Update on SVT dE/dx

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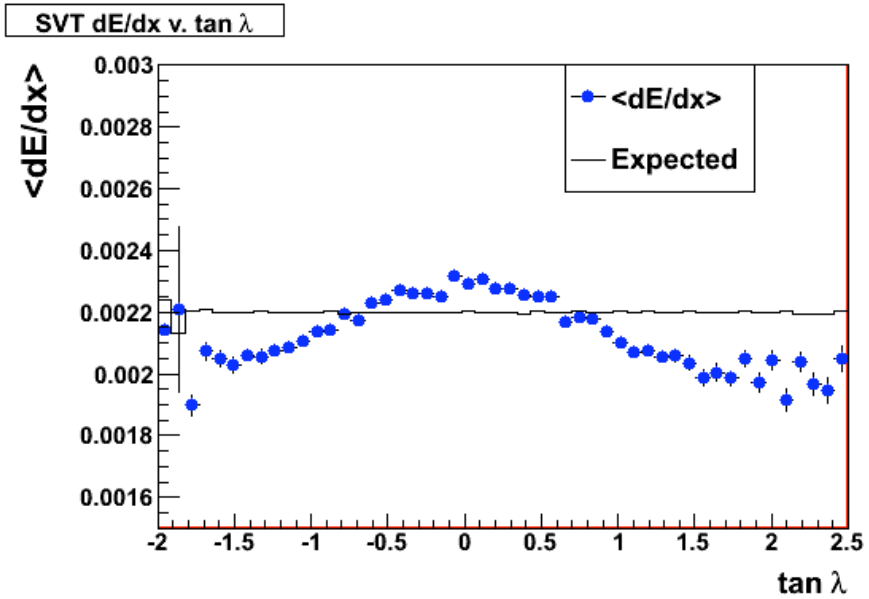
Reminder…

- SVT dE/dx implemented last fall
- However, strong dependence on tan λ precluded its use in PID selectors for production - pointed out by Leonid Burmistrov

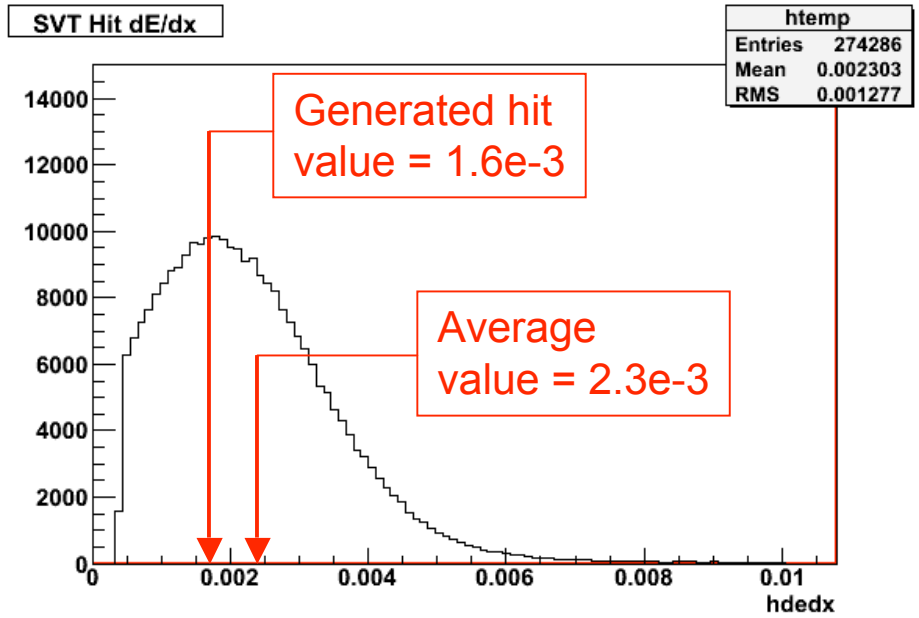


- Want to solve this problem.
- Need to review a little bit…

Making SVT dE/dx useful for PID selectors

- PID selectors typically need three pieces of information for a given track:
  1) the value of dE/dx
  2) the expected value of dE/dx
  3) the error on dE/dx
- What is expected value 2) ?

