Data ⇒ Long term target behavior

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20.11.13

<u>Tracking behavior of targets through measurements used:</u>

- Rates
  ⇒ target material in beam

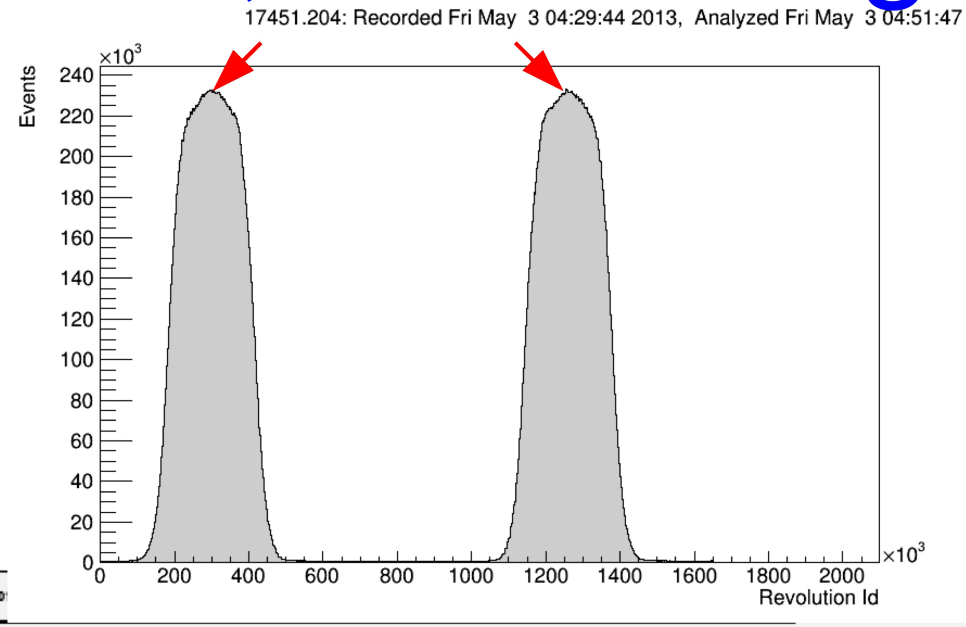
<u>& from rotated detectors 1&6:</u>

- Longitudinal carbon hit distribution centroid
  ⇒ longitudinal 'sway', looseness of target

- Longitudinal carbon hit distribution width
  ⇒ target→detector thickness

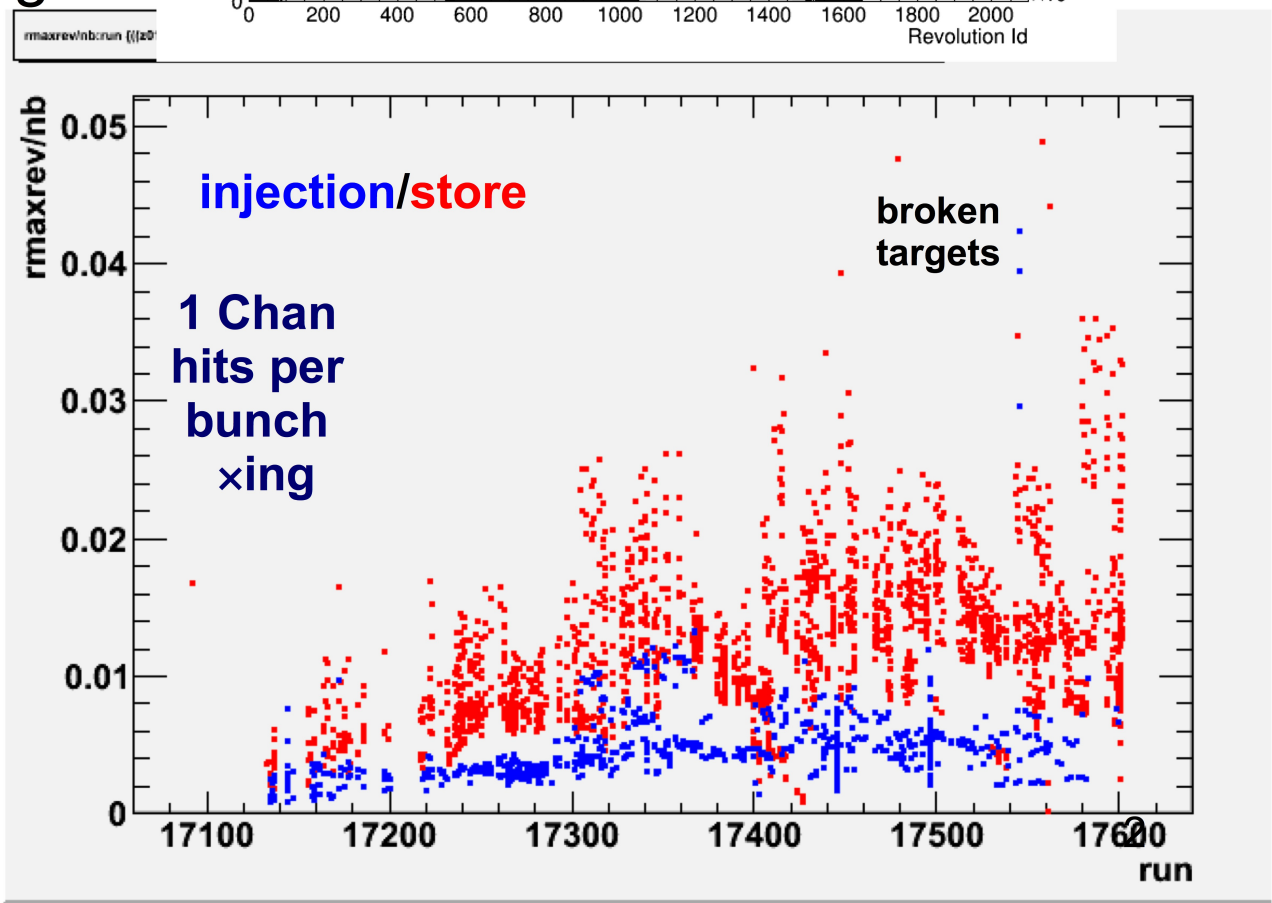
Rates per channel, bunch ×ing

- From rate vs. time sweep plots take max. value of hits/revolution:



- Normalize to (C-hits/channel) / bunch ×ing:

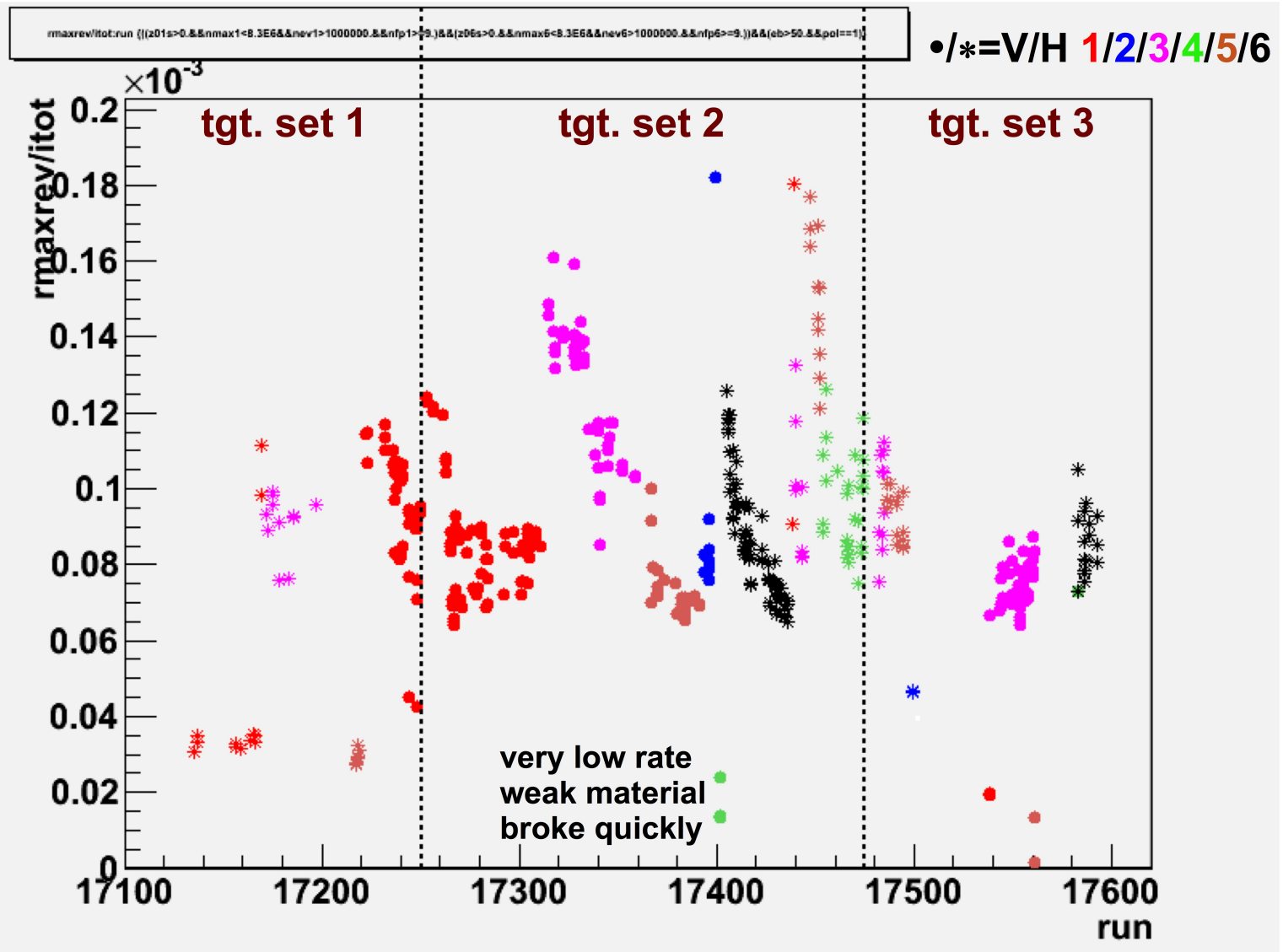
- rates increased thru Run13 as I_p increased
- rate higher at store: higher traverse beam density



