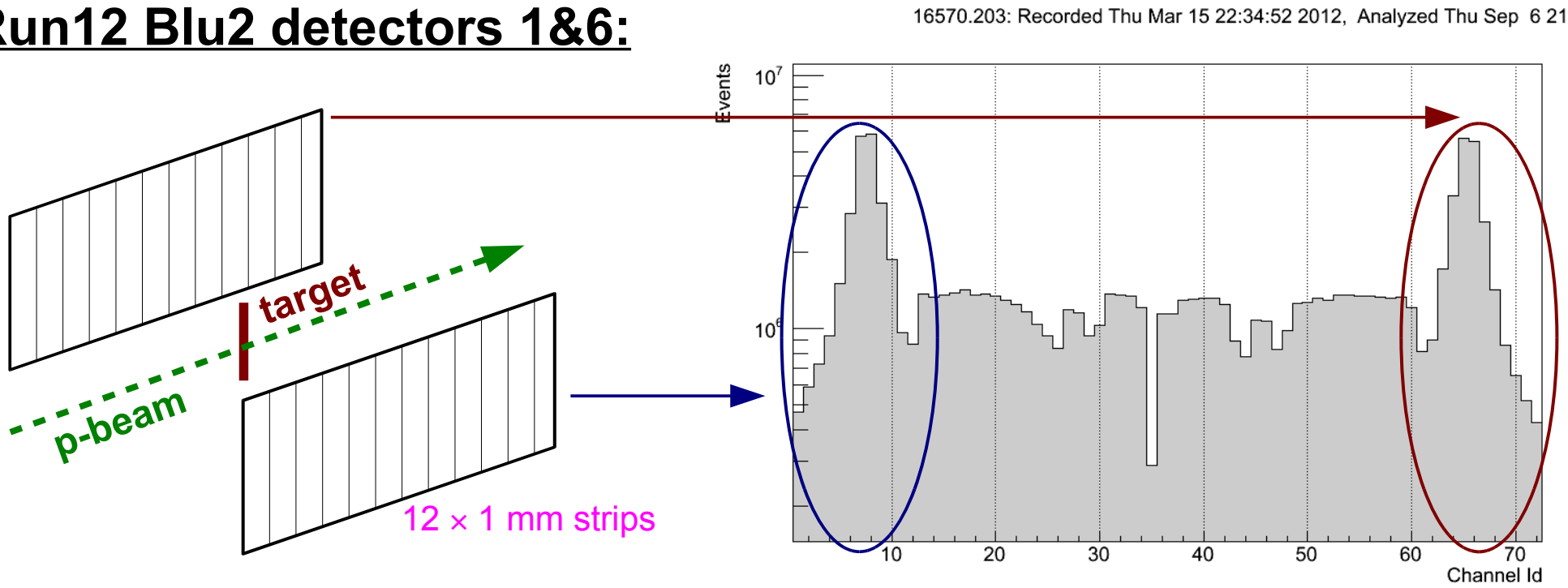
# Results: Longitudinally segmented detectors

polar. mtg.
05.12.12

**Run12 Blu2 detectors 1&6:**

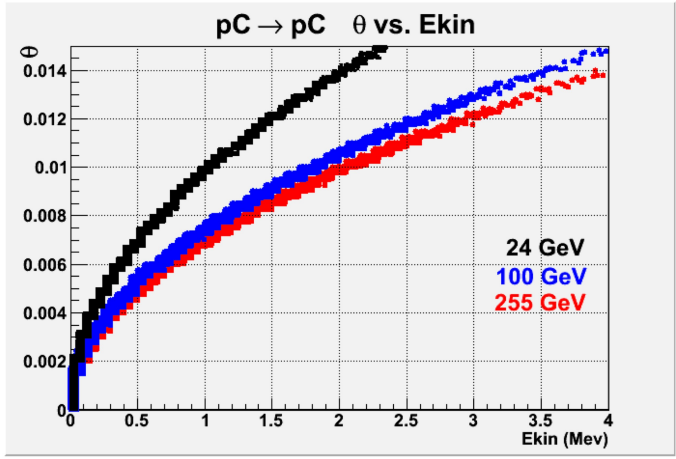



#hits/channel distribution provides info:

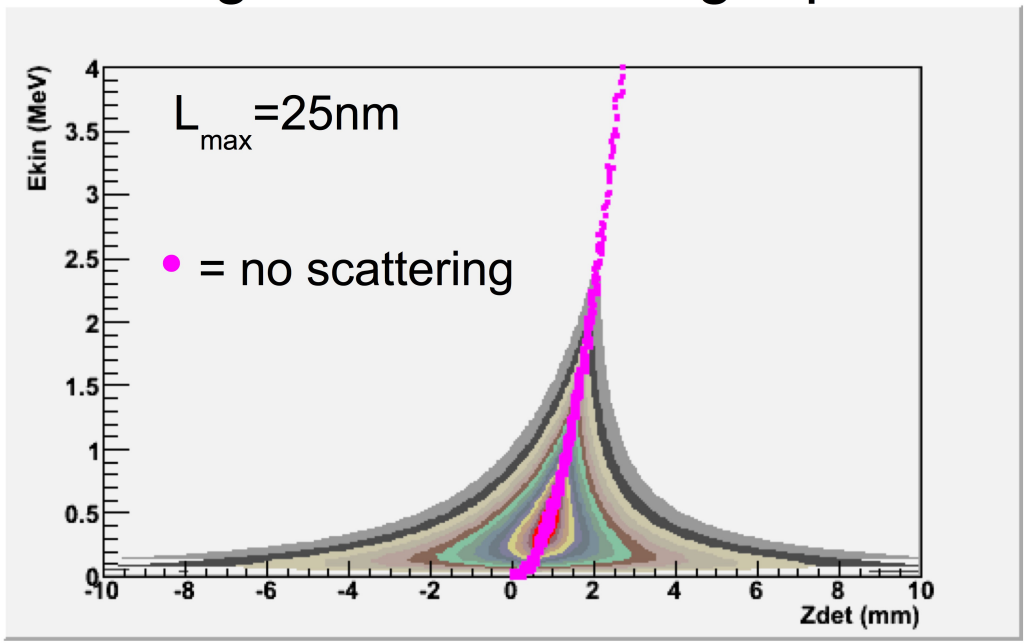
- Centroid ⇒ longitudinal (Z) position of target
- Width ⇒ amount of multiple scattering through target

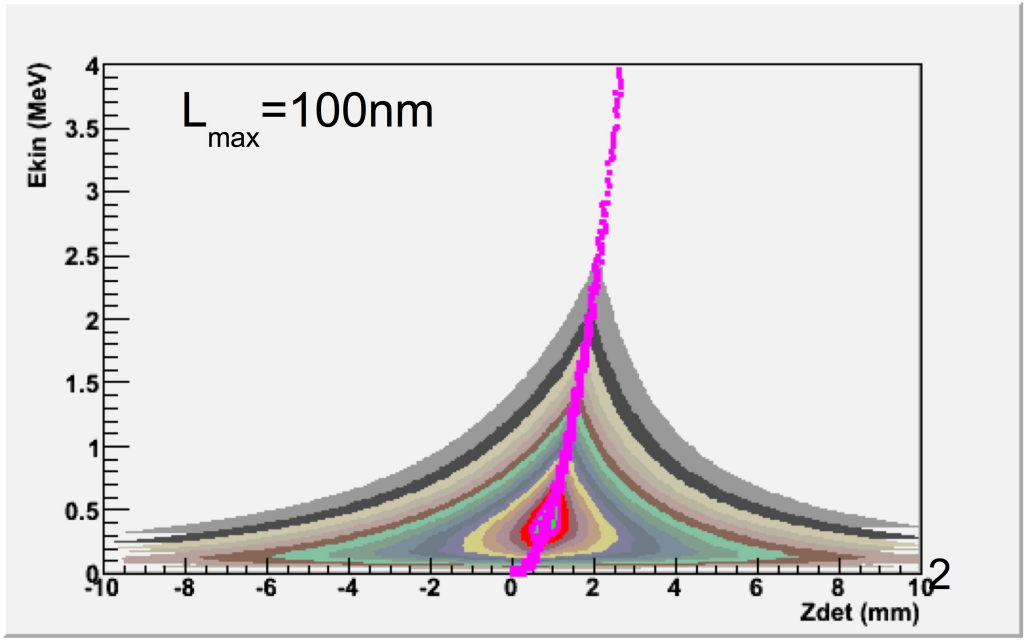
# Toy Monte Carlo

- To extract info from distributions need model: simple Monte Carlo
- Model
  - exponential in scattered carbon energy
  - correct E↔θ scattering angle dependence




  - passage of scattered carbon through varying amounts of target material $0<L<L_{max}$ with:
    → small angle multiple scattering in target material
    → dE/dx carbon energy loss
  - target → detector flight path 192 mm



# Fitting

- Here am using Dima's histos in root files from each measurement
- There are #hits/channel distributions for 0.4<E<0.9 MeV
- Project MC distributions for E-range into 1 mm detector bins
- Vary: target position ($z_0$) in det. coord & $L_{max}$
- Include flat 'background' distribution: other effects
- Fit results:

  N = # events corrected for geometric & E-range acceptance

  $z_0$ = target position in detector coordinates (in mm)

  ~ centroid of distribution

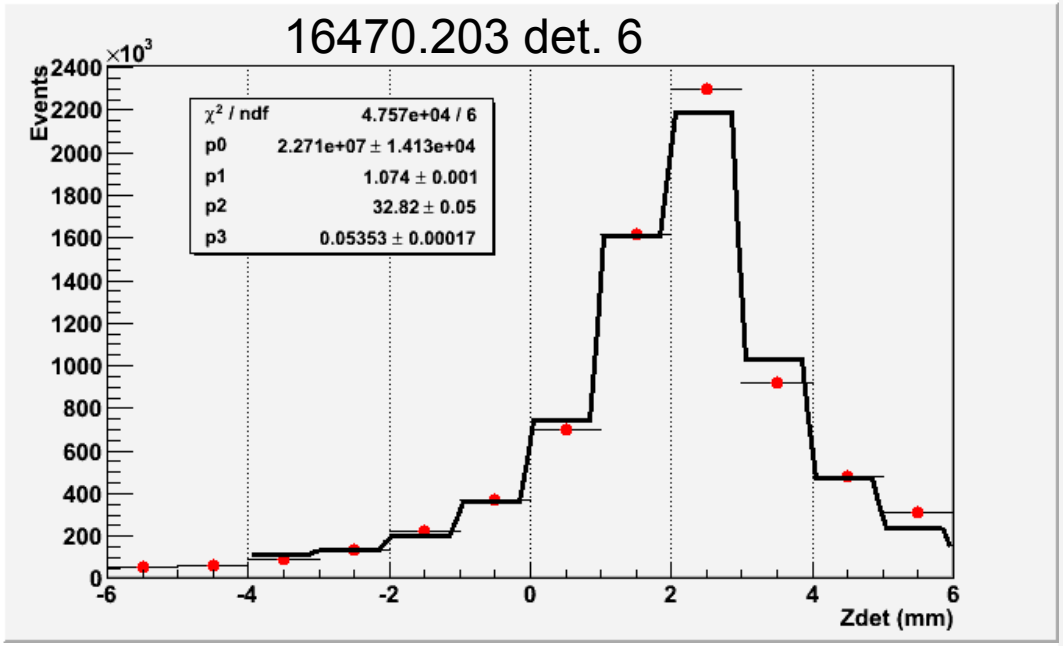
  $L_{max}$ = max. amount of material scatter site→detector (in nm)

