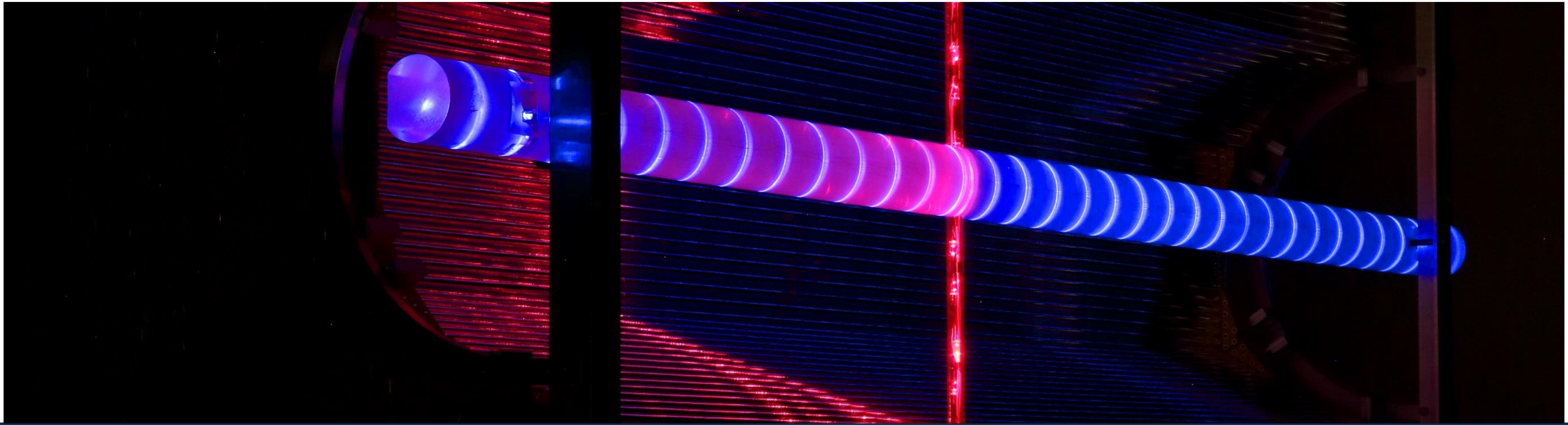

STT TRACKING ISSUES

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Outline

- Tracking QA
  - Simulation - Experiment Data
- STT Detector Response
  - Hit Information
  - Inputs for Simulation
- STT Tracking
  - Hit Pattern w/o T0
  - T0 Determination

Tracking QA

- Simulation: MC truth information
  - Comparison: reco track to true track, momentum, vertex, ..
- Experiment data: only hit information
  - Tracking QA information only: deviations of reco trajectory to isochrone hits (total χ^2 and/or individ. hits)
  - Calibration precision, efficiency and δ-electron hits .. and trackfit model enter

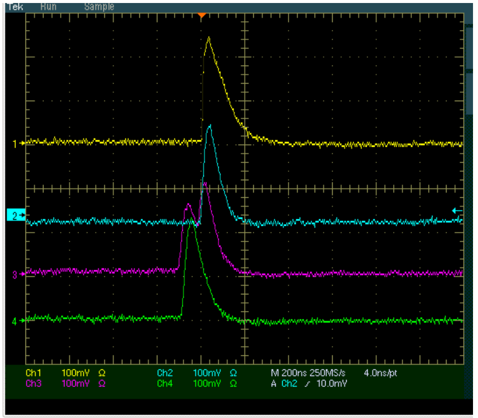
- Trajectory model & specific cases
  - Circle fit approximation: only if low dE/dx, low MS, no δ-hits ..
  - Circle segments: also higher dE/dx & MS (low momentum p/K tracks), treats B-field inhomogenuity
  - Curling tracks: only outer circle is precise → skip inner hits
  - Borderline tracks: distortion of trajectory → skip border hits (DIRC/EMC)

- Tracking QA: needs clear separation between track model resolution and hit resolution