- Aside: max. rate/channel ~few % per bunch ×ing
- pileup ~ few %

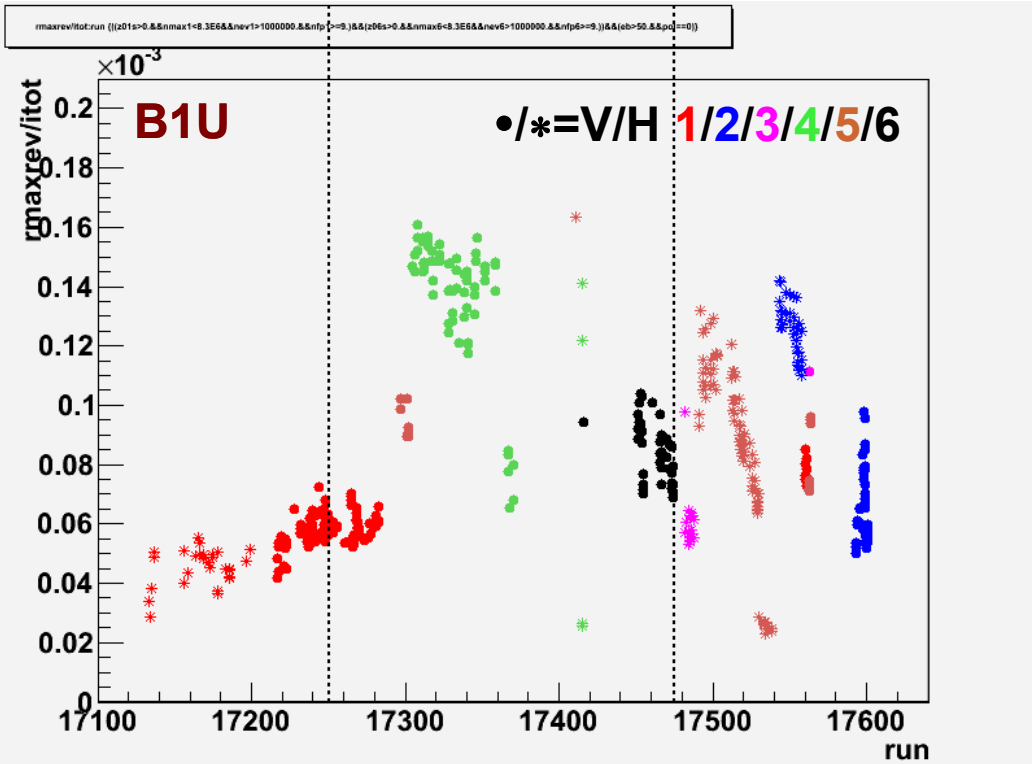
Rate ⇒ material in beam

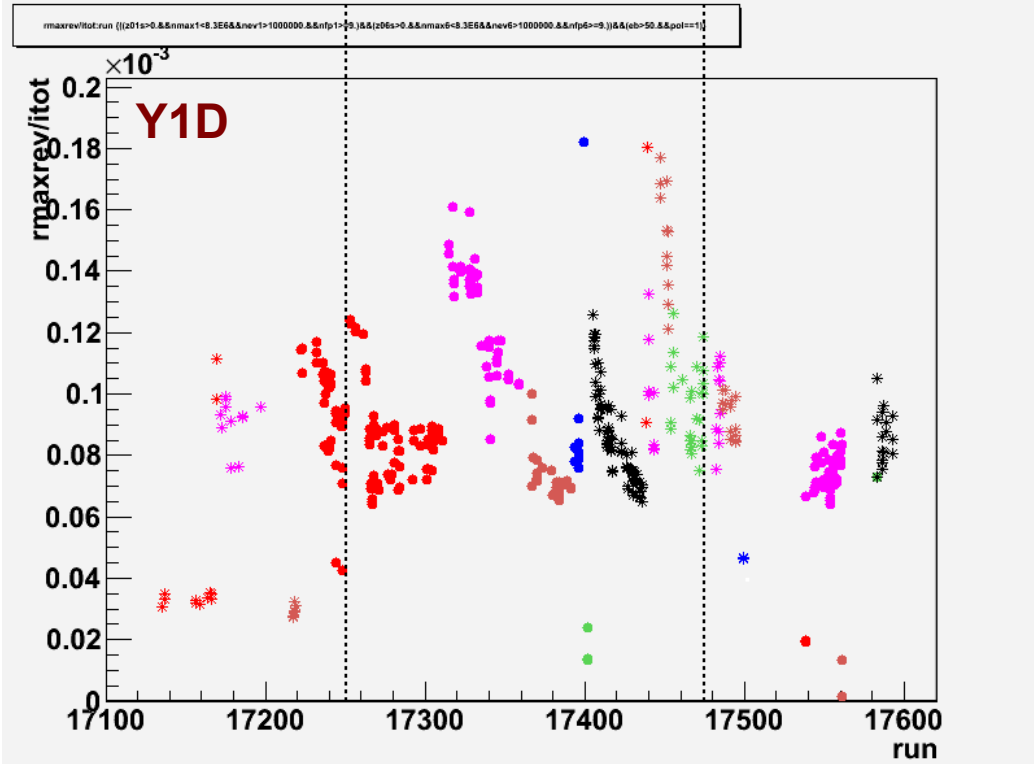
- rate ∝ (material in beam)×(I_p/σ_T); σ_T= transverse beam size
- Take only measurements at store: σ_T ~constant
- Then (rate/I_p) ∝ (material in beam); track (rate/I_p) each target, e.g. Y1:

