BCAL Time Calibration with Charged Tracks

BCAL

Z_0 [from **DTrackTimeBased**]

T_U
Z_U

T_D [**t** from **DBCALTDCHit**?]
Z_D

pathLength
pmag
Mass(PID) after dFOM cut
[All from **DChargedTrackHypothesis**]

Target

"DEventRFBunch::dNumParticleVotes≥2" condition to insure correct RF time choice

T: chosen RF time, propagated to the z-vertex of the track in the target
[**T** from **DVertex** or t_0 from **DChargedTrackHypothesis**?]

BCAL Time Calibration with Charged Tracks (cont.)

- **Channel-by-channel spectra** for

$$T'_{U/D} = T_{U/D} - T - \textcolor{red}{\textit{Time-of-Flight}} - \textcolor{blue}{\textit{Time-of-Light-Propagation}} =$$

$$= T_{U/D} - T - \textcolor{red}{\textit{pathLength*pmag/SQRT(Mass}^2\textit{+pmag}^2\textit{)/c}} - \textcolor{blue}{|Z_0 - Z_{U/D}|/v_{eff}}$$

should be centered at zero (*time shift*), and the dependence

$$T'_{U/D} = f\ (\textit{Pulse Hight }_{U/D})$$

should be removed (*time-walk correction*).

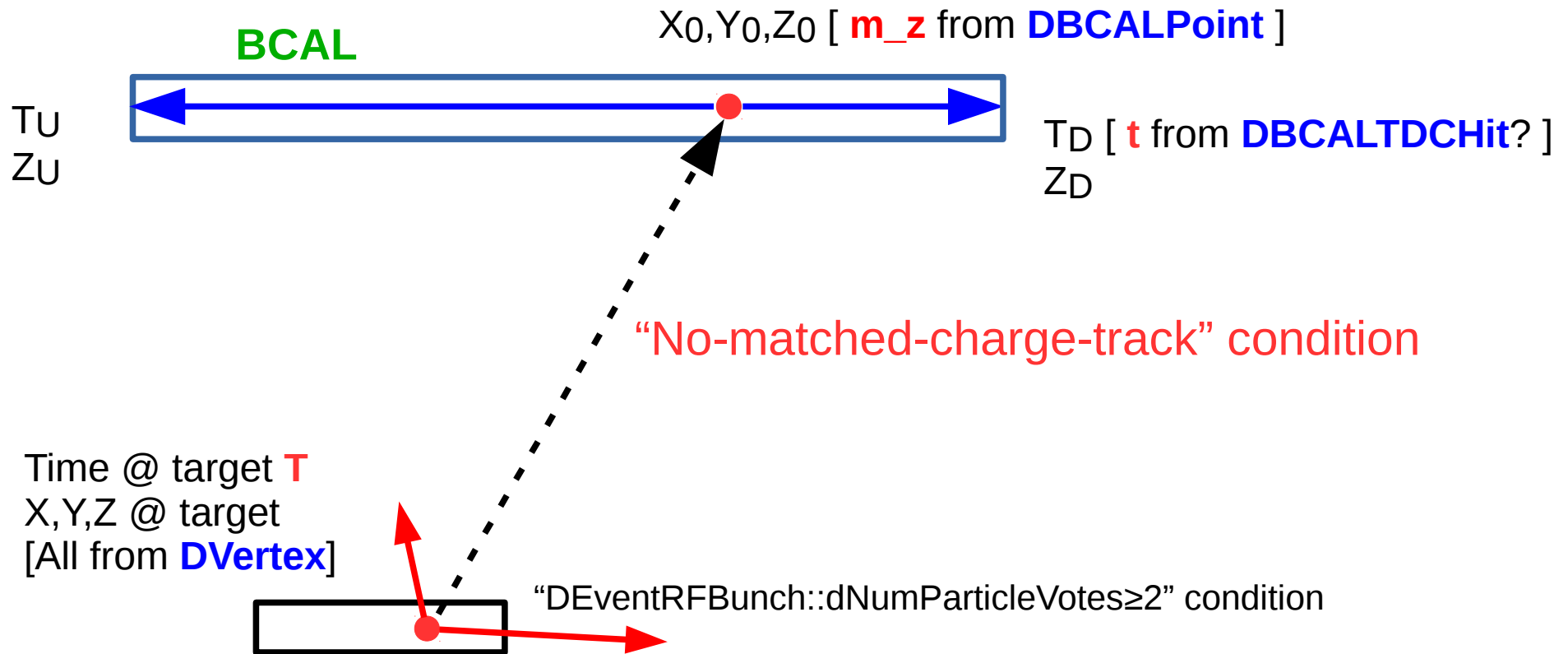- **Problem:** Charged particles does not cover whole pulse-hight dynamic range.

