Fast simulation of acceptance and resolutions

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- The beam @ 420 m
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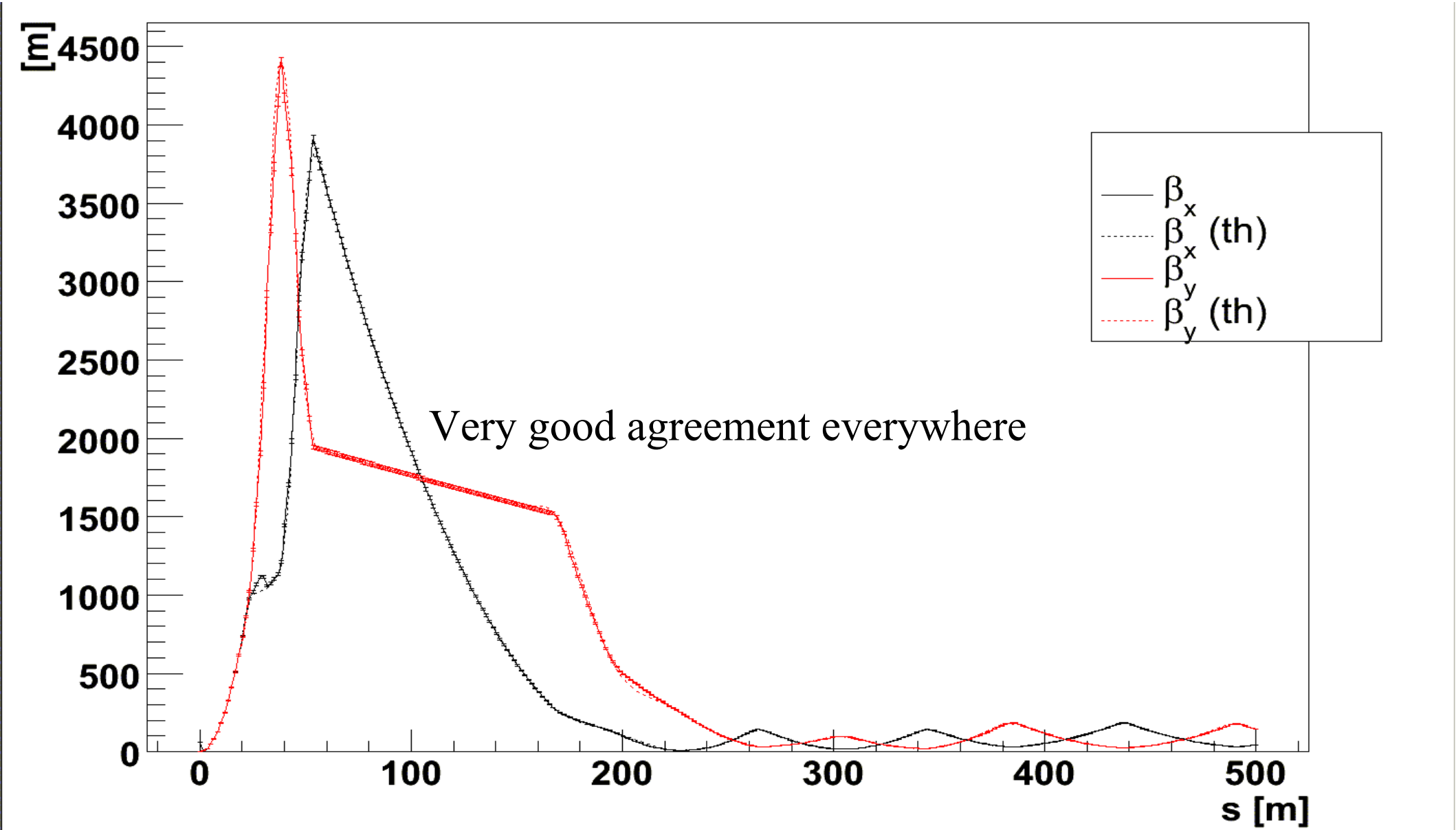
Beam parameters

- Beam size at IP : 11.8 x 11.8 μm
- Beam divergence at IP : 30.2 x 30.2 μrad
- Energy divergence : 0.7 GeV
- Using optics version 6.5
- Kickers included, but giving unstable results -> Switched off (crossing angle = 0)

