Antiproton background and vertical misalignment

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Midterm presentation
29 August 2022

In partnership with:

- **I'm studying the antiproton background.**

- **Today I'm talking about what I learnt during these past weeks.**

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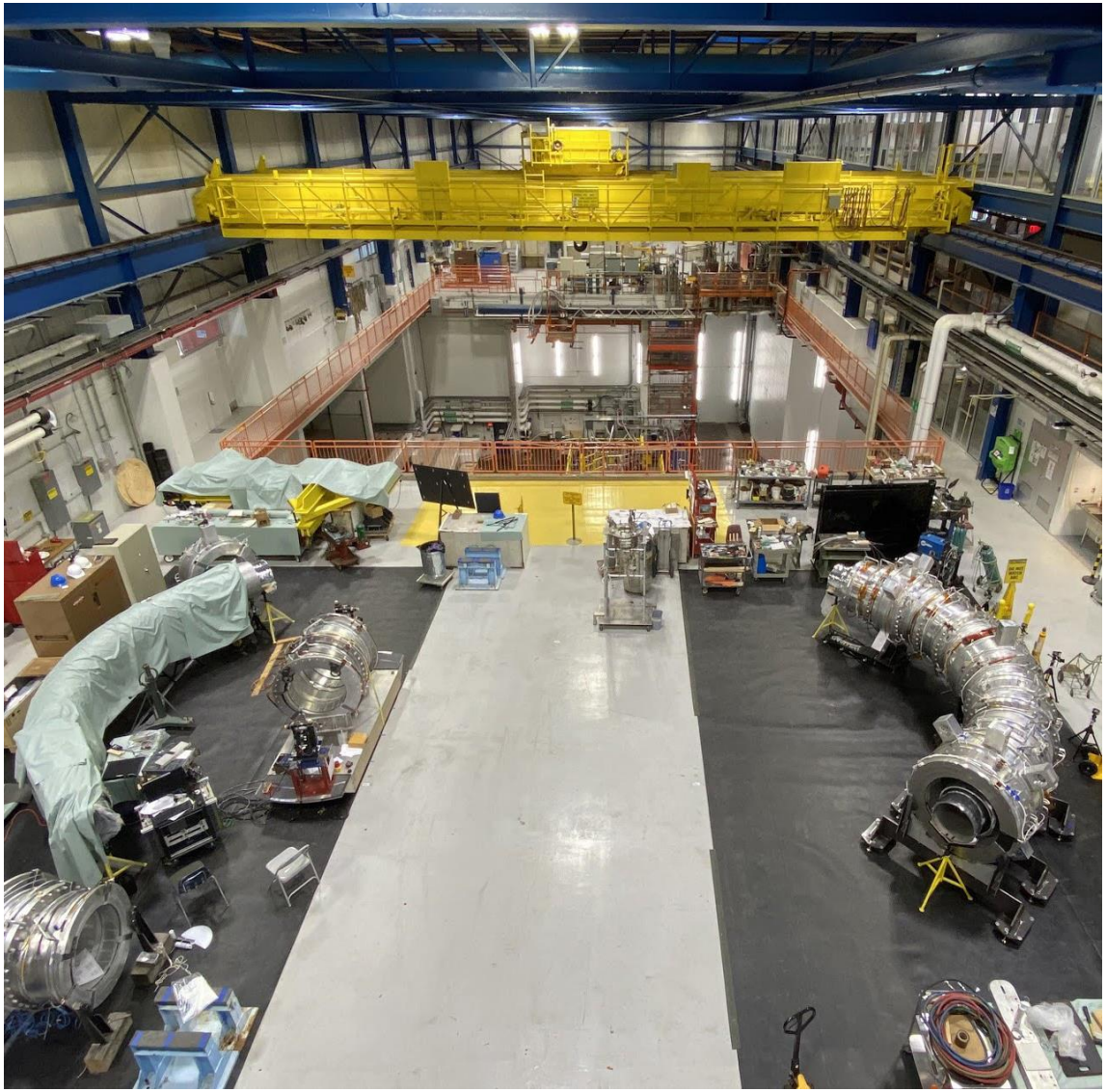

