SVT progress report

Bill Ashmanskas, CDF b physics meeting, 2002-08-22

- Most important point: there are two principal areas of recent SVT progress, with their respective sets of people who did the work:
  - SVX ladder recovery (mostly during June shutdown) by Gino Bolla, Chris Hill, and the SVX crew
  - SVT pattern improvements by Giovanni Punzi and Roberto Carosi

- Synopsis of rest of talk:
  - 30-second overview of SVT tracking algorithm
  - detector acceptance improvements and corresponding SVT updates
  - pattern efficiency improvements
  - effect on rates, yields
  - areas for further work, which could plausibly bear fruit by this fall

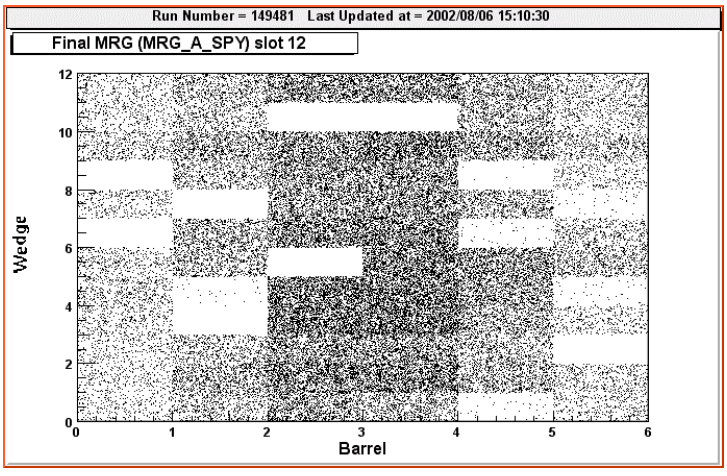
- Note:
  - This talk ought to contain more plots and numbers, but being on shift all week zeroed my efficiency

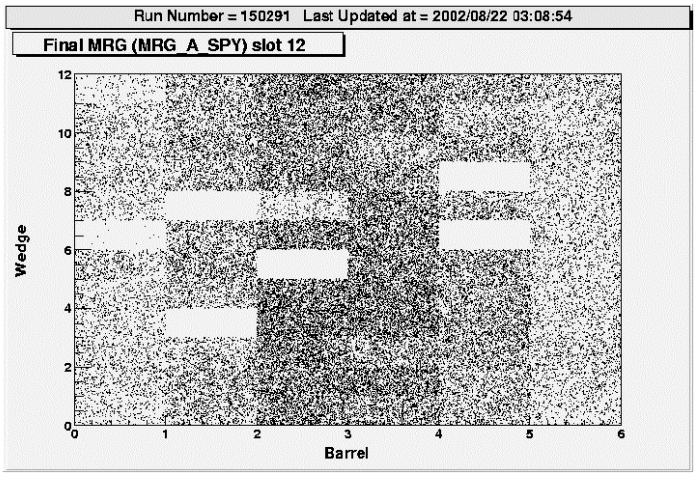
- SVT algorithm overview:
  - clustering combines adjacent channels that are above a programmable strip threshold, finds centroid
    - option to suppress hot strips, not currently used
  - pattern recognition looks for coincidence of 5/5 (optionally (4+1)/6) of the following
    - hits in silicon layers, binned to O(few hundred um)
    - XFT track phi at R=10.5, binned to O(1 degree)
    - bin = "superstrip," coincidence="pattern"
  - linear fit: 6 measurements → 3 parameters plus χ^2

$$(c, \phi, d, \chi_1, \chi_2, \chi_3) = \vec{p} = \vec{p}_0 + V \cdot \vec{x}$$

  - if there are multiple hits within a superstrip, track fitter iterates over combinations
  - ghost removal board picks just one SVT track (currently best χ^2) per XFT track
  - beam line is computed every ~30 seconds and subtracted dynamically from d vs phi
- System has tremendous flexibility/configurability
  - Don't assume we're already using the hardware as well as it is capable of being used

- Acceptance improvements:
  - SVT can now select a different (fixed) set of 4 SVX layers per 1/72 of SVX (was 1/12 before April)
    - allows us to use the 66/72 wedges that have at least 4 working ladders that include layer 0
  - we let the detector experts tell us which 4 ladders to use in each SVX wedge
    - they continue to make progress, every time they're allowed to sneak in for an access
  - went from 58/72 to 66/72 on August 8
    - but a few of these 66 have low efficiency that needs to be understood
    - could get B1W3 and B2W5 by skipping layer 0
    - could get all the rest except B1W7 by using 3 layers