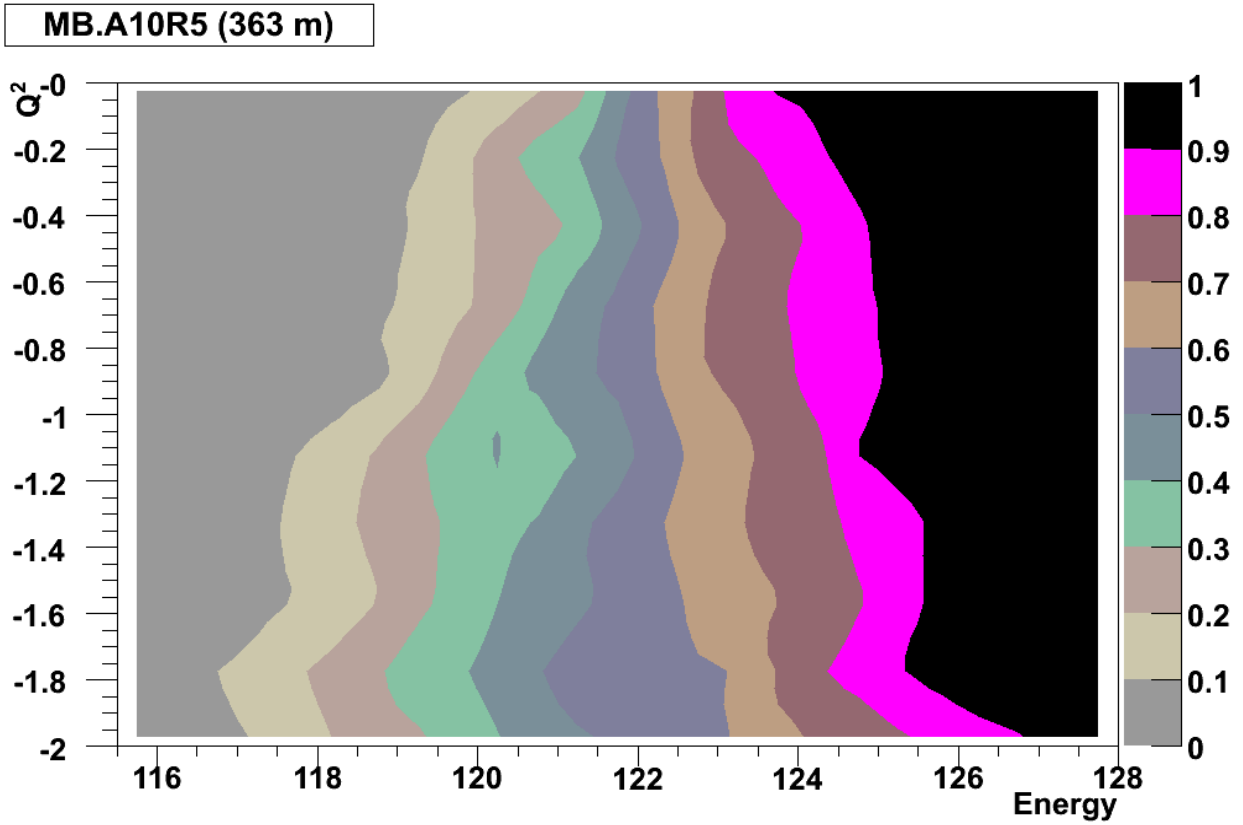
Beam envelope check

Beam size (β) simulation :



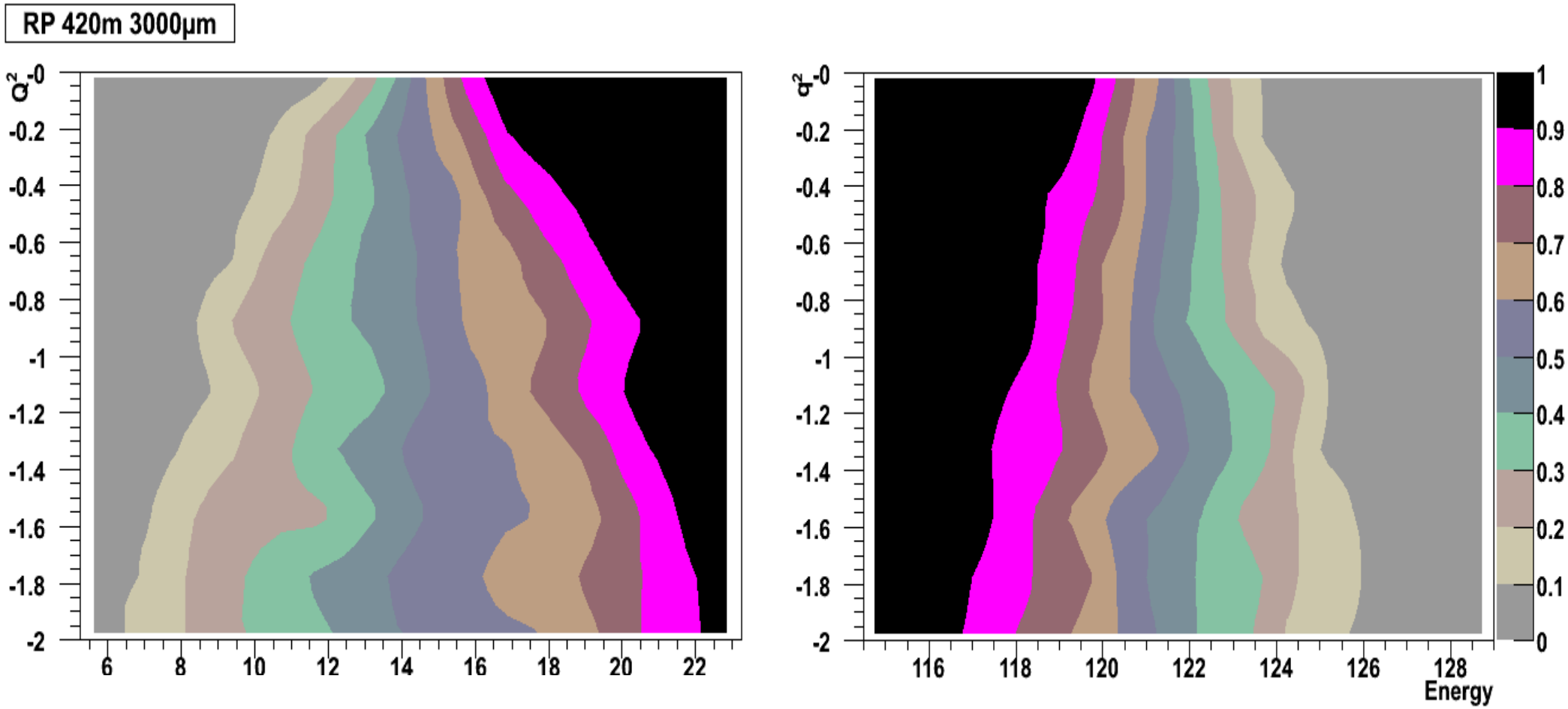
Acceptance @ 420 m

- Lower energy limit given by distance of detector from beam : 3mm (~ 12.4 σ).
- Higher energy limit : beam elements aperture. Main aperture limitation is @ 363m.