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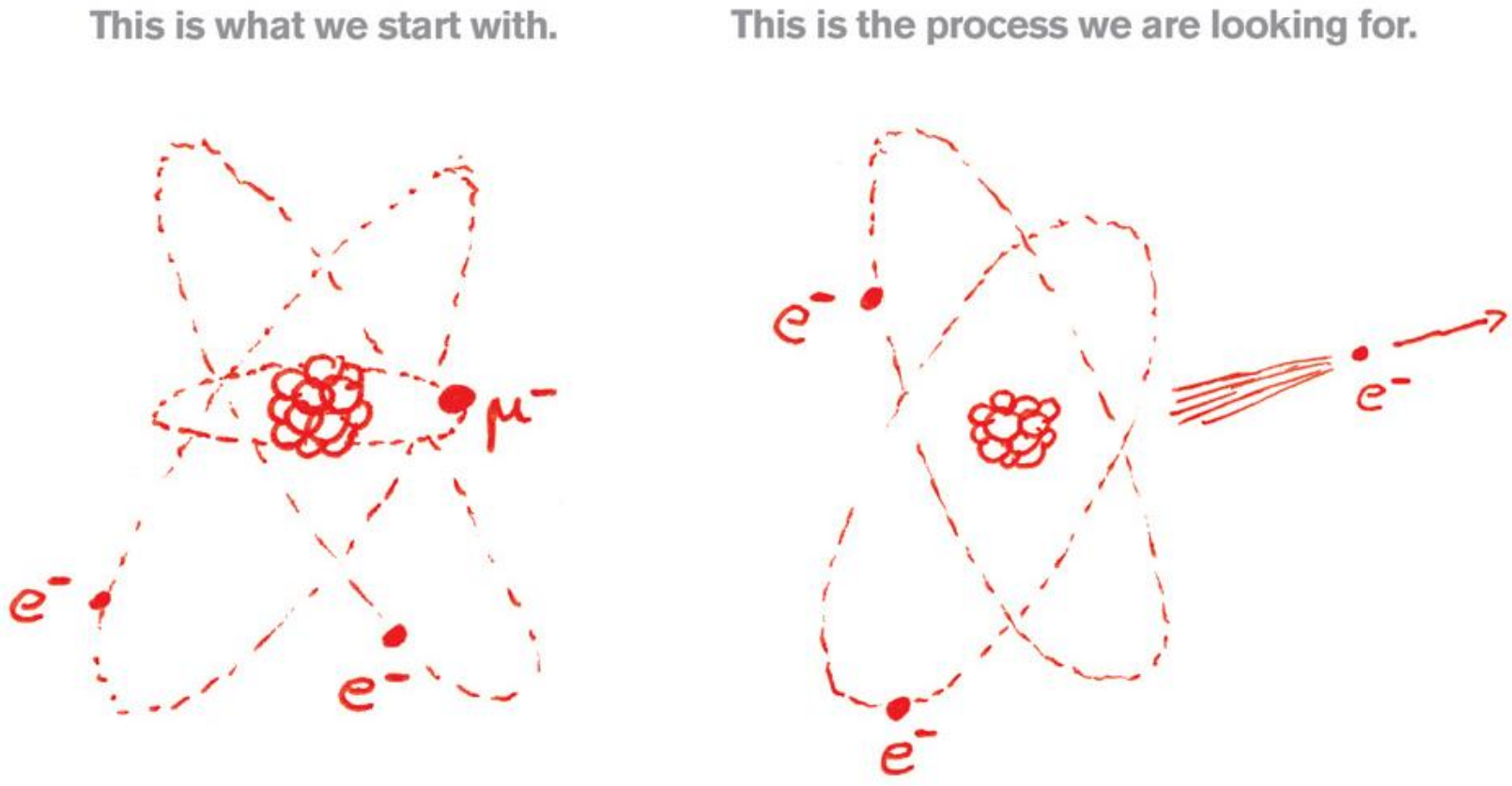
MU2E



The Mu2e experiment at Fermilab will search for the neutrinoless

$$\mu^- \rightarrow e^-$$

conversion in the field of an aluminum nucleus.

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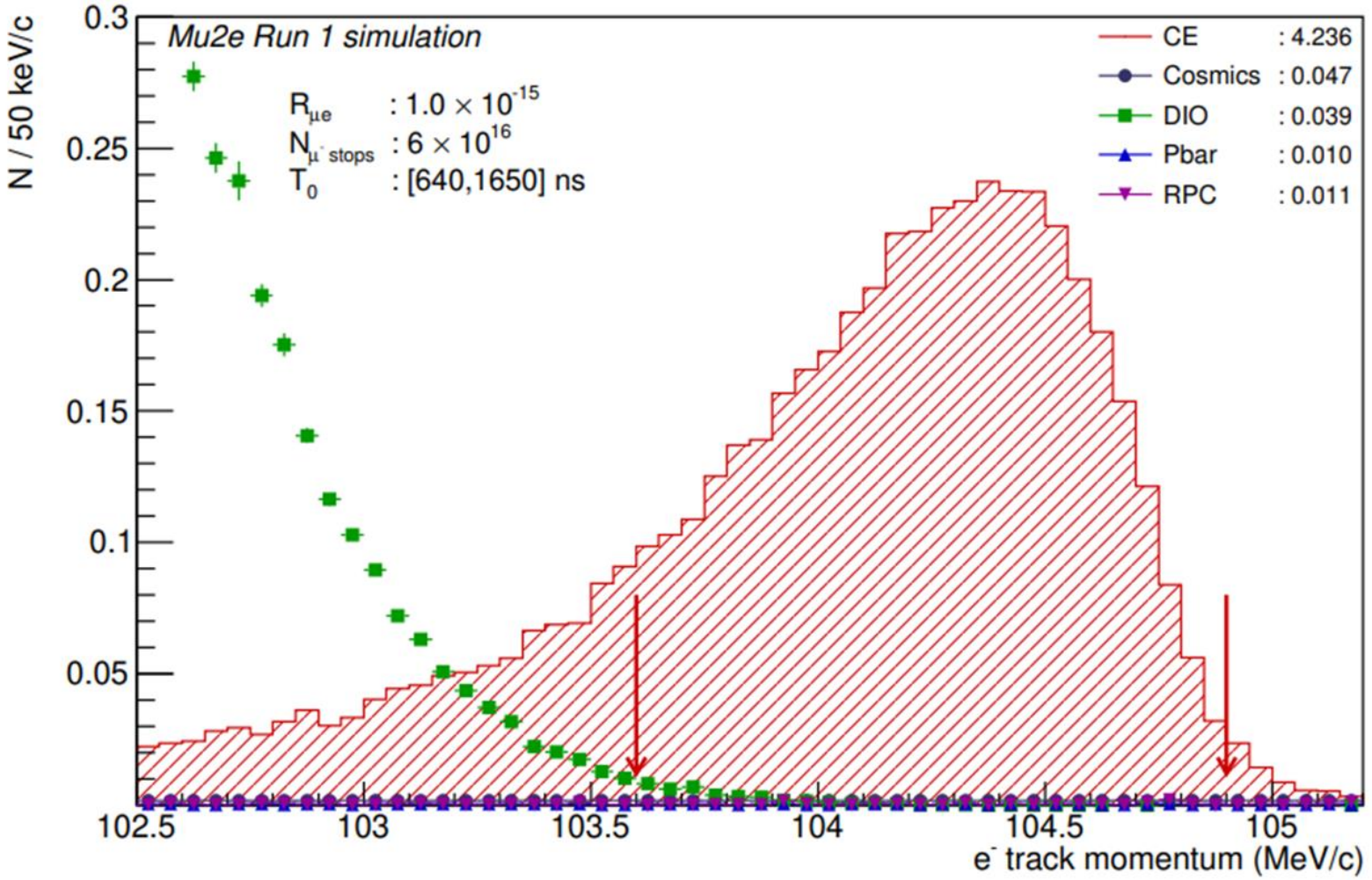