- Originally used Gaussian mean as expected track dE/dx
- Threshold effect makes generated mean different from actual mean
- Get expected track dE/dx values using empirical calibration

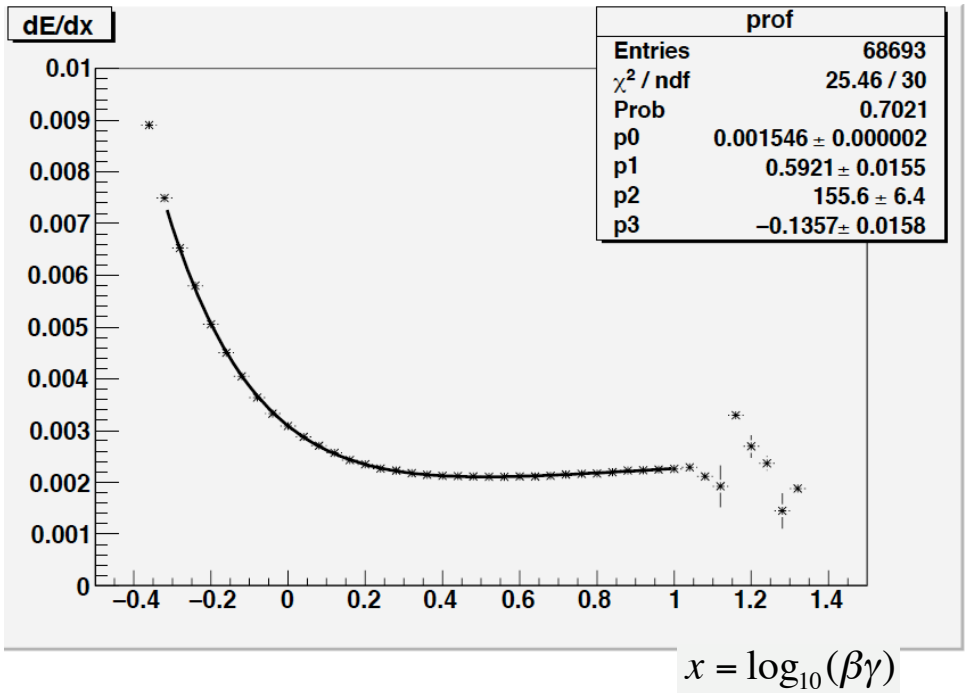


Calibrating SVT dE/dx

- Need to calibrate dE/dx, i.e., parameterize expected dE/dx by fitting track dE/dx directly
- Use BAD1500 as a guide, but use simpler 4-parameter fit function:

$$\left.\frac{dE}{dx}\right|_{\text{exp}} = p_0(1 + p_1 x + p_3 x^2)(1 + p_2^{-x})$$

- For x>2 (in BaBar, only electrons), expected dE/dx is constant (0.00243)



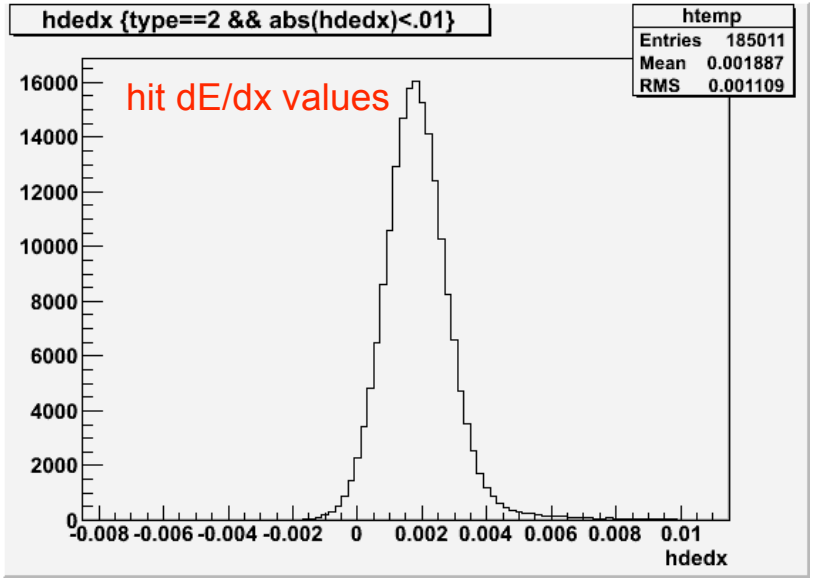
This worked globally, but introduced a tan λ dependence.