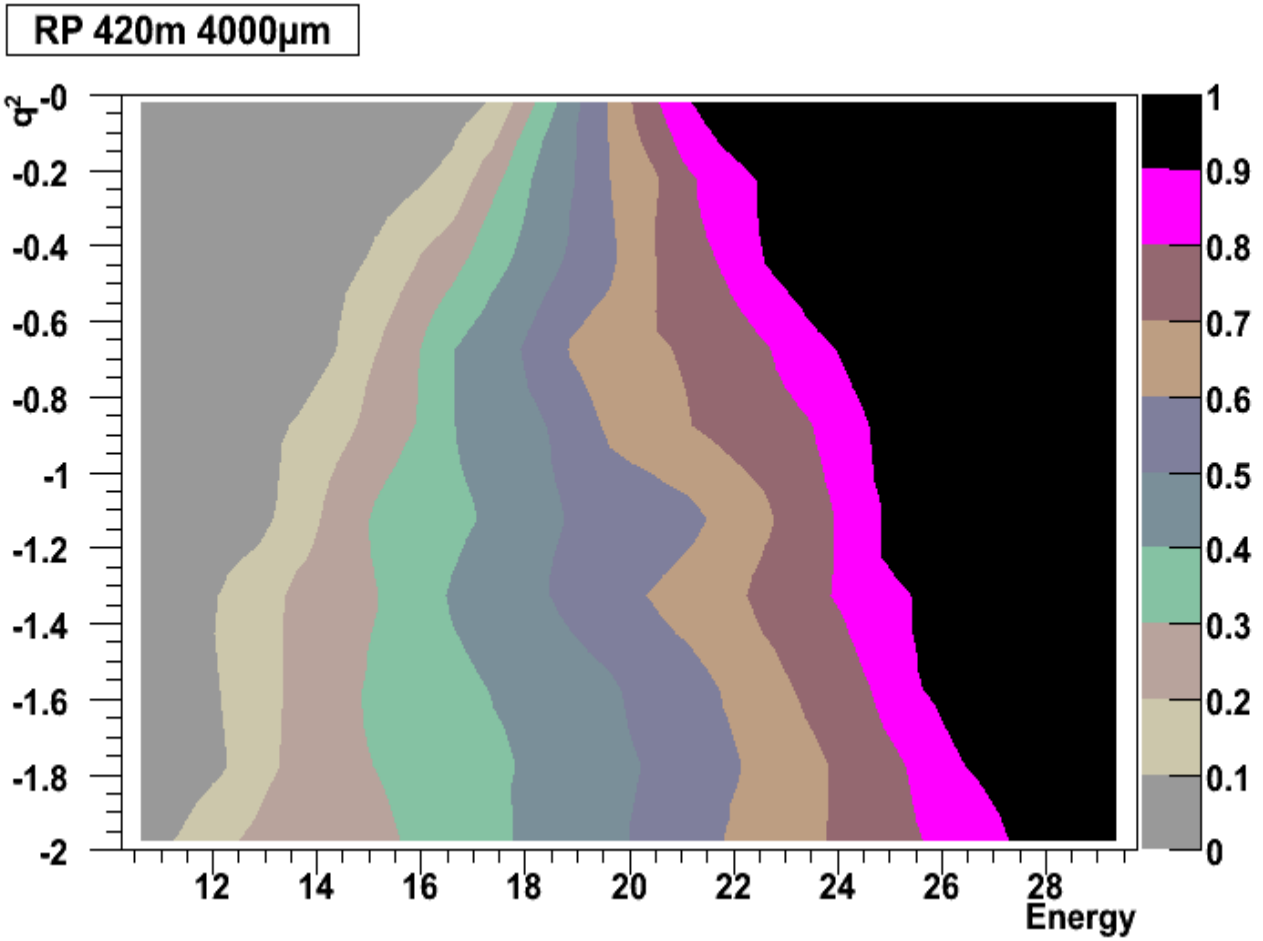
Acceptance (II)

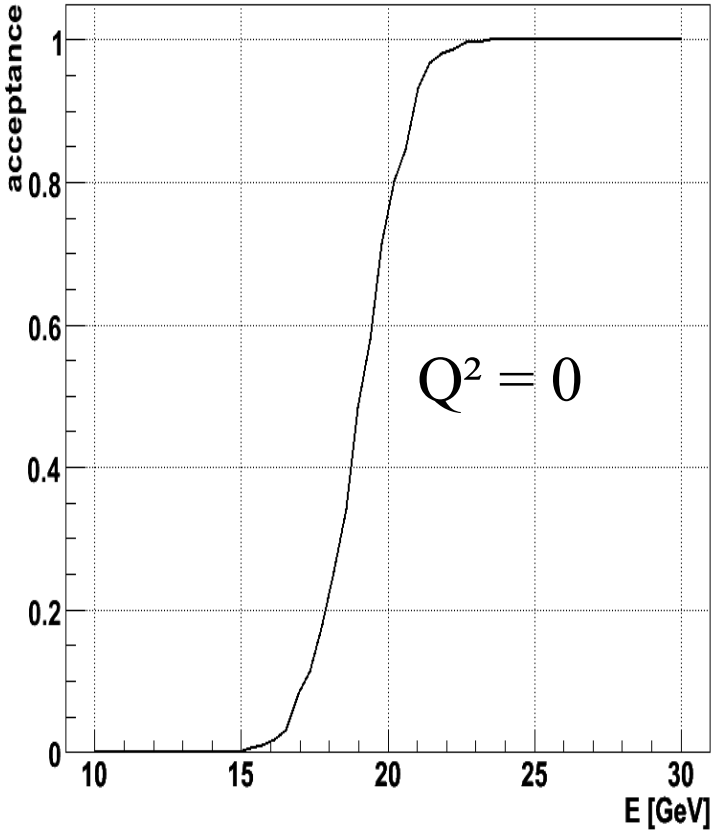
Full detector geometric acceptance (3mm, beam 1):



Acceptance (III)