- **We are looking for a conversion e^-.**

- **Expect a peak around 105 MeV/c in the momentum distribution.**

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Backgrounds

The main background processes in Mu2e are:

- **RPC – Radiative capture of pions**
- **Antiprotons**
- **DIO – Decay in orbit of Muons**
- **Cosmic rays**

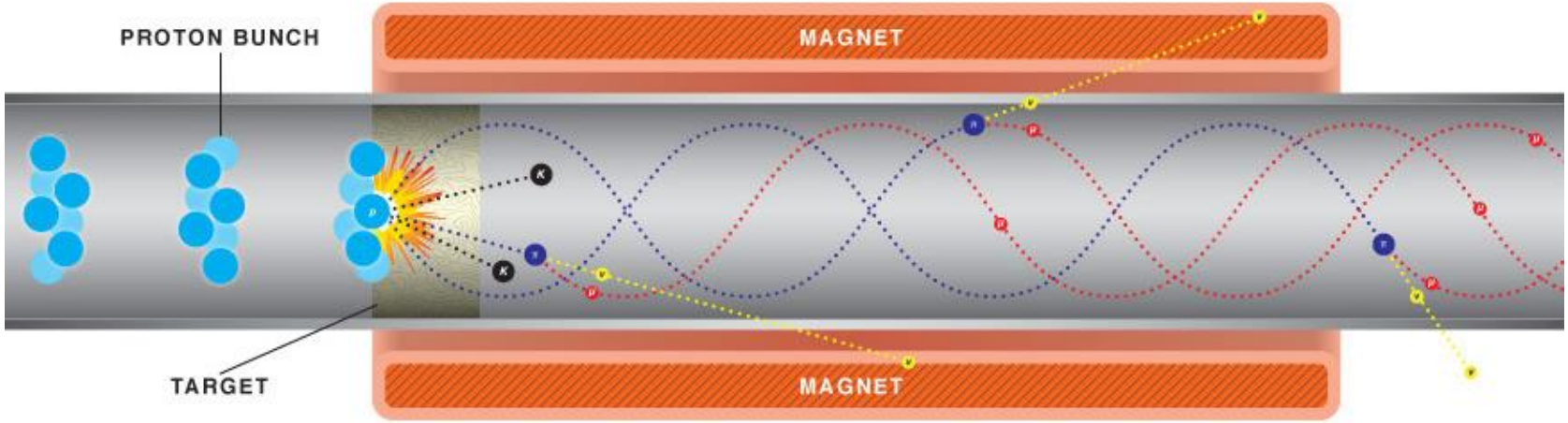
- **The estimated total background for Mu2e is about 0.1 events per year.**

- **It is still necessary to study the background well as it is a very sensitive search.**

Antiproton Background

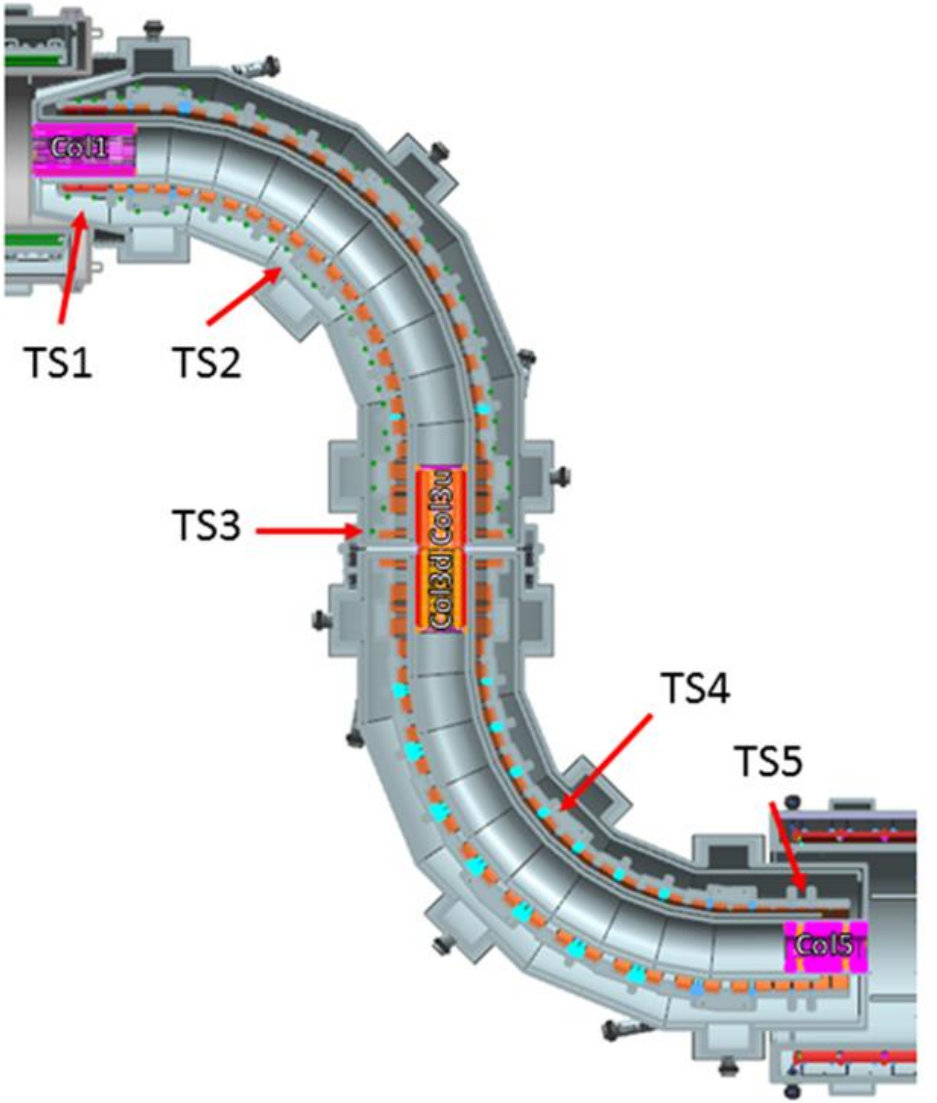
- **Antiproton annihilation in the stopping target.**

