Progress in Estimating Track Momentum using Multiple Scattering

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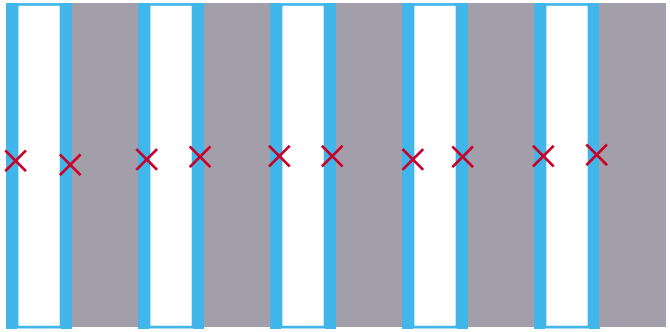
Goals:

1) Determine momentum and errors for candidate tracks

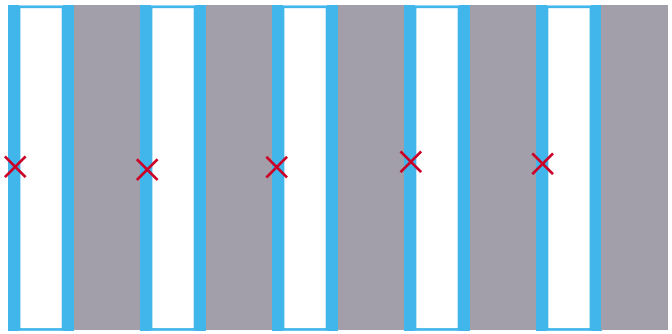
2) Produce unbiased p_T spectrum for kinked tracks

Procedure:

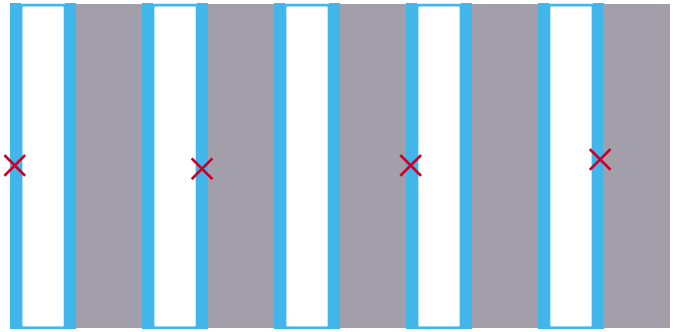
- Calibration
  - find set of tracks with momentum measured in spectrometer
    - insure tracks are non-interacting (muons / Sta 3 or 4)
  - check m-file data in detail (slips, alignment, other systematics)
    - set of through-going muons near track of interest (spectrum)
    - track of interest (u,v vs. plate)
- Corrections / Cuts
  - check view consistency, momentum fitting procedure
  - produce momentum estimate / errors



"skip 0"



"skip 1"



"skip 2"