  Solution: Use neutral (viz., "not-matched-with-charged-tracks") showers for the time calibration in addition to the charged tracks.

- **Cross-check:** Invariant-mass spectra for charged particles with calibrated
$$TOF = (T_U + T_D)/2 - T$$
should provide correct pion, proton and kaon masses.

BCAL Time Calibration with Neutral Showers

BCAL

X_0, Y_0, Z_0 [**m_z** from **DBCALPoint**]

T_U
Z_U

T_D [**t** from **DBCALTDCHit**?]
Z_D

"No-matched-charge-track" condition

Time @ target **T**
X,Y,Z @ target
[All from **DVertex**]

"DEventRFBunch::dNumParticleVotes≥2" condition

$$T'_{U/D} = T_{U/D} - T - \textit{Time-of-Flight} - \textit{Time-of-Light-Propagation} =$$

$$= T_{U/D} - T - SQRT((X_0-X)^2+(Y_0-Y)^2+(Z_0-Z)^2)/c - |Z_0-Z_{U/D}|/v_{eff}$$

The BCAL Z-hit position (Z_0) comes from BCAL timing => Iterative procedure

What Time Resolution We Expect with Charged Tracks?

Charged Tracks: Run 10913_020, Module=22, Sector=1, Layer=2, End=1

Entries	2045
Mean	76.08 ± 1.373
RMS	61.91 ± 0.9709
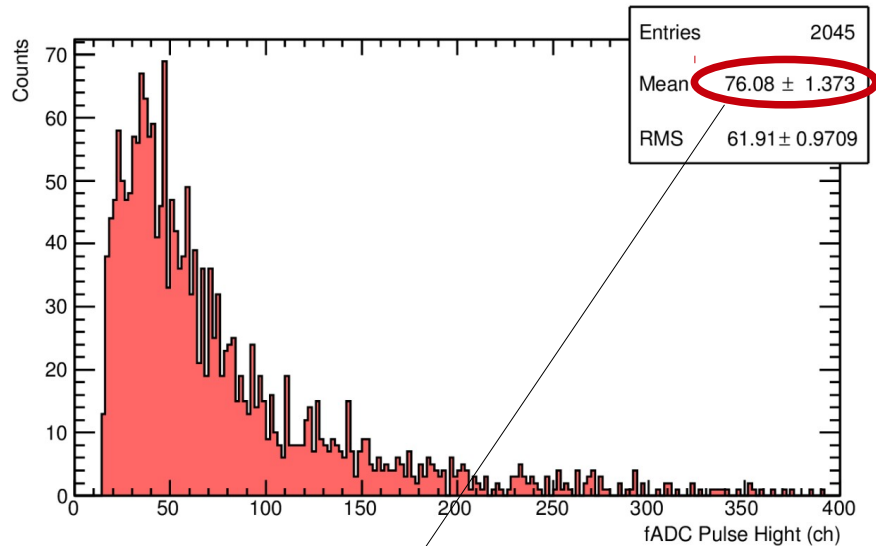
$\sigma T = 80$ ps / SQRT(E) $\oplus$ 130 ps