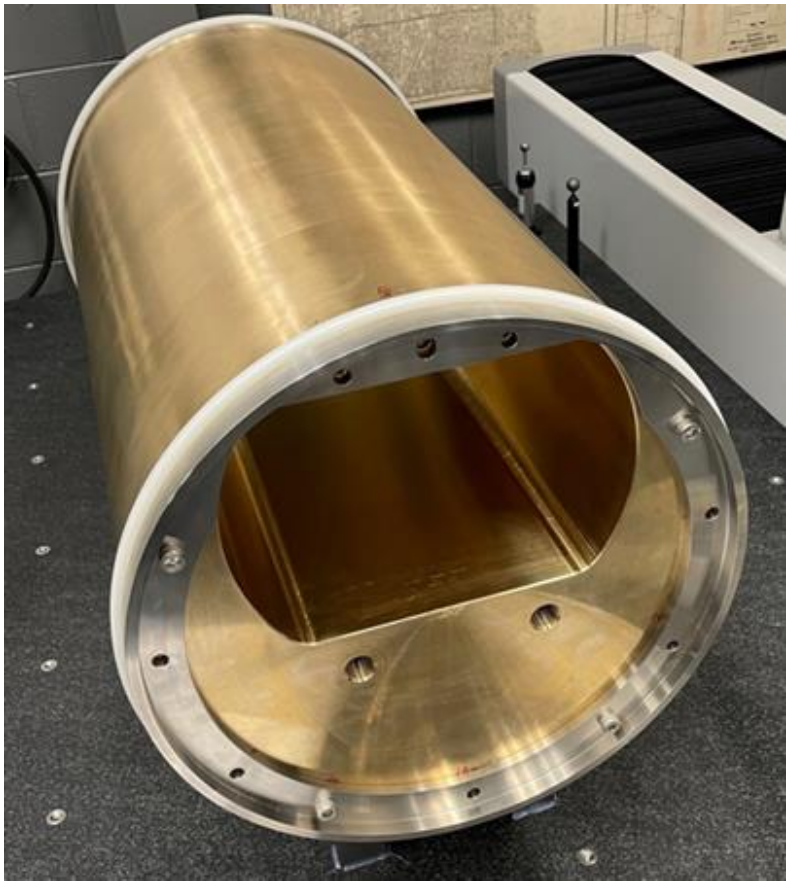
- **Uncertainty on the angular dependence of antiproton production cross section.**