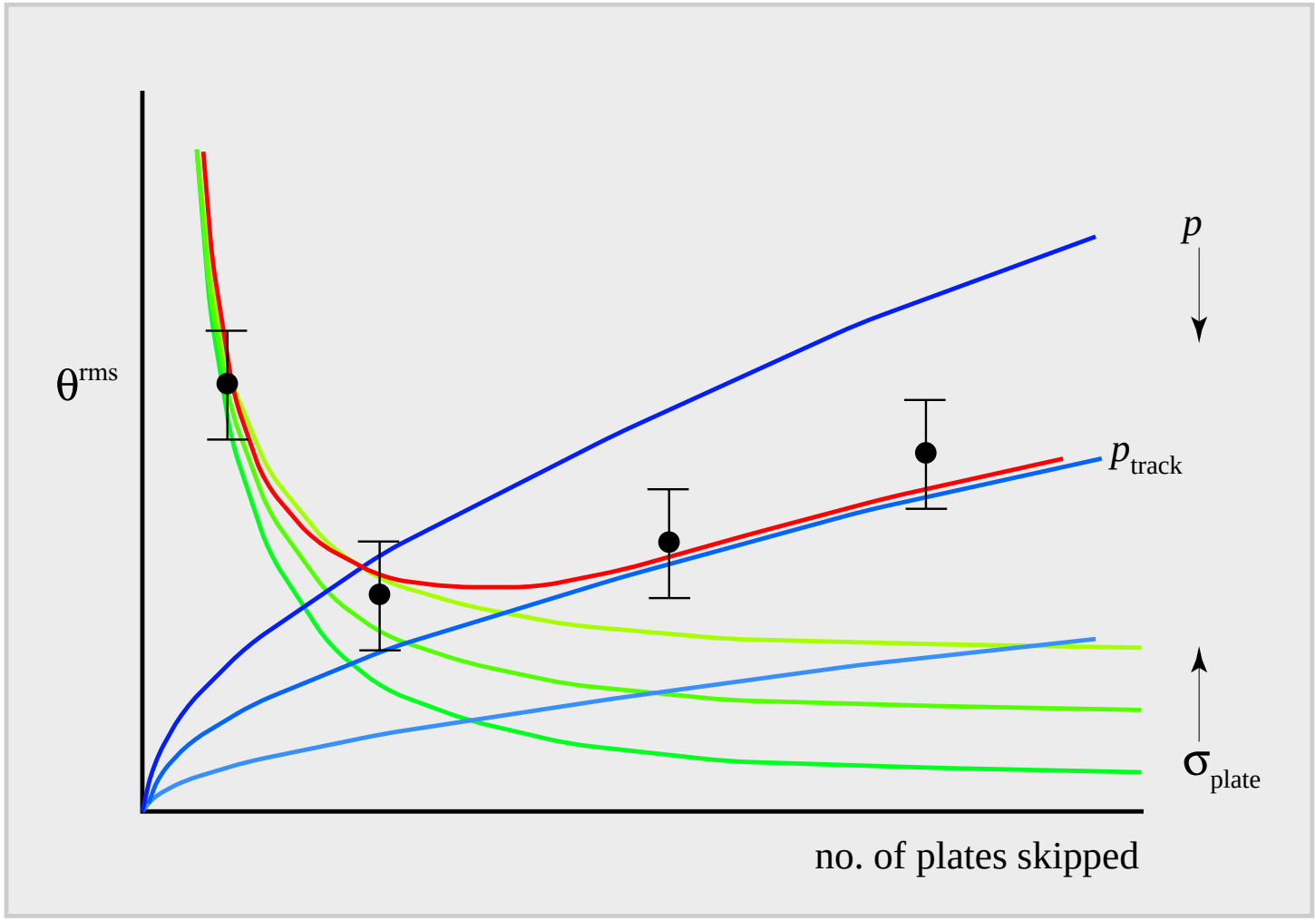
Different sets of data points are used to separate the effects of the finite angular resolution and the deflection due to multiple scattering.

The “skip 0” set yields one value for the rms of the angular difference between points (0,1) and (1,2) ...

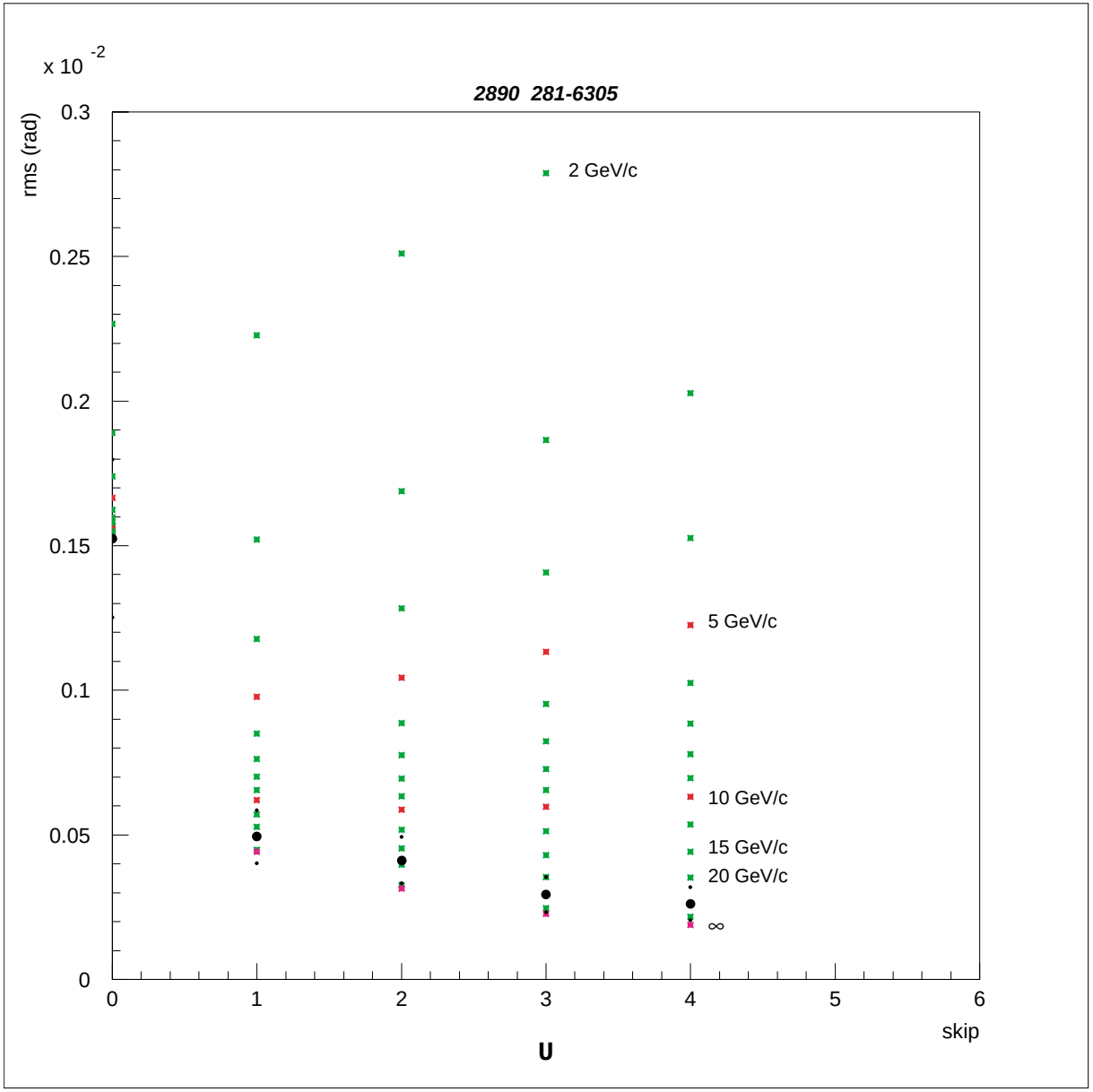
The “skip 1” set gives the rms between points (0,2) and (2,4) ...

