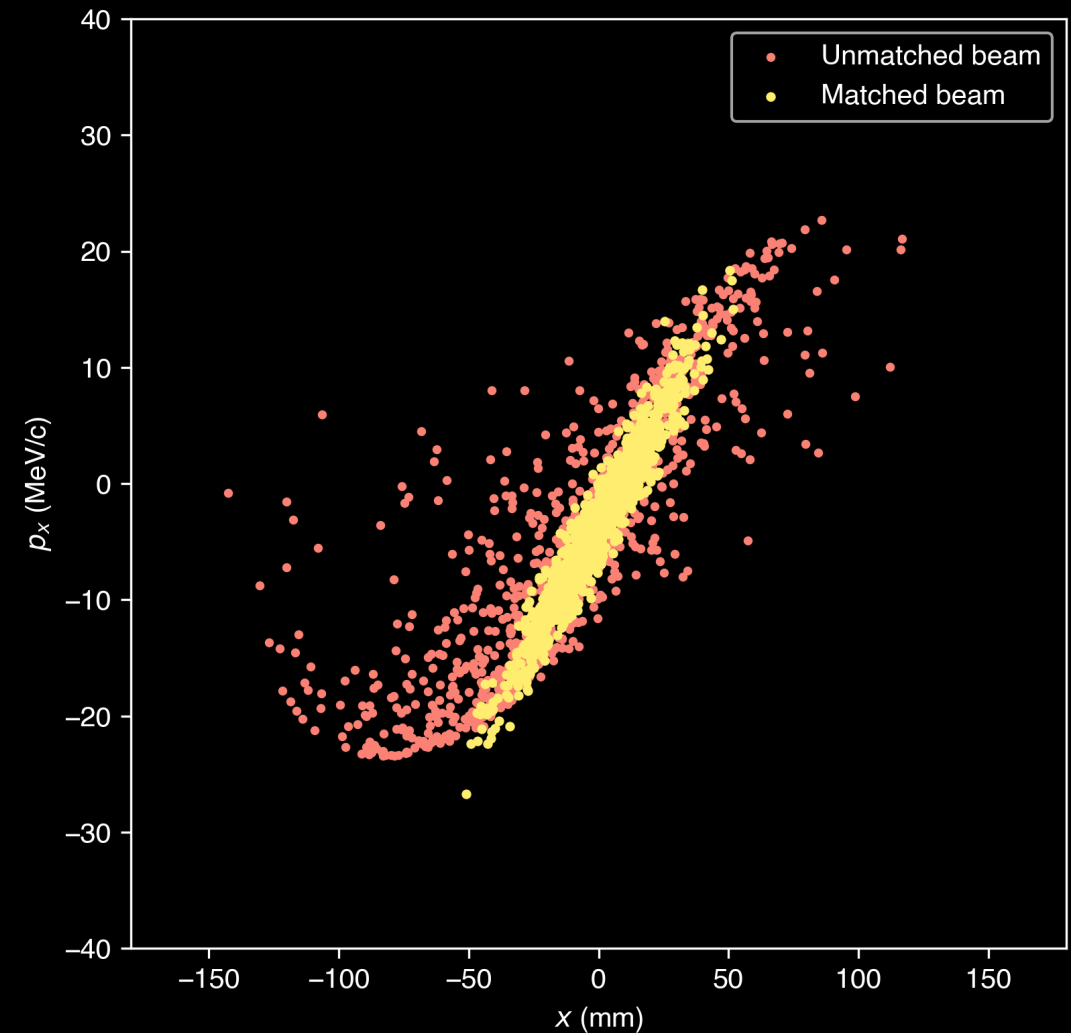
These tilts are also key players in the HFOFO's matching section.



Scan to see a visualization of the rotating fields!