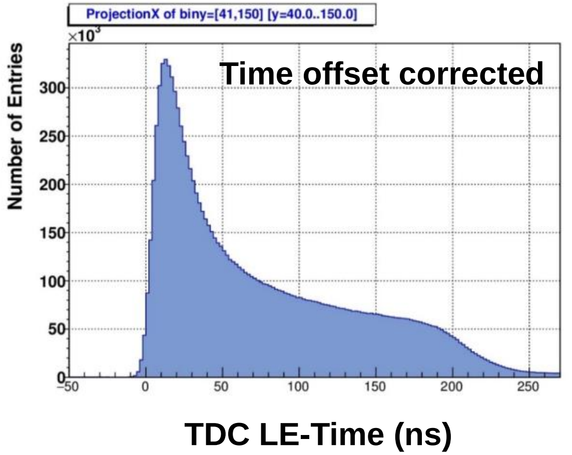
STT Detector Response

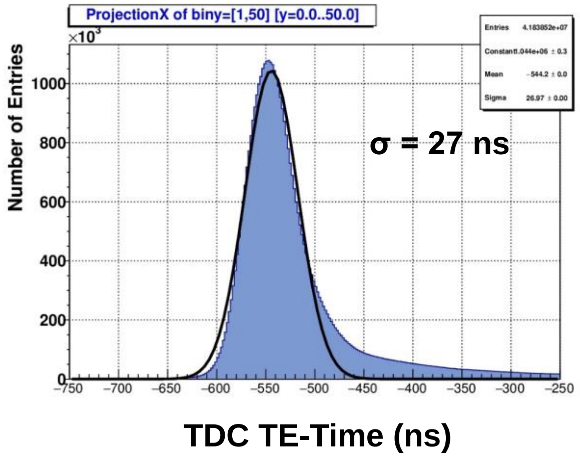
TDC Hit Information

- Straw hit information:
  - TDC channel no. → straw no, (& layer no.)
  - TDC LE-time (→ drift time after offset corr.)
  - TDC TE-time (→ time-ovr-threshold)



Straw signals (in-beam data), measurement of signal leading and trailing-edge (LE-Time, TE-time)





- Build straw hits in simulation:
  - MC track → generate straw hit map
  - Determine which straw is hit by track (calc. track-to-wire distance) → straw channel no.
  - Perp. distance to straw wire → isochrone radius → add smearing → determine drift time: t_{dr} (r) = LE-time
  - TDC-ToT from particle velocity (p/M) and testbeam data fit (next slide) → TE-time = LE-time + ToT
  - Optional: straw (in-)efficiency, noise, δ-electron hits (~ 10% in Argon)

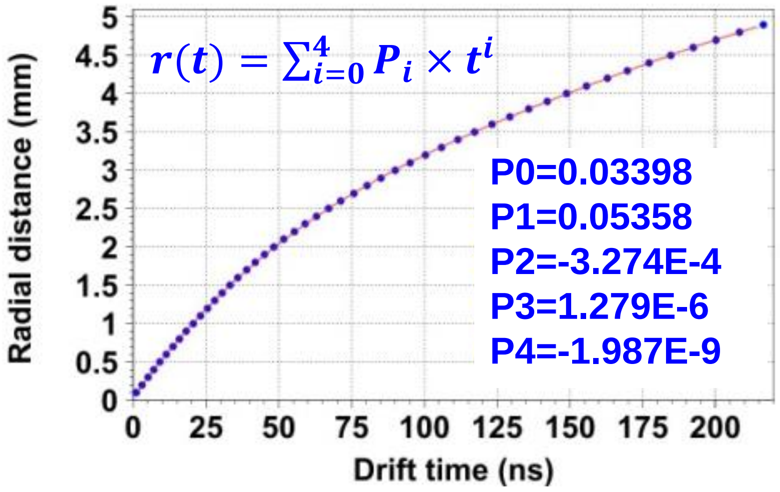
- In future: add TDC/FPGA hit processing algos
  - at moment: single (earliest) hit within drift time window
  - add e.g. max number of hits per channel, per TDC, per board (e.g. curling tracks)