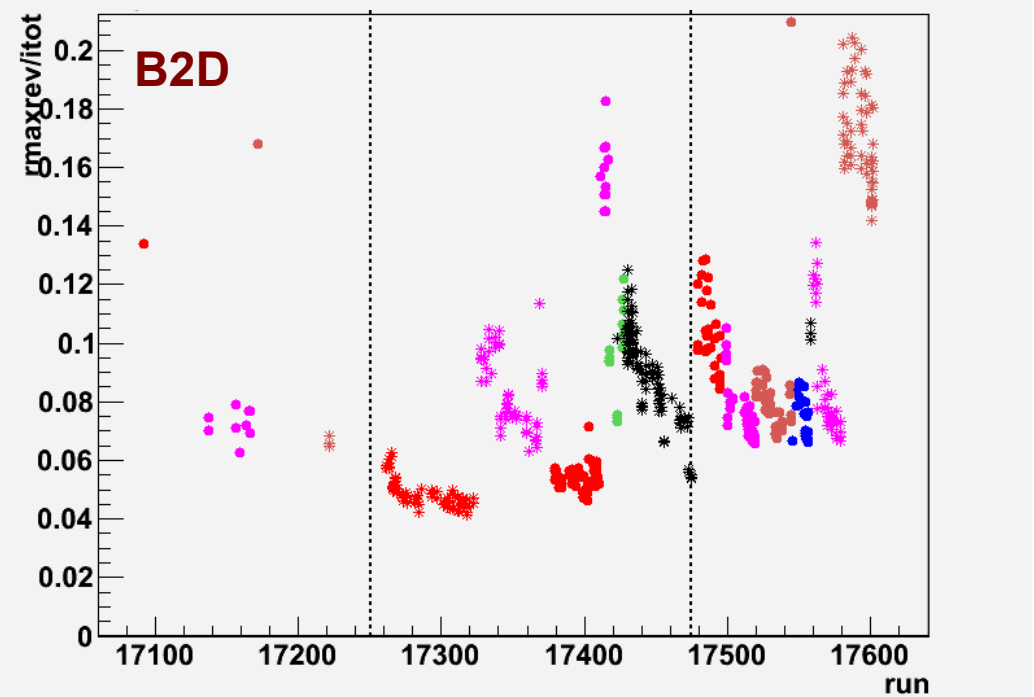


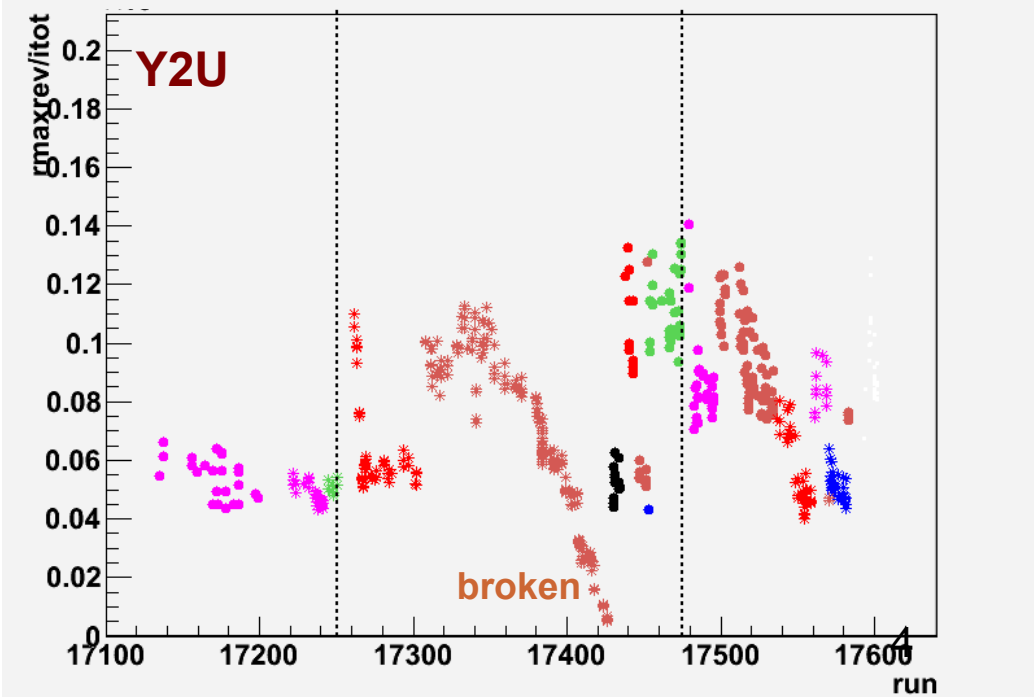
- different targets, varying material
- trend: drop in material with exposure
- burning off carbon?
- decreasing wire curled into beam?

Rate ⇒ material in beam









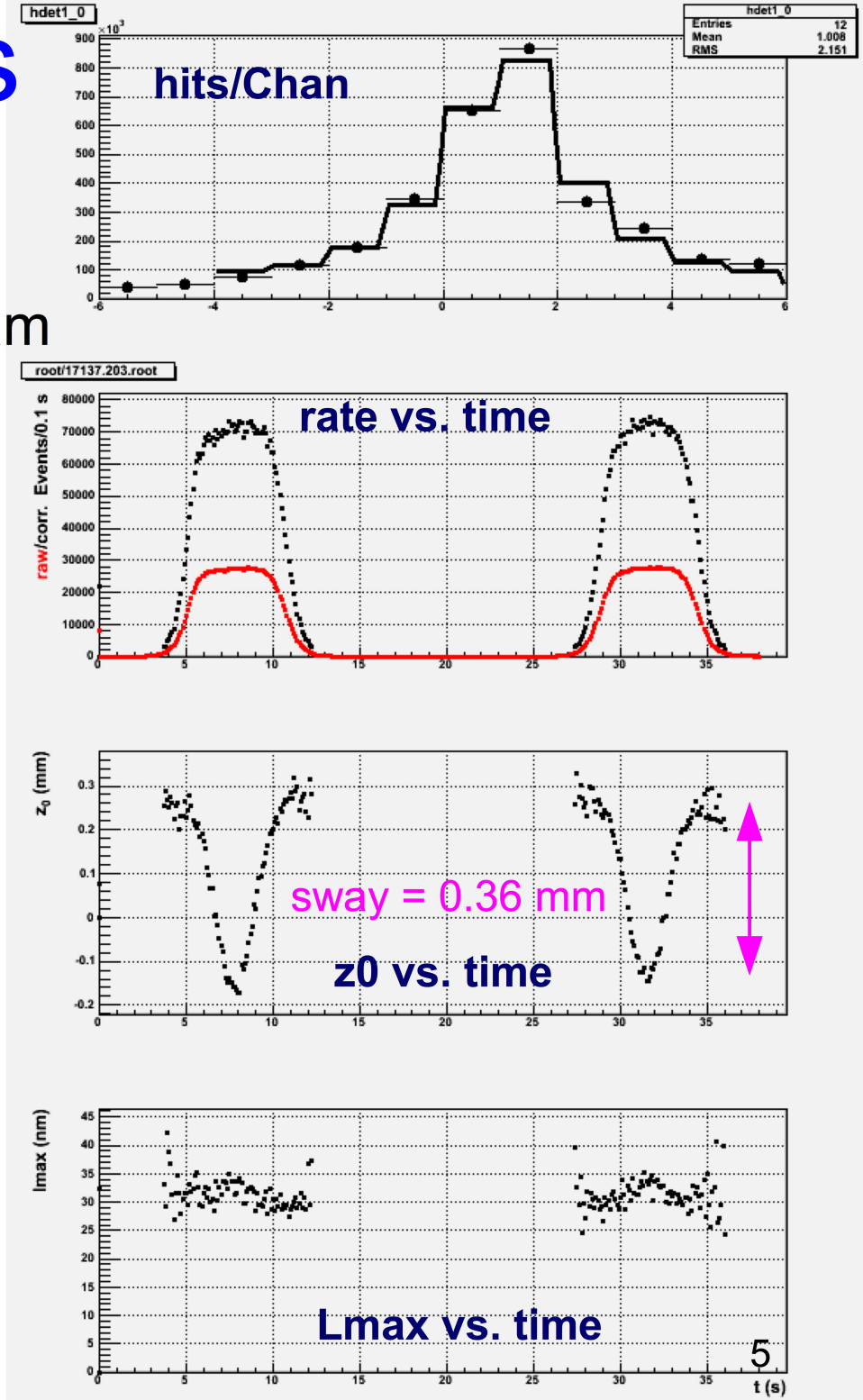
Rotated detector fits

(details slides polar. mtgs. 05.12.12, 06.03.13)

- Fits to detector hit distribution:
  centroid⇒z0: target position along beam
  RMS⇒Lmax: thickness target→det.
  (Lmax∝RMS^2 defined extra slide)
- Do fits in 0.1 sec. bins

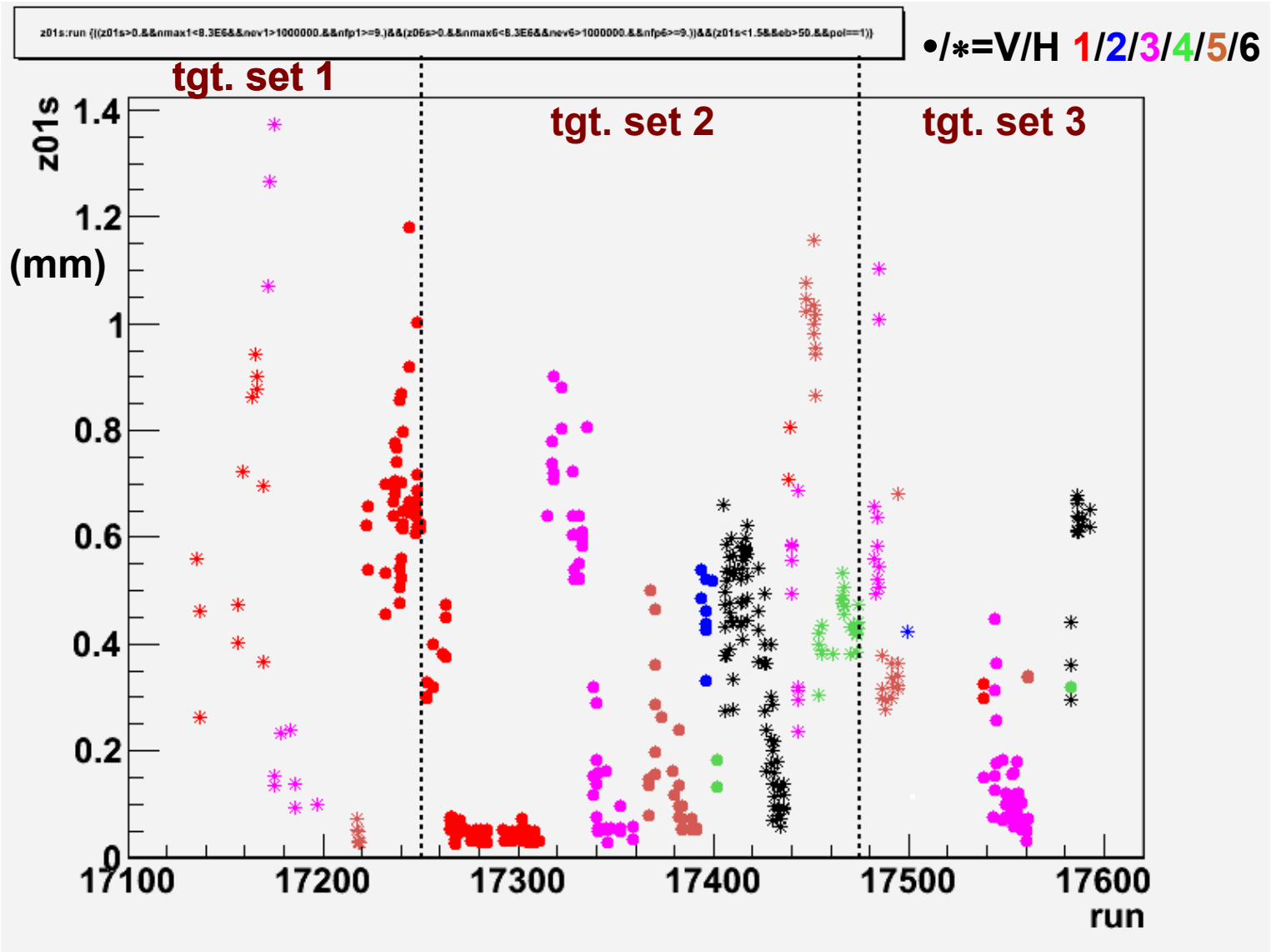
- Targets move along beam (*upstream*)
- Define 'sway' of target:
  width of z0 window with 70% events
  (avoid wild fits, z0 values)
- Just rough measure of looseness;
  sway always > 0.1-0.2 mm stat. noise
- Track 'sway' vs. measurement