fADC Calibration

Attenuation

E = 76 peak-ch * 13 int-ch/peak-ch * 0.045 MeV/int-ch * 1.5 ≈ 66 MeV

Mean-Time Resolution: $\sigma T = 80$ ps / SQRT(0.066) $\oplus$ 130 ps = 337 ps
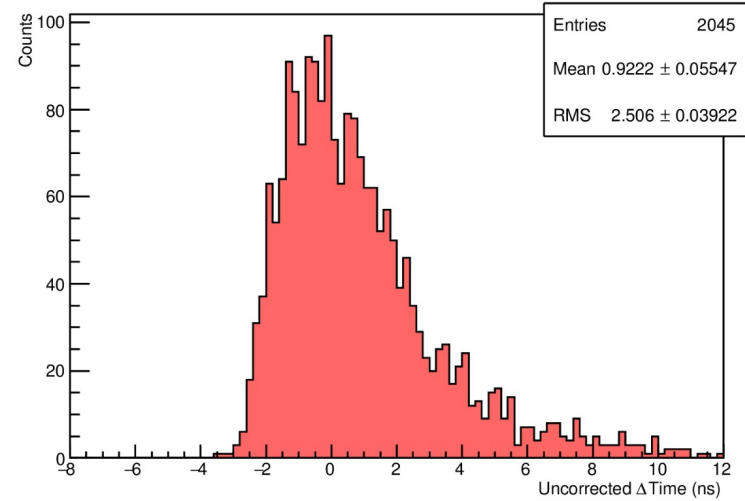
Single-End Resolution = σT * SQRT(2) = 477 ps

BCAL Time Calibration with Charged Tracks

Charged Tracks: Run 10913_020, Module=22, Sector=1, Layer=2, End=1

$$f(X) = -2.82 + 83.07 \cdot (X-4.90)^{-0.84}$$

Charged Tracks: Run 10913_020, Module=22, Sector=1, Layer=2, End=1

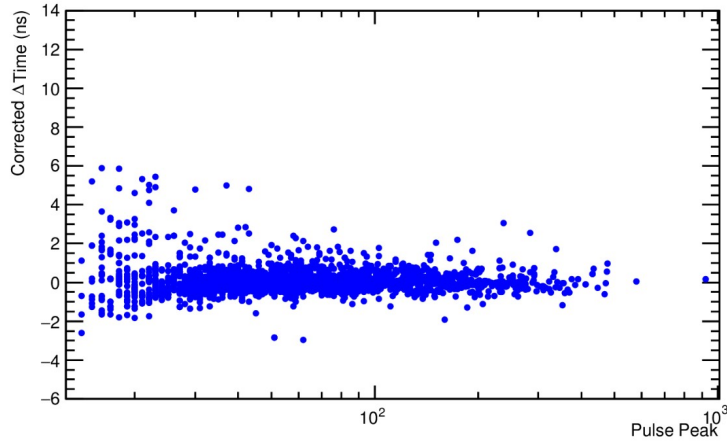| Entries	2045
Mean	0.9222 ± 0.05547
RMS	2.506 ± 0.03922
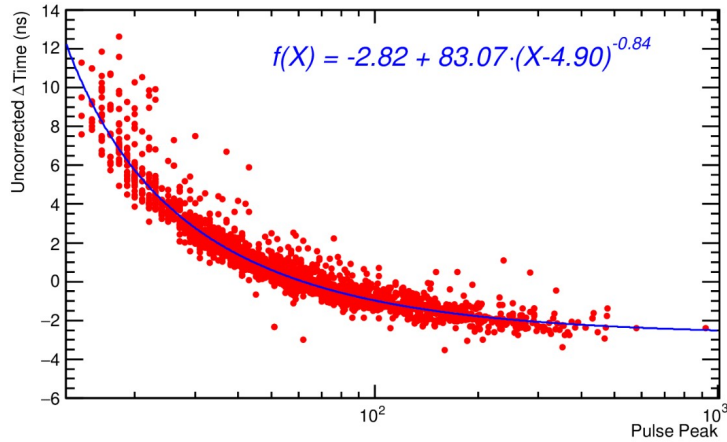
Charged Tracks: Run 10913_020, Module=22, Sector=1, Layer=2, End=1

Charged Tracks: Run 10913_020, Module=22, Sector=1, Layer=2, End=1

Entries	2045
Mean	0.1136 ± 0.01676
RMS	0.758 ± 0.01185
χ^2 / ndf	21.13 / 15
Constant	177.2 ± 5.5
Mean	-0.008738 ± 0.011383
Sigma	0.4171 ± 0.0102