The greater the “skip” the better the angular resolution, but lower statistics.

Many systematic effects come into play for the real data.

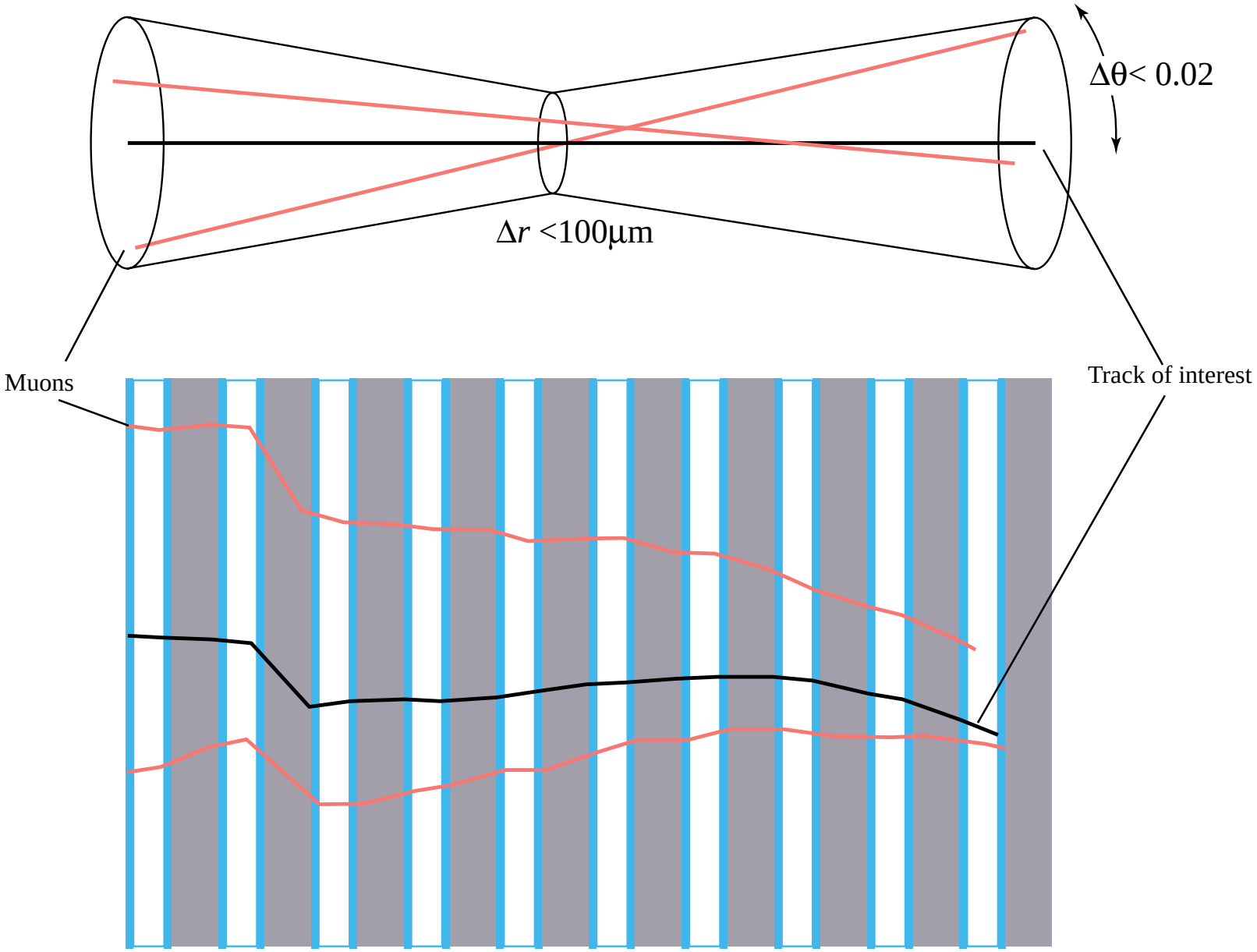


Schematic illustration of the algorithm for estimating track momentum using emulsion data. The rms width of the angular differences is measured as a function of interval between measurements ("skip"). There are two main contributions that add (quadrature) giving the