Time-of-Flight reconstruction

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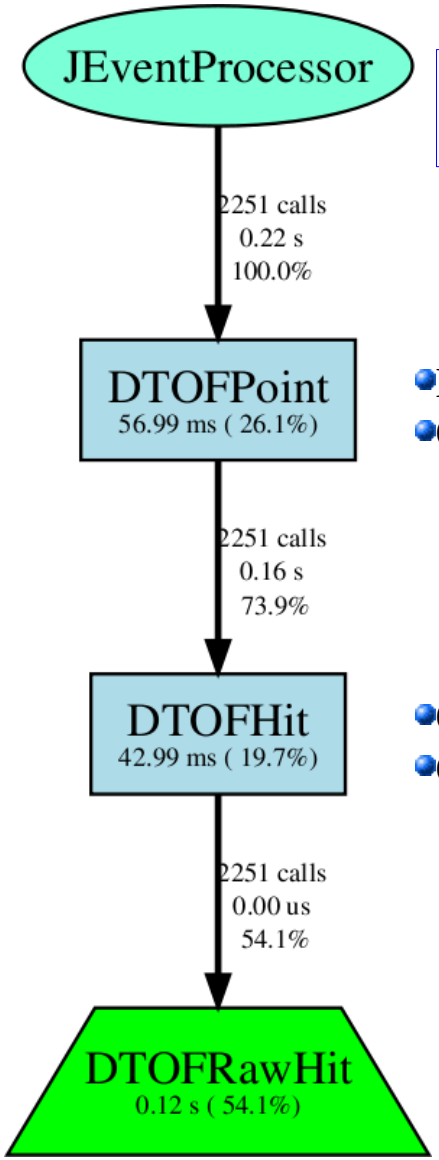
JLab

Reconstruction chain



$$t=(t_{x,s}+t_{x,n}+t_{y,s}+t_{y,n})/4$$

$$x=c_{eff}(t_{x,s}-t_{x,n})$$
$$y=c_{eff}(t_{y,s}-t_{y,n})$$

Δt=1 ns (10 ns for single-ended paddles),
$\Delta x,y$=0.55×(paddle width)

- Match hits in two views by position and time
- Compute combined (x,y,z) position for matched hits

- Gather hits by paddle side (north or south)
- Compute mean time, time difference, and mean energy deposition

More details

- In *DTOFHit*, thresholds applied in software based on ADC values, but currently hits below the threshold are still kept... with many parameters (t_{mean}, etc.) set to NaN
  - Code also computes corrected energy deposition in the bars:

$$E_n = E_{n,ADC} \cdot e^{(\frac{L}{2} - x)/a}$$

$$E_s = E_{s,ADC} \cdot e^{(\frac{L}{2} + x)/a}$$

L=length of paddle
a =attenuation length

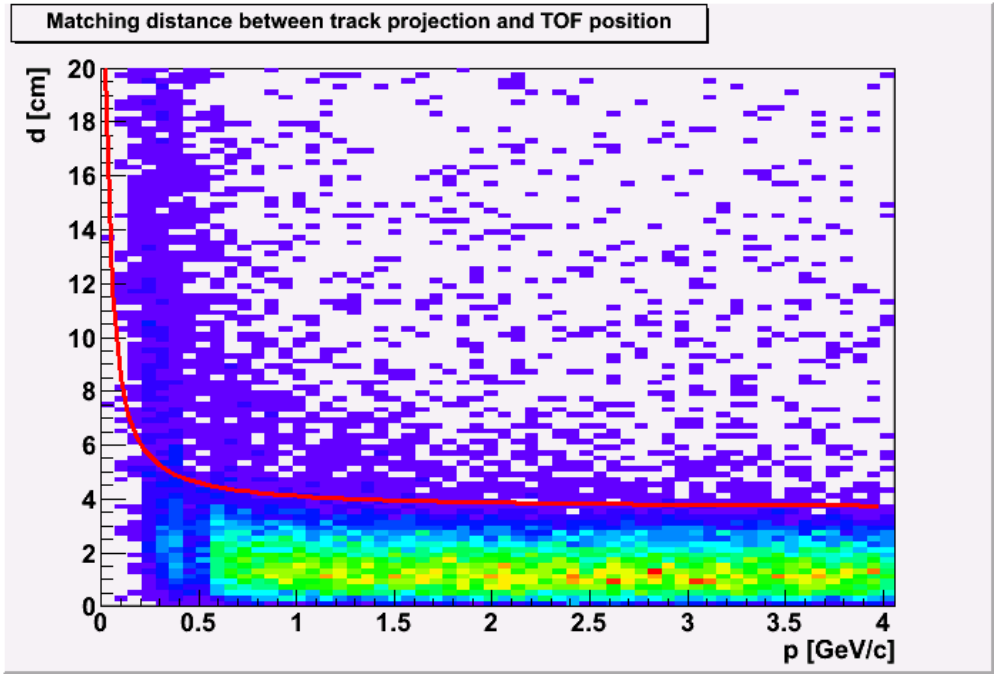
$$E = \frac{E_s + E_n}{2}$$

in *DTOFHit*
(geometric average in *DTOFPoint*)