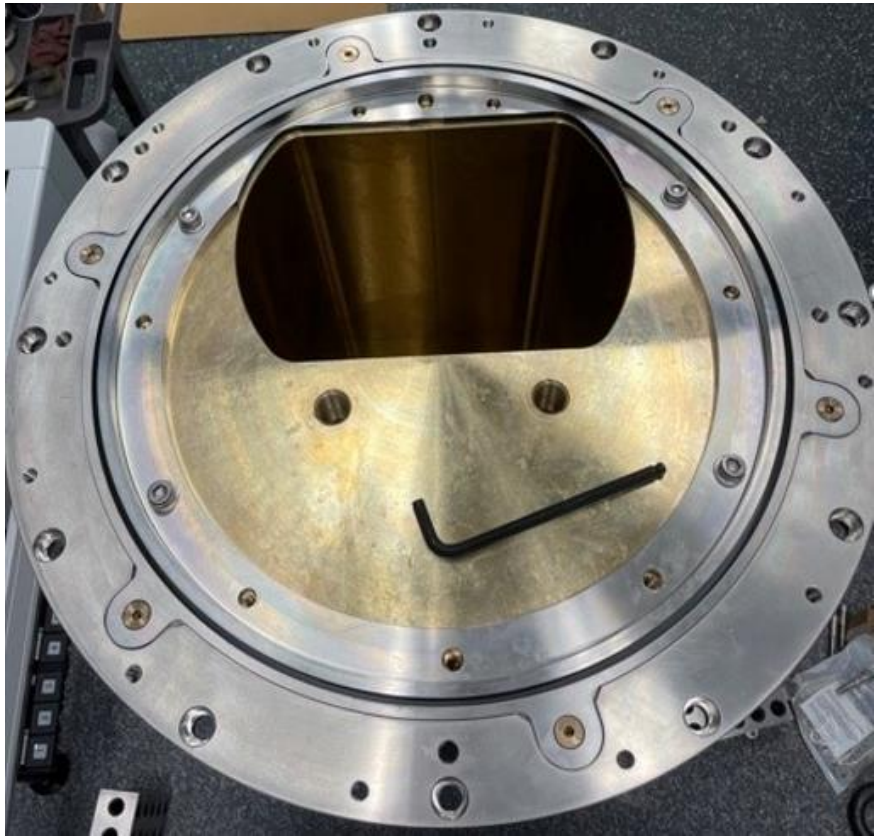


- **Antiprotons can enter the DS, interact with the stopping target and produce signal like e^-.**

- **There are absorber elements placed in the TS to reduce this background.**







- **A collimator is placed in the middle of the TS, to block the positively charged particles.**
- **The collimator Is not magnetic in nature.**

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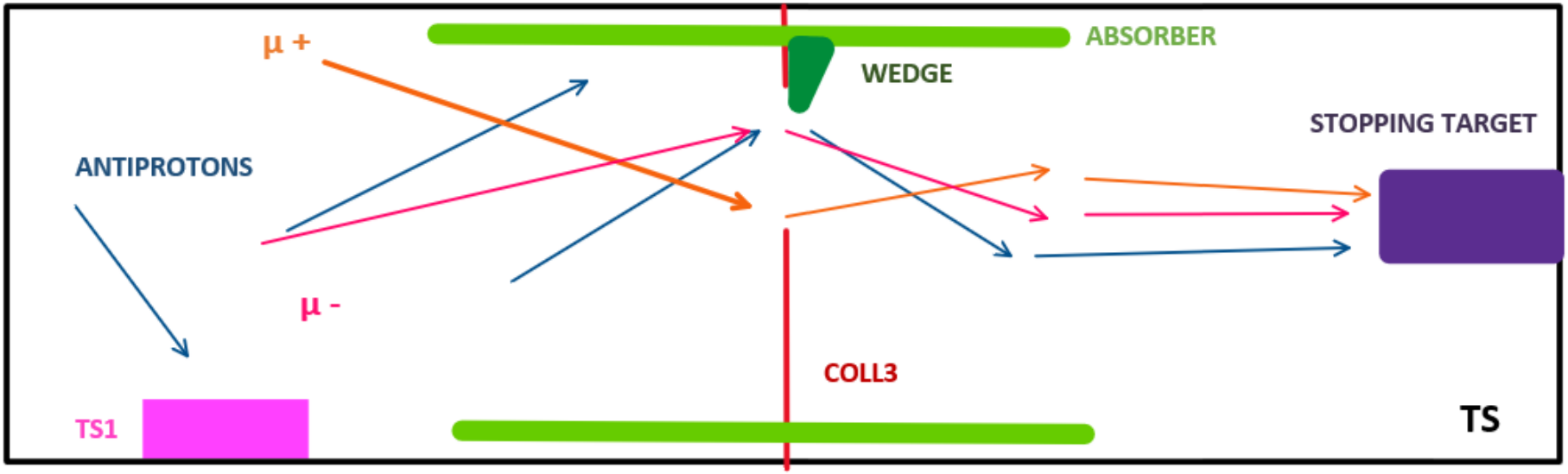
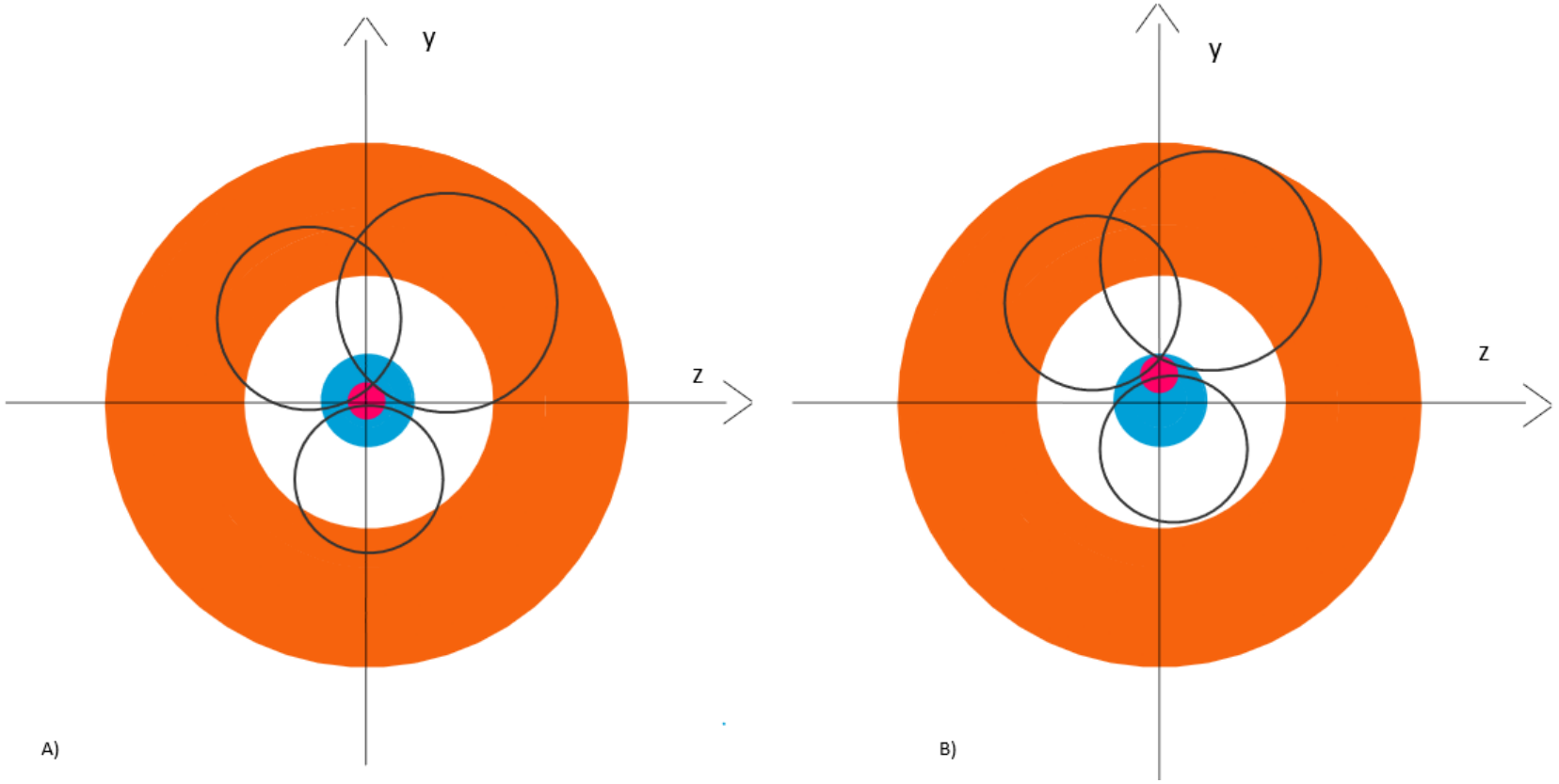
Vertical misalignment