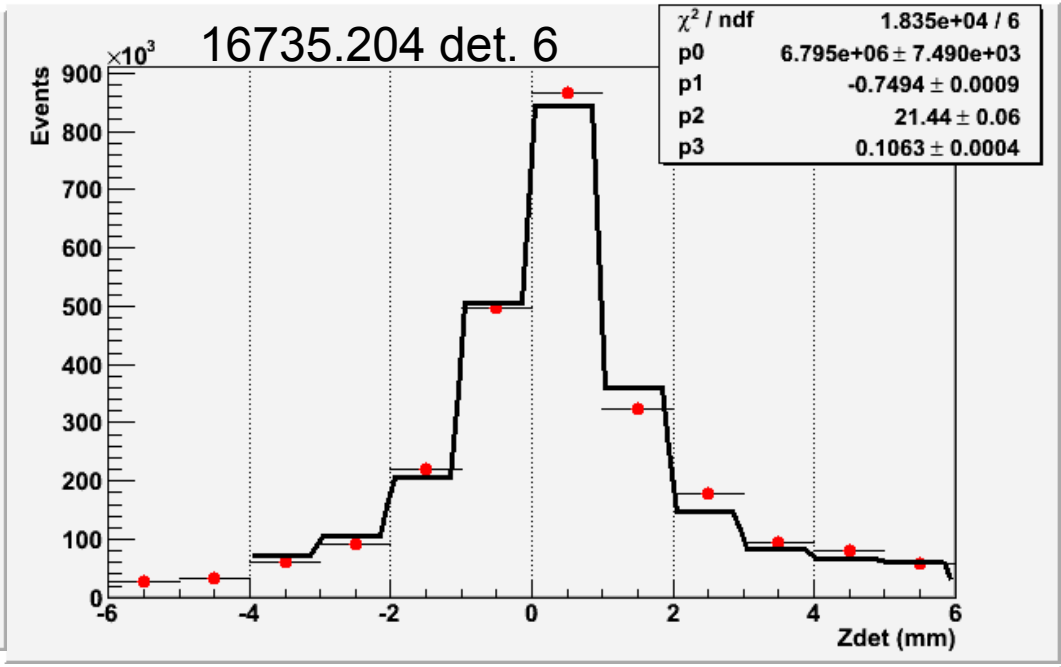
  ~ √(width of distribution)

  bg = fraction of flat background

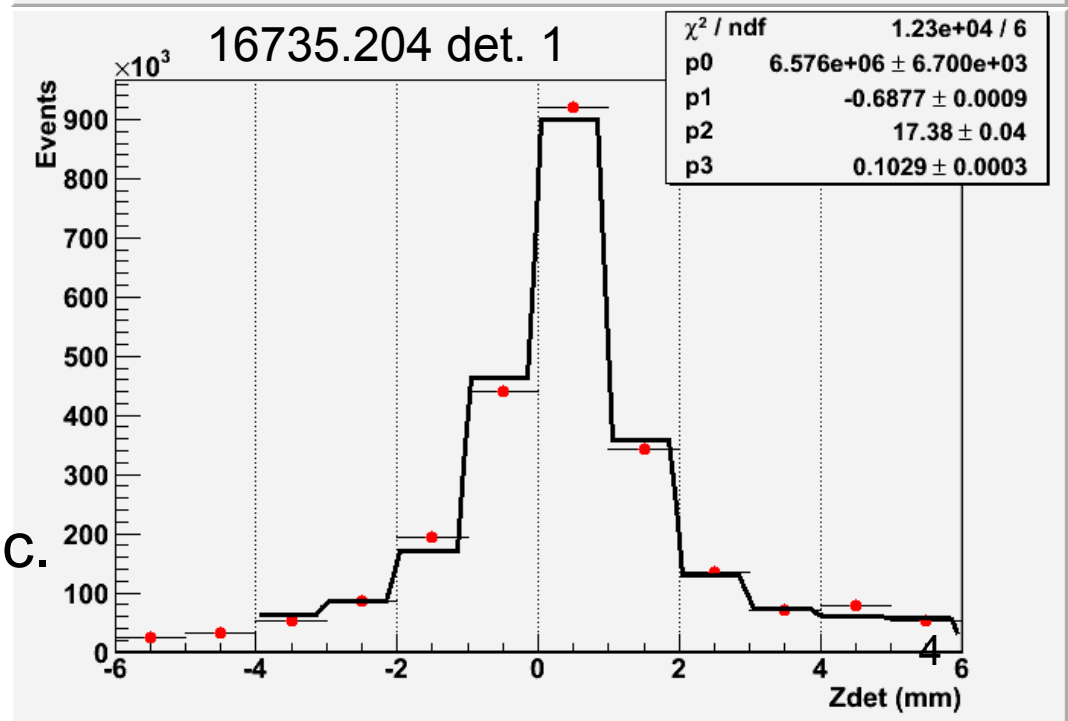
# Example fits

- All events one measurement :




- Model & fits describe distributions
  Can see large change in $z_0$:
  different targets, more later...
- Det. 1&6 same run:
  similar distributions & fit results
- These are all events in a run
- Can do distributions & fits in 0.1 sec.
  bins Dima uses for P-profiles ↘

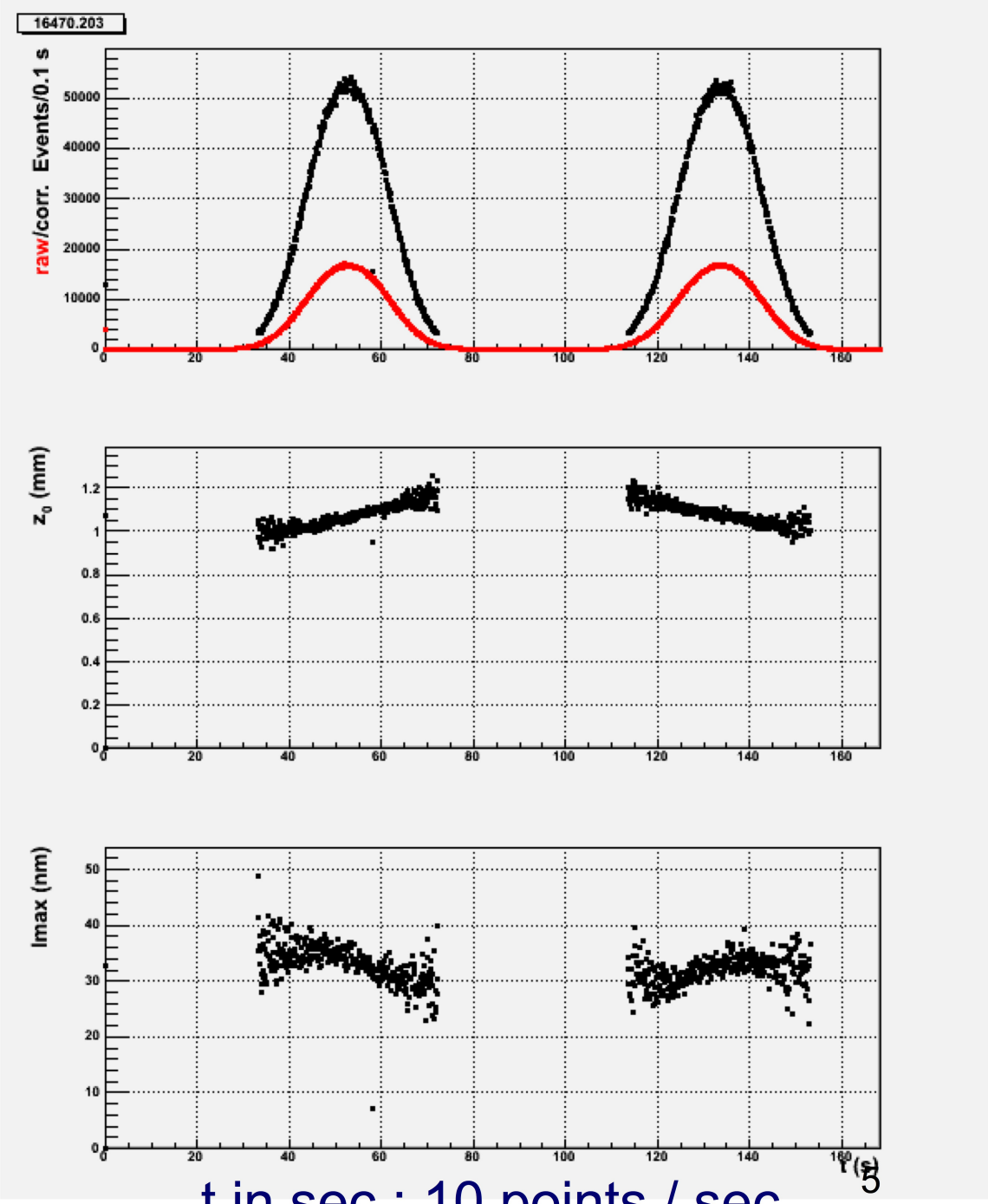


# Run profile

- Fits performed for 0.1 sec. bins w/ > 1000 events; each bin ~ distributions previous slide
- Red is raw #events / 0.1 sec.
- Black is acceptance corrected to all C-scatters E>0

- $z_0$ varies ~linearly in time
- Target sweep direction not perpendicular to beam axis, crosses beam at an angle