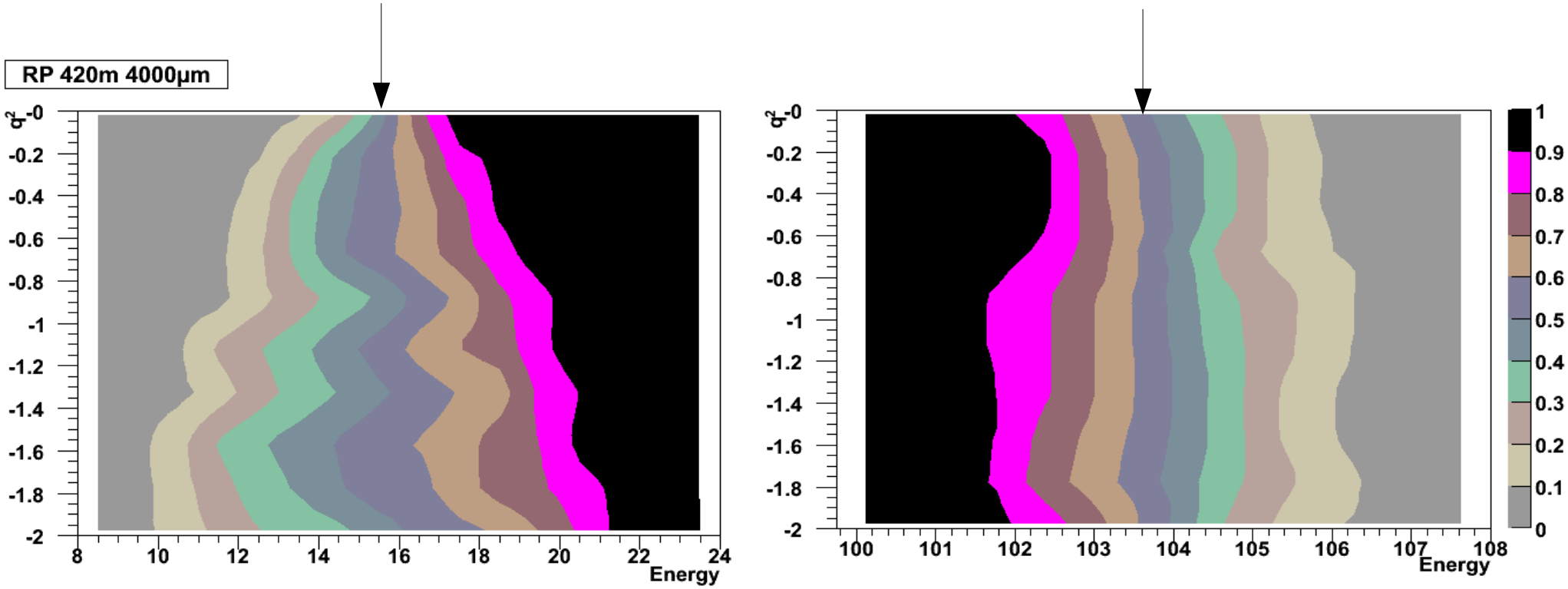
Moving the detector to 4mm :





Acceptance (IV)

Beam 2 :



- Window is moved from 20 - 122 GeV to 16 - 104 GeV
- Upper limit is less sensitive to Q^2

Energy / Q^2 reconstruction

- Two methods for Energy:

- Method I : E = x / dispersion
- Method II : E is computed by inverting the propagation matrix, to compensate for angle effects

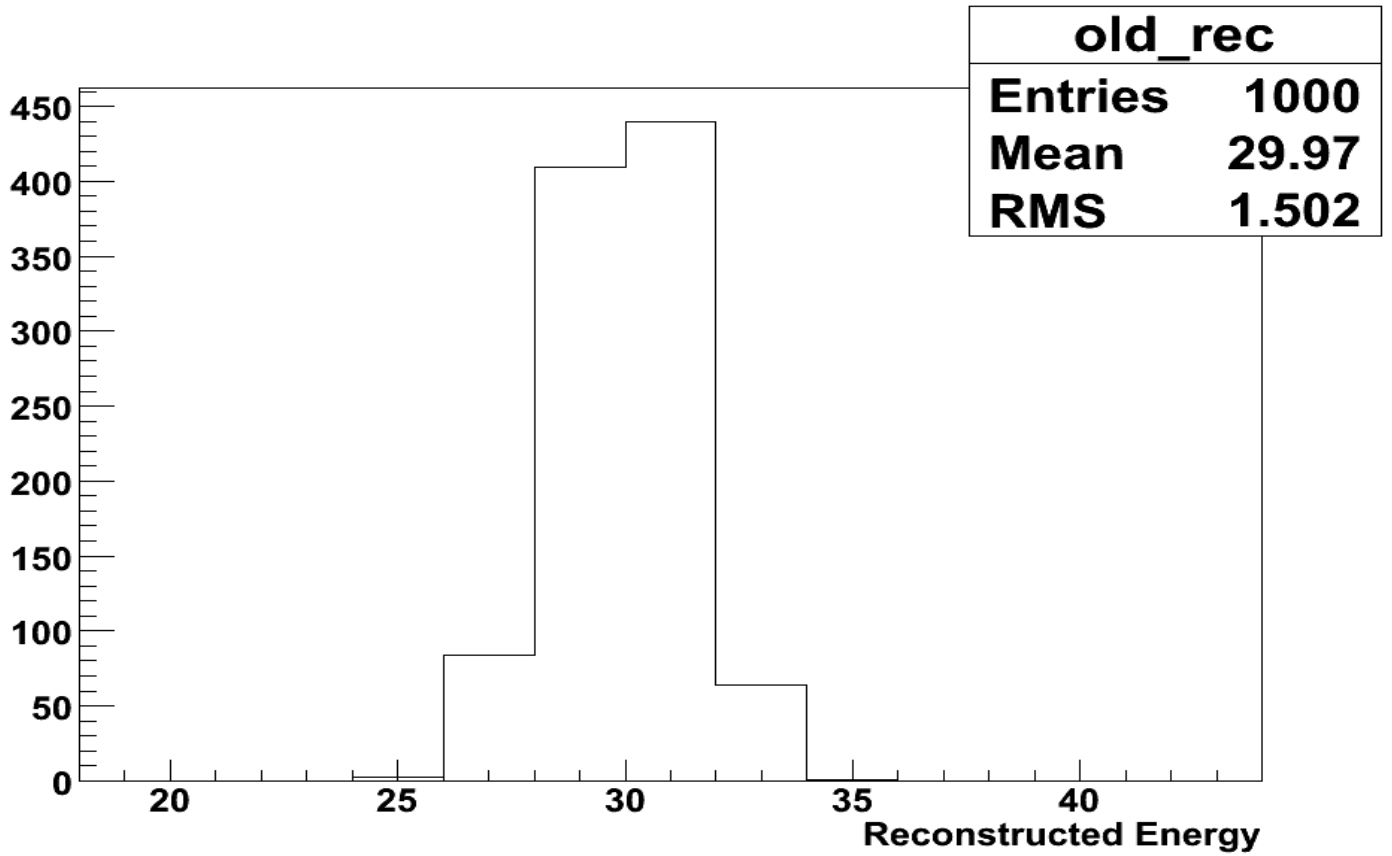
- Q^2 is computed from matrix inversion

- Contributions to the reconstruction resolution :