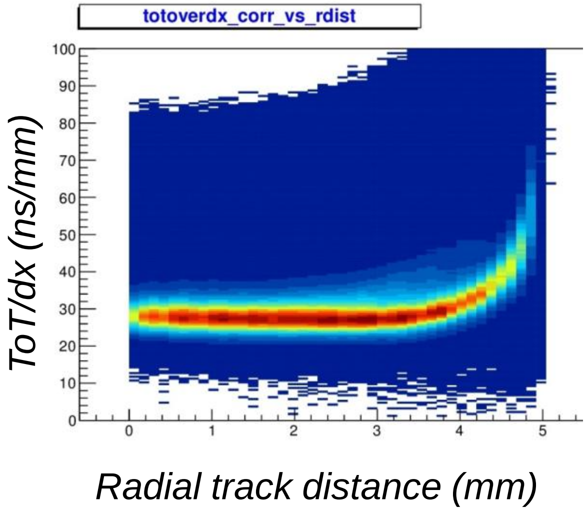
STT Detector Response

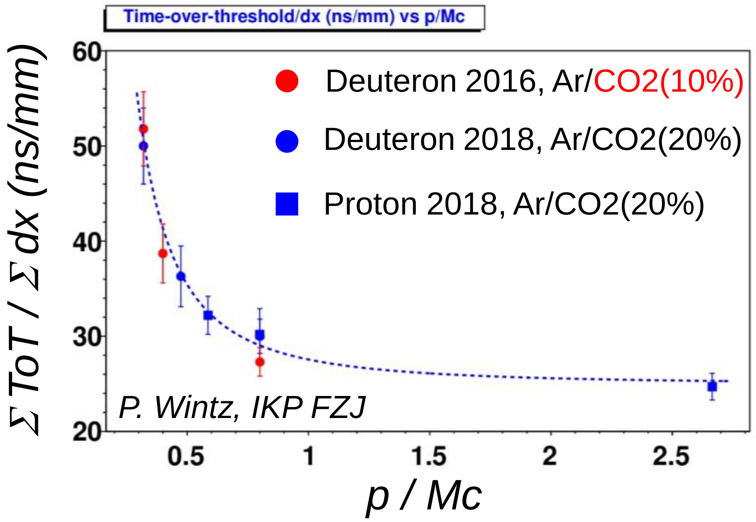
TDC Times → Drifttime & Time-over-Threshold

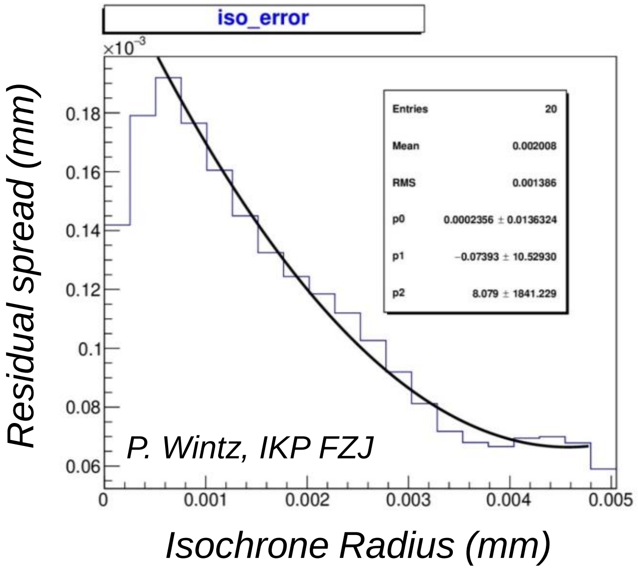
- TDC time relations from in-beam data analysis (→ G. Perez)
- Drift times from inverse isochrone relation *r(t)* → *t(r)*
  - Smearing from isochrone resolution (r-dependent)
- TDC TE-times from time-over-threshold relation
  - ToT/dx from data p/Mc relation, TE-times are dE/dx dependent
  - Extract TE-time from LE-time + ToT, and dx from radial track distance

