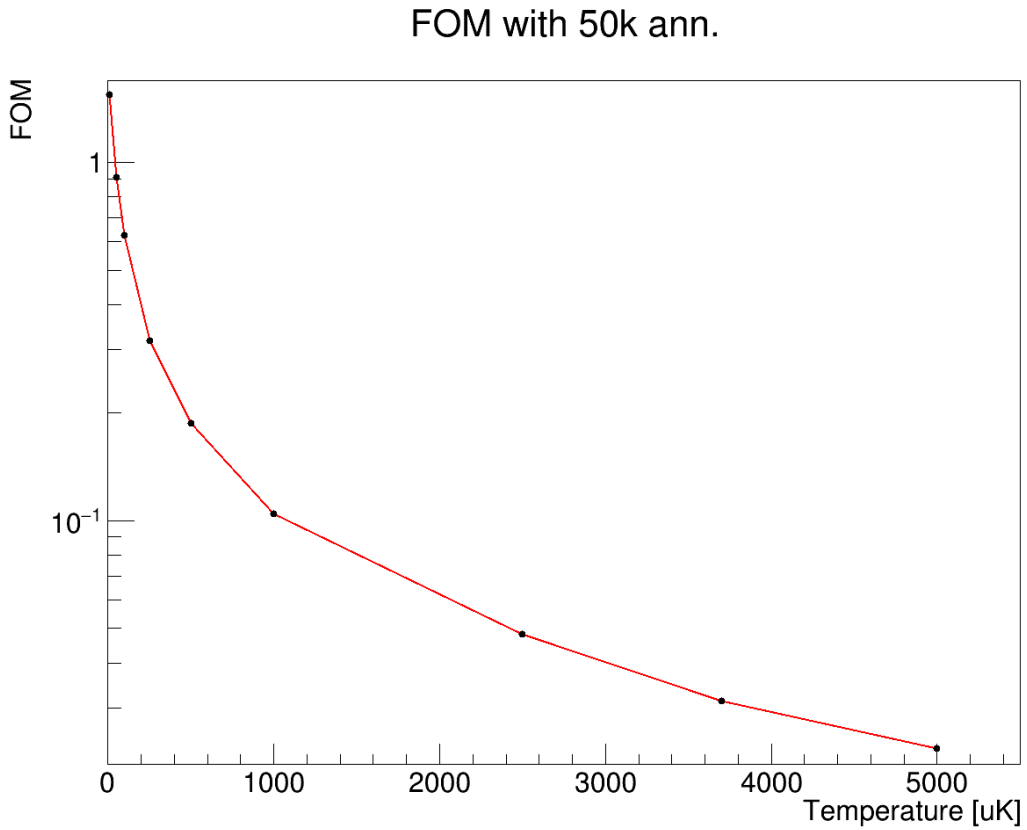
Order of magnitude of energy

- Gravity (30cm fall) : ~10neV
- T = 10uK : ~1neV
- T = 0.5mK : ~10neV
- T = 5mK : ~100neV
- No concern on EM scattering

Figure of merit of upward-downward g

- $\frac{|T_{upward,mean} - T_{downward,mean}|}{(\sigma^2_{upward} + \sigma^2_{downward})\text{^}0.5}$ = FOM