- Beam transverse size
- Beam angular divergence
- Energy spread
- Detector resolution

Energy / Q^2 reconstruction (II)

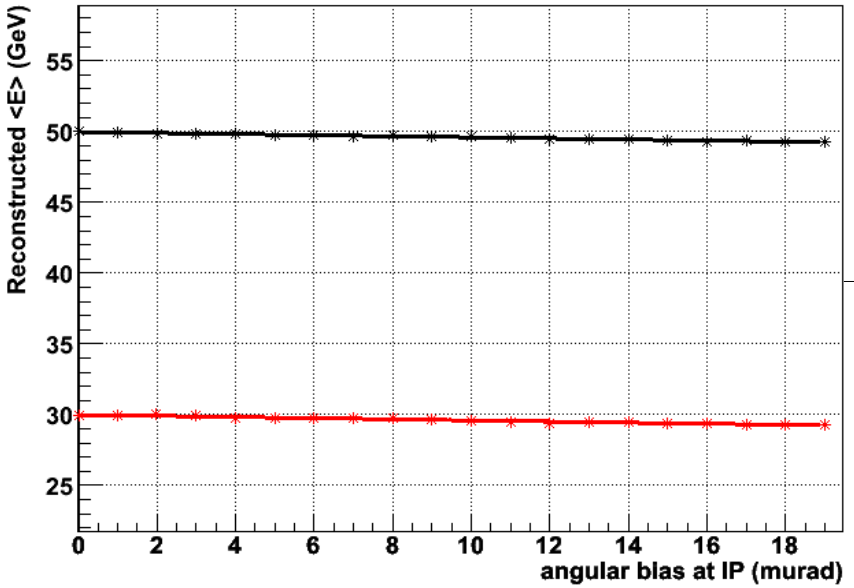
I) Beam spread + detector resolution (10 μm) included ($Q^2 = 0$, method I) :



Not sensitive to detector resolution

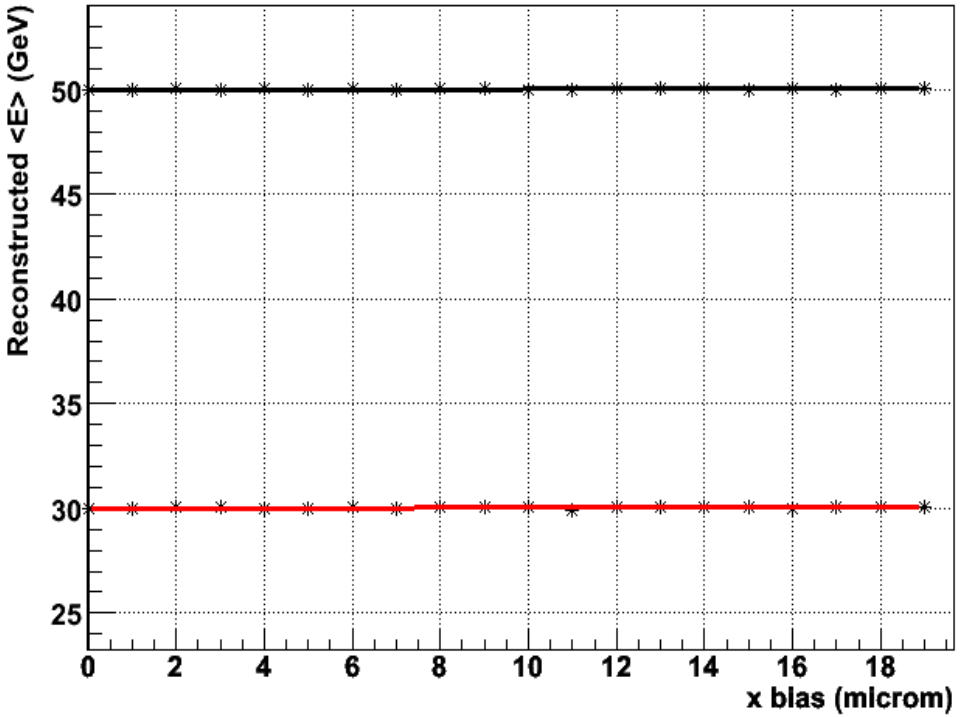
Energy reconstruction

Effect of an angular / spatial bias (in x) @ IP :



