Particle Timing and Distance

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Project Overview

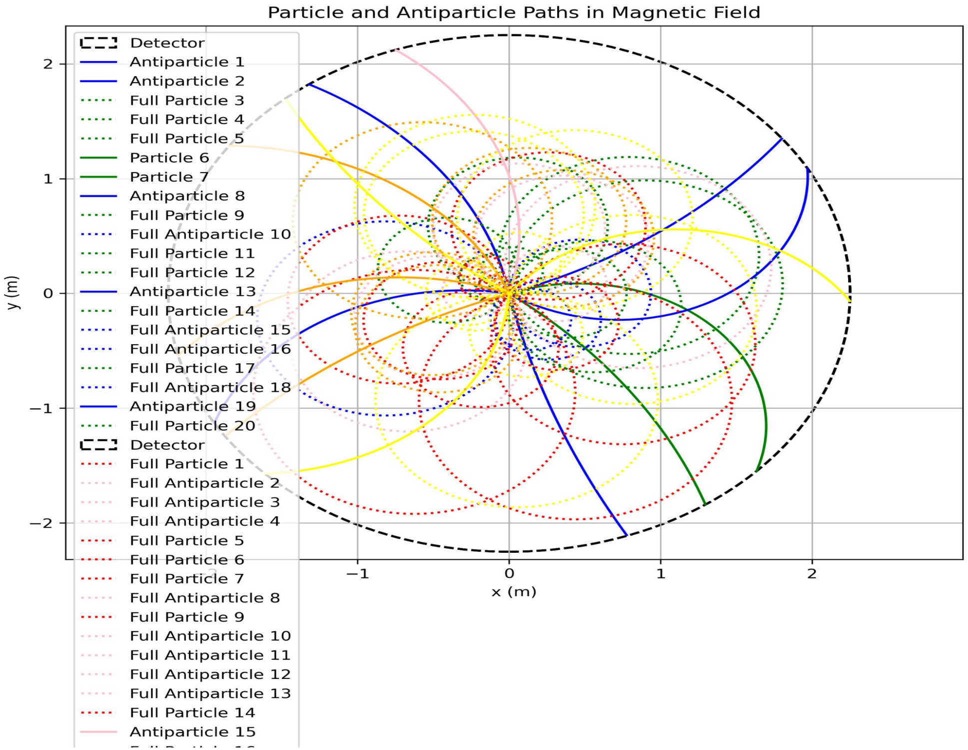
- In flavour physics it is very important to correctly identify charged hadrons.
- Possible by measuring their time-of-flight from one point in the detector to another.
- Hadrons differ in their mass, m = p/velocity = p/(distance/time)

Project: Is it possible to distinguish charged hadrons by measuring their time-of-flight with the tracking detectors?

Shekinah's Approach

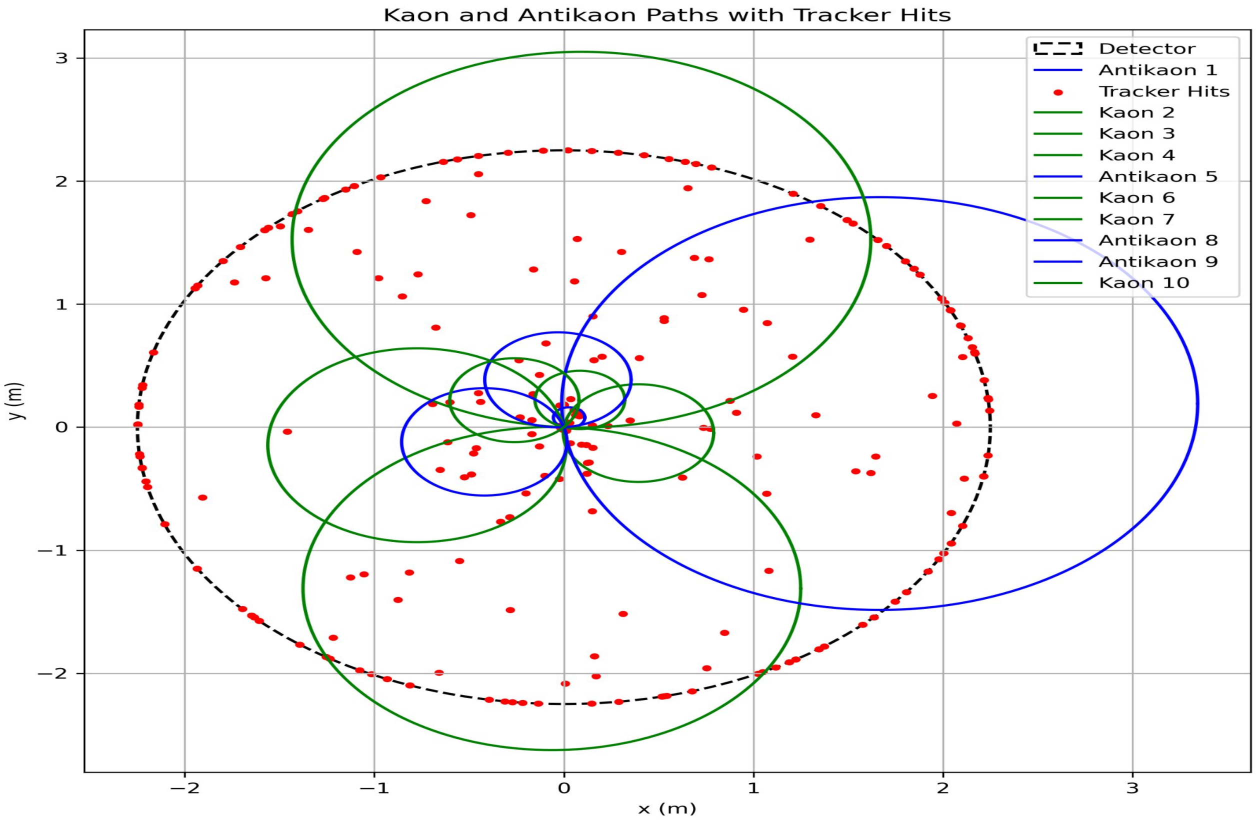
- Looking at kaons, pions and protons.
- Have momentum data, charge and the B field.
- Able to get the radius of the detector by plotting the Tracker.hits and extracting value from there.
- Used formula for gyroradius to calculate the radius of each circle described by each particle. ($r = p/qB$)
- Used another similar formula to get the centre of the circle for each particle. ($x=py/qB$).
- Plotted circular paths of the particles up to when they hit the detector.
- Checked whether they hit by checking for intersection points.