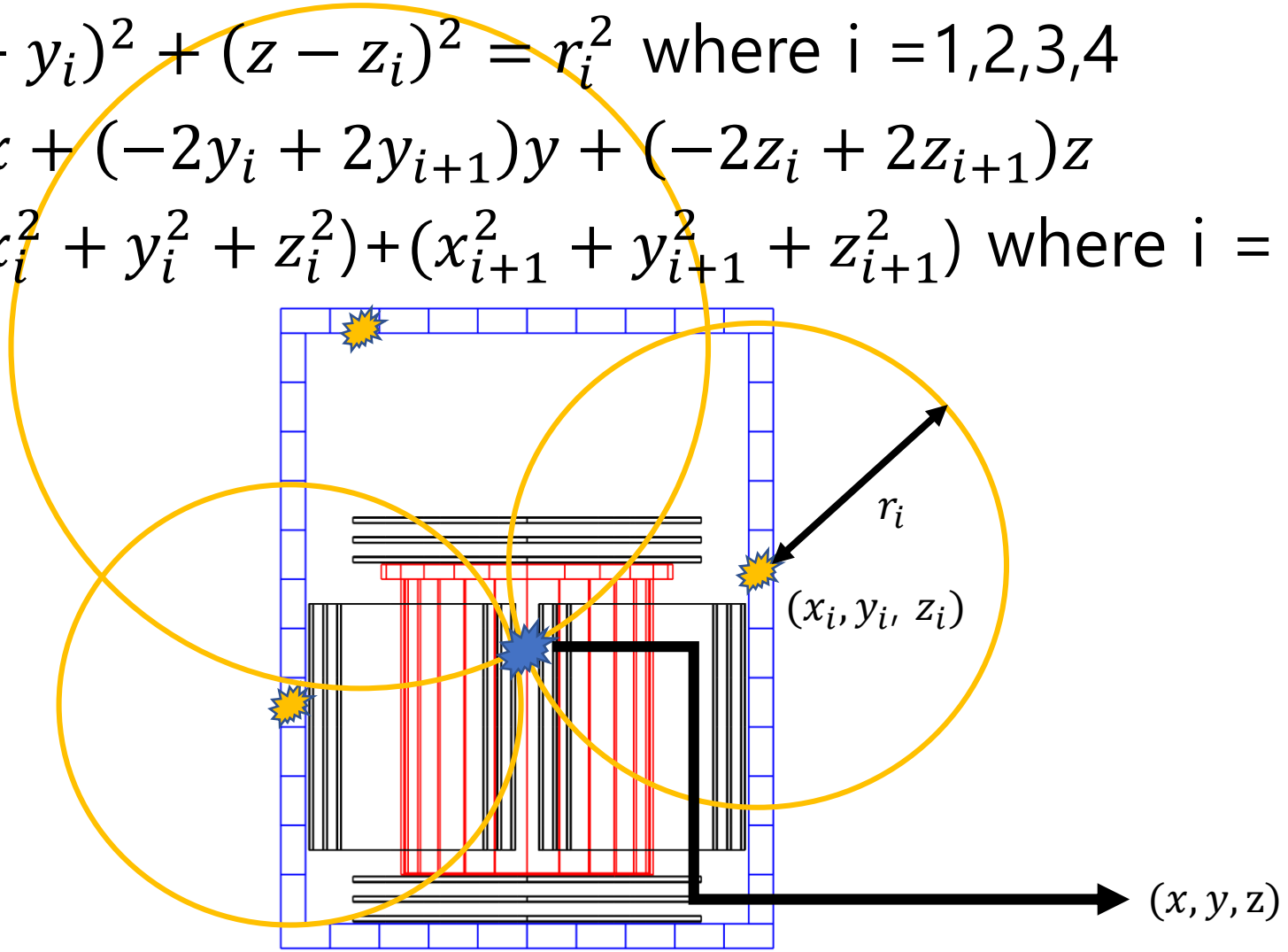


Trilateration

- Find out the position of annihilation by using hit positions and flight lengths.
- 4 hits are needed to find the annihilation position.
- <4 hits give multiple solutions.
- But the trilateration needs the flight lengths of particles.
- Can we estimate flight lengths only using TOF data?

Trilateration

- $(x - x_i)^2 + (y - y_i)^2 + (z - z_i)^2 = r_i^2$ where i =1,2,3,4
- $(-2x_i + 2x_{i+1})x + (-2y_i + 2y_{i+1})y + (-2z_i + 2z_{i+1})z$
  $= r_i^2 - r_{i+1}^2 - (x_i^2 + y_i^2 + z_i^2) + (x_{i+1}^2 + y_{i+1}^2 + z_{i+1}^2)$ where i = 1,2,3