- $L_{max}$ ~ constant

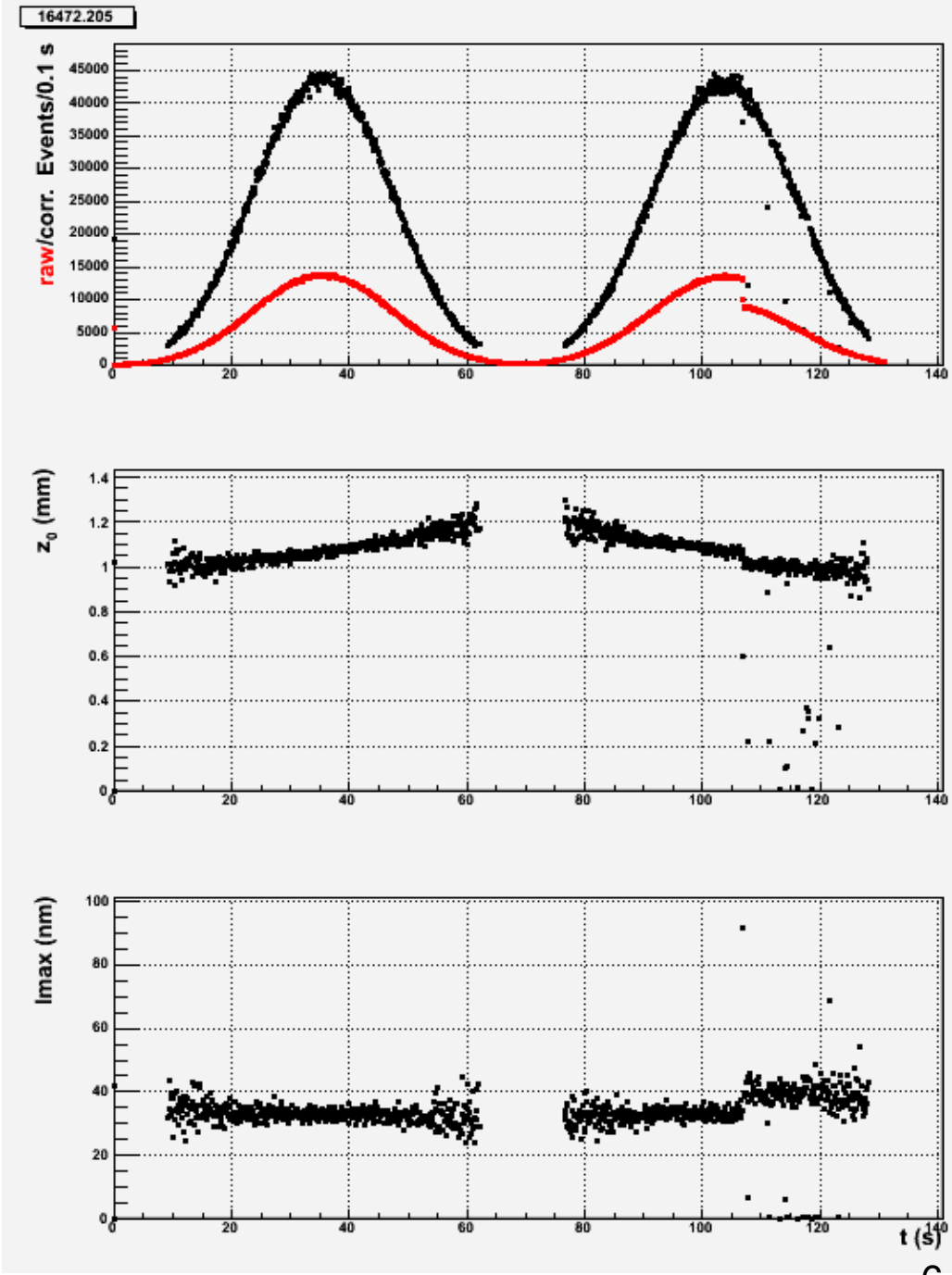



t in sec.; 10 points / sec.

# Run profile

- Raw event rate drops when one WFD buffer fills
- Fit normalization corrects for this loss

- $z_0$, $L_{max}$ small jumps
- Fit reacts imperfectly to loss of one bin



# Run profile

Hypothesis:

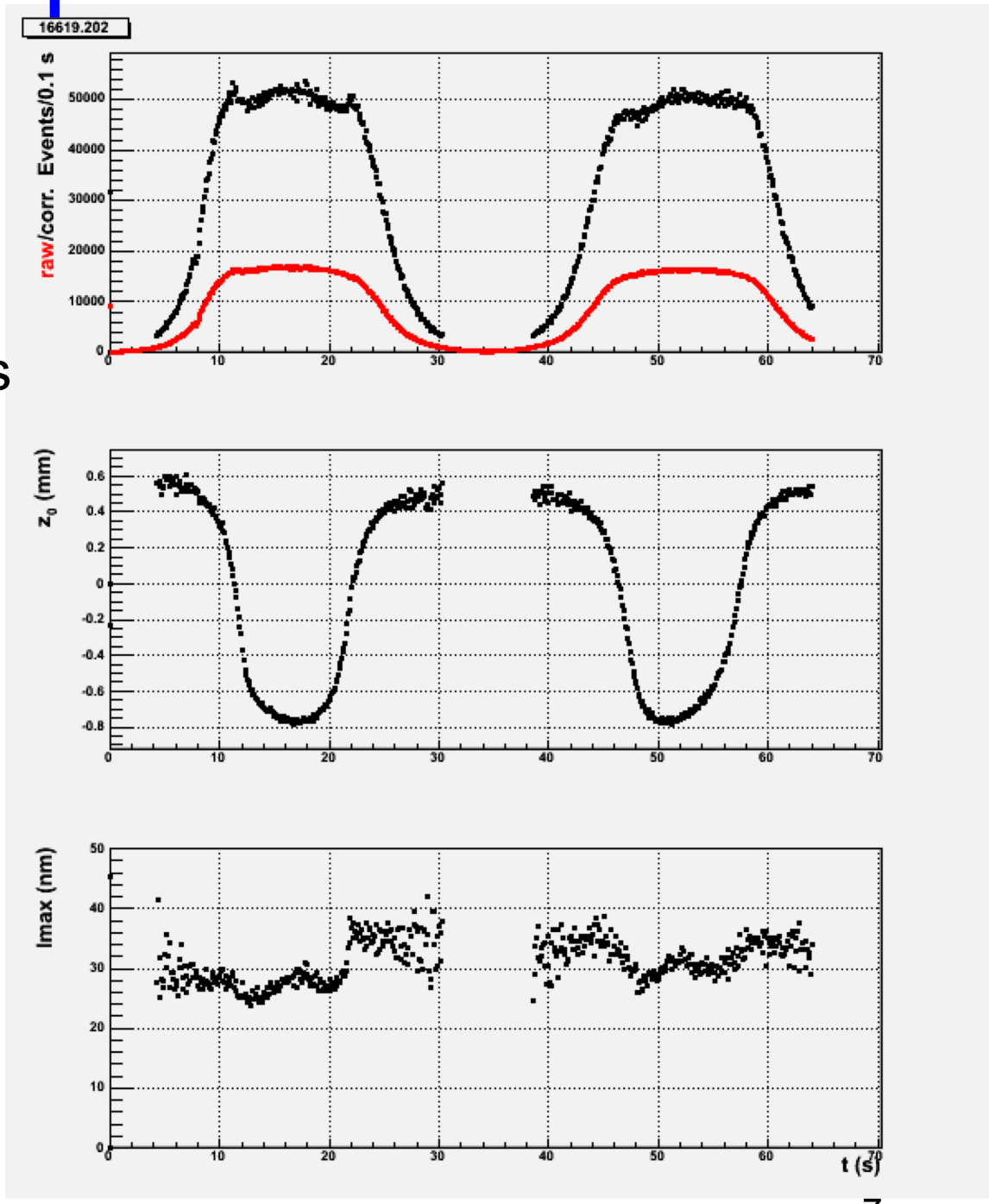
- Loose target, ~1.2 mm sway
- Attracted radially toward beam

- As it reaches radial center of beam it stays there, rate flat tops
- While at radial center of beam, other forces attract it toward -z, it moves ~1.2 mm along beam

- Reverse process as target drawn out other side of beam

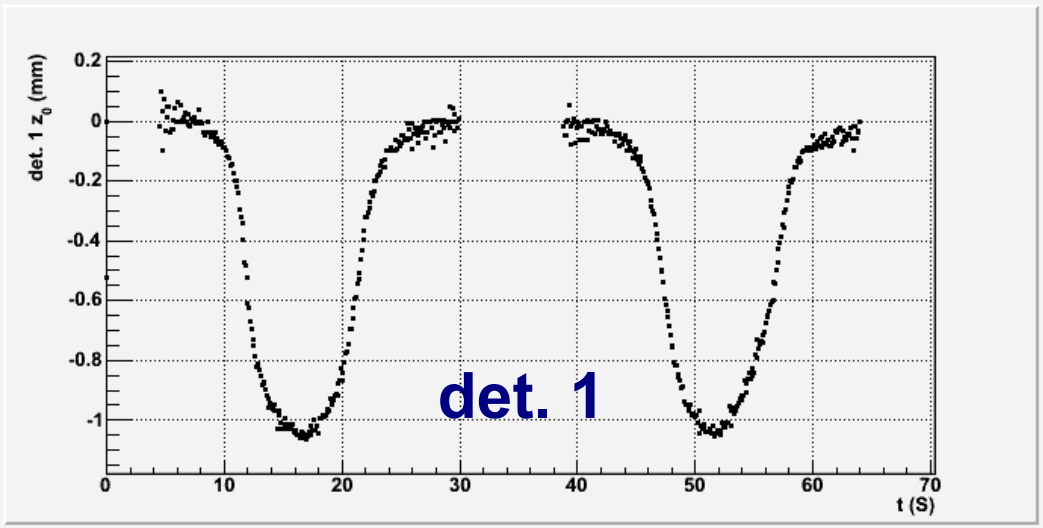
If true:

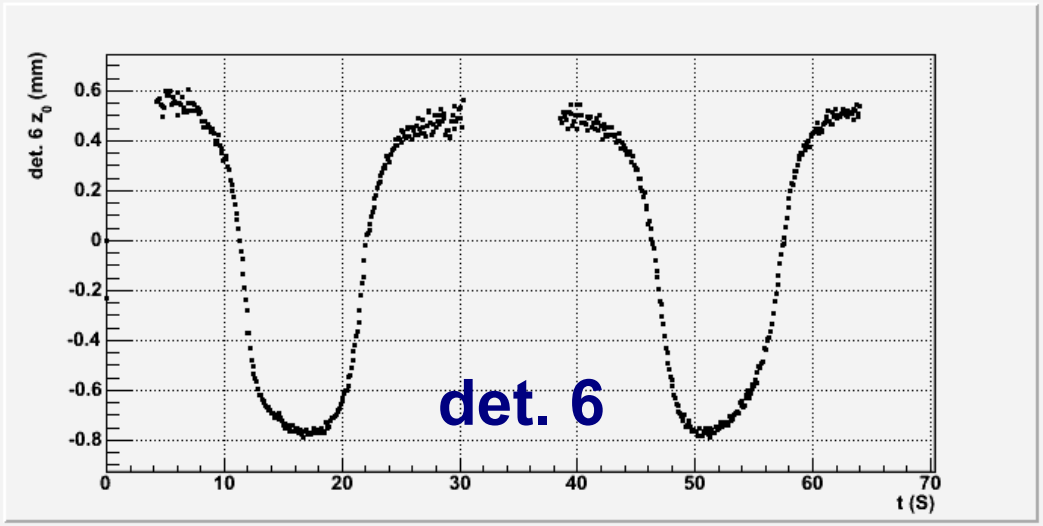
- Our assumption that rate is related to position w.r.t. beam is OK (used for $P \propto I^R$)