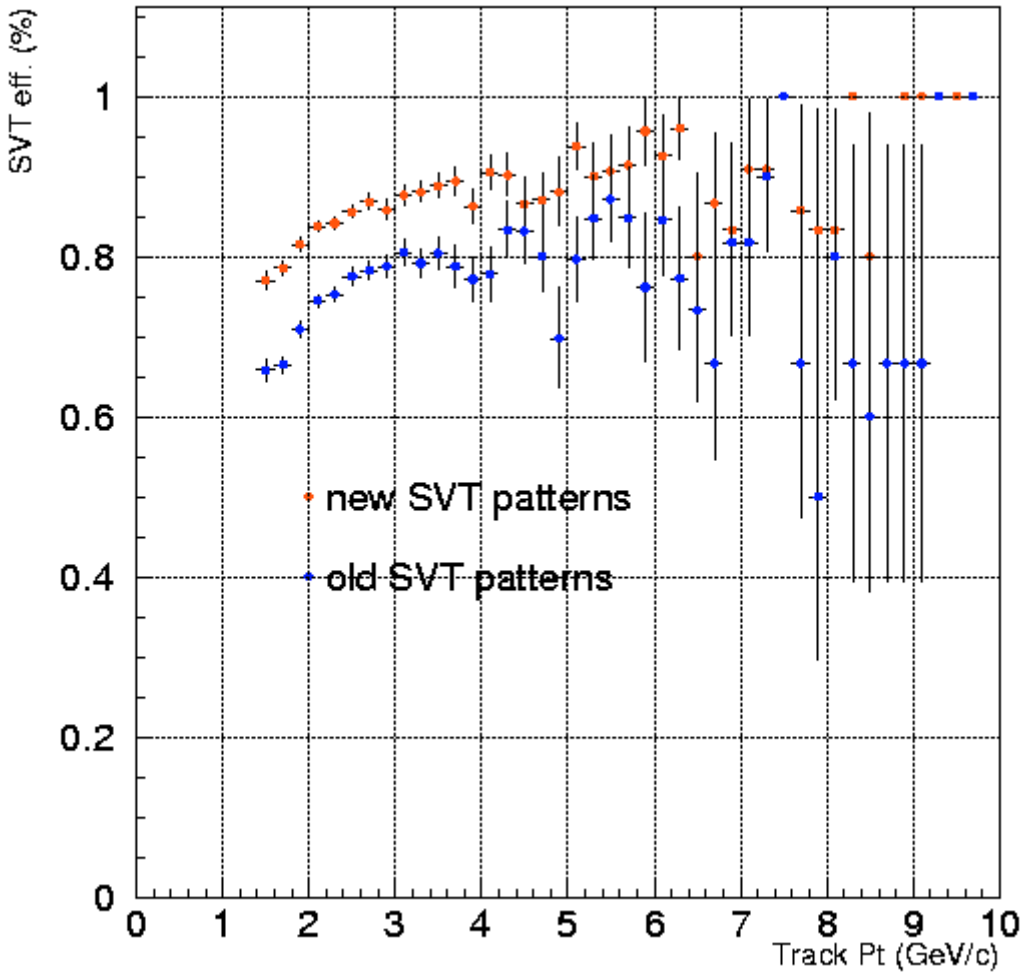
- Efficiency improvements:
  - pattern-generation geometry now accounts for large SVX/COT shift (not expected in SVT design)
  - changes in parent distribution flatten out efficiency vs d; flattening vs pT is a bit more work
  - deal with reduced coverage (fraction of potentially useful patterns that will fit in finite associative memory) that results from large beam offset
    - make roads a bit wider
      - was 6,4,4,6,8 (360,248,240,360um, 1.25degrees)
      - now 8,4,4,8,12 (480,248,240,480um, 1.875 degrees)
        - » actually varies slightly with layer choice
  - relax some cuts on max hits per superstrip
    - was 4 svx, 1 xft; now 8 svx, 4 xft
    - in particular, 1 xft track in 1.25deg bin at R=10.5cm was probably not optimal for finding phi decays
      - has anyone looked to see if it's improved?