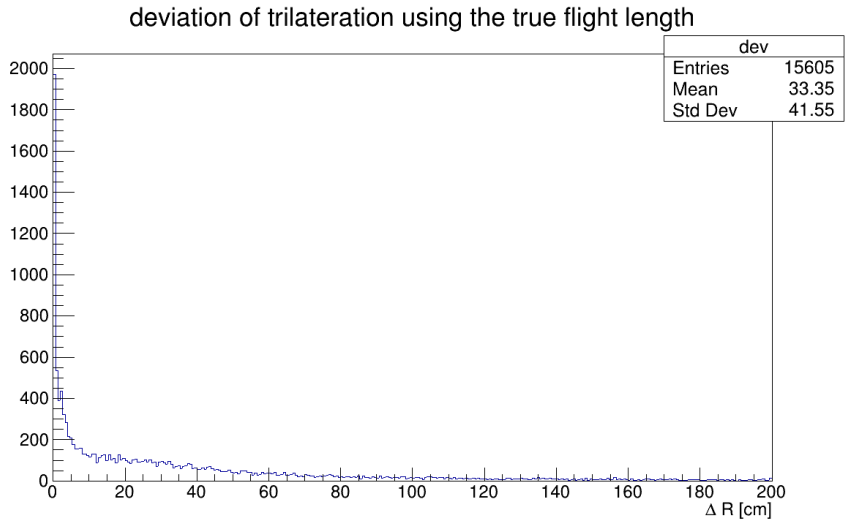
Trilateration

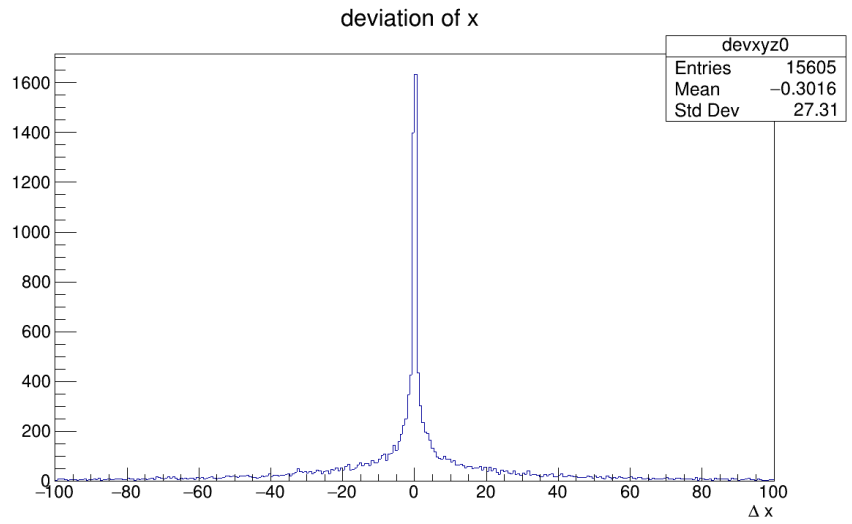
- T-B included 3< hits
- 3 MeV threshold
- Get (x, y, z) by using the positions of the fastest 4 hits
  -> (Not only prompted pion but all particles)

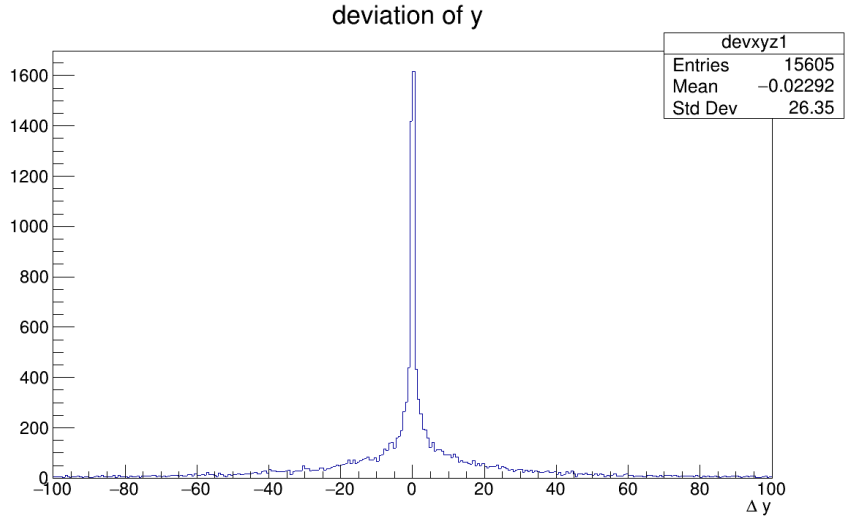
- Test 3 cases :