How to fix it

- Easiest way to fix is to remove the threshold requirement on hits
  - –not logical (hits below threshold or with negative dE/dx don't make sense)
  - –so what?

- Procedure:
  1. generate hit dedx values with gaussian
     - mean based on track mass, momentum
     - sigma parametrized with 3 parameters
     - allow negative values

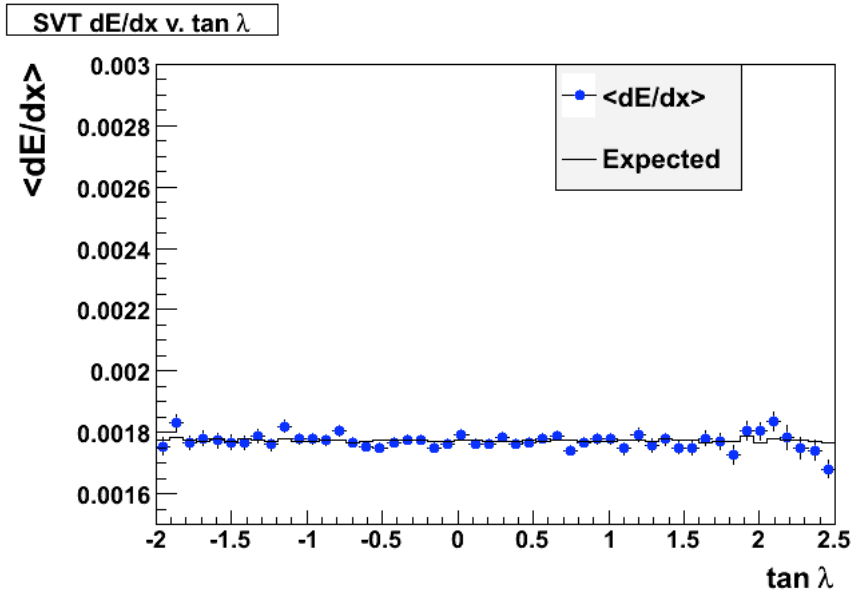
     as before
  2. Track dE/dx is (truncated) mean of hit dedx values
     - pars are re-tuned to give desired MIP resolution
  3. Expected dE/dx equal to mean of hit generation gaussian
     - calculated using reco track momentum, particle mass