  - Improved turn-around time:
    - if SVX conditions change, or beam moves by more than a couple of hundred um, patterns can be remade in a matter of hours

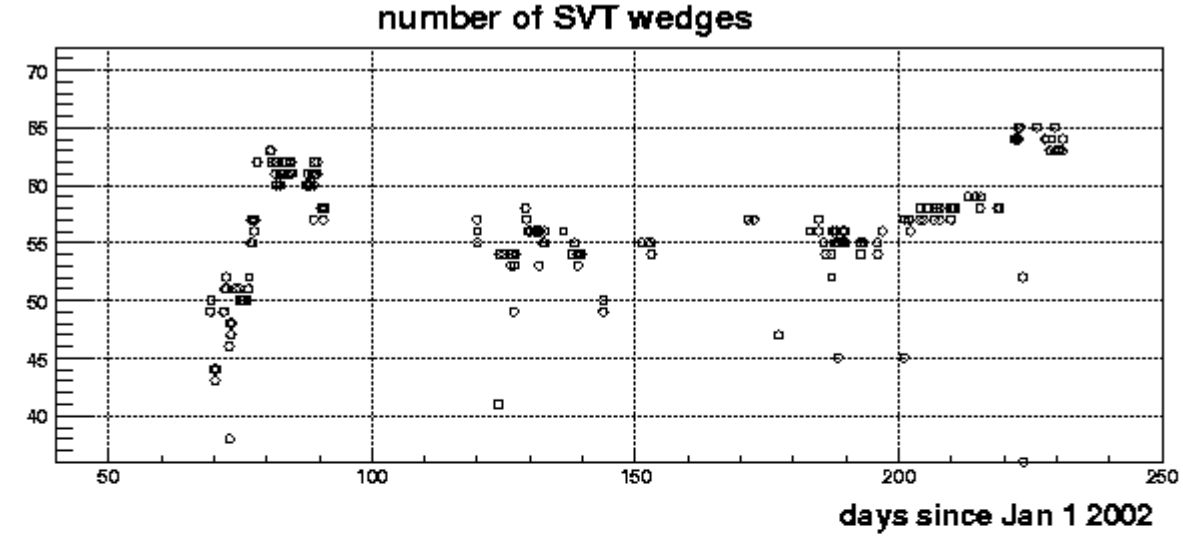
- Rates and yields:
  - number of useful wedges increased by ~10+%
  - pattern efficiency increased by ~10+%
  - Rolf measures
    - SVT track eff up 22%
    - B_CHARM xsec up 56%
    - D0$\rightarrow$Kπ yield up 66%
    - Ks $\rightarrow\pi\pi$ yield up 65%

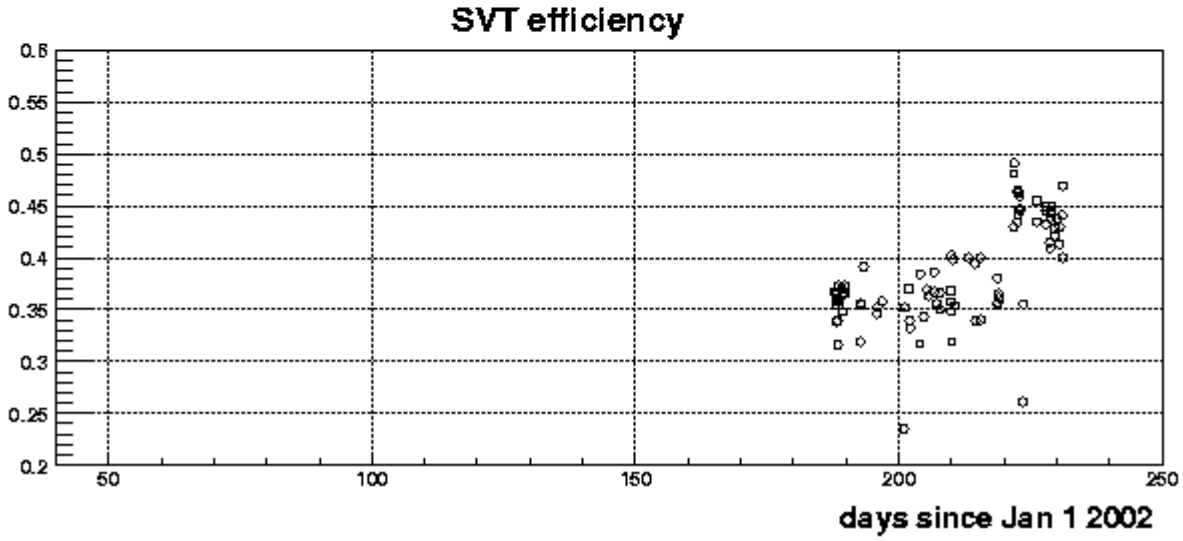
- Could/should plausibly be done by fall
  - make use of 71/72 wedges (skip layer 0, use 3 layers)
  - improve fit constants
    - remove biases/structure in d vs phi
    - match offline beam spot better (now off by O(50um))
    - make use of offline alignment data?
      - Should be at the very least a good starting points
  - evaluate 4/5 SVX hit option
    - 5 good layers available in ~2/3 of detector wedges
    - in these wedges, the per-track efficiency gain could be as much as ~30% (Barry's estimate), depending on per-layer hit efficiency (e.g. 90 vs 95%)
    - there would be some penalty in execution time
      - estimates from Giovanni's numbers were ~2-3us
      - roughly, one would do it if efficiency**2 increases by more than the maximum L1A rate decreases
  - less directly related:
    - hot channel suppression
    - timing improvements
    - tracking down source of fakes