- Lmax ~constant
- Track mean Lmax vs. measurement
  <u>note:</u> mult. scat. very low E_{carbon}
  Lmax scale uncertain

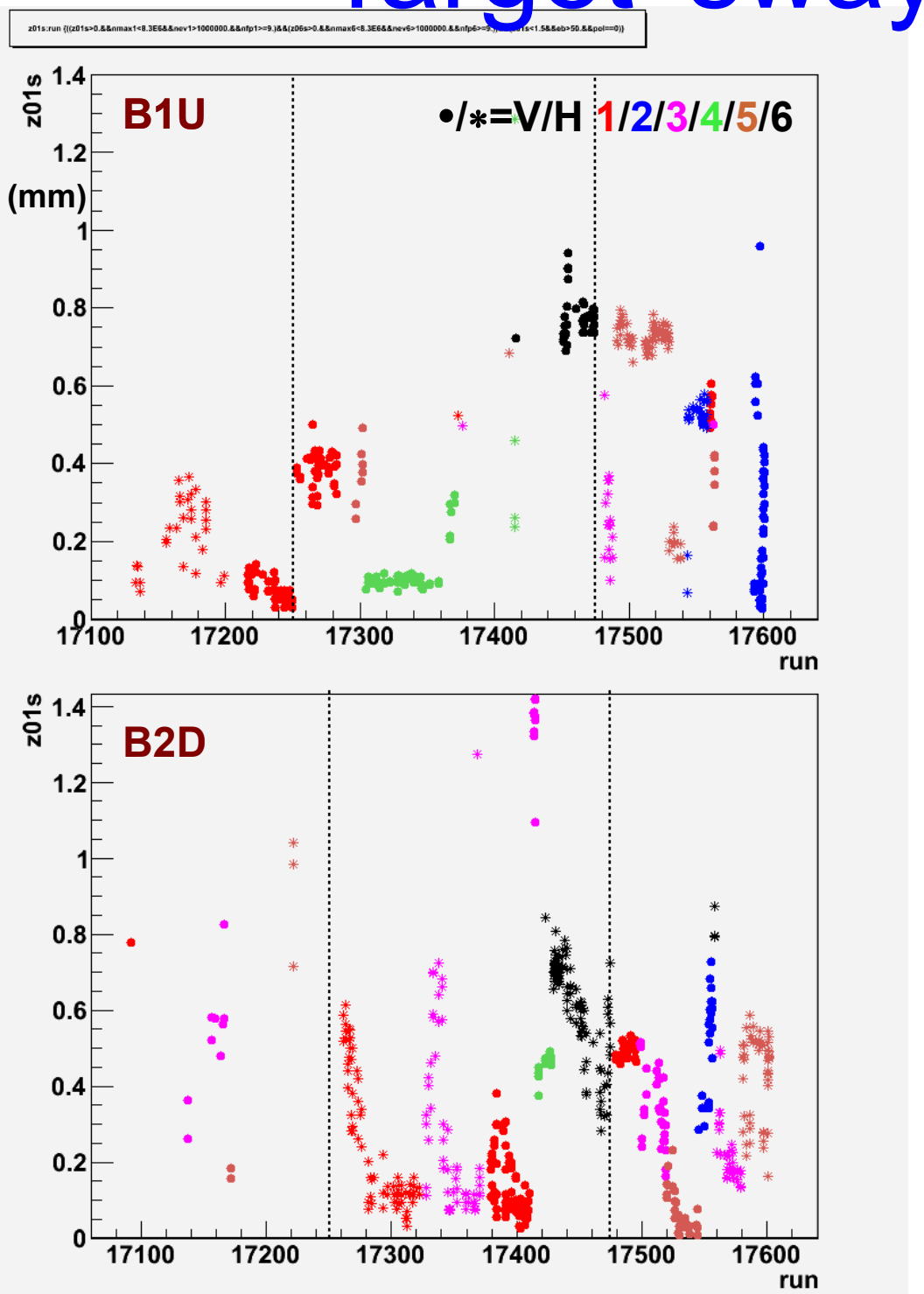


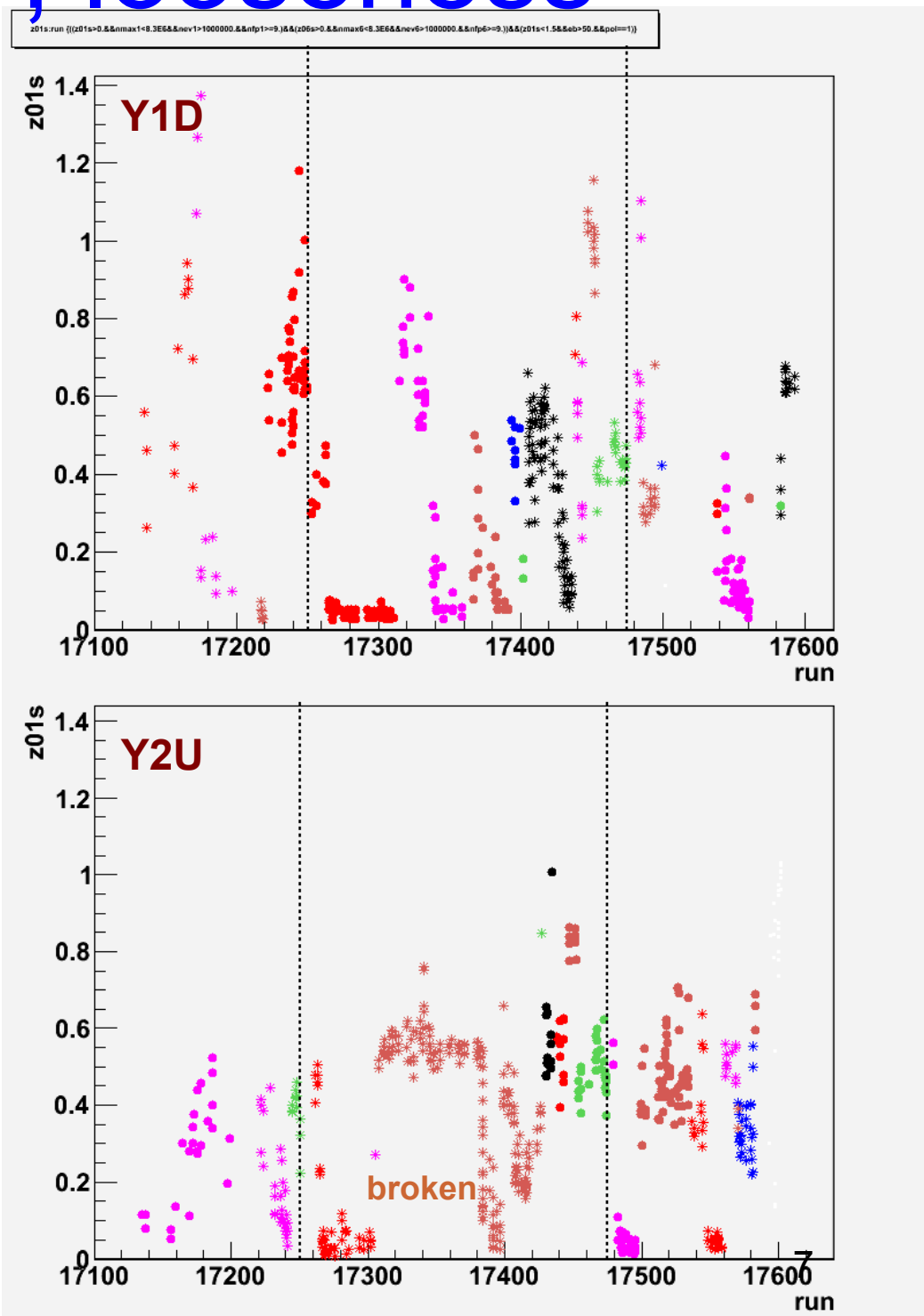
Target 'sway', looseness

- Here e.g. Y1 @ store (injection↔store comparison extra slide)
- Different values (looseness) each new target
- Trend: decreasing sway with exposure ⇒ target tightening?