total effect (red curve). The scattering due to finite momentum is shown as blue curves, and the effect of finite angular resolution is shown as green curves. Of course the actual measurements result in a set of points with errors. Both p and σ_{plate} are determined from the fit, for each track.



Example of a track with many points and good alignment.

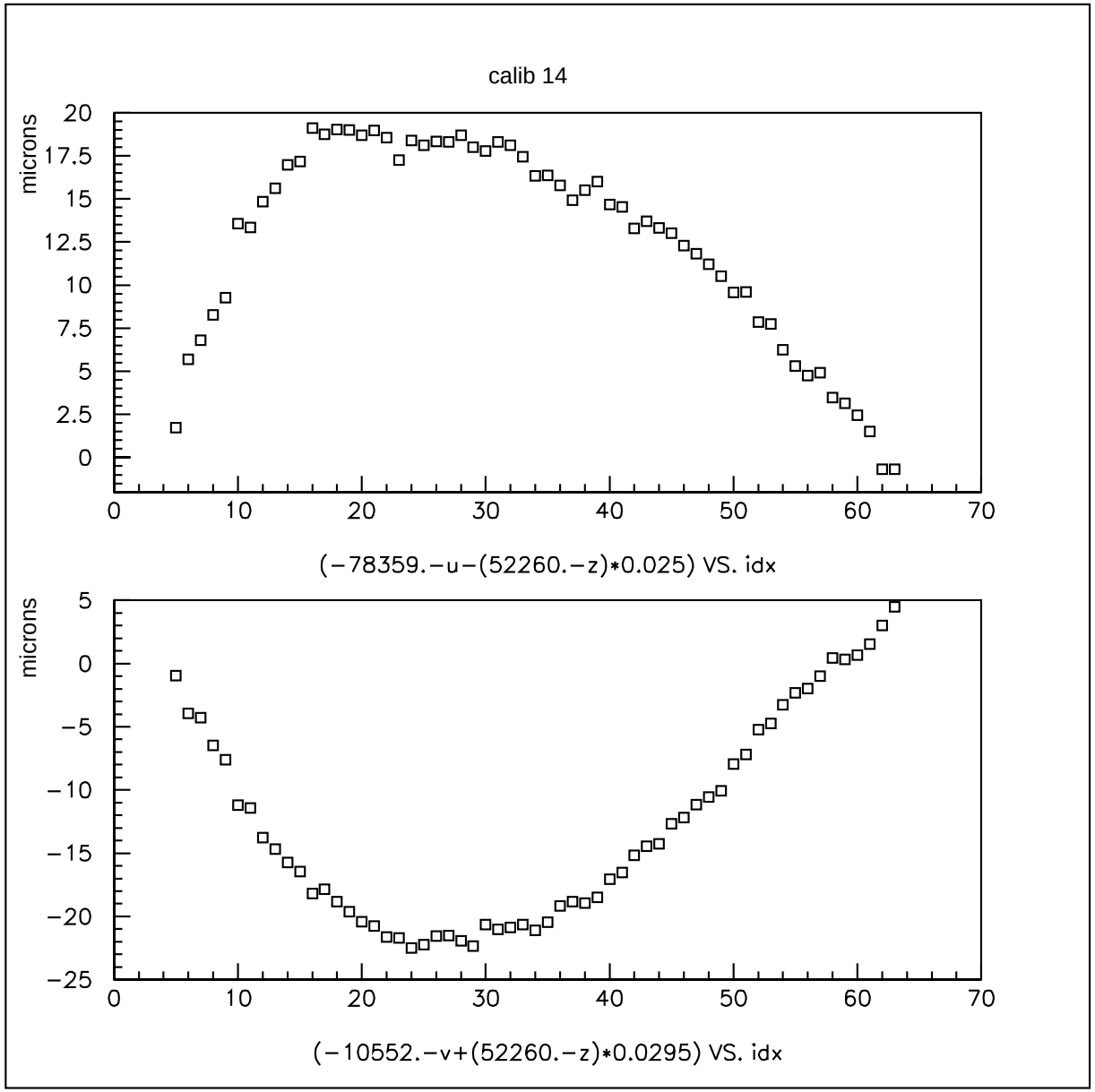
It is measured in the spectrometer to be 100 GeV/*c*