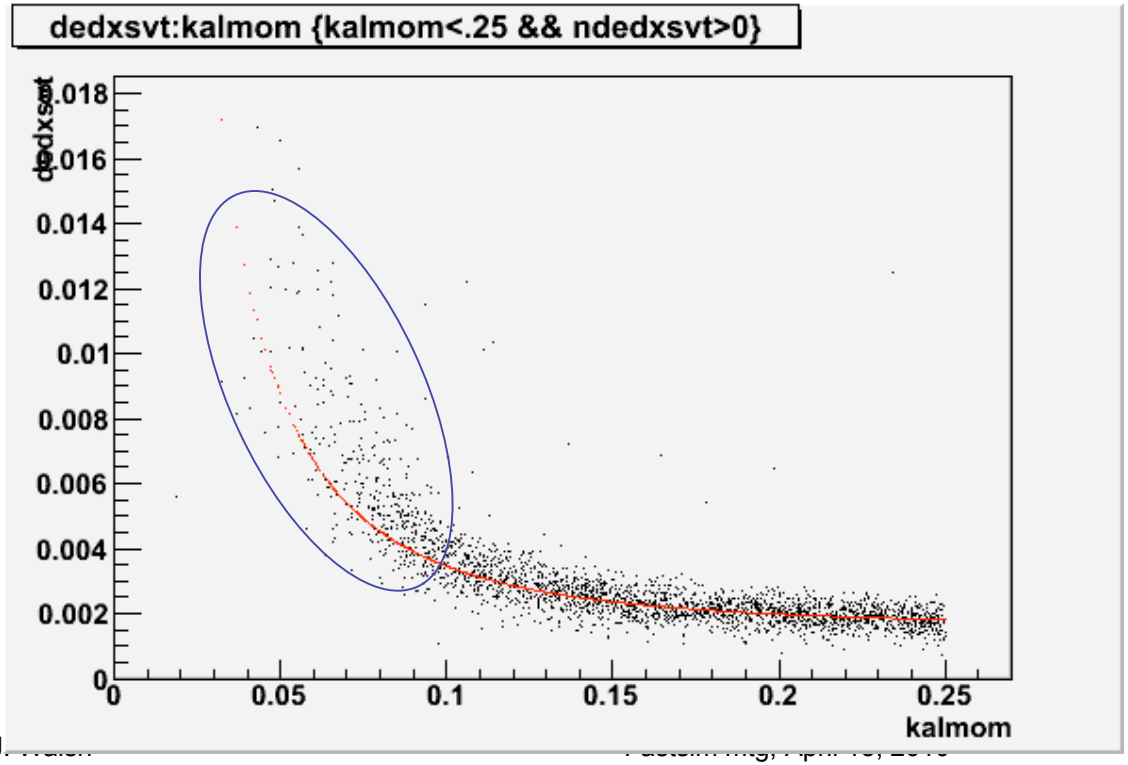


Good news, bad news

- tan λ dependence cured

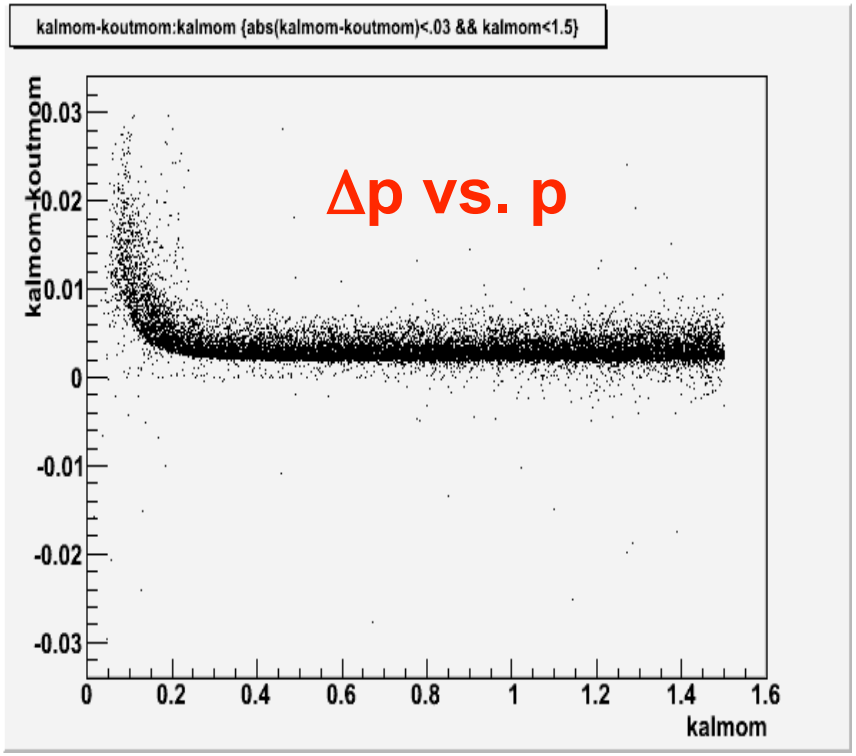
- Track dE/dx not compatible with expected value at low p