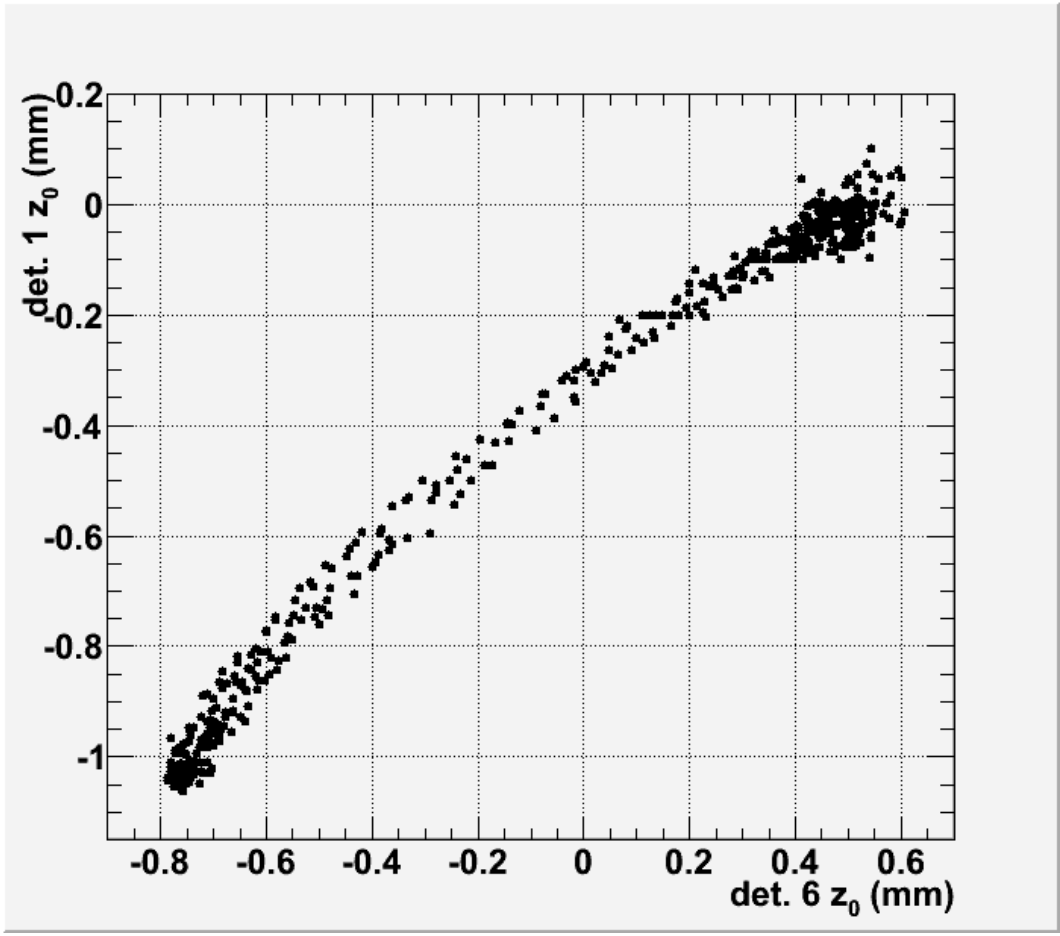
# Aside: $z_0$ det. 1 vs. det. 6

- Same run, $z_0$ det. 1 & 6 vs. t:




- $z_0$ det. 1 vs. $z_0$ det. 6



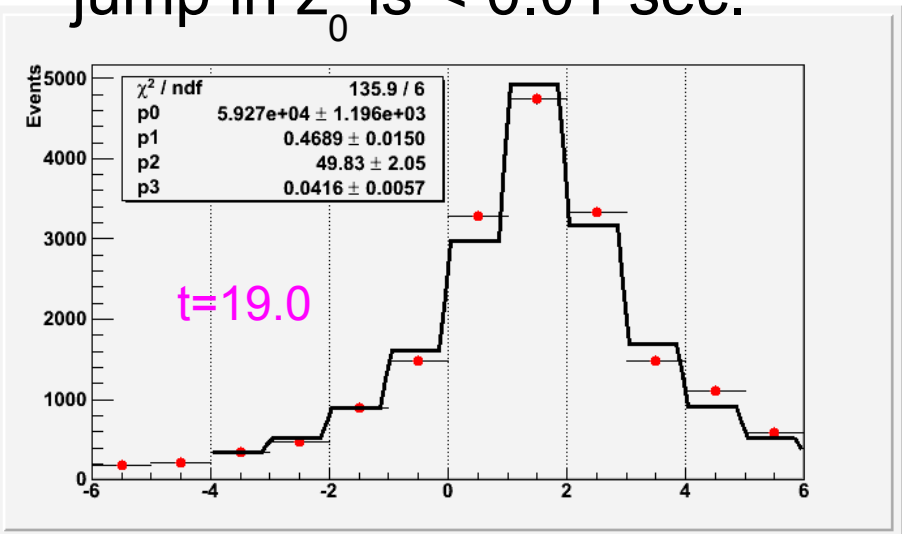

- $z_0$ measured independent detectors tracks to < 0.1 mm

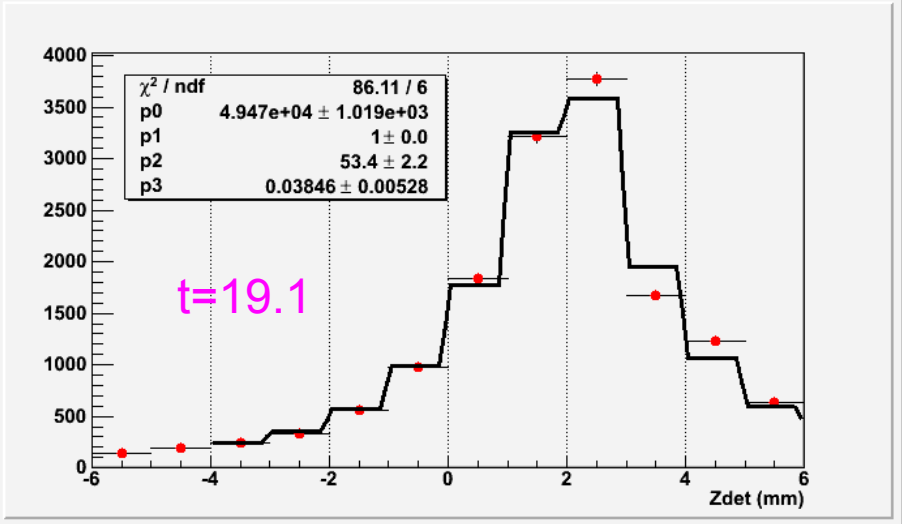
**And now a brief cinematic interlude**

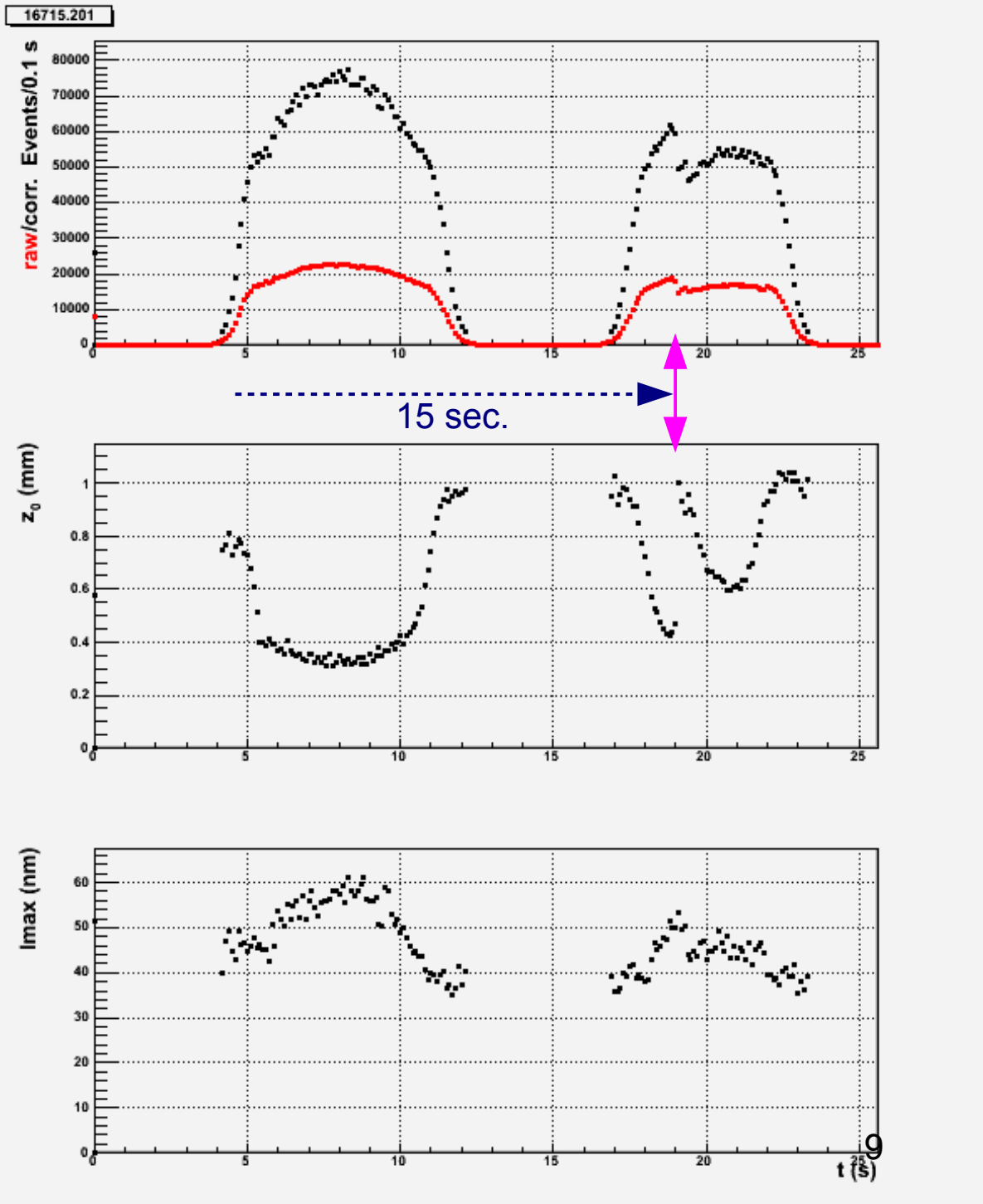
# Run profile

As seen in movie:

- Small sway on 1st pass
- Abrupt jump in rate, $z_0$ (0.6 mm) @ t=19 sec.
  ~15 sec. after start exposure
- Examine in 0.01 sec. bins; jump in $z_0$ is < 0.01 sec.