Δθ< 0.02
Δr <100μm
Muons
Track of interest

Example:

2884_18223 track 291-10339

- Calibration
- Cuts
- Results

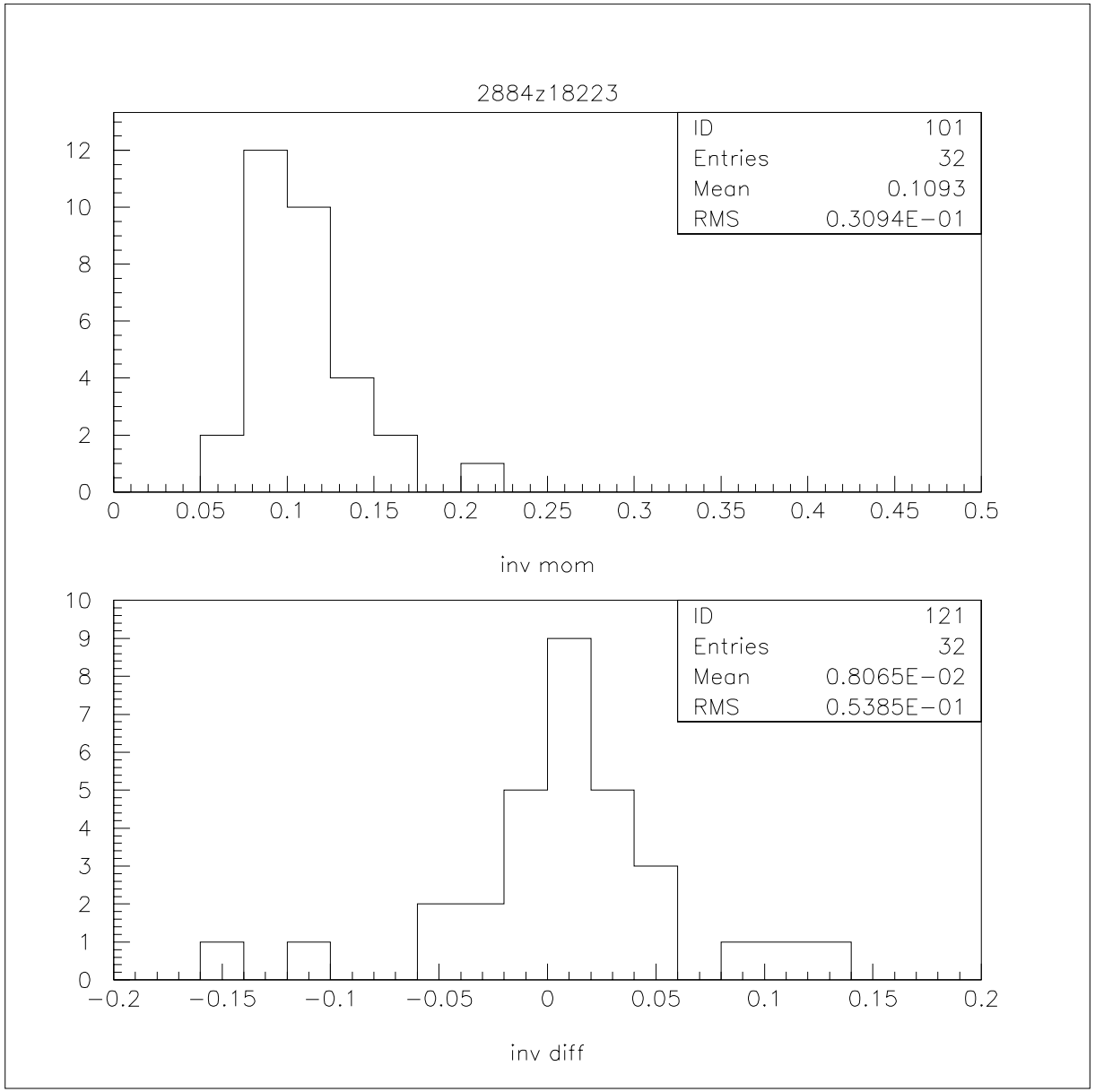


Calibration muon track near the track of interest.