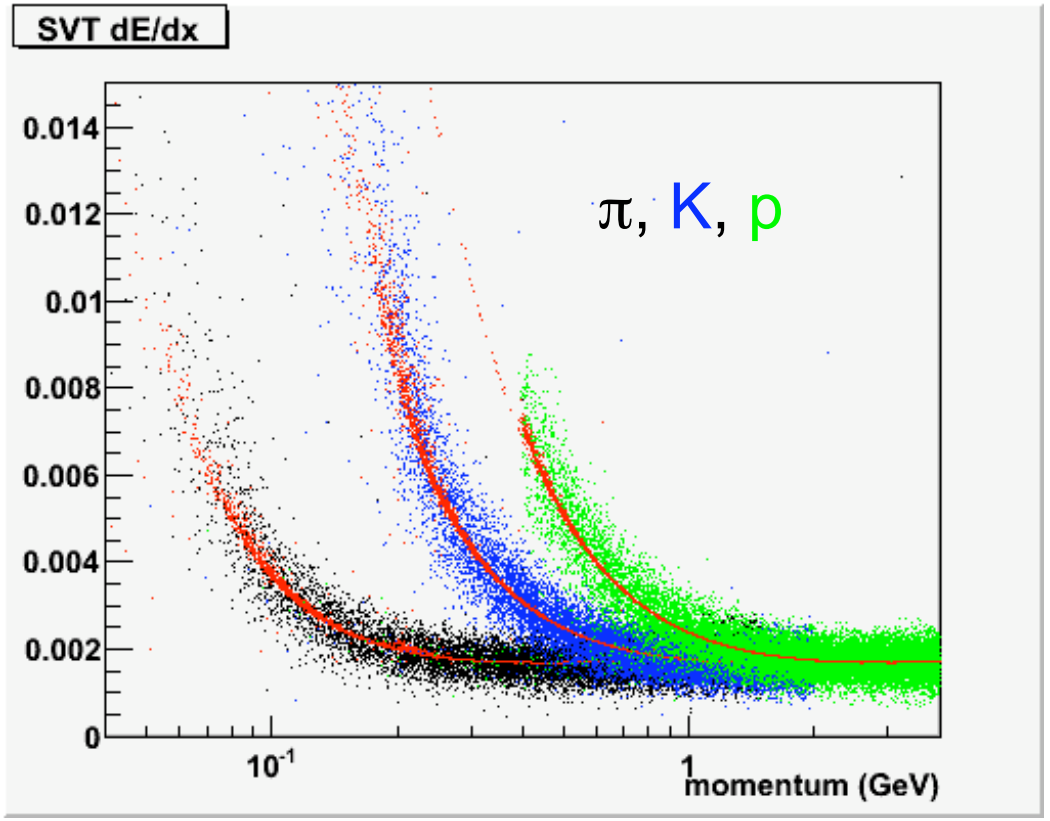
Mis-match between track and "hit" momentum

- Hit dedx generated using track momentum **at the hit,** I.e. including energy lost by the track previously
  - so, average momentum over all hits is somewhere between initial track momentum and final track momentum (after all energy loss)
- Expected dE/dx for a track is determined using momentum from fitted track, I.e. momentum at the origin, I.e. **before any energy loss**
- For low momentum tracks, this mis-match can be important
  - because Δp is greater
  - on steep part of dE/dx curve