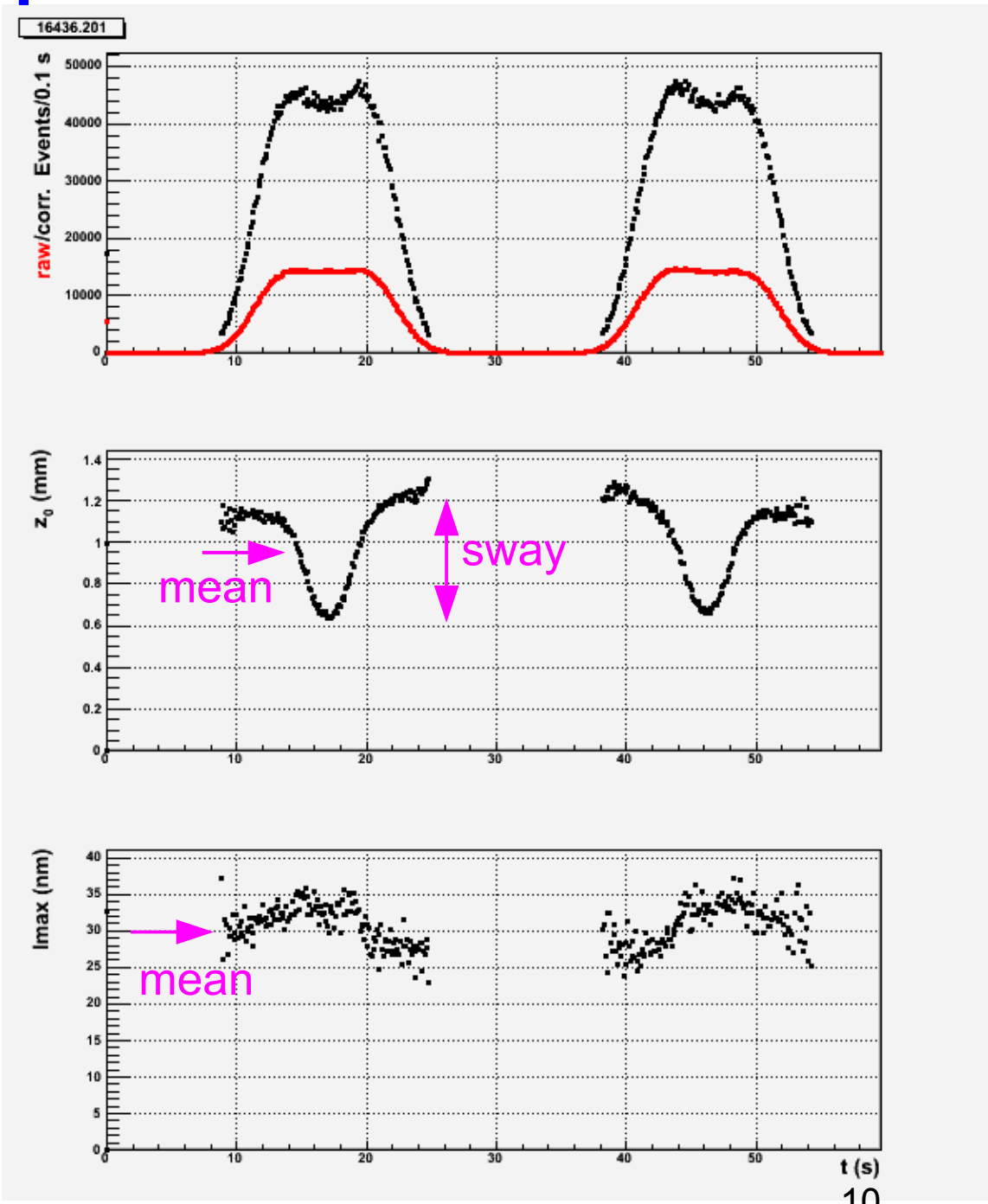



# Run profiles

Characterize runs:

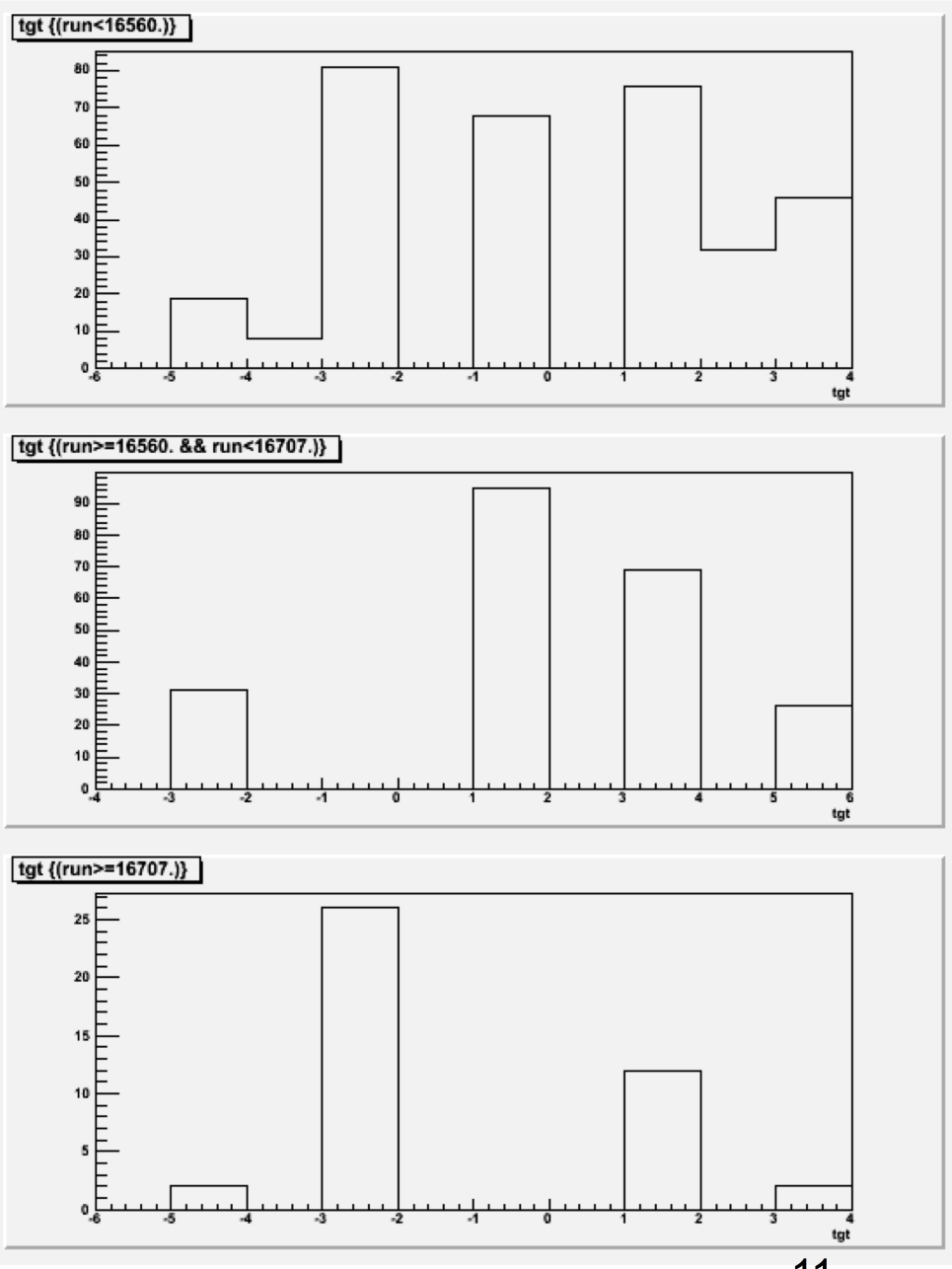
- RMS of $z_0$ not good, spurious
  bad fits give huge RMS
- define sway in $z_0$:
  range of $z_0$ including e.g.
  70% of the points
- A mean $z_0$ in this range
- A mean $L_{max}$
  (doesn't vary much in run)



# Targets Run12

- We had 3 different sets of targets
- 12 different targets used for > 10 measurements
- Illuminating to look at profile results (mean $z_0$, sway $z_0$, mean $L_{max}$) versus target used
- Look long term events, trends in target behavior
- A few observations... ↘