From Marco Rescigno
(denominator=OI track in same 4 layers)



From Rolf Oldeman
(efficiency denominator = COT track, |z|<zmax)





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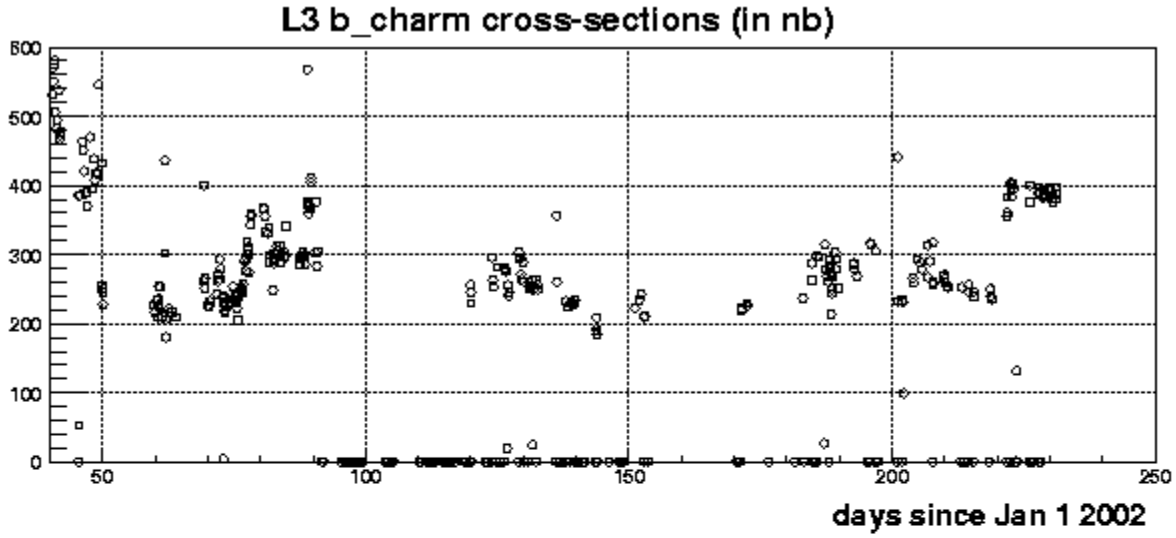