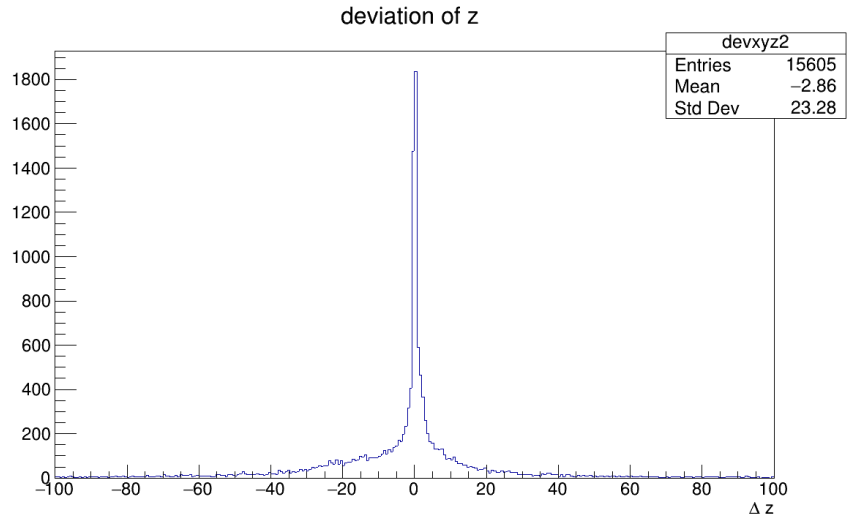
true flight lengths,
the same speed,
mean speed for each particle species