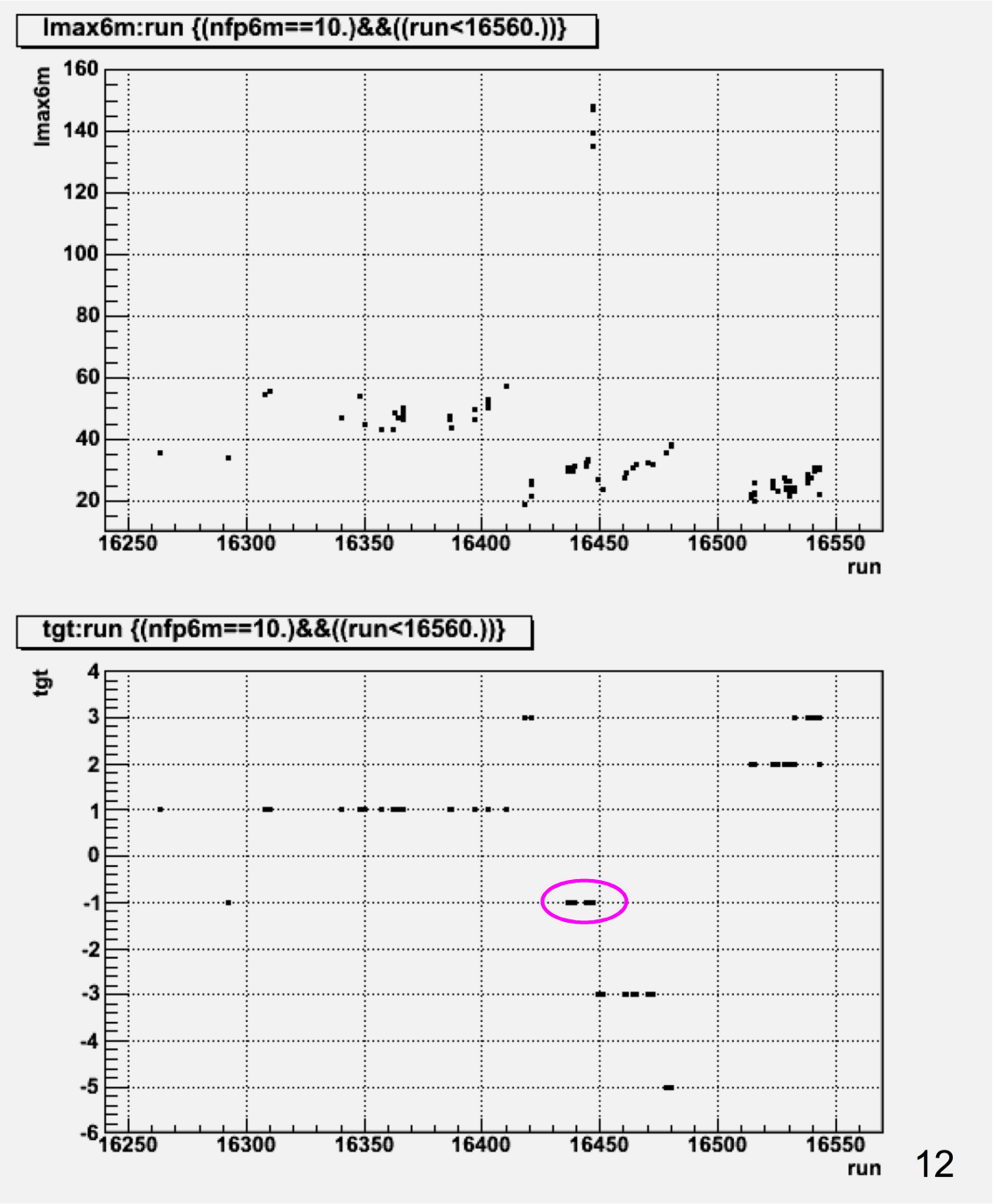
measurements / target



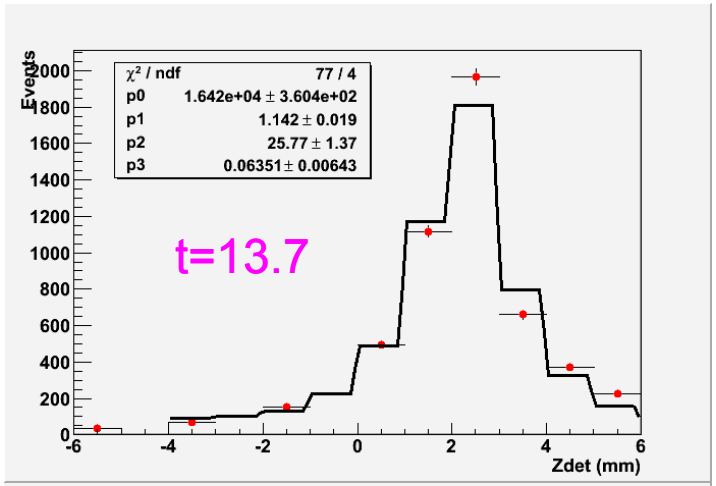

tgt>0 vertical
tgt<0 horizontal

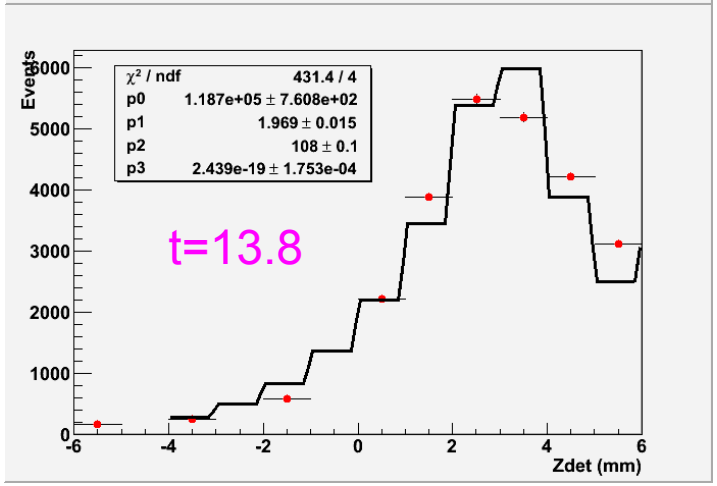
# E.g.: mean $L_{max}$ target set 1

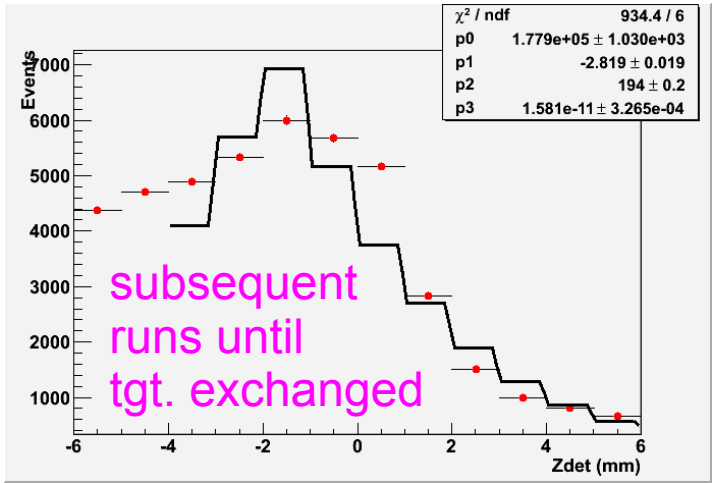
- Big jump in Lmax during tgt. -1 use, until exchanged
- Look in detail: target broke during run 16447.202