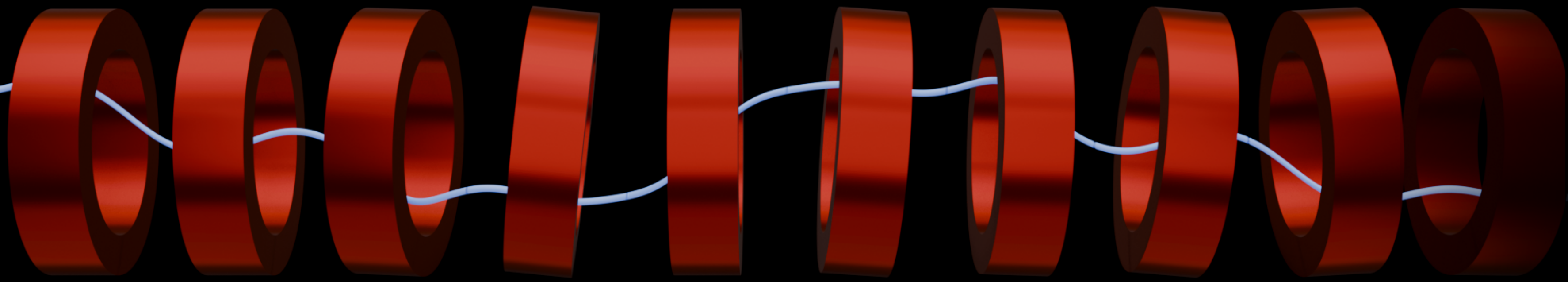
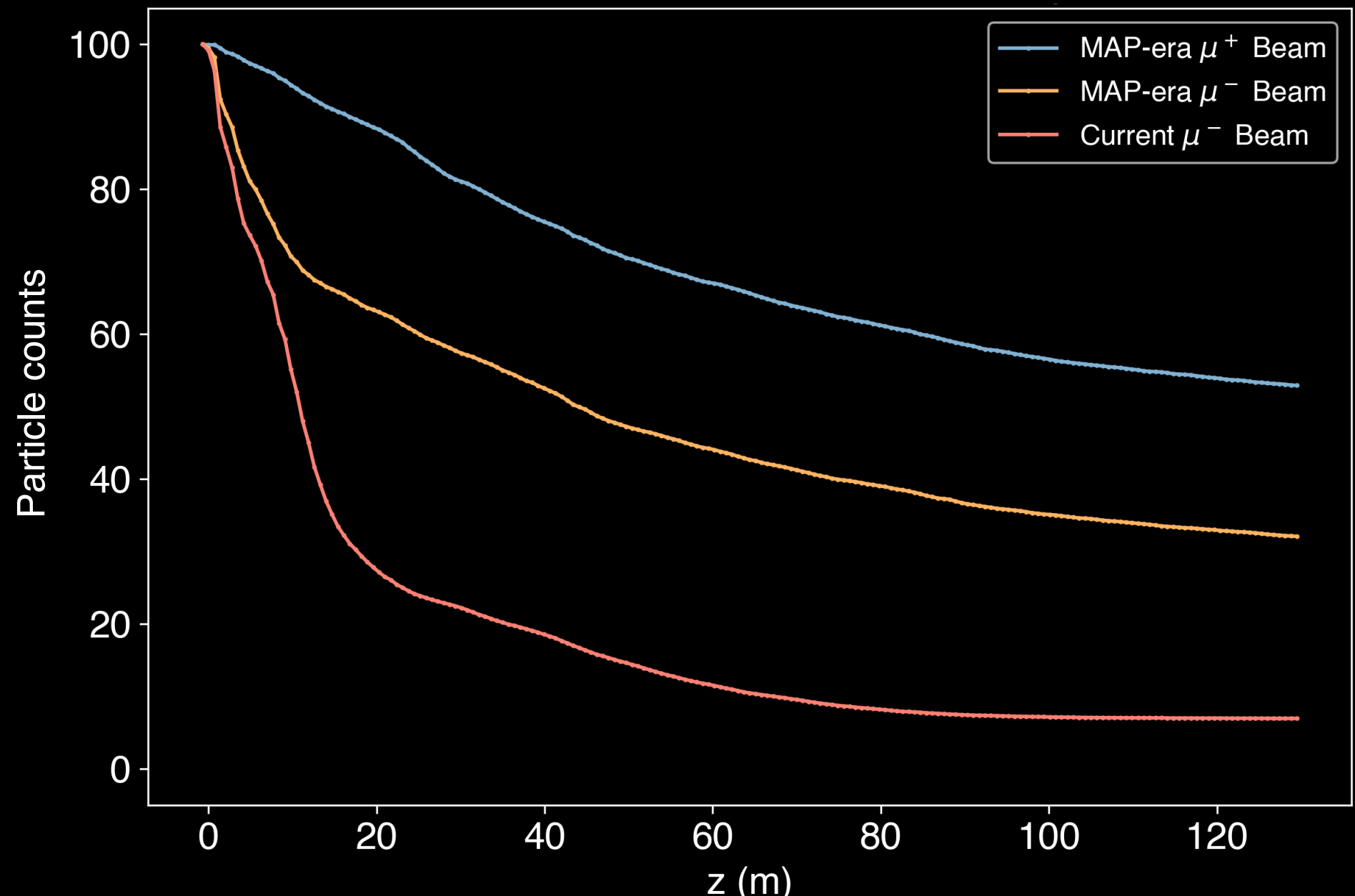