Plots Created



- Got radius of 20 particles and antiparticles each (kaons, pions, protons etc.).
- Some would intersect hit the detector and others wouldn’t.
- Those that didn’t, hit the endcaps.
- Plotted paths up to detector boundary and full circular paths for those not intersecting.

Plots Created

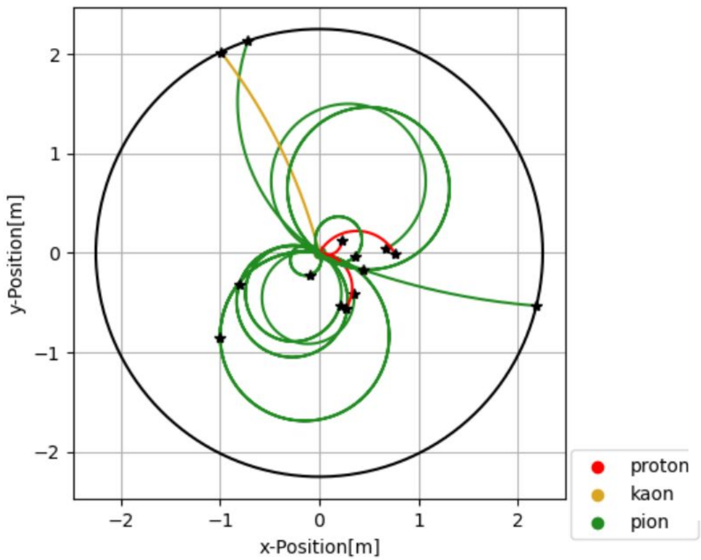


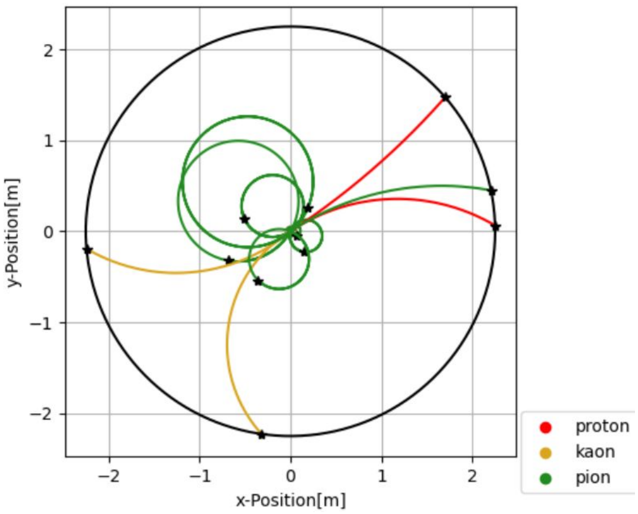
- Plotted tracker hits for 100 particles (detector boundary shows up).
- Also plotted full circular paths of particles.

Jovani’s Approach

- Isolate the kaon, pion, and proton information into a seperate file with all relevant information
  - X,Y,Z momentum
  - Coordinates in main file
  - Particle Type
- Found the size of the tracker using information in the tracker hit data
- Using the equation F = (qv)x(B) plot the change in position over small step sizes.
- Determine whether the particle has touched the tracker by checking the distance of the particle from the center after each step.
- If the particle hits the ends of the cylindrical tracker, the steps stop
- Measure total travel distance of particle by adding the distance traveled over each step

Plots Created



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Particle:
Ending X: 0.20842504810156415
Ending Y: -0.5239130855189521
Ending Z: -2.4999813594308375
Radius = 0.5638492013421037
Distance traveled:6.019038353051974
Cylinder End Reached
Step number: 79009
Particle Type: anti-pion

Particle:
Ending X: -0.7181453296479122
Ending Y: 2.132162386668041
Ending Z: -1.0427282442144126
Radius = 2.249855363710535
Distance traveled:2.6402861735801455
Radius Too High
Step number: 9300
Particle Type: pion

Particle:
Ending X: -0.8046263284386508
Ending Y: -0.31413072786255847
Ending Z: -2.0178658998135393
Radius = 0.863771753766077
Unfactored Distance:8.268972402536324
Distance traveled:10.244700110275437
Max Steps Reached
Step number: 100000
Particle Type: anti-pion
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- Sample plots of 10-15 particles each

- Data about each particle plotted

Currently

- Working on particles that hit the endcaps.
- Can get helical distance.
- Looking at z-momentum.