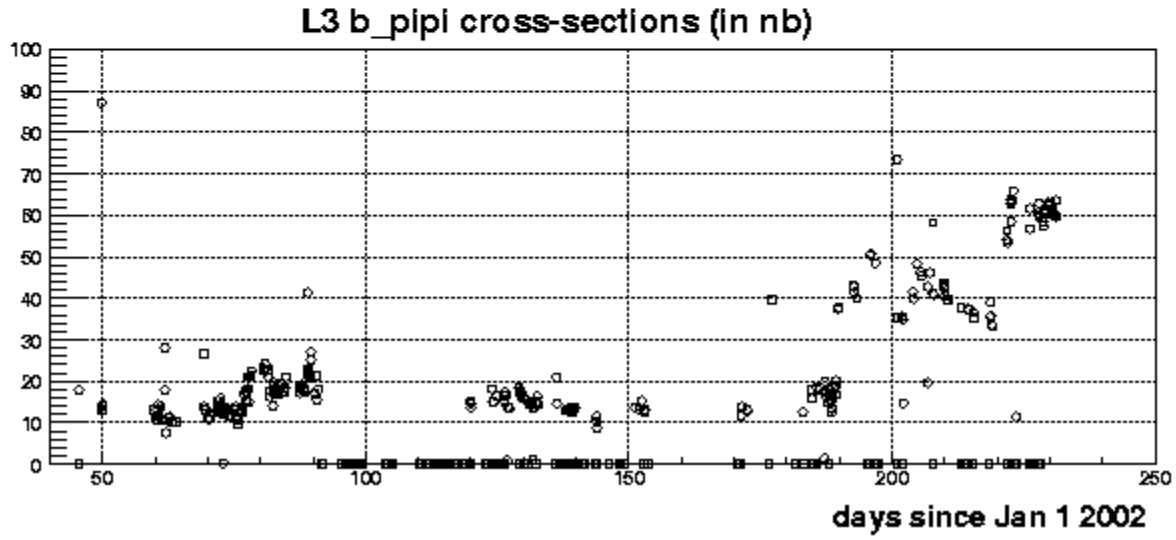

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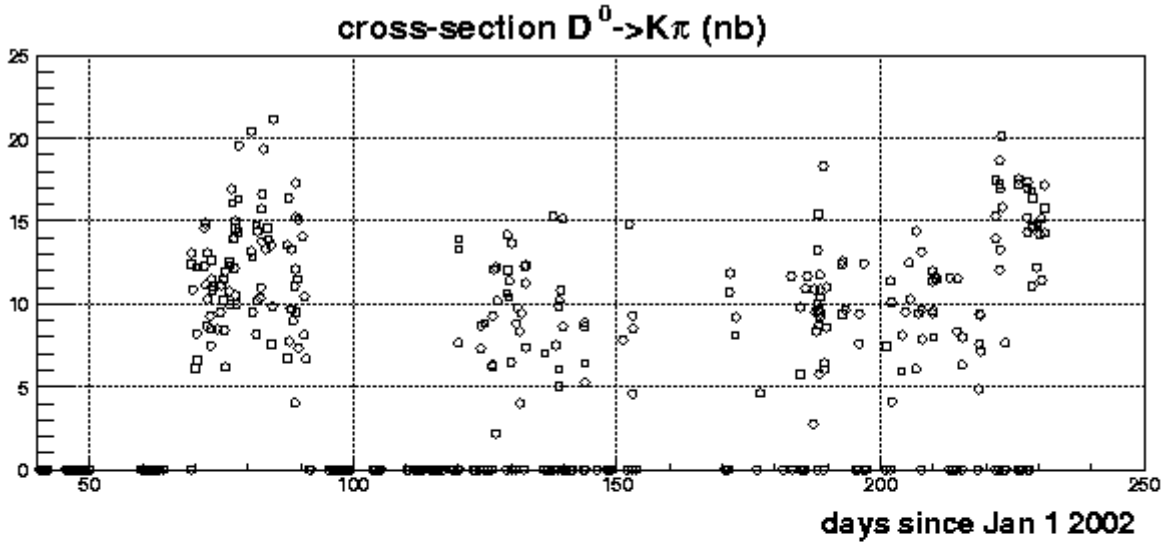
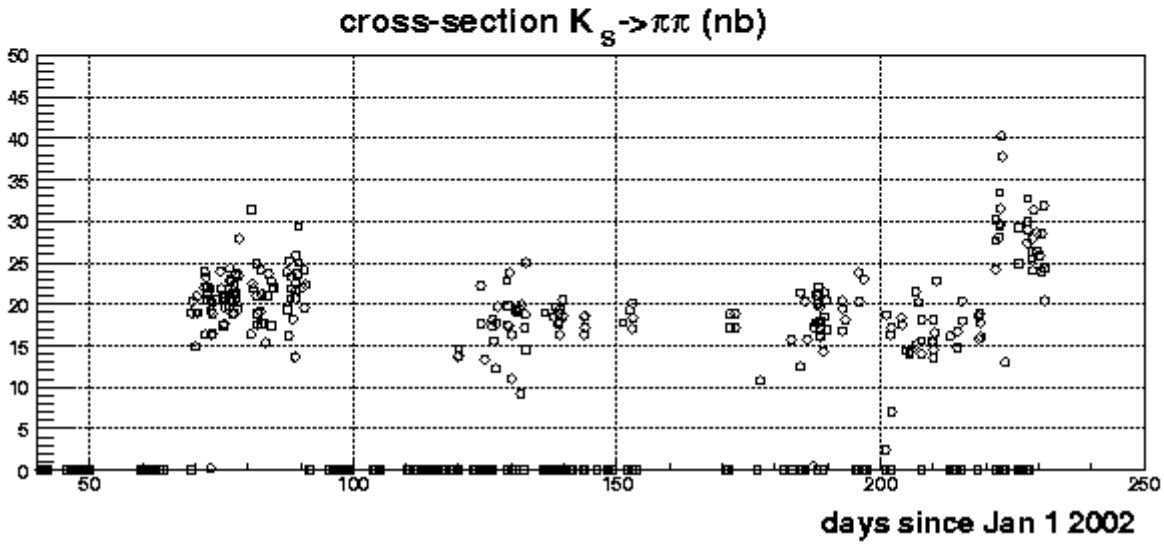