r(t) relation





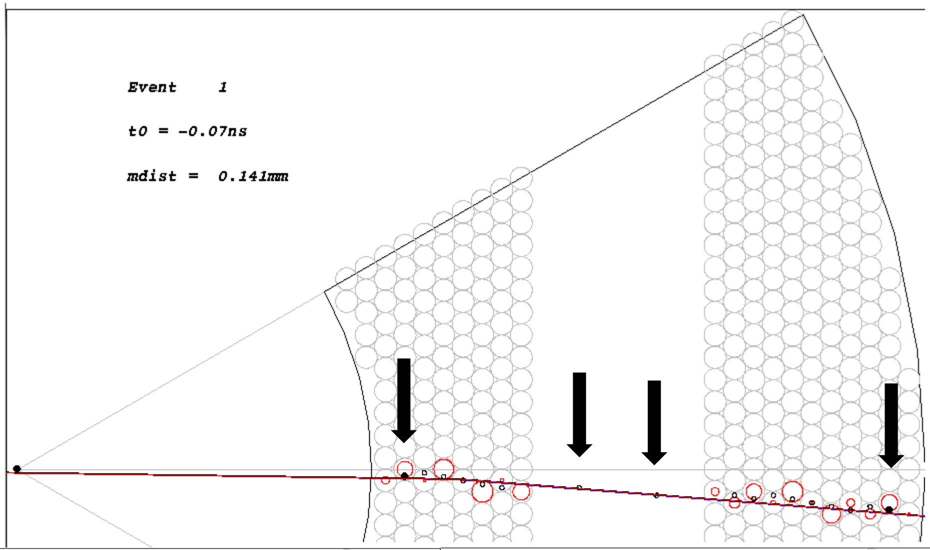


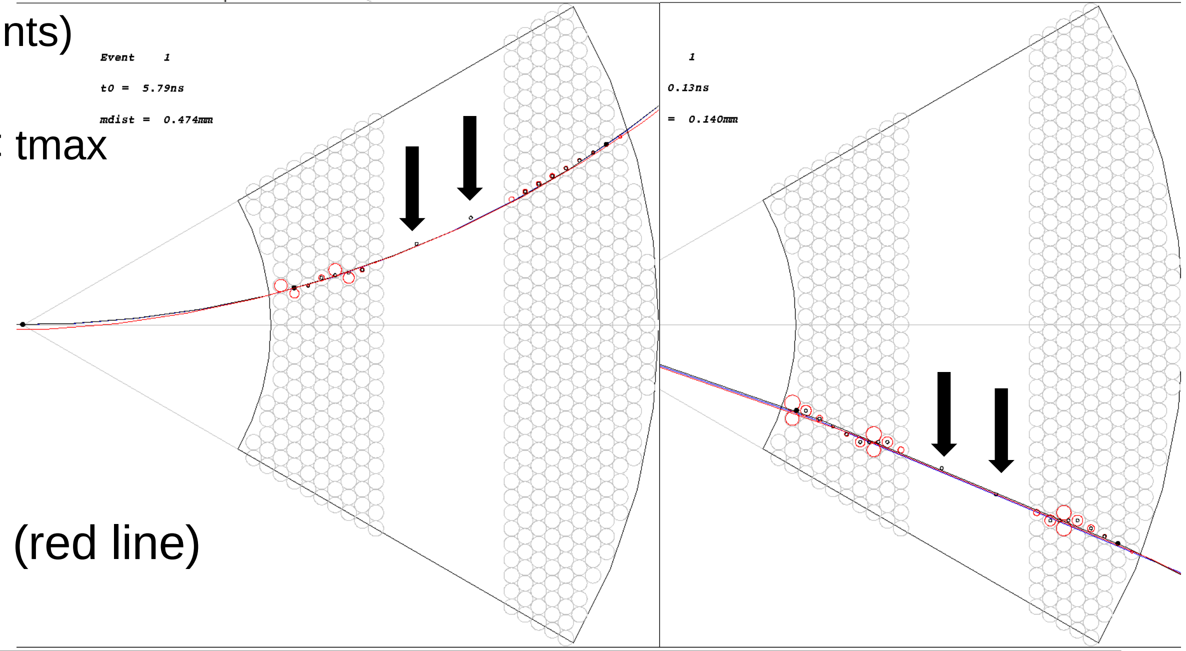


STT Hits & Tracking Steps

Without T0

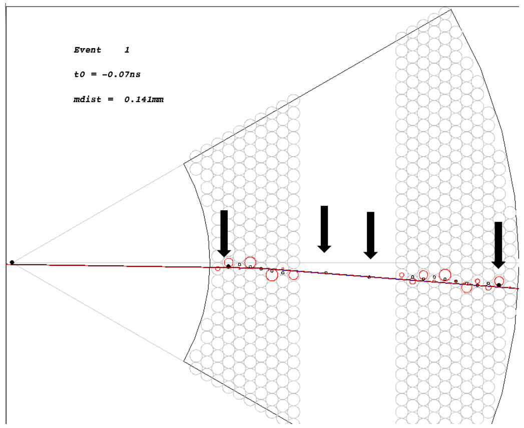
- Pattern / tracklet recognition without T0 and isochrones
- Exploit STT close-packed cell geometry (“continuous tracking“)
- Triplet hits give additional track information:
  - Each straw hit has (≥) 2 neighbour straw hits
  - Center points (“triplets“) from three neighbour hits (black points)
    - $(x, y)_{triplet} = \frac{1}{3}\sum_{i=1}^{3}(x_i, y_i)$ and require time difference < tmax
    - Gives many points around track with ~ mm resolution
    - Gives also (x,y) points in stereo-layer zone !
- Sufficient for 1st tracking step w/o isochrones (black line)