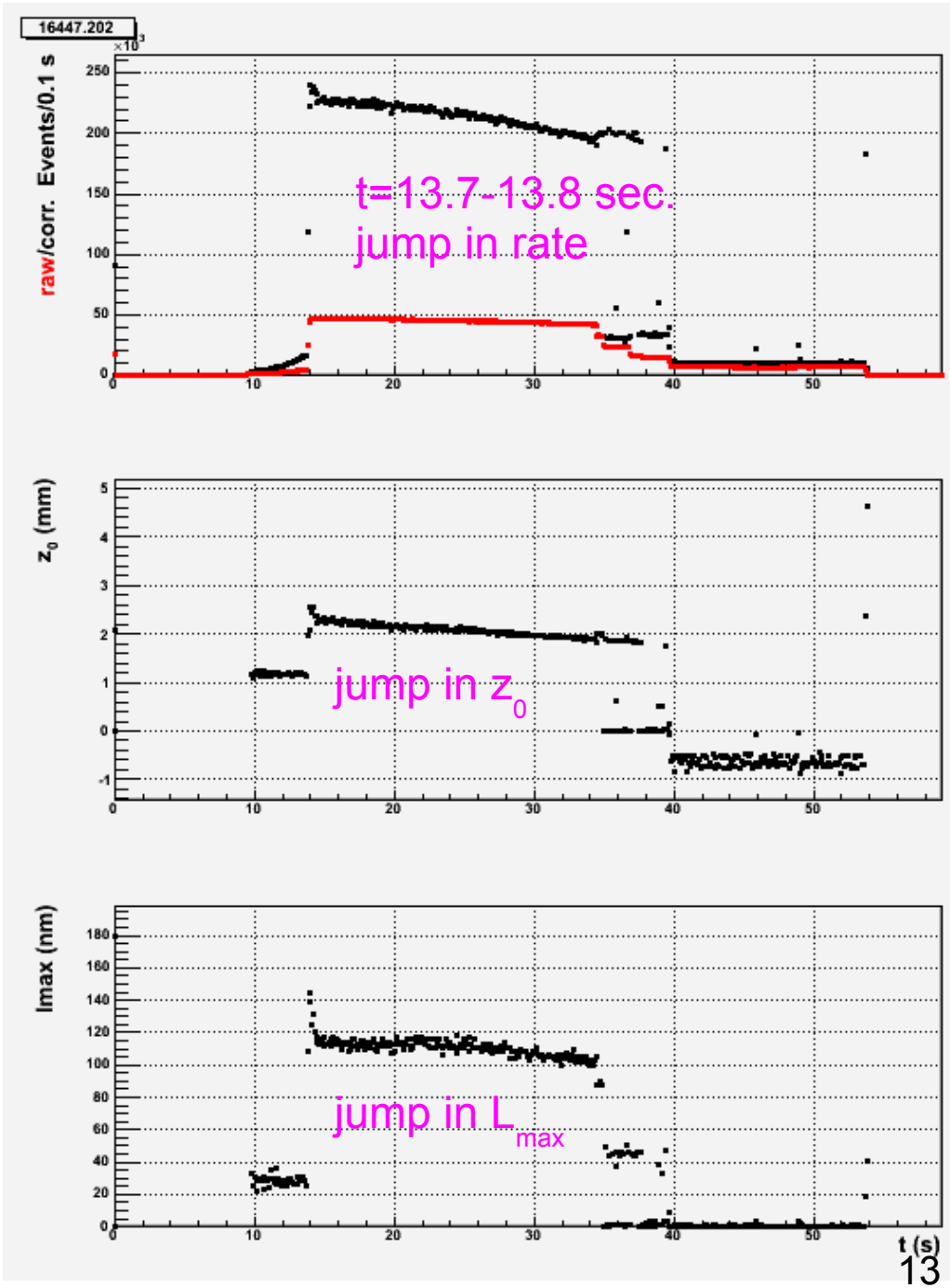


# Run 16447.202: target broke



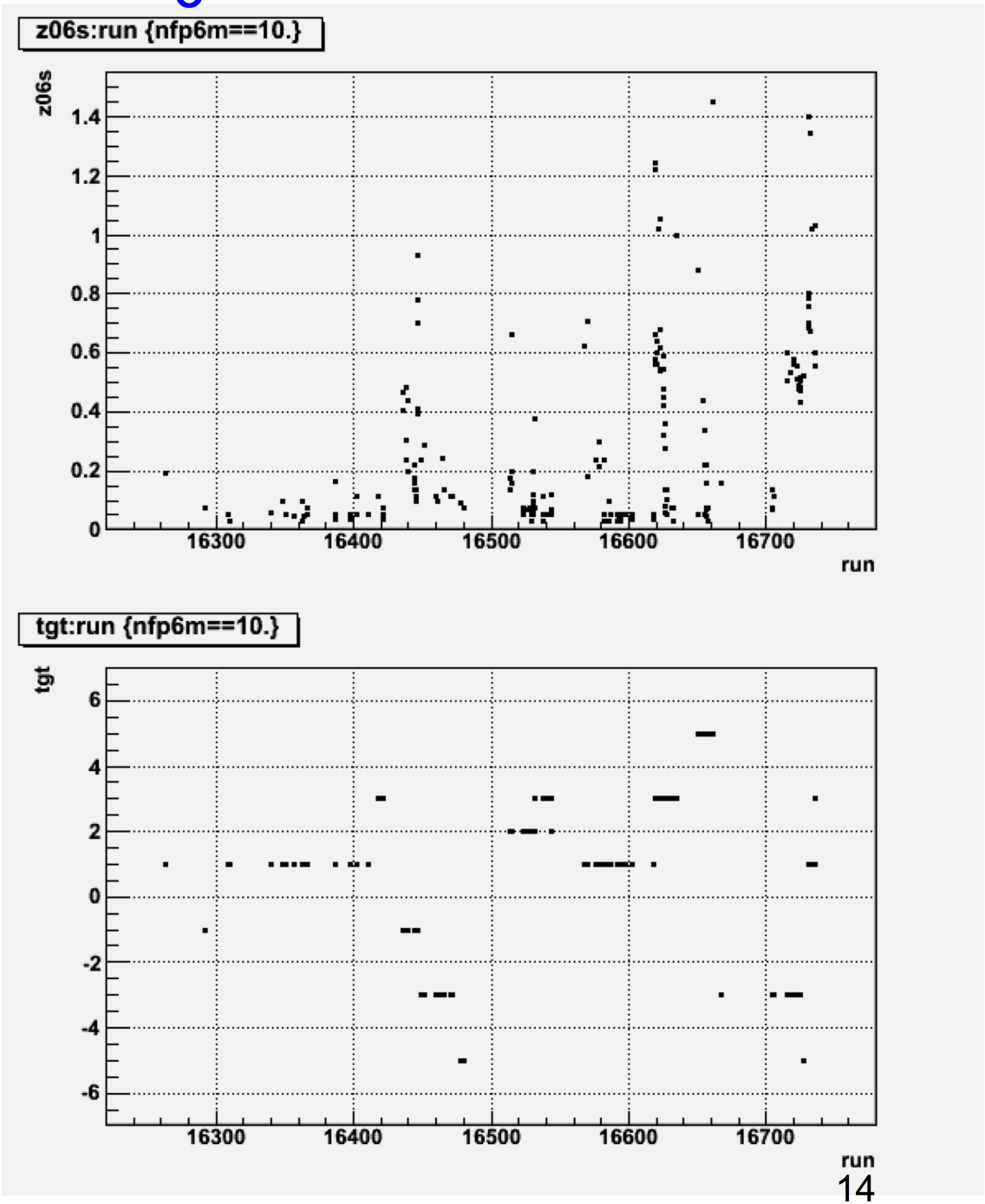



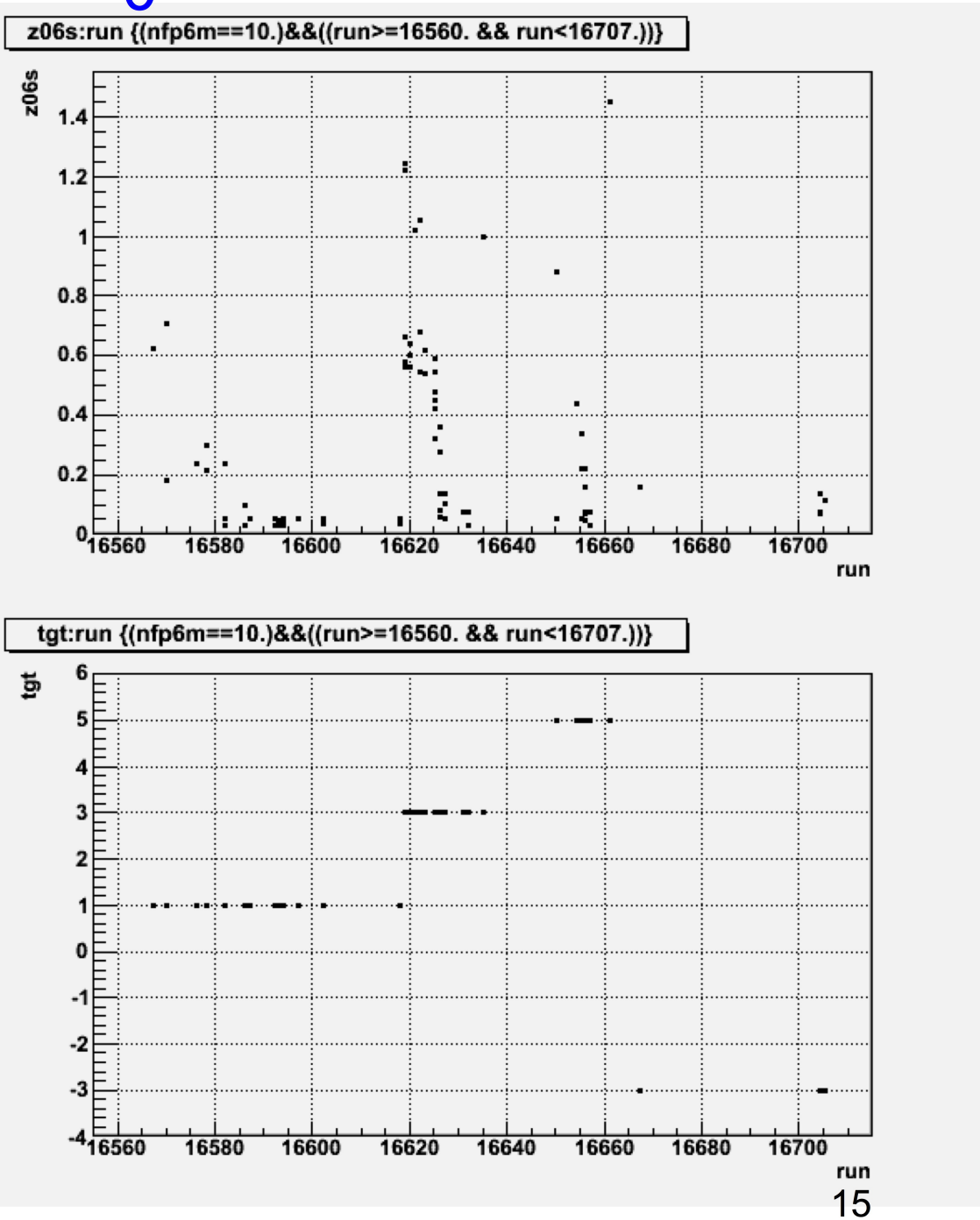
# E.g.: 'sway' in $z_0$ all targets

- Varies by target
- Some target always small sway
- Some have large variations in amount of sway: looser targets?
- Sway seems to decrease with # exposures of target(?)



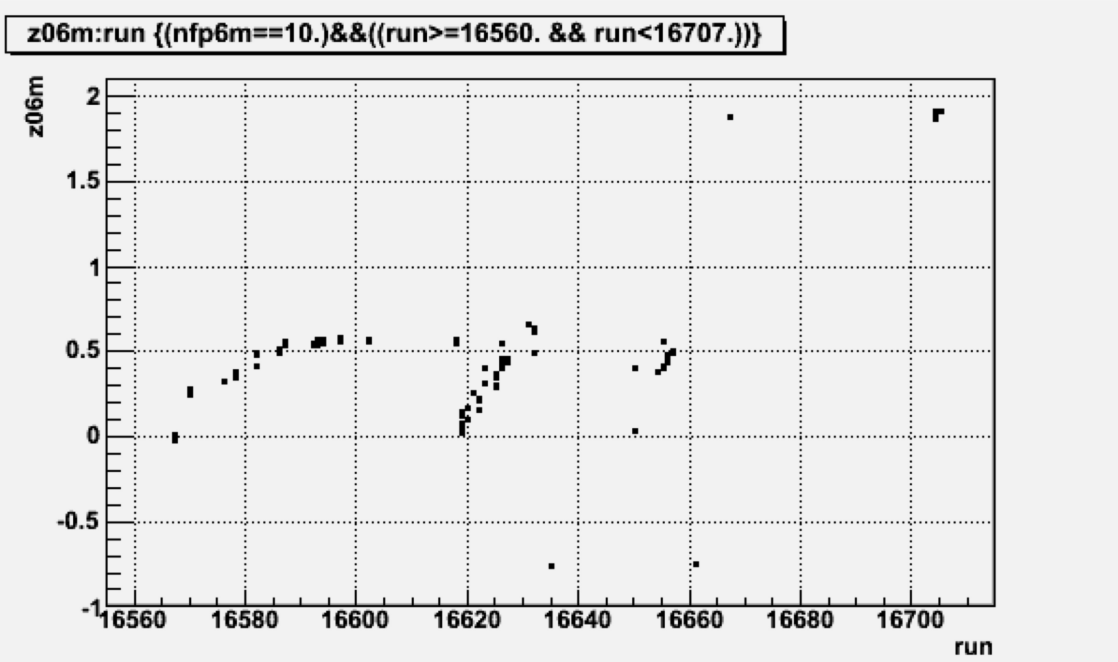
# E.g.: 'sway' in $z_0$ target set 2

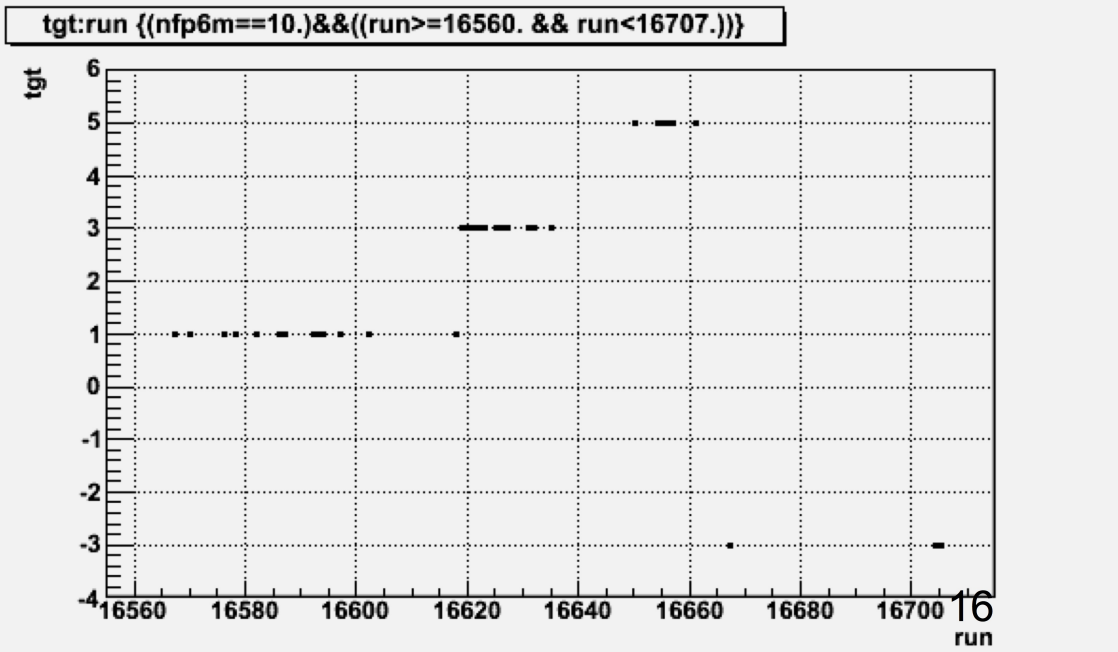
- Varies by target
- Some target always small sway
- Some have large variations in amount of sway: looser targets?
- Some targets: clear decrease in sway with # exposures of target - tightening?