Trilateration : true flight length



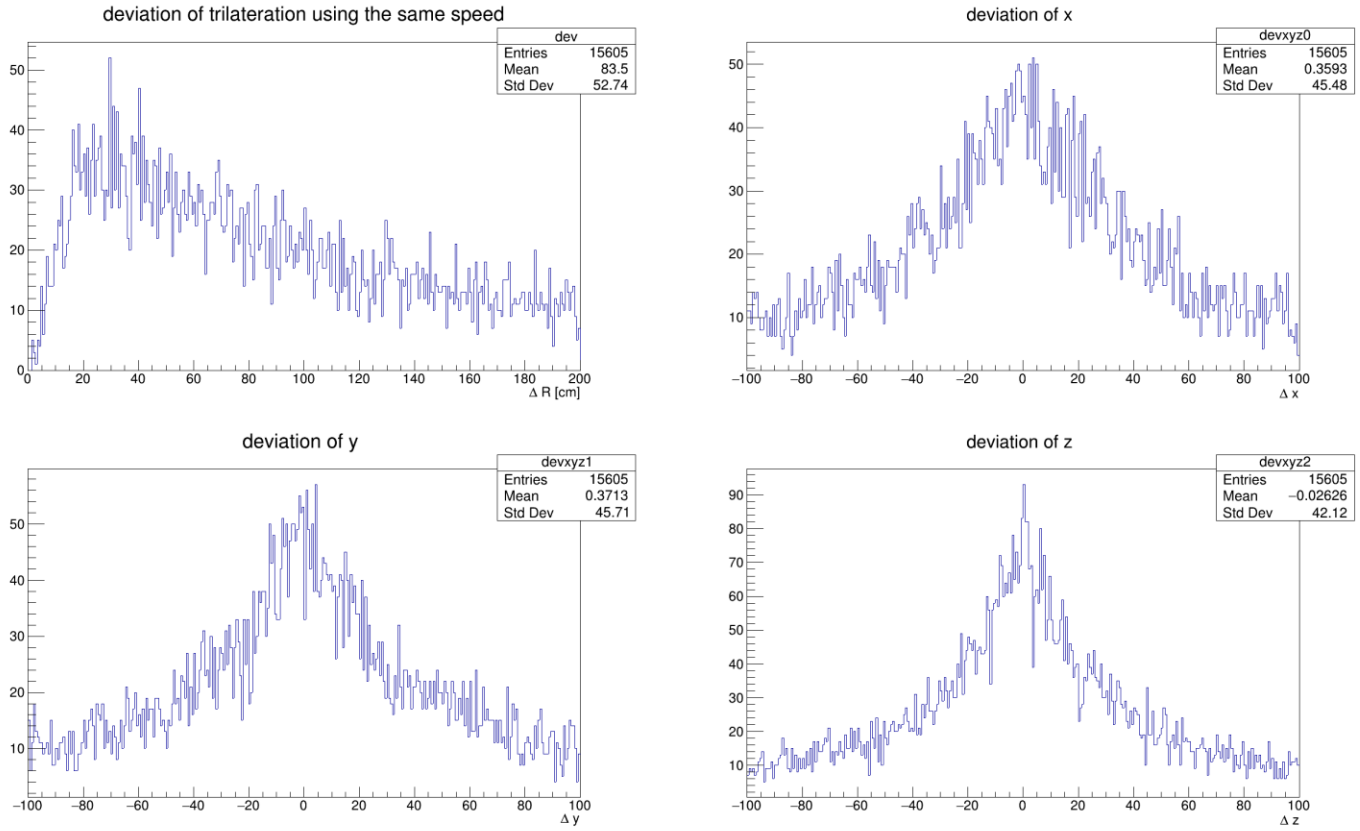




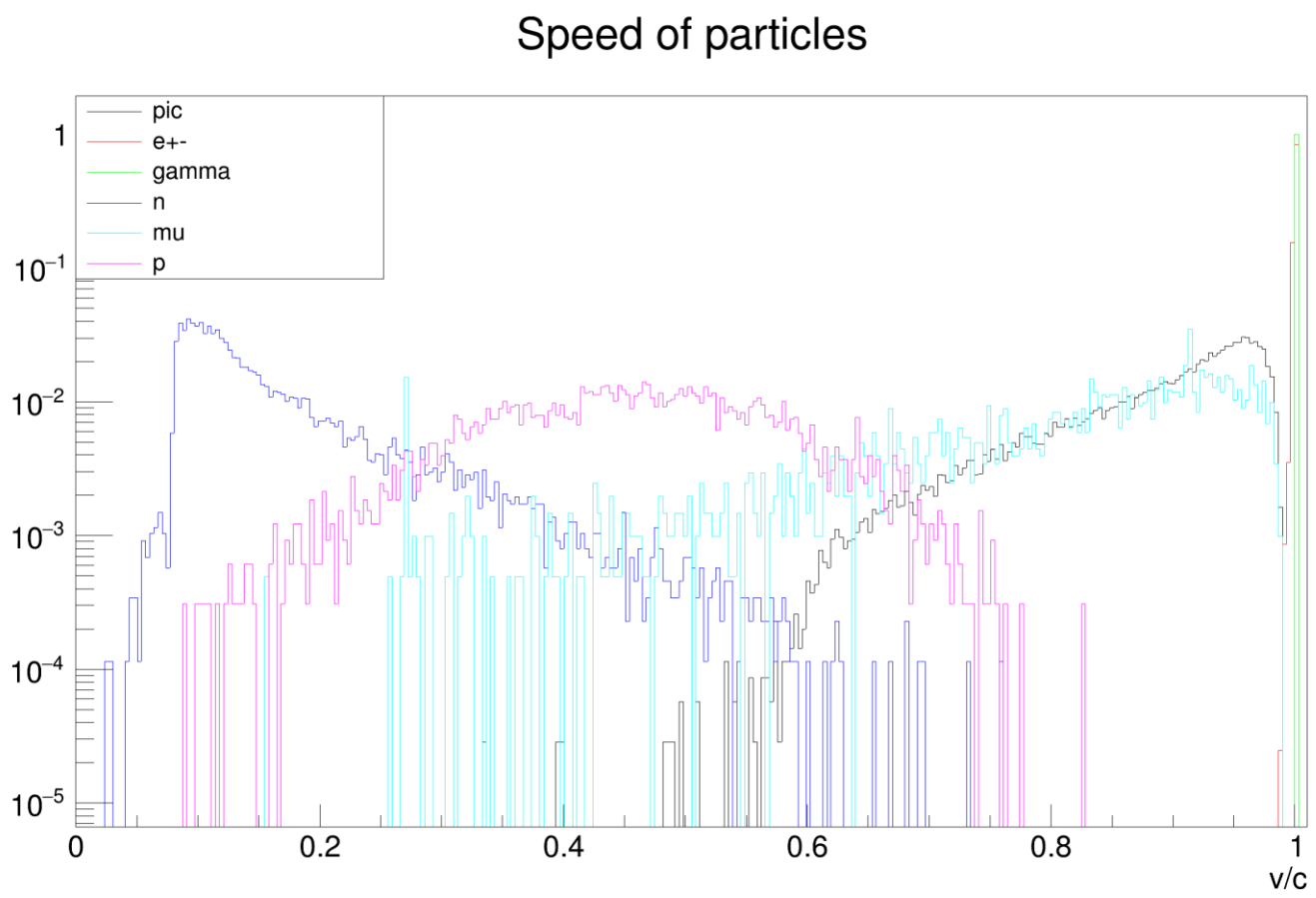


Trilateration : the same speed

- Assume $r_i = c(t_{i,hit} - t_{ann})$, but we do not have information about t_{ann} in the real experiment.
- The result is also not good.



Trilateration : the mean speed



Trilateration : the mean speed

- Assume $r_i = v_{i,mean}(t_{i,hit} - t_{ann})$
- The results highly depend on accuracy of $r_i's$