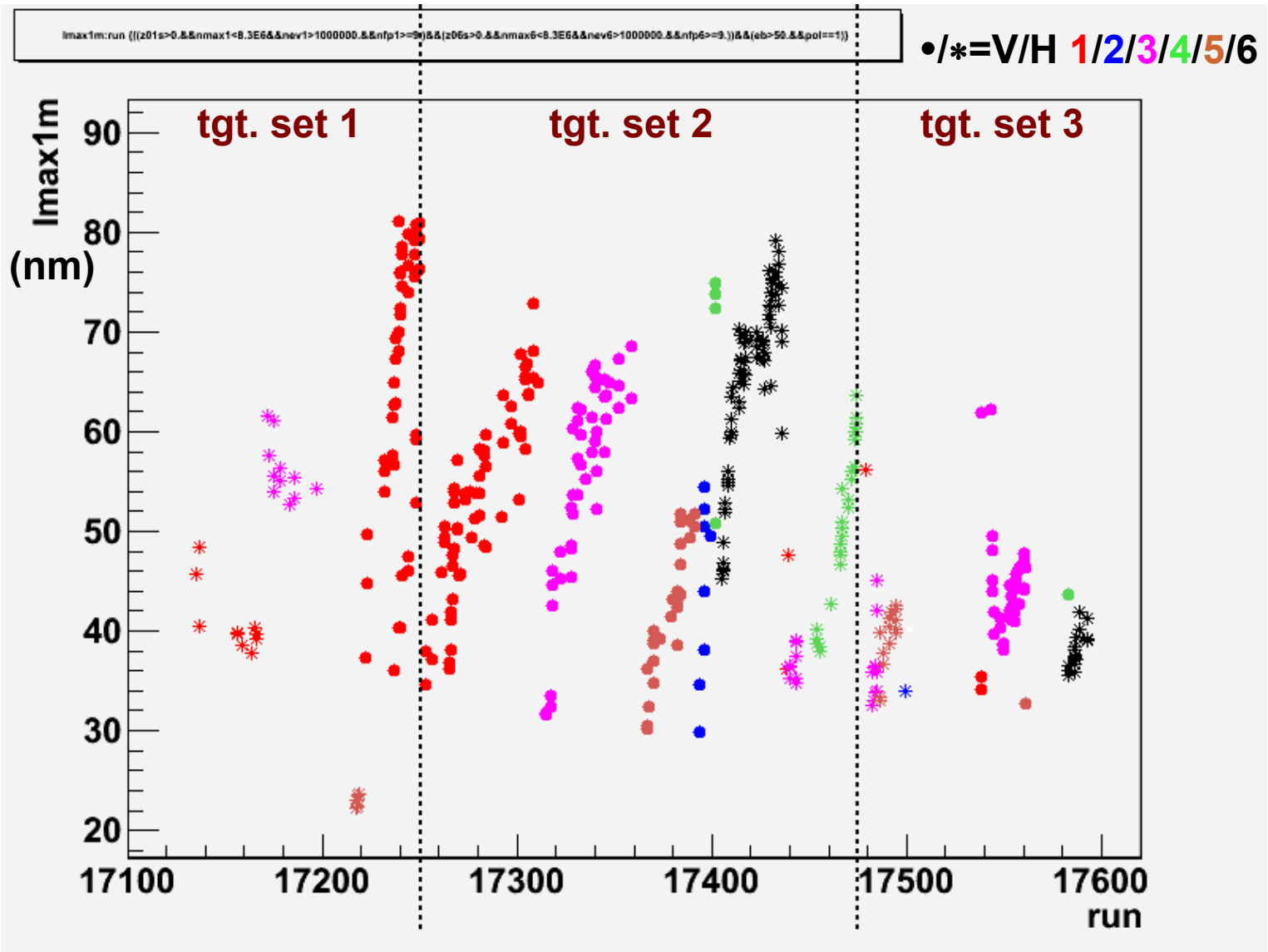
Target 'sway', looseness



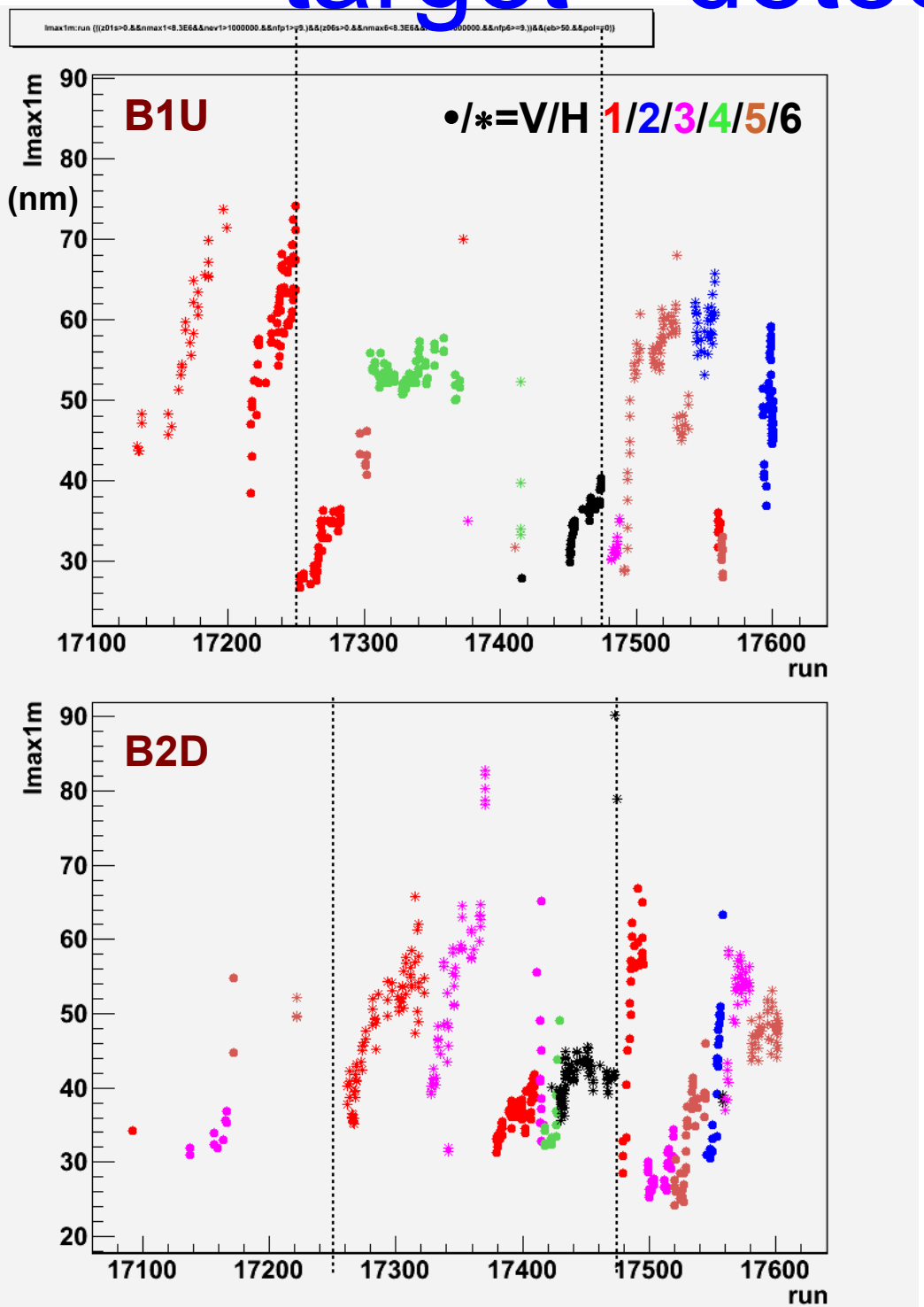


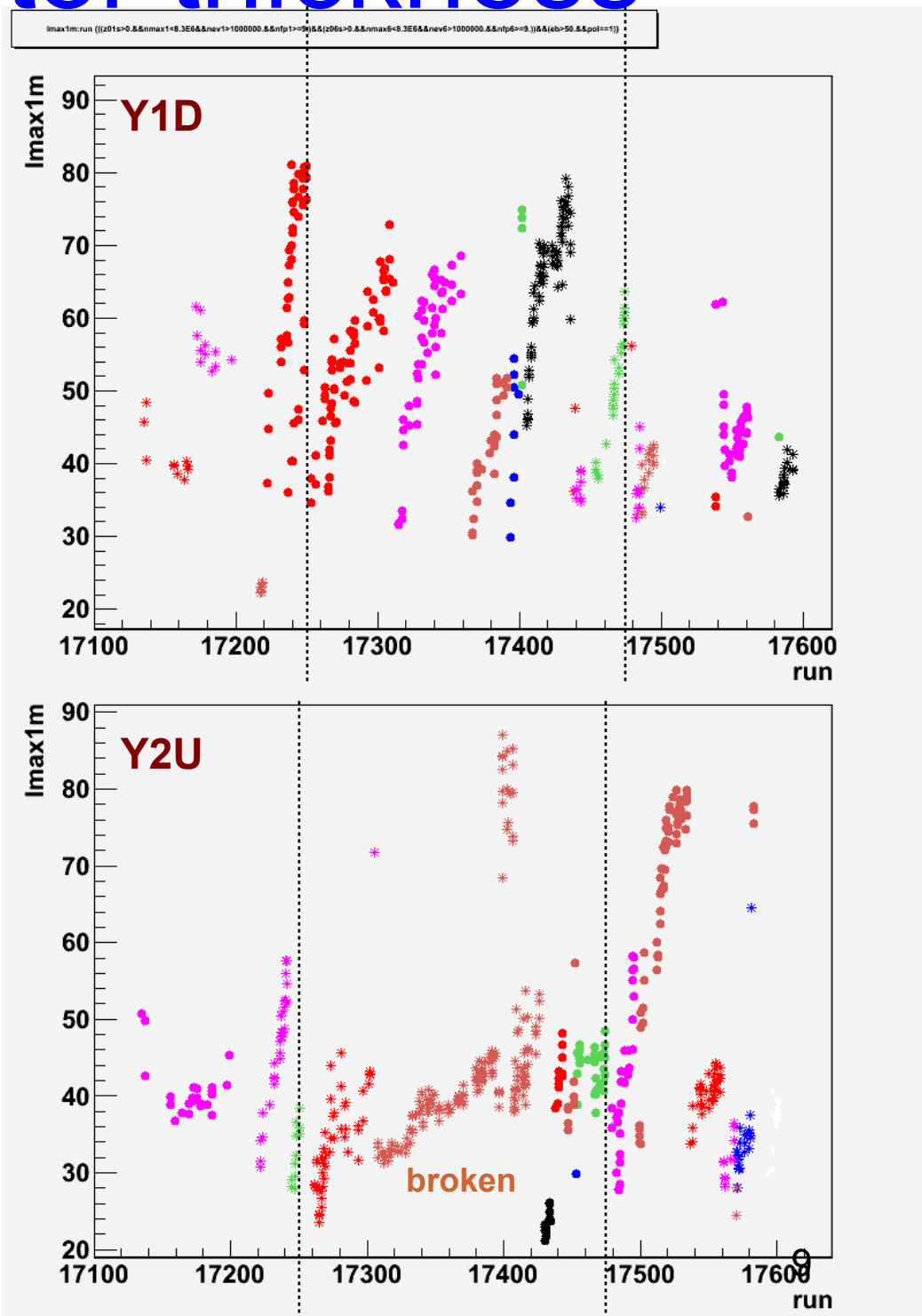
target→detector thickness

- Here e.g. Y1 @ store (injection↔store comparison extra slide)
- Different values (looseness) each new target
- values less than minimum 50 nm; mult. scat. scale?
- Trend: increasing thickness with exposure



target→detector thickness





Summary: observations & speculation

<u>As targets are repeatedly exposed to beam:</u>

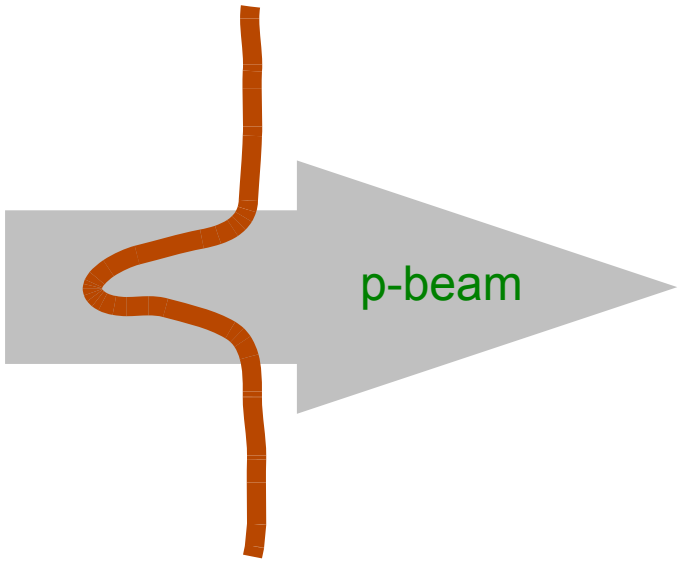
- Present less material to beam
  - burning off carbon?