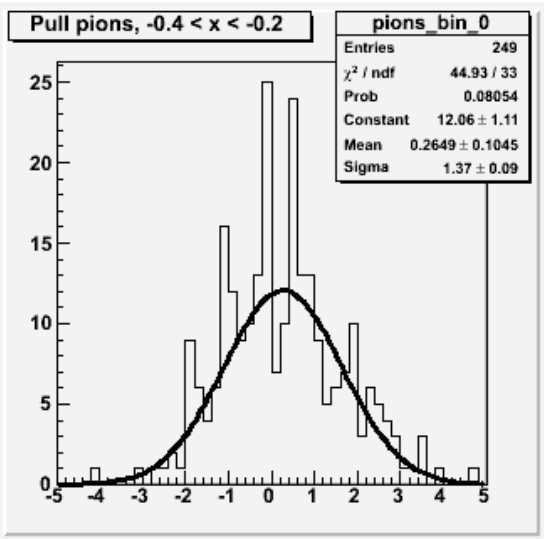


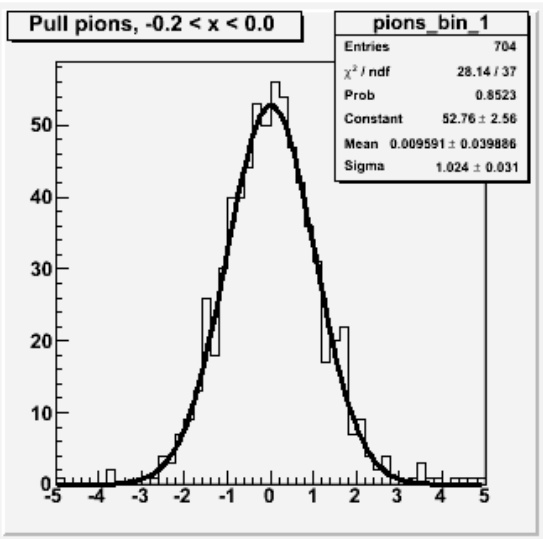
Use average p for expected track dE/dx

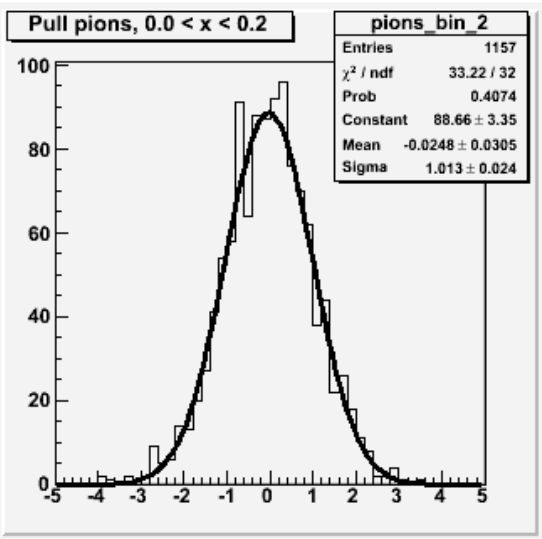
- Get initial and final track momentum from Kalman fit
- Use average when calculating expected track dE/dx
  - should closely approximate average momentum used for hit generation

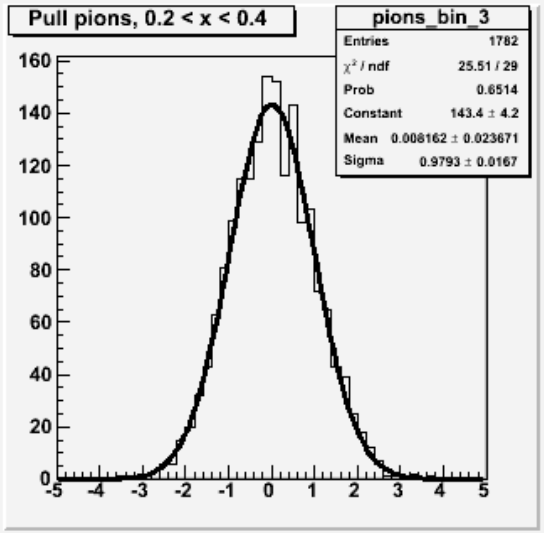


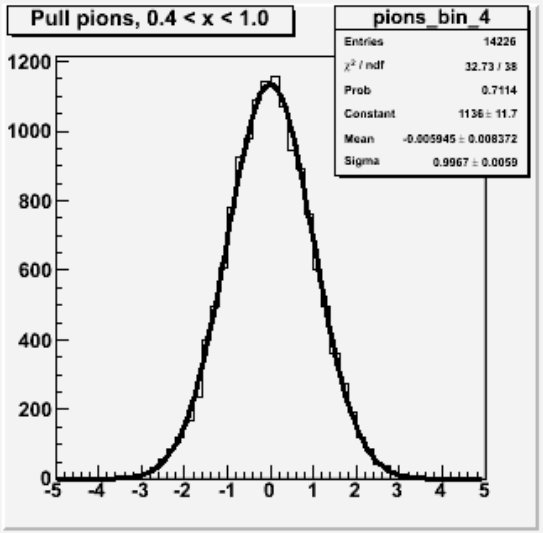
Pulls for pions











$$x = \log 10(\beta\gamma)$$

Summary

- Changes made:
  - Modified generation of hit dedx, removing threshold requirement
  - Re-tuned generation parameters to give 16% resolution on MIPs
  - Calculate expected track dE/dx using usual (hit) calculation, but use average reco track momentum
  - no longer a need for dE/dx calibration
- Results:
  - dE/dx plots look good, pion pulls good (better than previously)
  - average dE/dx is flat in tan λ
- To do:
  - commit these changes
  - further tests