# E.g.: mean $z_0$ target set 2

- Some clear trend:
  mean target position $z_0$
  changes +z with time
- These were 'tightening' targets;
  less sway toward -z,
  increasing mean $z_0$

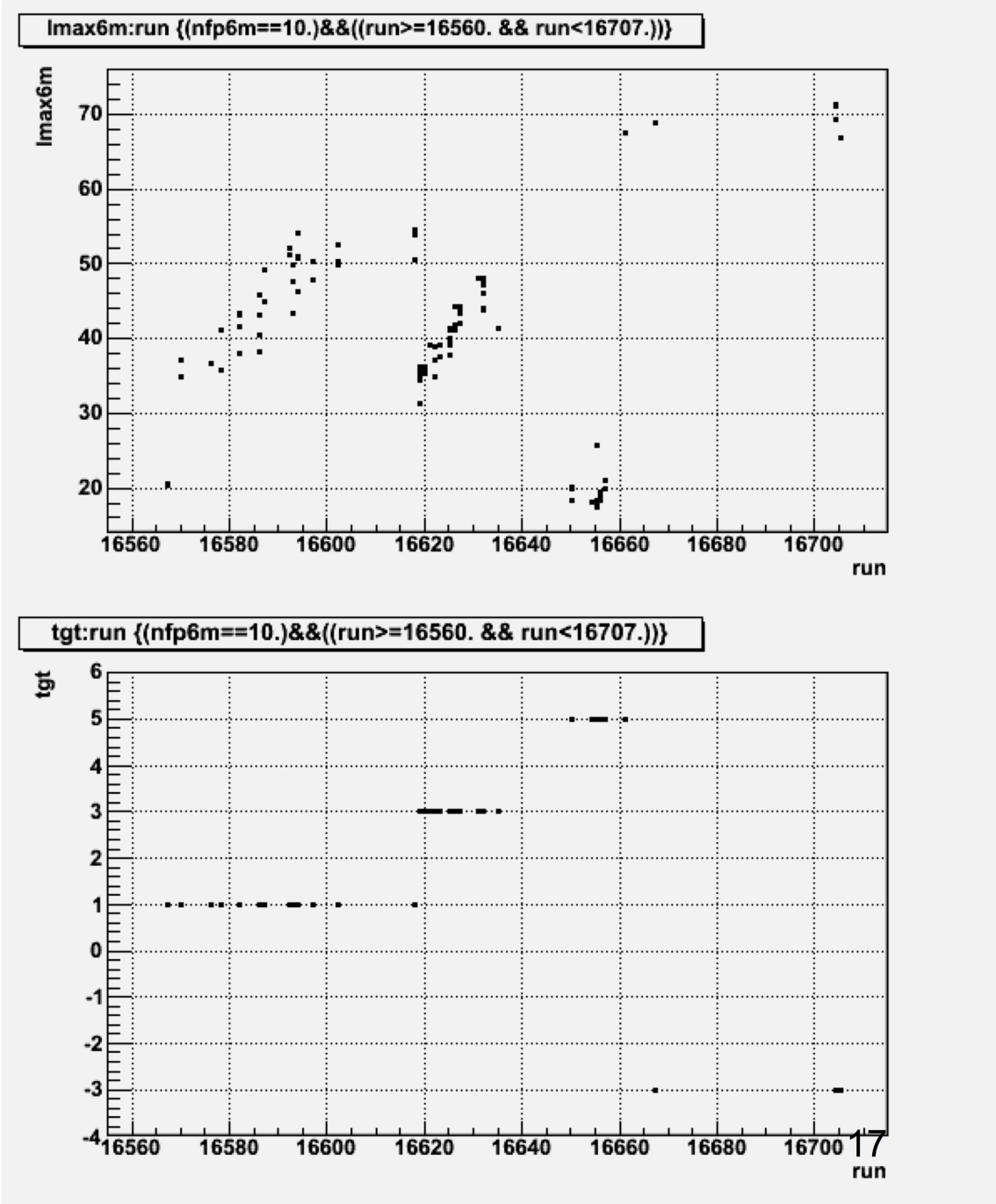


# E.g.: mean $L_{max}$ target set 2

- Effective thickness $L_{max}$ some targets seems to increase with # exposures
- Real? Or jitter in position increasing width of distribution $L_{max}$ ~ √(width of distribution)
- Or is this artifact of fit, shifting $z_0$ biasing $L_{max}$

**Enough examples:**
**Clearly a wealth of info**
**to study target behavior**



# Original motivation

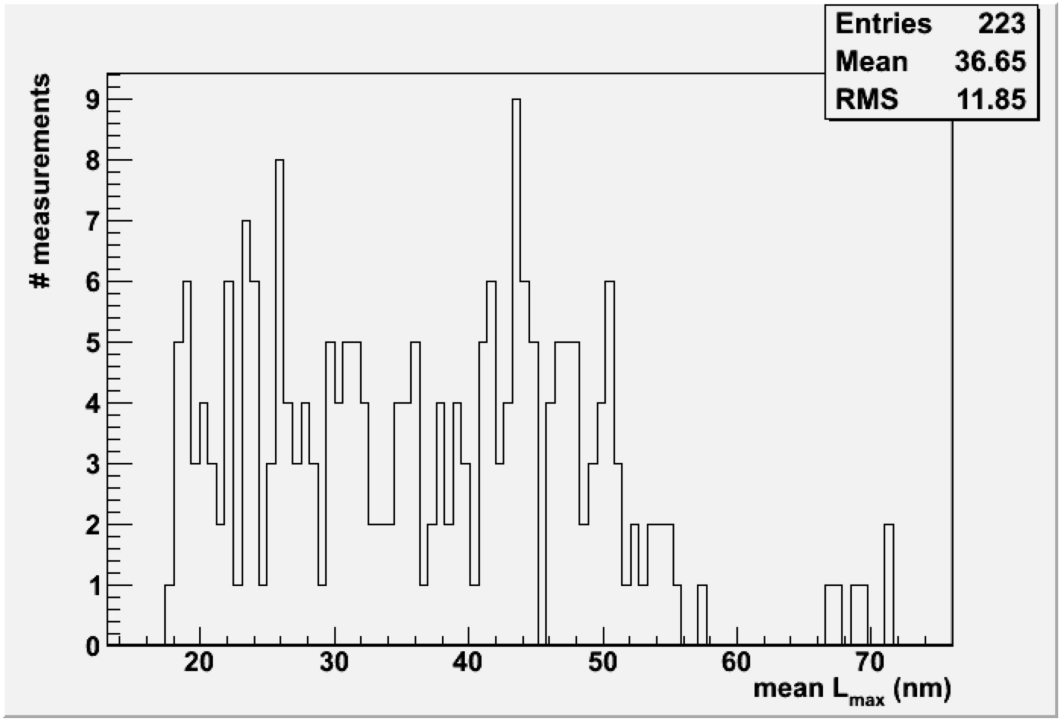
Original concern:

- Twisting targets provide varying amounts of material ($L_{max}$) scat. → det.
- Shifting dE/dx loss → shifting measure E-range → shifting $A_N$
- Expect $\Delta L_{max}$ 5 nm → $\Delta A_N$ 1% (my slides 14.07.11)

Run12:

- $\Delta L_{max} \approx \pm$ 15 nm
- $\Rightarrow \Delta A_N \approx \pm$ 3%
- Small effect to see, didn't check
- But tentative conclusion:

**apparently no large variations of $L_{max} \Rightarrow A_N$ stable**



# Proposal

**Run13 install longitudinally segmented detectors on all 4 pC polarimeters (1 pair det. each polarimeter?)**

Benefits:

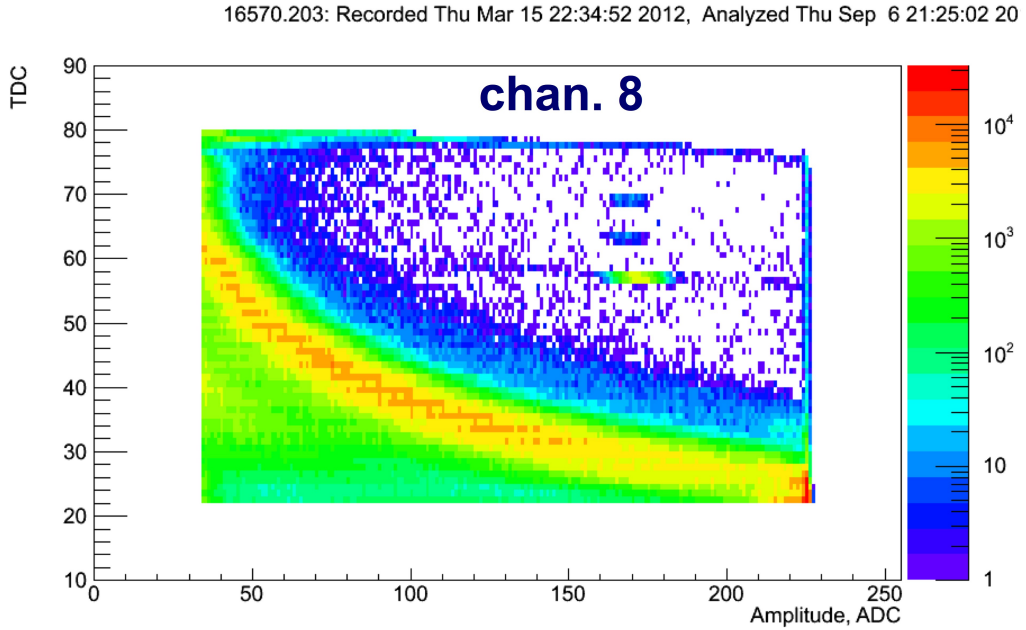
- Fast feedback on target status: add to fast offline QA plots complement new target video system
- Unique info on long term target behavior
- Run13 2× thickness targets:
  - variations of $L_{max}$,$A_N$ may be significant
  - maybe can track & correct

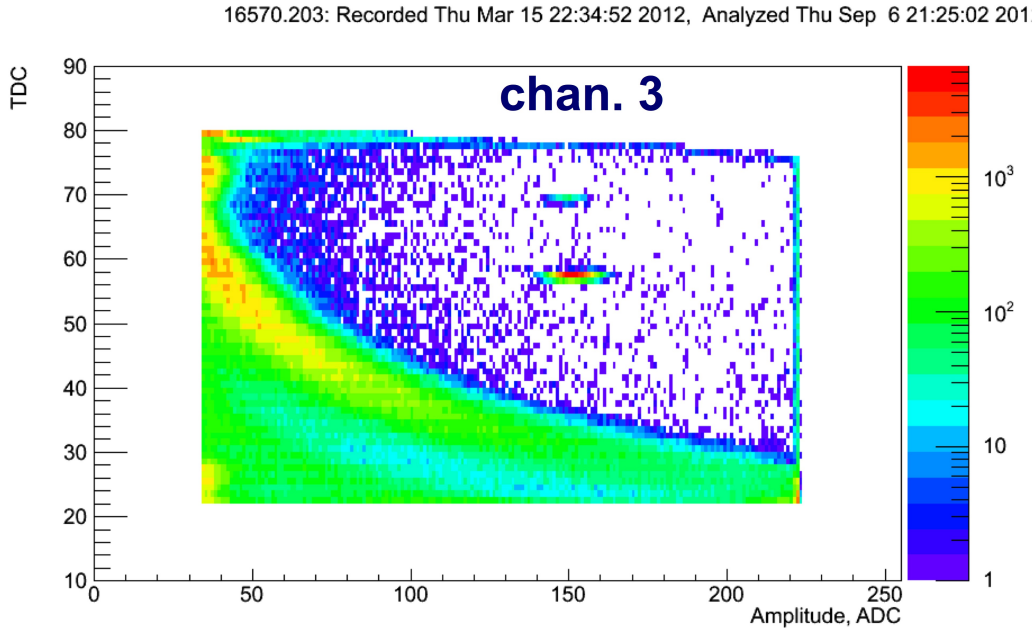
# Proposal

Drawbacks:

- Max. channels get high rate; need fast tgt. sweep velocity

- Non-central channels only get low-E hits
  lower-E → mult. scattered larger angles
- Limited statistics over full range of 'banana' for calibration:




- Run12 calibration didn't show special problems
  (but didn't look very hard...)