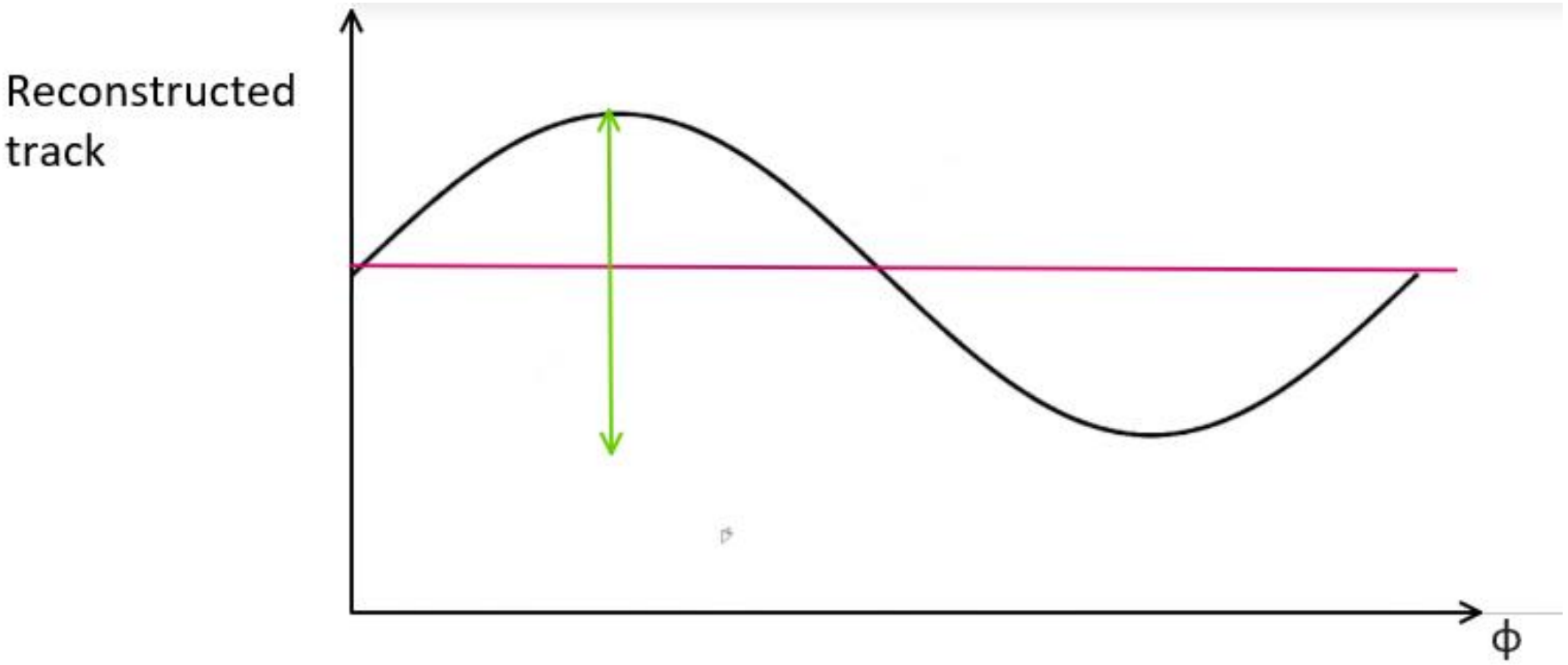


- In the magnetic field the particles drift.
- If the antiproton doesn't interact with TS there is a non zero probability to pass through the TS.
- Alignments affect this probability.