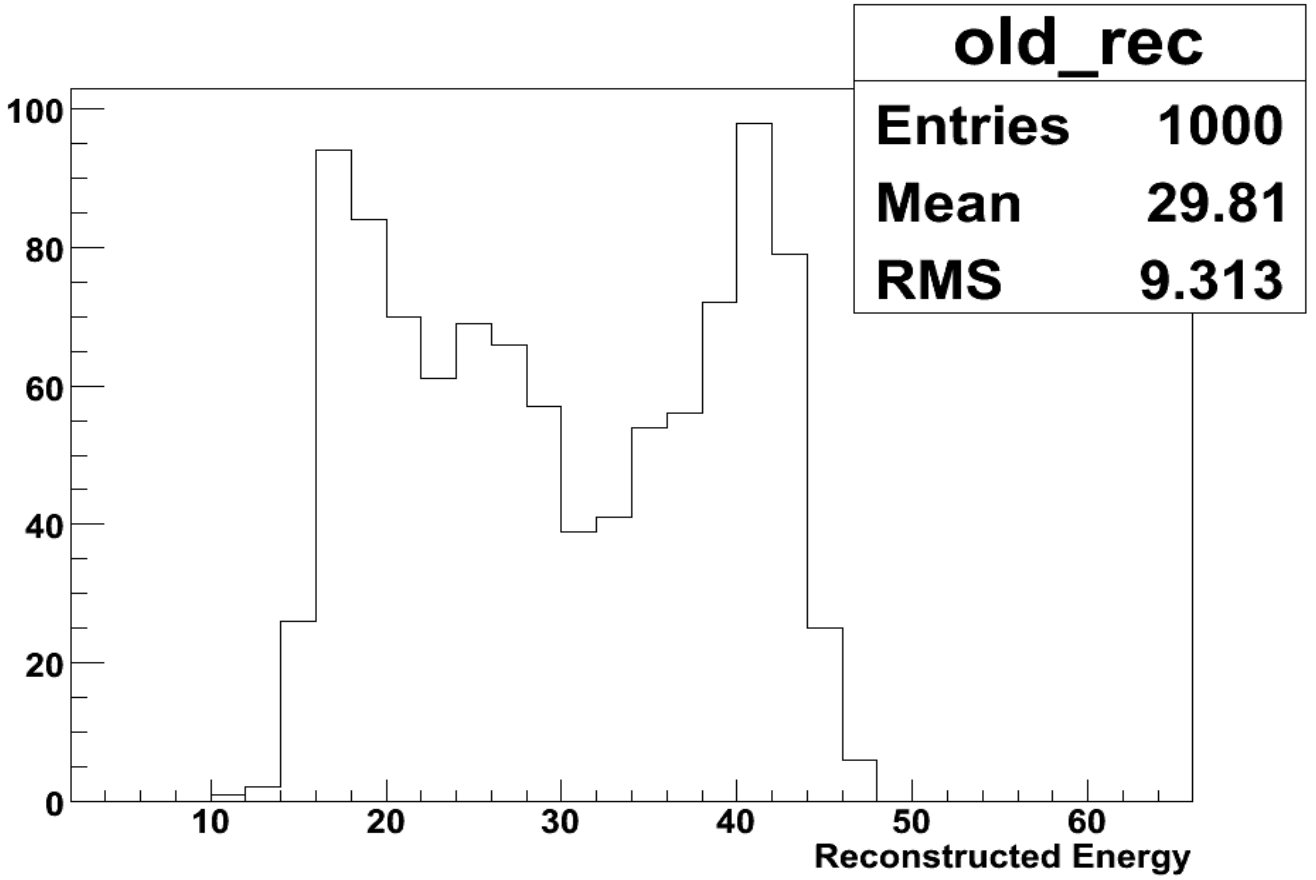
Bias : ~ 0.04 GeV / µrad

Bias : ~ 0.002 GeV / µm



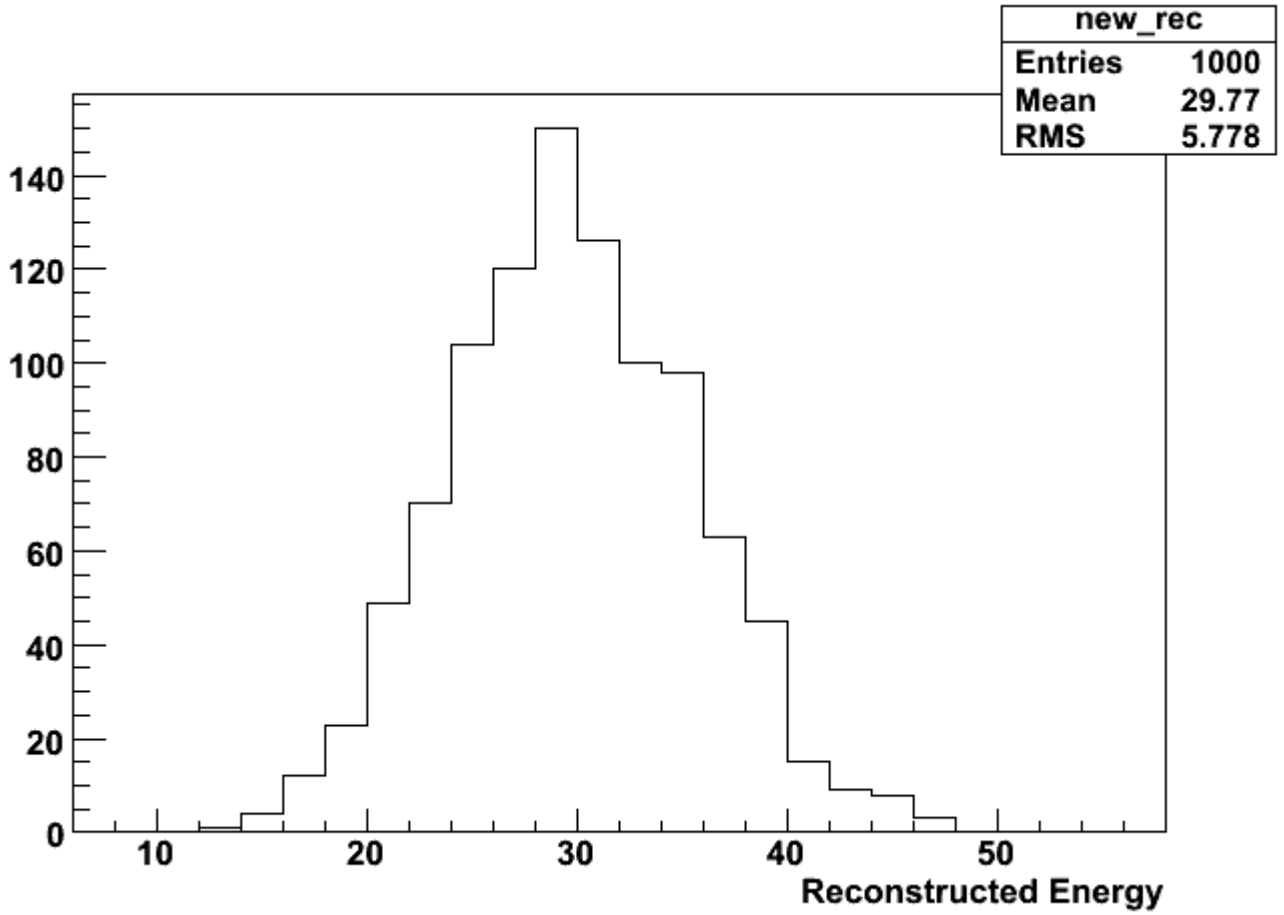
Resolution (III)