  - decreasing wire curled into beam?
- Sway less along beam (*upstream*)
  - target tightening?
- Present more material along target↔detector axis
  - twisting?
  - extended C-source along beam increasing RMS?

$$\text{Lmax} \propto \sigma^2_{\text{dist.}} = \sigma^2_{\text{mult. scat.}} + \sigma^2_{\text{source}}$$

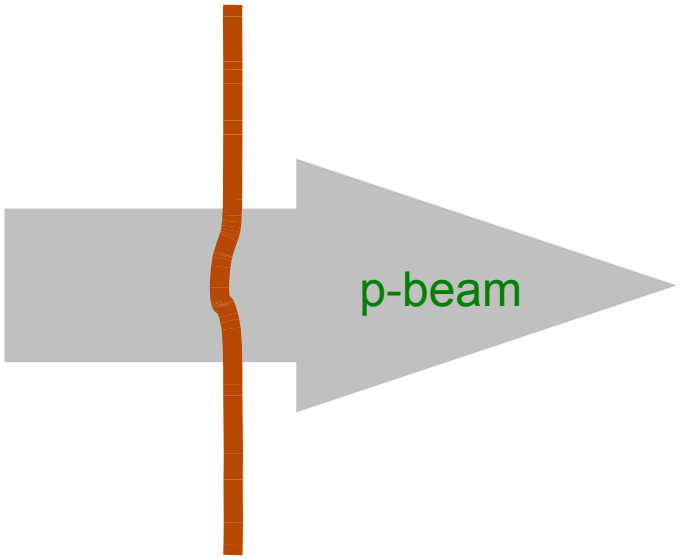
$$\sigma^2_{\text{dist.}} = \text{RMS of hit distribution}$$

Pure speculation

Loose target:



Tight target:

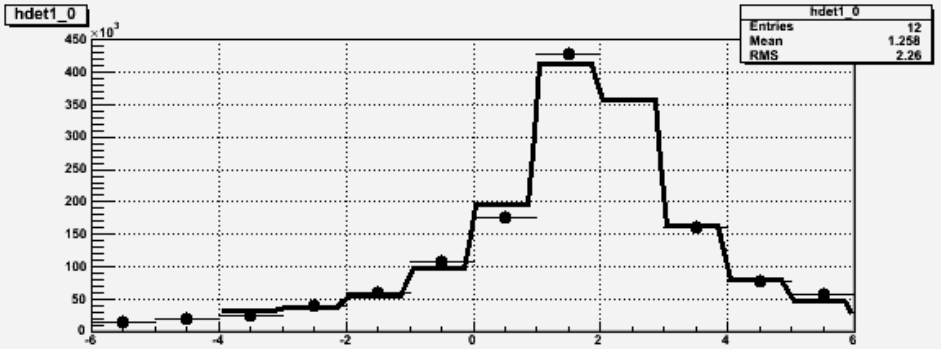


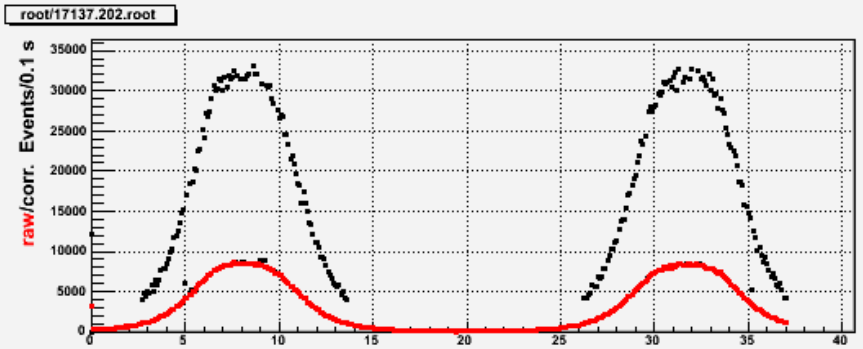
- More material in beam
- Centroid of C-hits moves more
- Wider RMS of C-hits