- **The beam may shift from its expected trajectory.**
- **The light spot of the beam and the axis of the system will misalign.**
- **This decreases the number of blocked particles by the collimator.**

Possible effect of misalignment

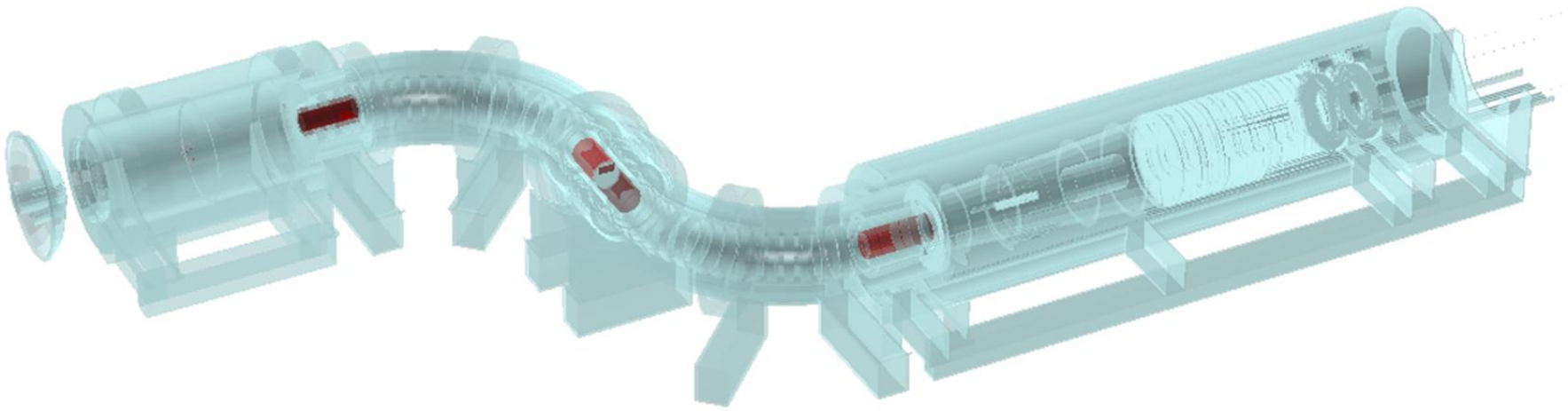


- **Expect asymmetry in the phi distribution of the reconstructed tracks.**
- **The size of the asymmetry determines the vertical misalignment.**