II) Q^2 effect (5 GeV^2, method I) :



Resolution (IV)

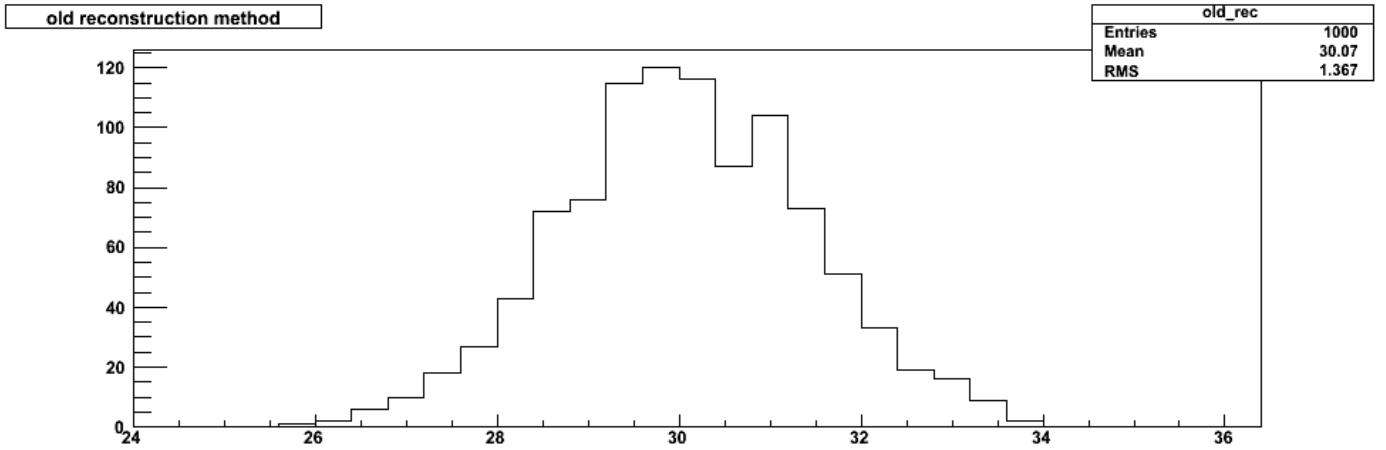
III) $Q^2 = 5\ GeV^2$, Method II (successful)

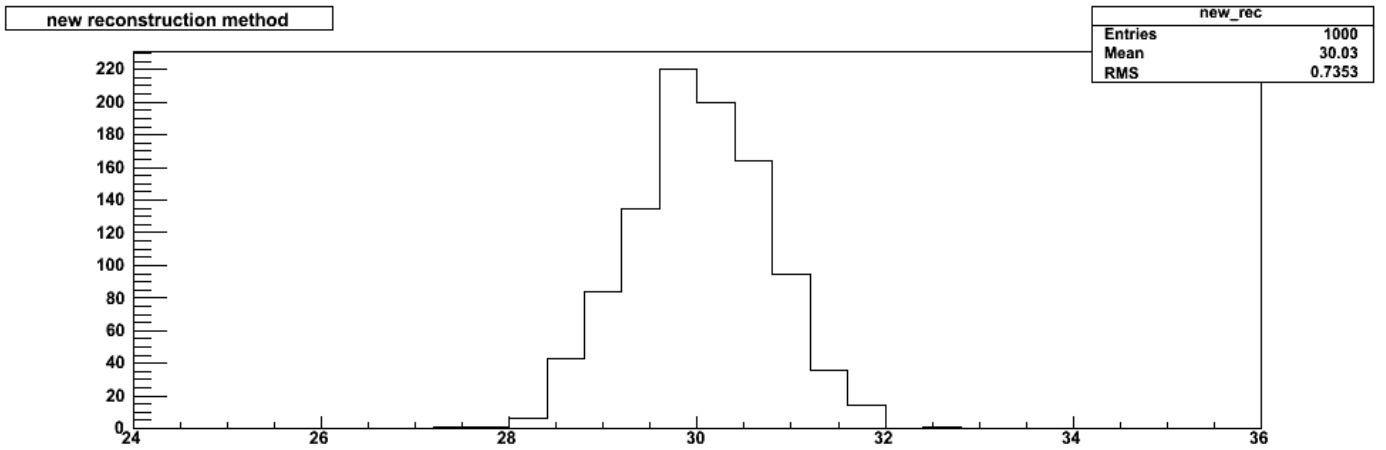


But : Very sensitive to small errors in position measurements !!!