- Less material in beam
- Centroid of C-hits moves less
- narrower RMS of C-hits

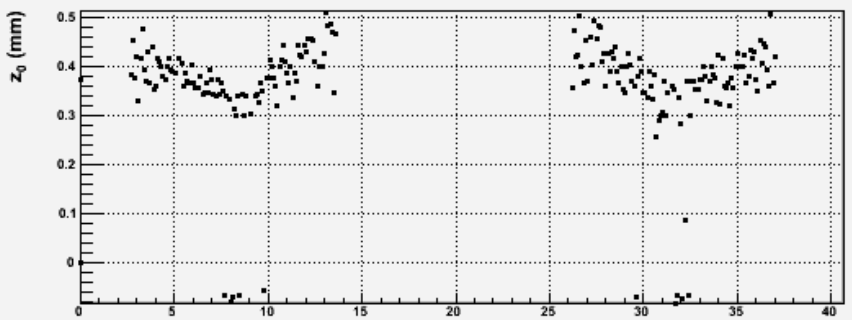
- Decreasing rates, sway consistent with loose→tight target
- Increasing Lmax consistent with tight→loose target

Extras

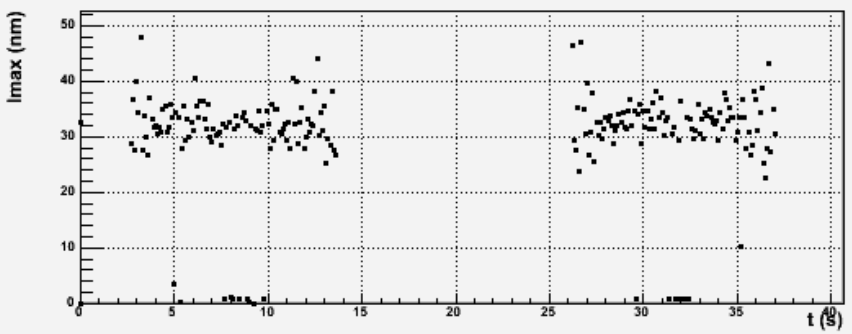


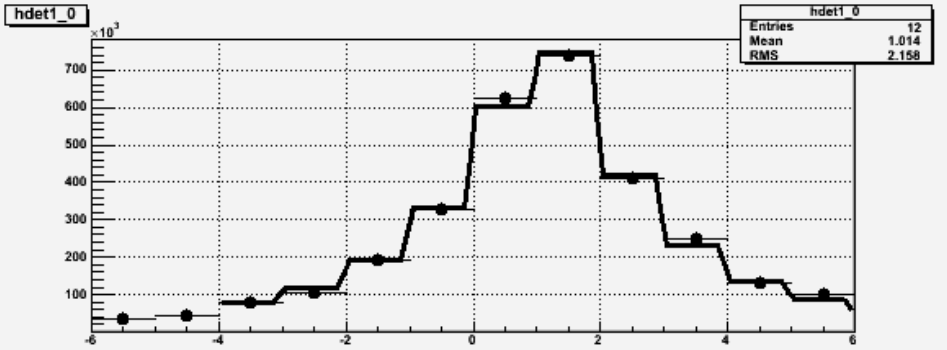


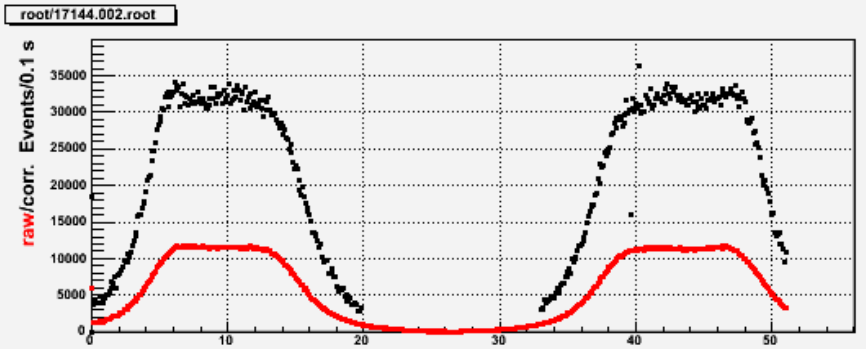
sway = 0.1 mm