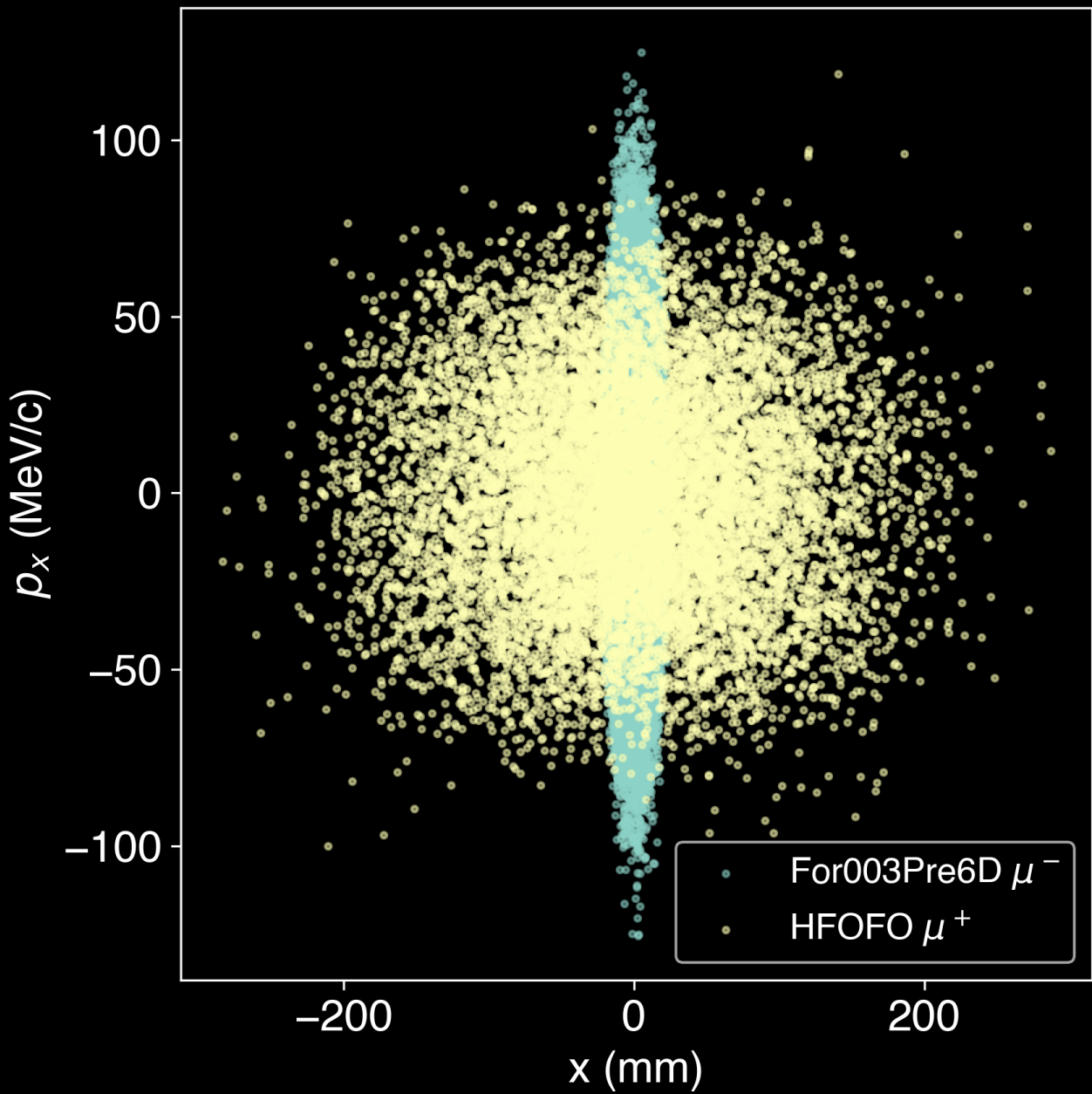
The case for beam matching