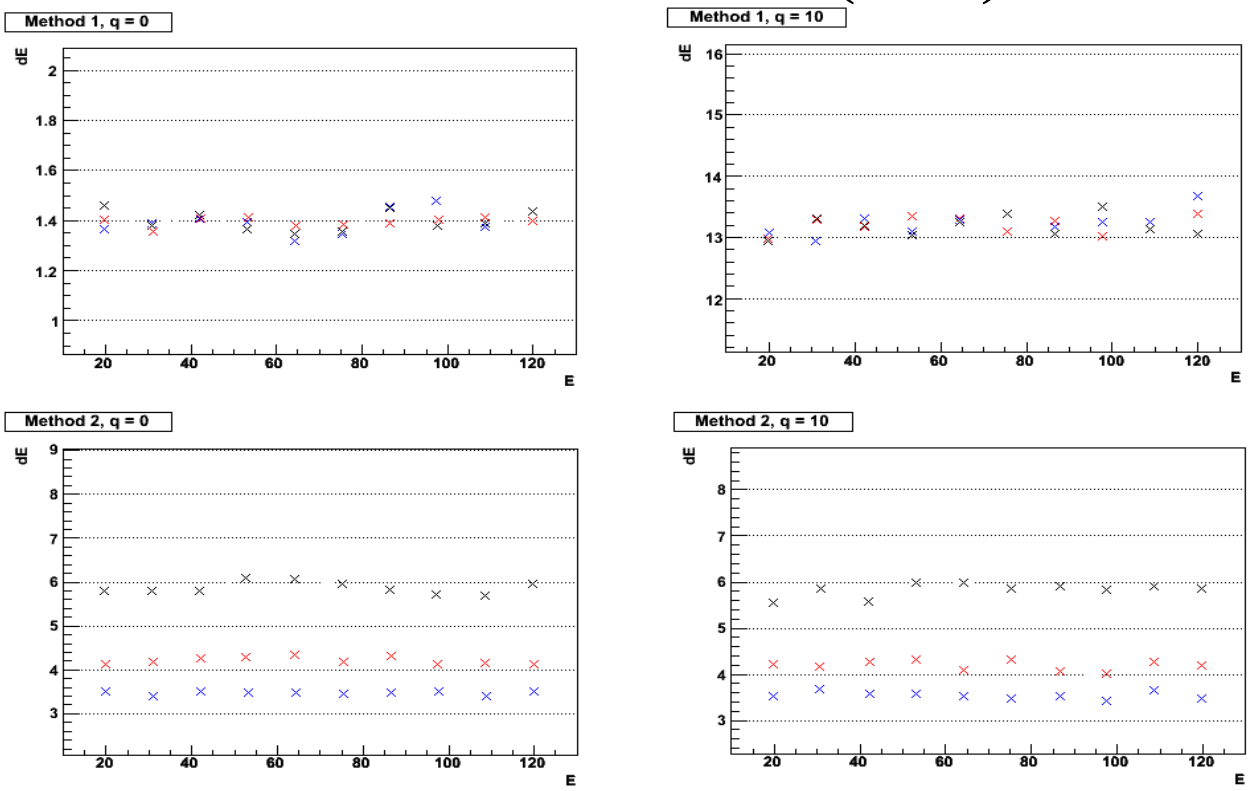
Resolution (V)

Ideal case : perfect knowledge of vertex position, perfect detector, but nominal beam angular divergence and energy spread.





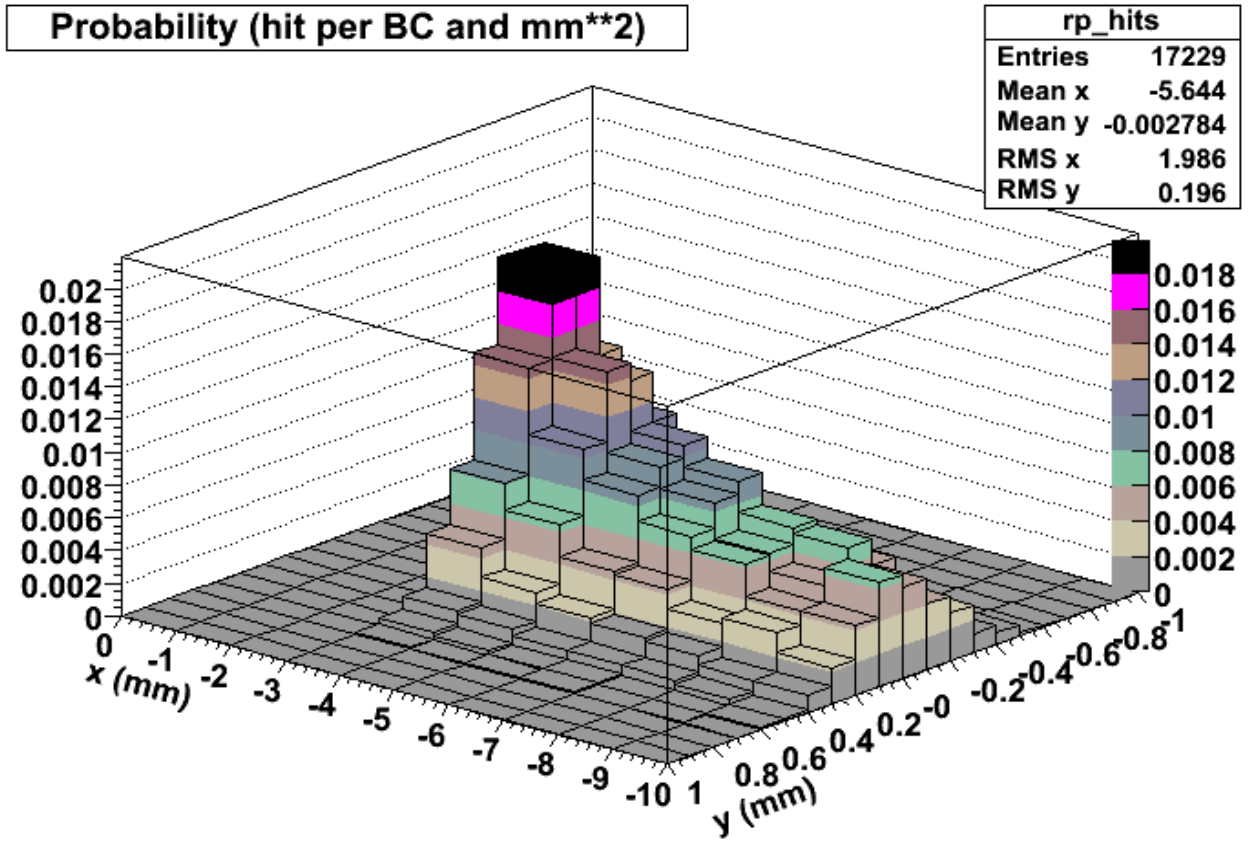
Resolution (VI)



- Problem : we have two methods good at low / high Q^2 respectively
- Possible scenarios : depending on physics, we can assume $Q^2 = 0$ or not.
- Problem (II) Q^2 resolution is poor (~3GeV²)

Diffractive Background

- Main background is due to diffractive processes with a simultaneous central detector event.
- lumi : $2*10^{33}$ cm^{-2} s^{-1} , $\sigma \sim 7.15$ mb
- PYTHIA (6.2) was used (single diffraction pp->pX).



Background (II)

This means that :

- We have a hit in the detectors in ~6.5% of BC.
- Fluency in the detector is of the order of $\sim 1.3 * 10^{14}$ (“worst” part), which requires good radiation hardness.