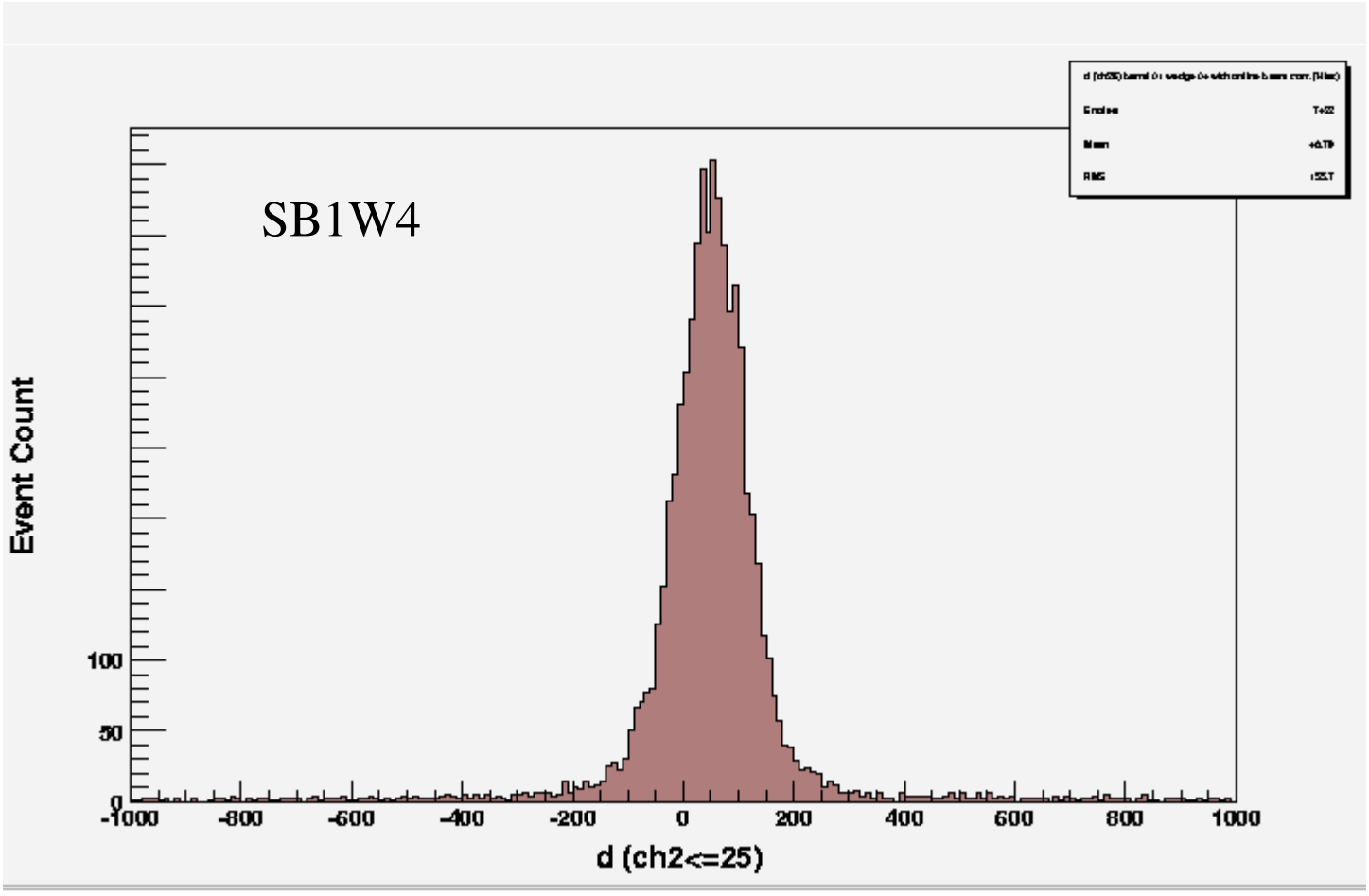




From online svtspymon (CDF Rome group)



This illustrates that some wedges in which SVT layer choices changed could benefit from updated SVT fitting constants