Tools

- Simulation
- Reconstruction
- Event display
- Analysis software

Simulation

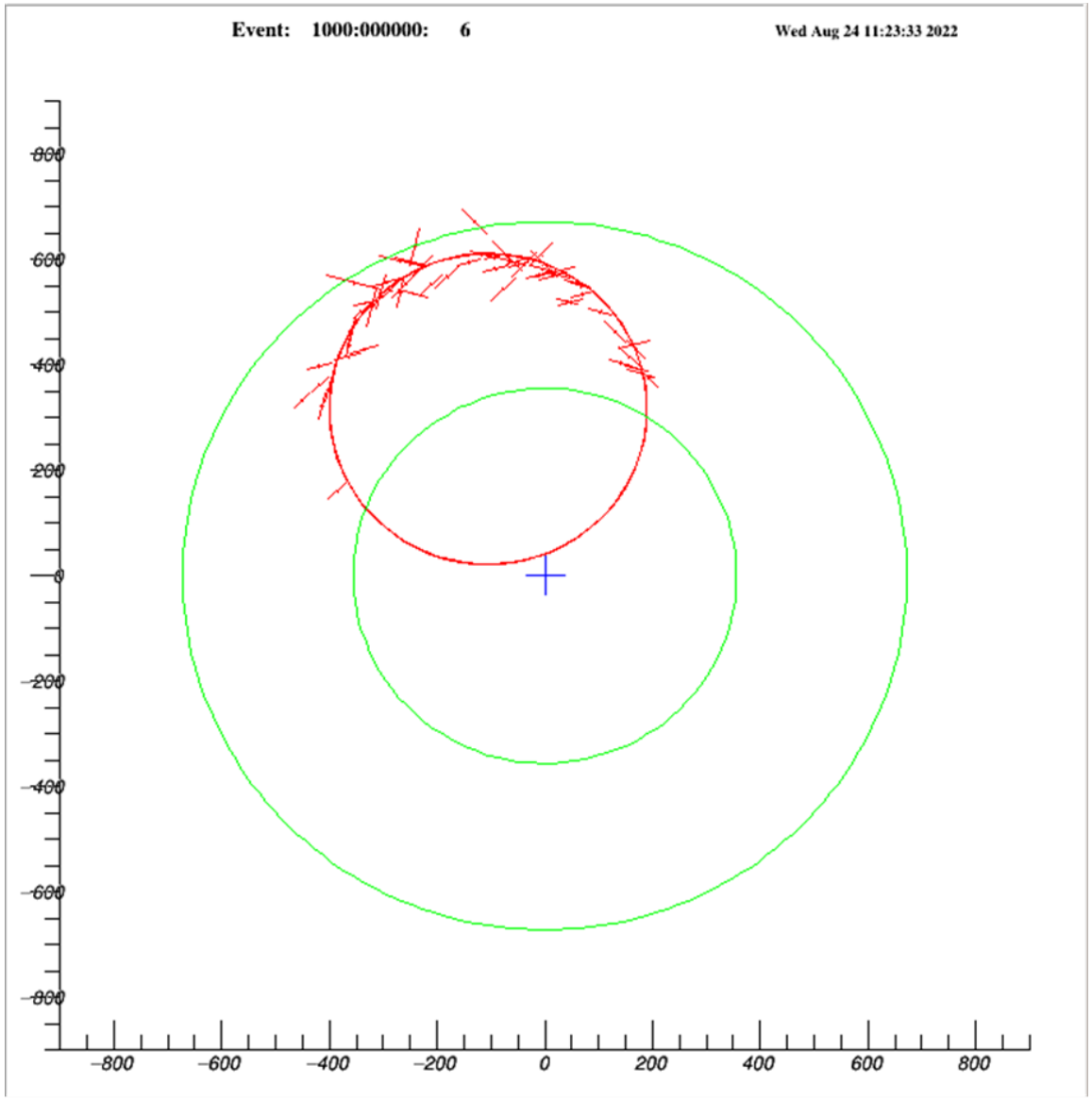


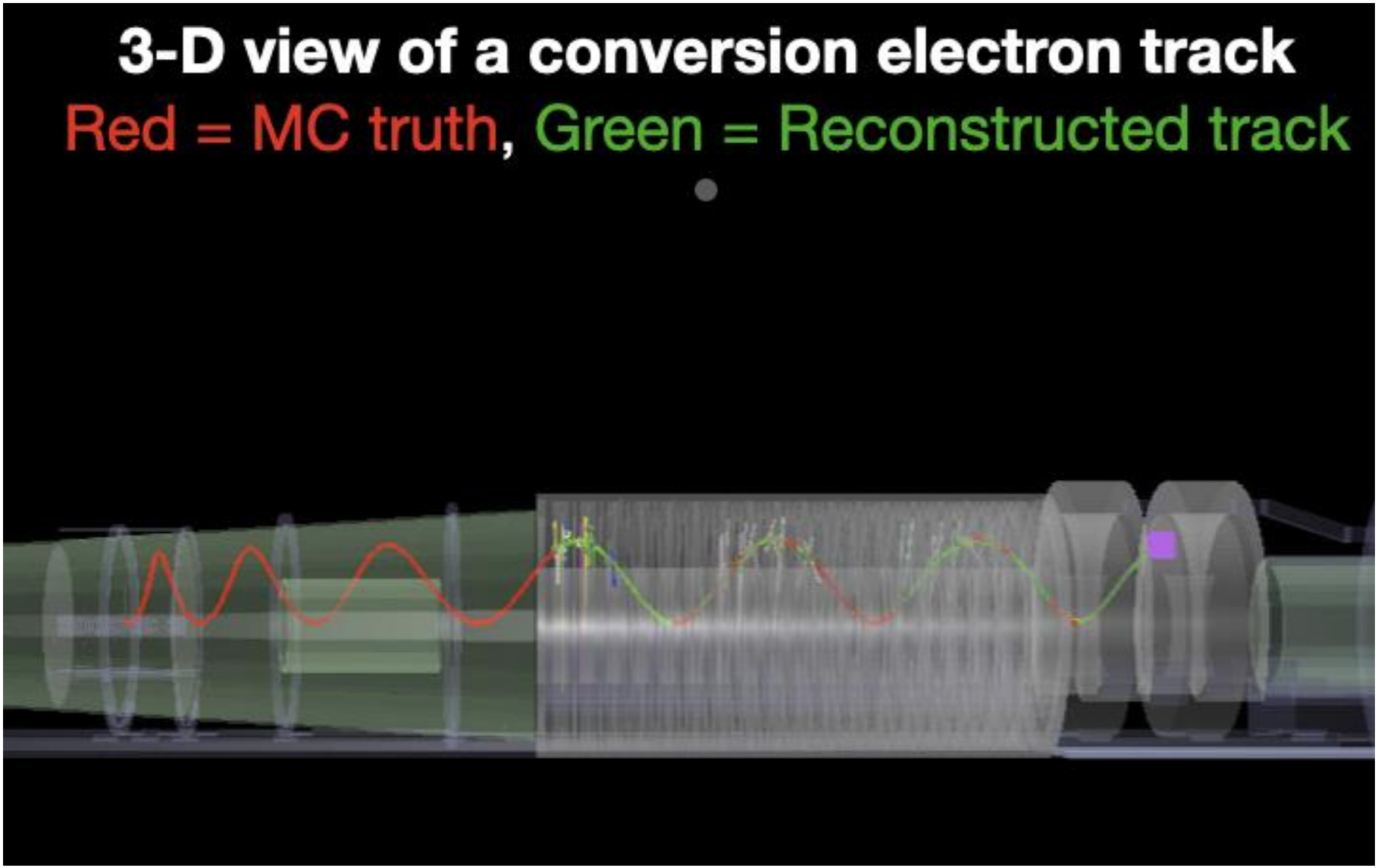
- We simulate and study processes of interest in the detector
- Beam transport – one of the studied processes

Event display

- The muons stopping in the stopping target could produce conversion e^-.

- Electron tracks are reconstructed in the straw tracker.




3-D view of a conversion electron track
Red = MC truth, Green = Reconstructed track

Goals for the coming weeks

With these tools I intend to study the impact of misalignment on the antiproton background.

The following are the upcoming steps :

- **Simulate the muons produced by the interaction between proton beam and production target**
- **Trace the muons to the stopping target**
- **Appropriately vary the geometry of the transport solenoid**
- **Reconstruct the events and calculate the misalignment**


THANK YOU FOR YOUR ATTENTION!