  - In *DTOFPoint*, E $\rightarrow$ $(E_x + E_y)/2$ (except for matches involving single-ended paddles)
- In *DTOFPoint*, for intersections involving single-ended paddles:
  - Mean time from matched double-ended paddle is used for *t*
  - Center of single-ended paddle used for coordinate (x or y)

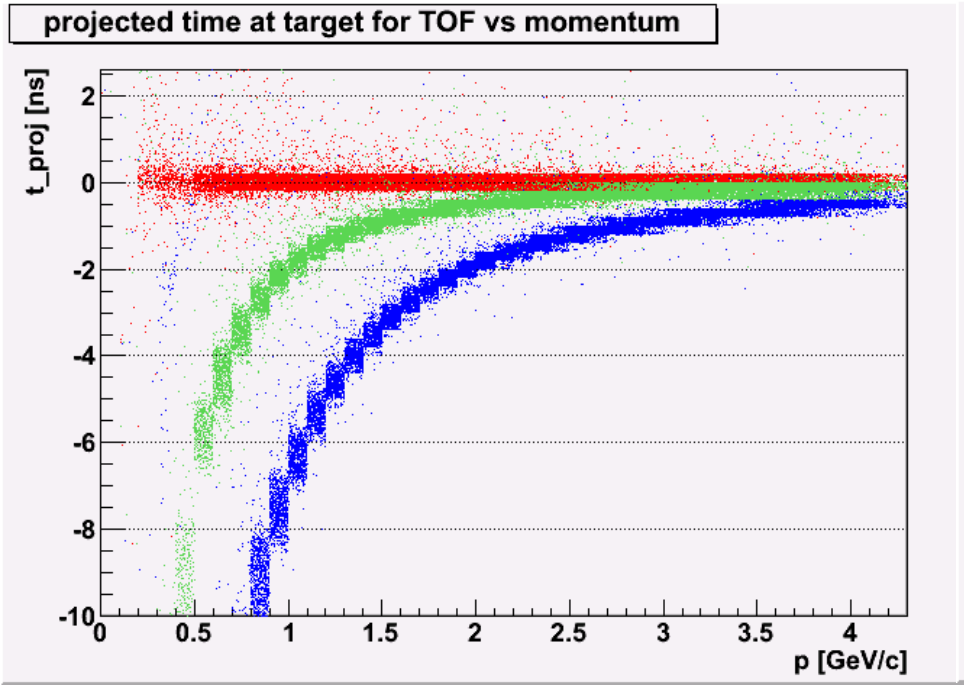
Matching between tracks and TOF

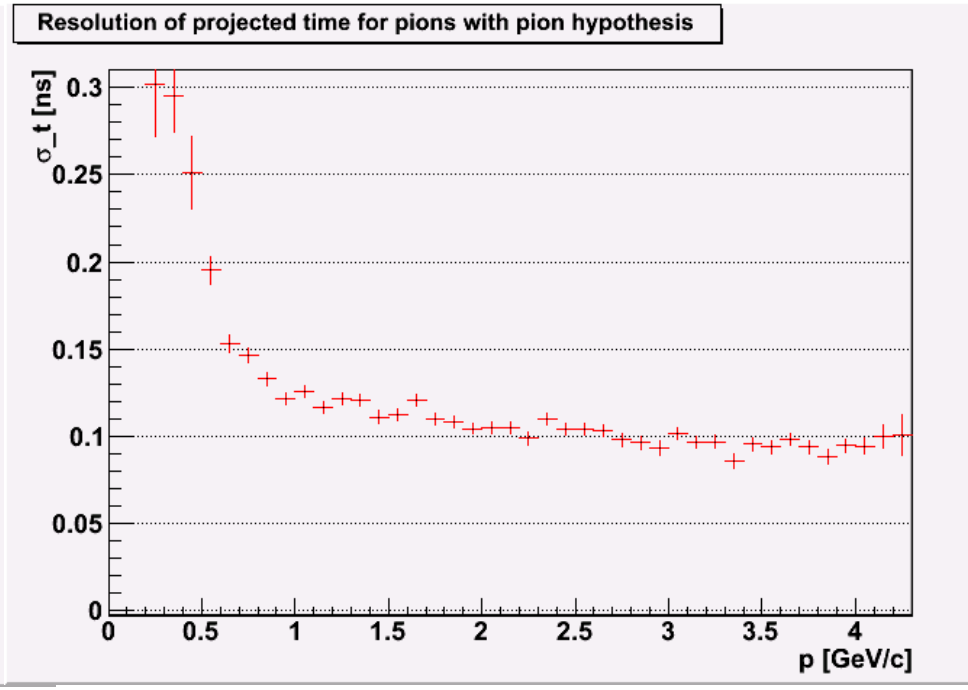
- The helper class DParticleID provides many useful utilities related to particle ID
  - For matching to the TOF wall, it provides *DParticleID::MatchToTOF*
    - Match using distance *d* between track projection to the TOF z-plane and (x,y) position reported by DTOFPoint
    - Momentum-dependent cut: d<3.624+0.488/p



Projected time at the “vertex”

- π^+'s thrown from center of target, $\theta < 11°$
  - Thrown start time = 0
  - TOF resolution per PMT = 100 ps
  - $t_{proj} = t_{TOF} - t_{flight,\ from\ tracking}$





Missing pieces

- No time-walk correction algorithm implemented
- Cases where track crosses two adjacent paddles in a view not explicitly treated