Particle loss in an accelerator can be mitigated by **matching** the beam to the channel. The shape and size of the beam envelope ellipsoid in phase space, generally described by Twiss parameters, are altered to match the optimal parameters for a specific channel. HFOFO presents novel challenges in beam matching due to its helical design trajectory.



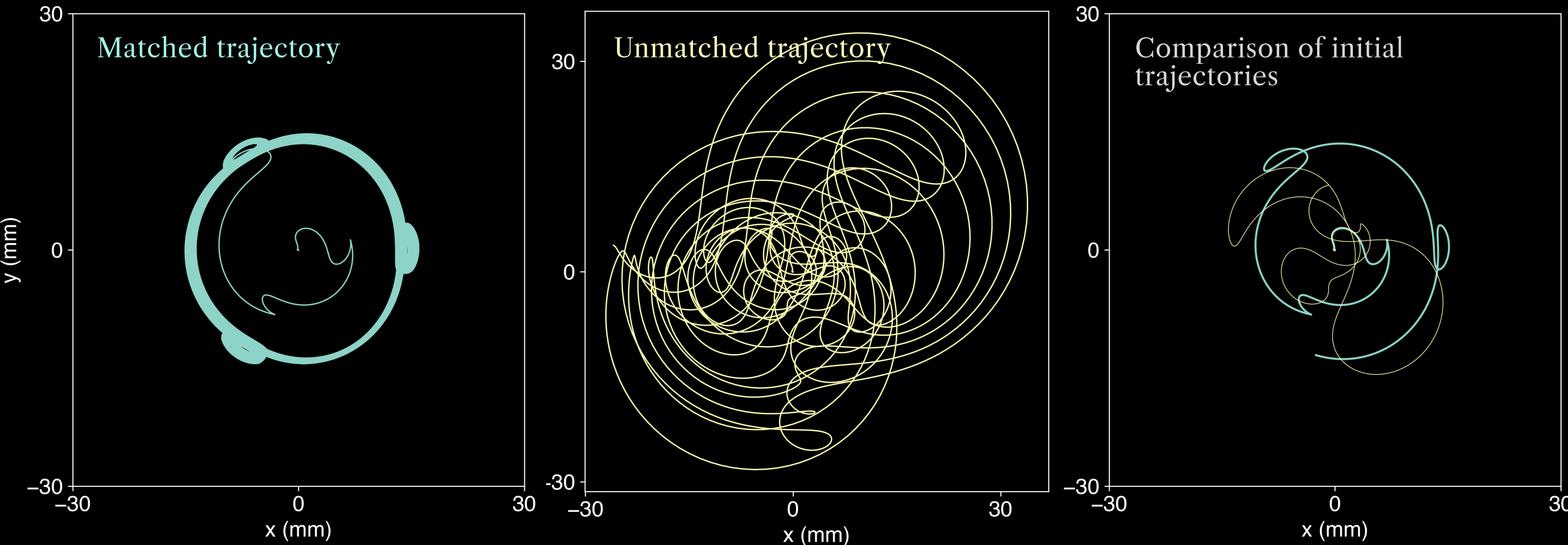
Performance

HFOFO was **pioneered**¹ during the Muon Accelerator Program, and the matching section was tailored for the beam paradigm prevailing then.



The HFOFO matching section

The matching section is a group of nine solenoids at the start of the main cooling channel, each with a unique set of parameters. This section prepares the beam for the HFOFO channel by modulating the reference trajectory and cancelling out fringe field effects.



A design-agnostic matching protocol

We **adapt** the existing channel to new beam designs by replicating the trajectories.