The plot shows the position vs. plate for a fitted slope in each view.

A perfect track would be points that all lie within a few microns of a horizontal line.

This track shows a systematic trend for idx < 40

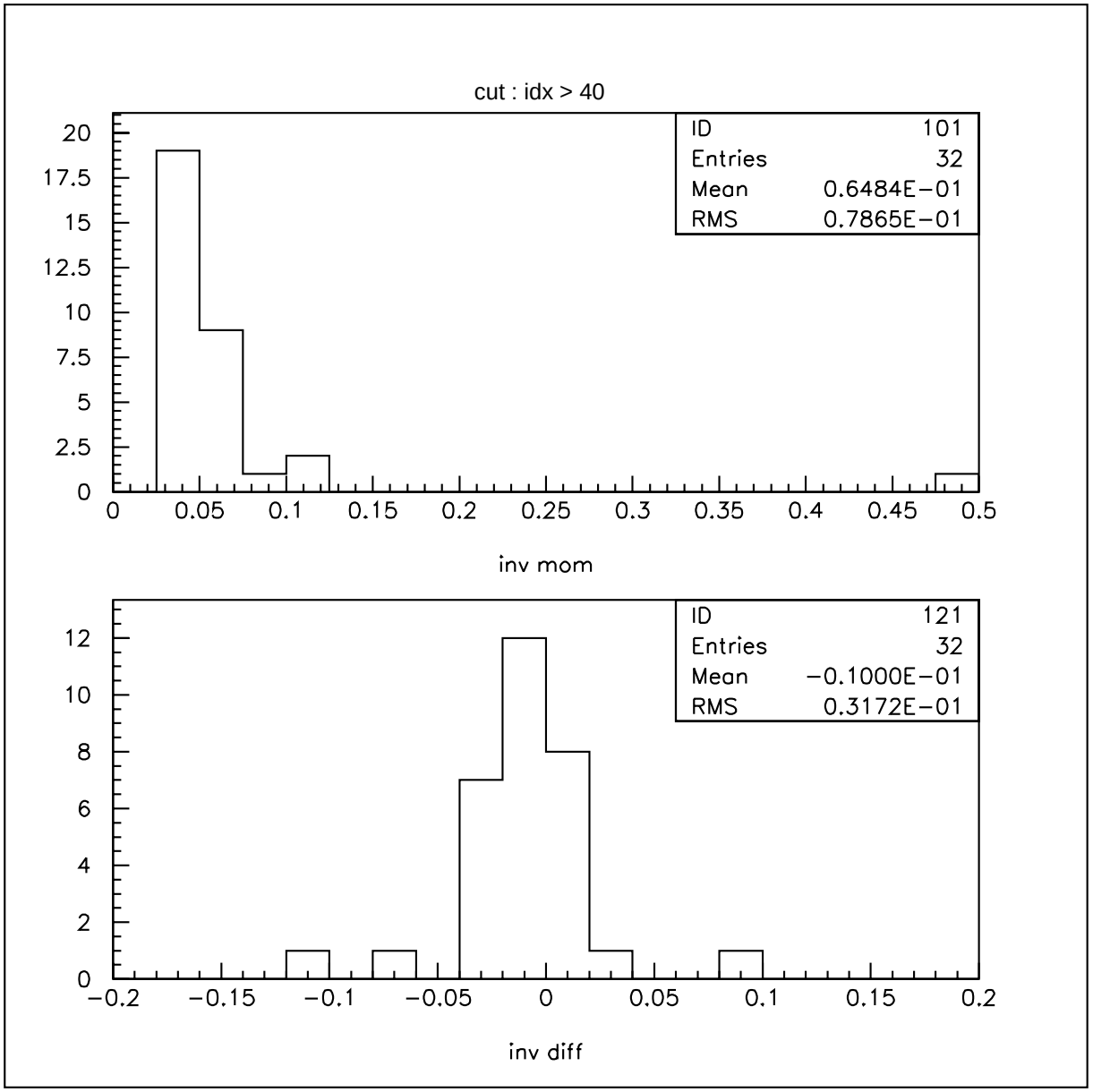