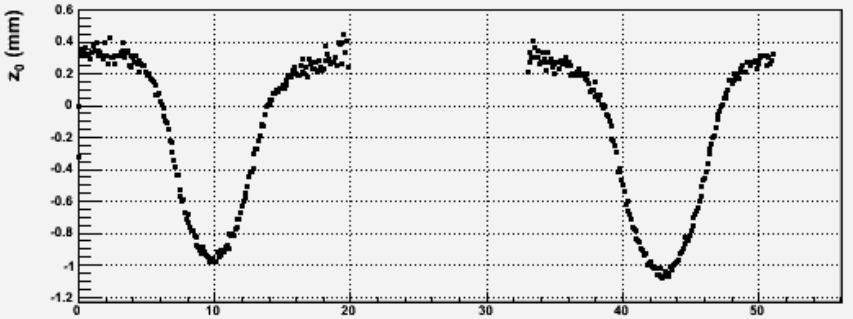


24 GeV

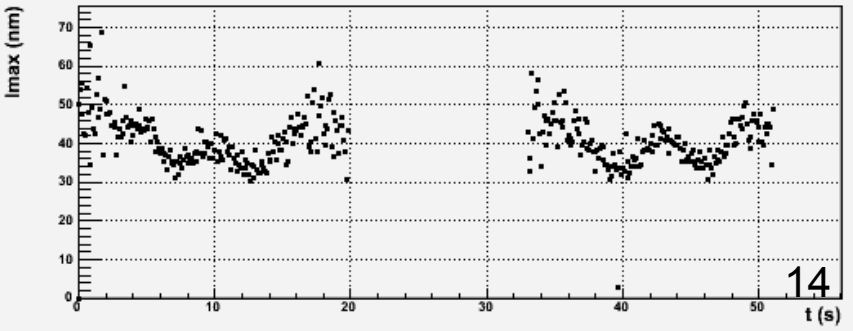






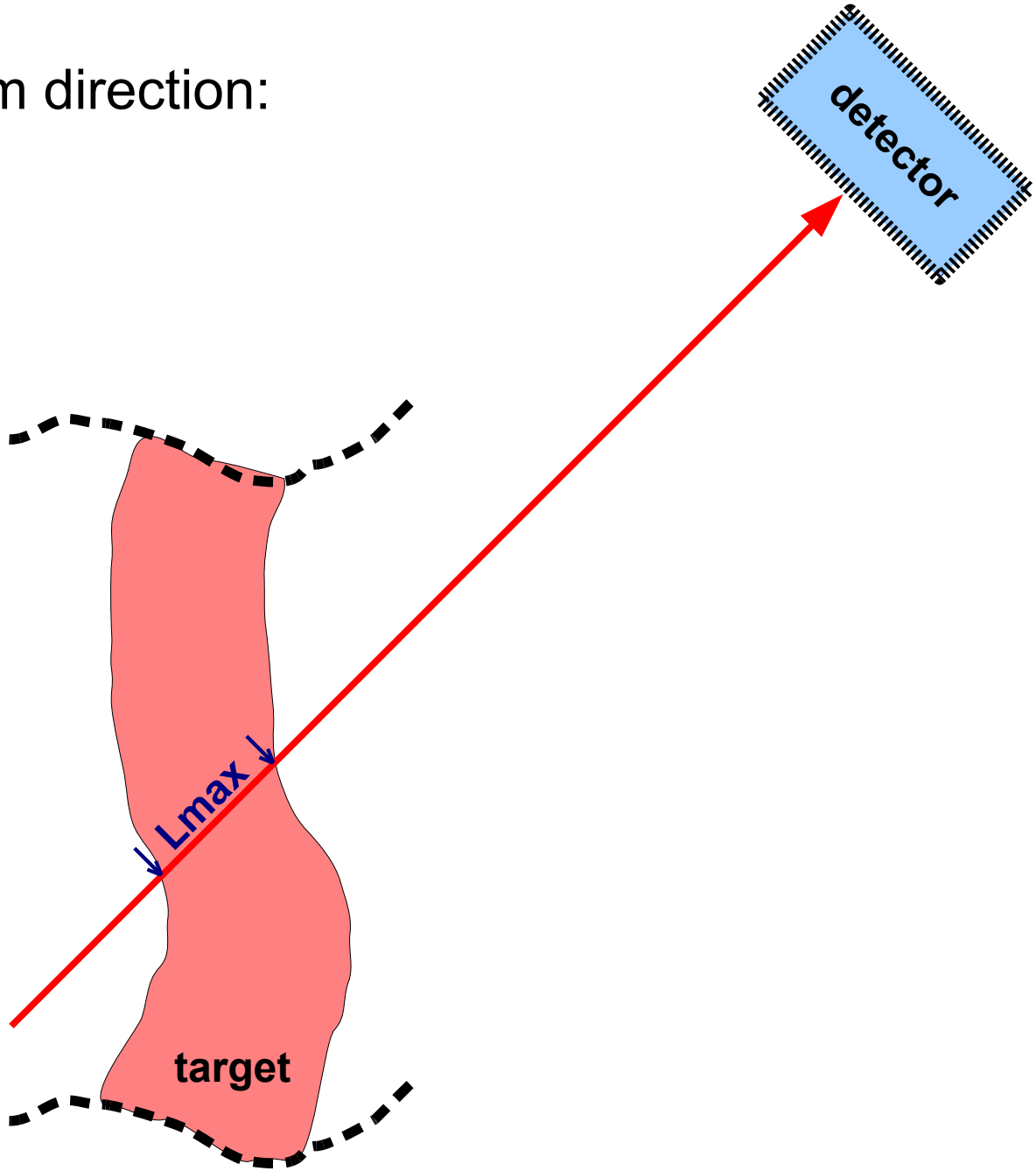


255 GeV



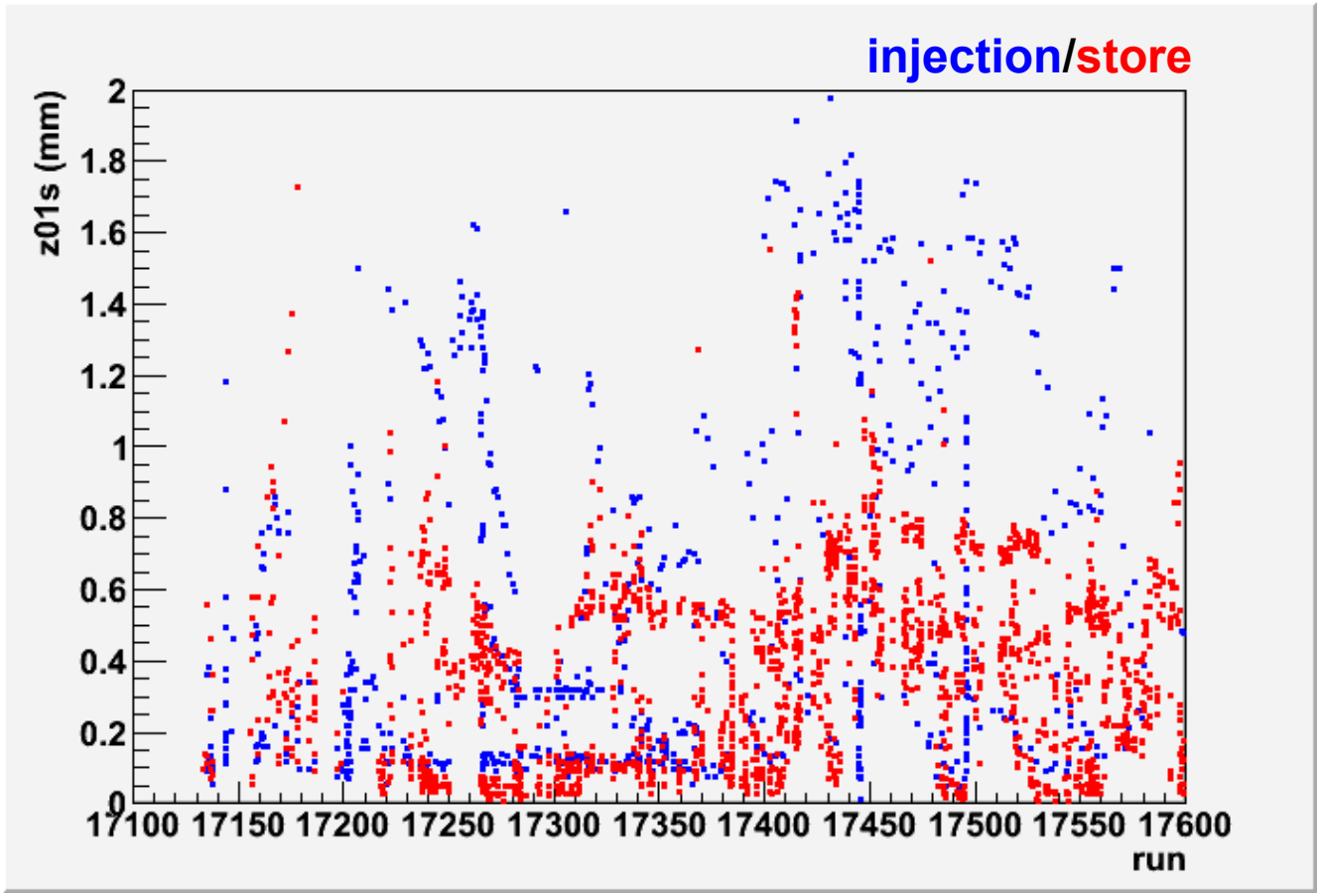
Lmax: target→detector thickness

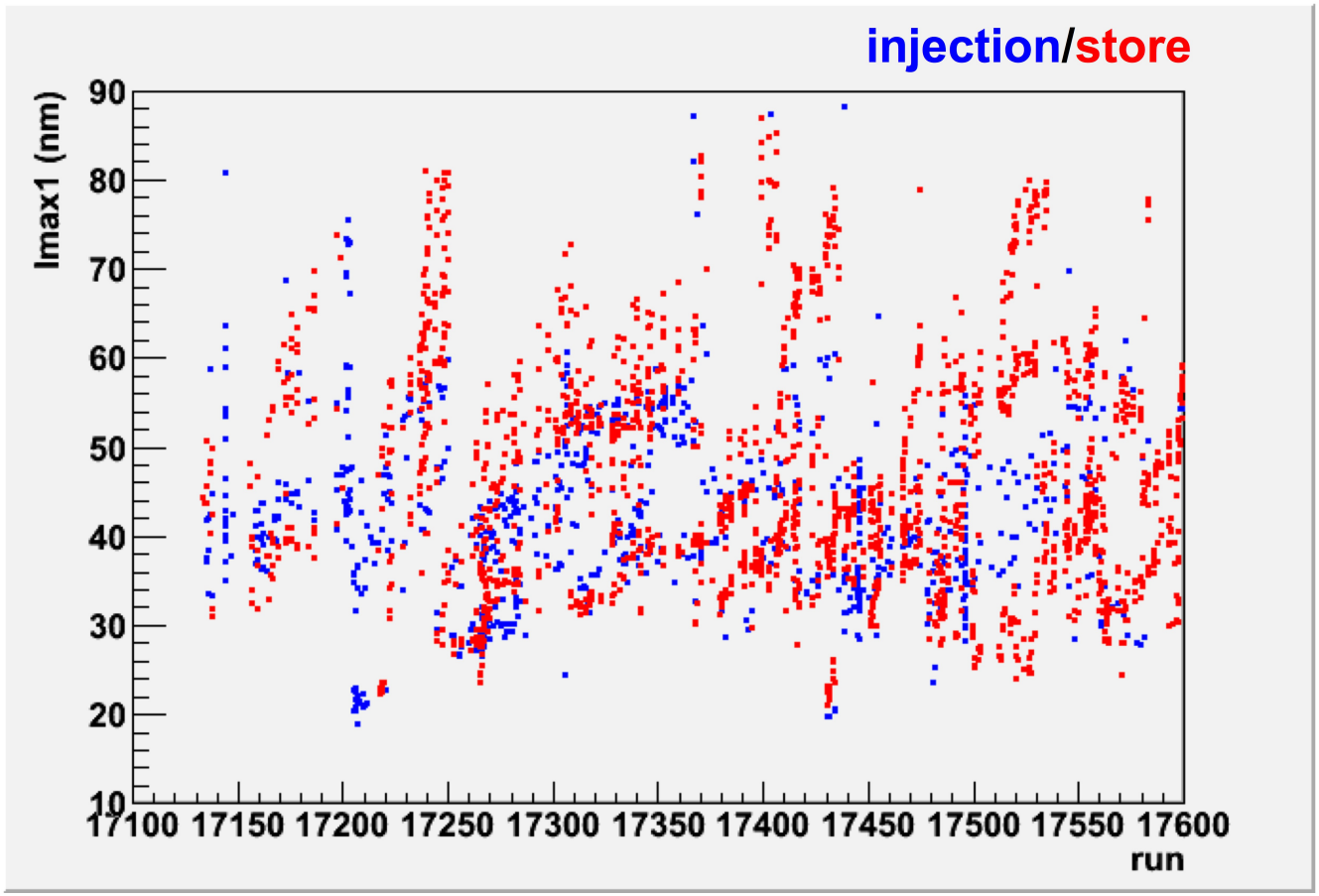
- In plane ⊥ beam direction:



Target 'sway': injection/store

- Not much difference:



target→detector thickness: injection/store

- ~same (as expected):