- Compare with generated isochrone hits (red circle) and fit (red line)



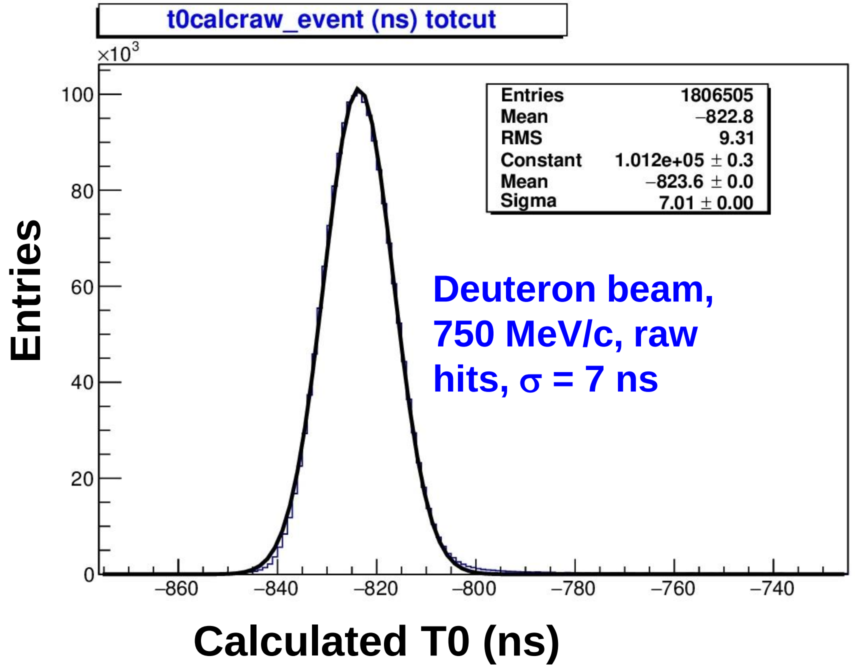


STT Hits & Tracking Steps

T0 - Extraction



- Procedure for T0 determination
  - Step 1: hit to track association using raw hits
    - Channel cluster (neighbour hits)
    - Time cumulation
  - Step 2: Simple T0 calculation from sum of track hits (no fit!)
    - $\Sigma\, r(t) / N_{hits} \sim 2.5\ mm$ (= avg. isochrone radius)
    - Use simplified $r(t) \sim P_0 + P_1 \times (t_{TDC} - t_0)$
    - Extract t_0
    - σ (t_0) ~ 7ns for in-beam data, ~ few ns t_0 shift to real
  - Step 3: iterative re-adjusting T0
    - trackfit with isochrones




Thank you
for your attention