The inverse momentum spectrum for the calib. muons <u>without cuts</u>

It should have a mean that approaches 0.05

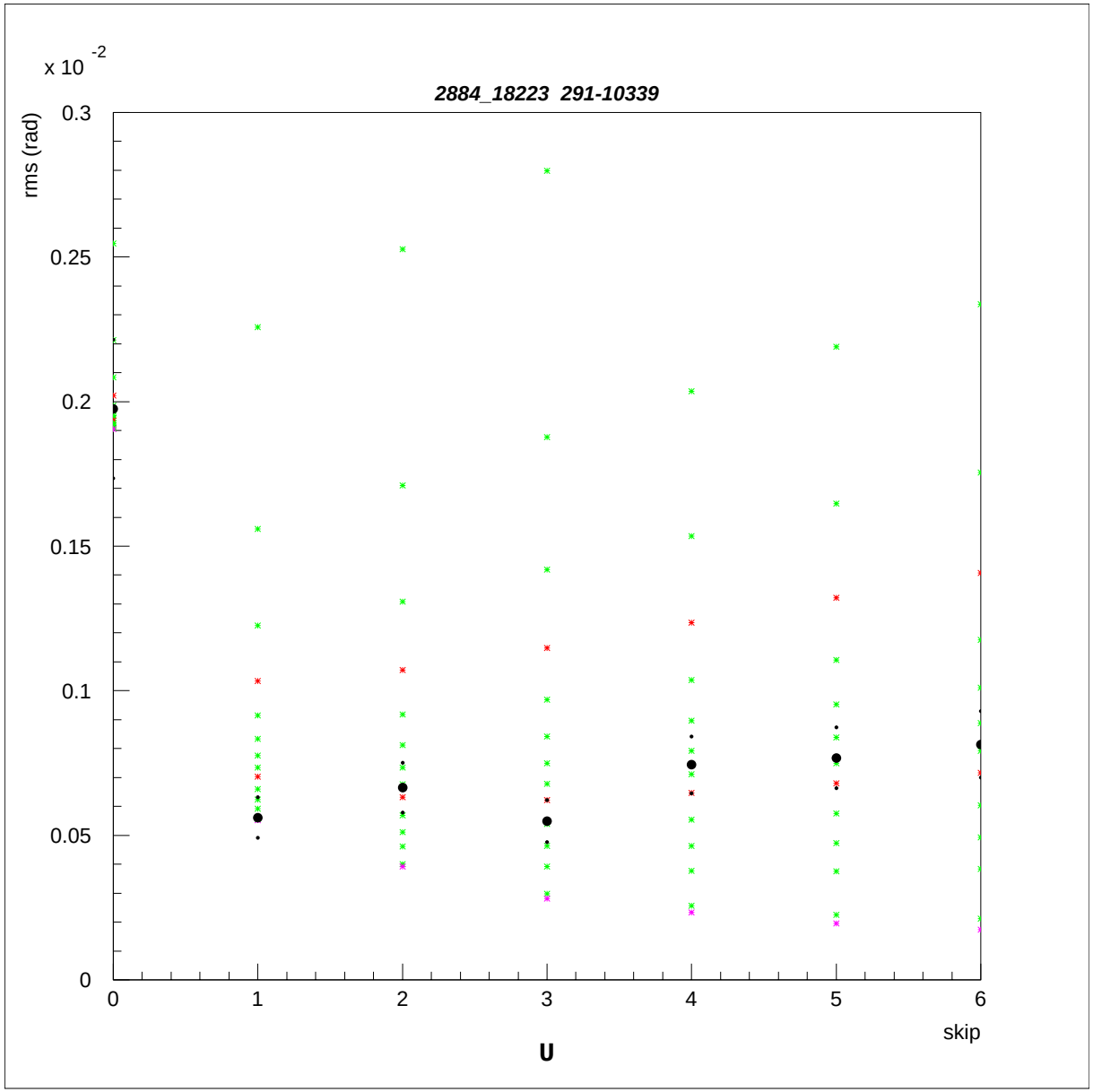
The difference in the inverse momentum between *u* and *v* .

It should be centered with an *rms* less than 0.05



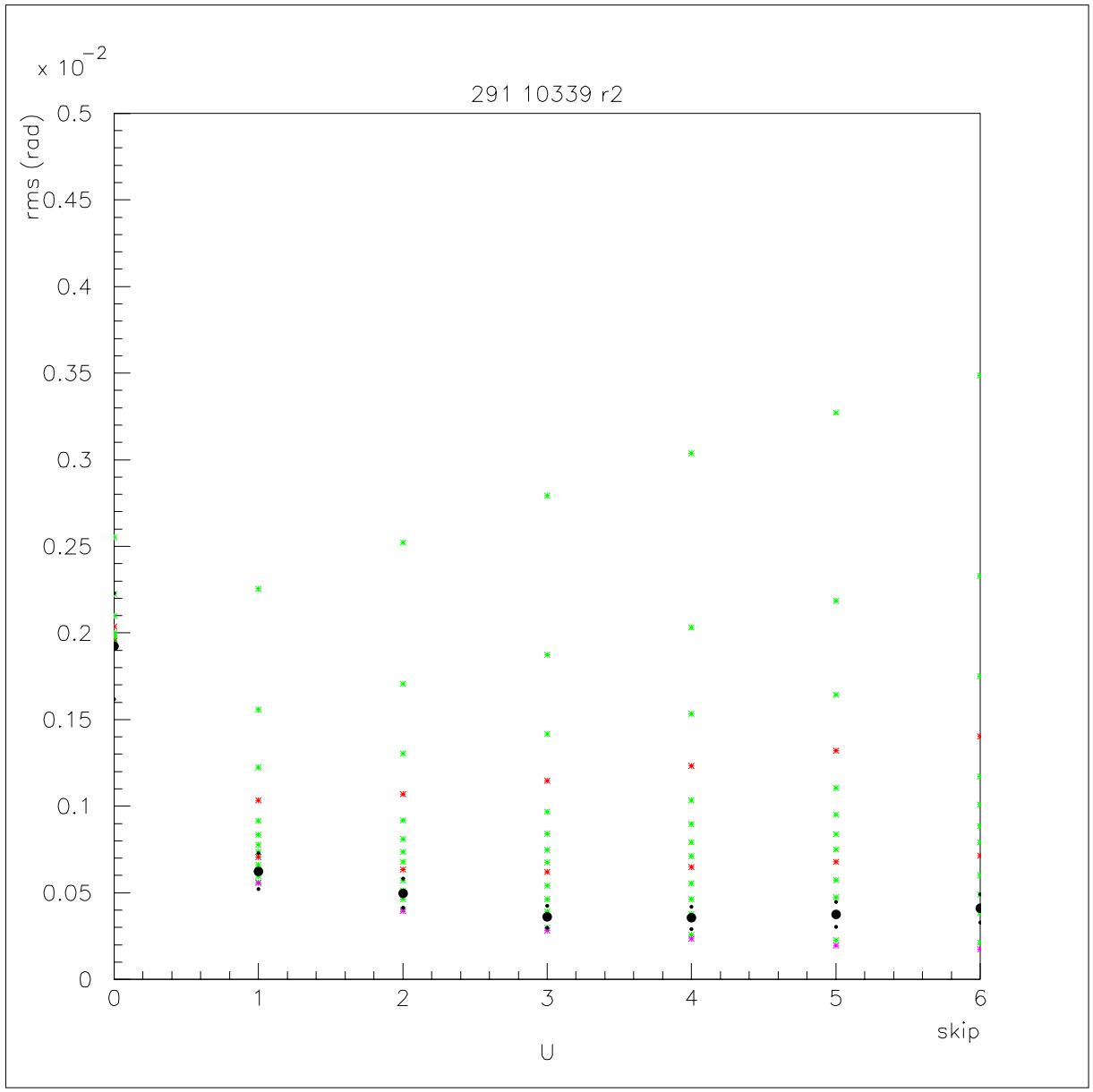
The inverse momentum spectrum after the cut is applied to the m-file data.

This is much closer to the expected background muon distribution



The track of interest in a plot of *rms* vs. skip before cuts.

This behavior is not expected for good data.



The same track after the cut `idx>30`.

The behavior is smooth and consistent even at large skip numbers.

The fitted value is 18 GeV/*c*.

2884_18223 291-10339

Cut	p	$p - \delta p$	$p + \delta p$	p^{-1}	δp^{-1}	$p^{-1}_u - p^{-1}_v$
None	6.5	3.8	22.0	0.153	0.139	0.021
idx > 30	17.8	14.3	23.7	0.056	0.014	-0.008
idx > 40	19.3	12.1	51.3	0.051	0.031	0.048

The results from the momentum fit for three cuts of the m-file data. The measured value in the spectrometer is 16.4 ± 2.5 GeV/c. The procedures outlined in the preceding pages are done for each track to be analyzed.