Position Response of the Polarimeter Transversely Segmented Calorimeter

Vahagn Gharibyan

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Incoming particle vertical offset y corresponds to an up-down energy asymmetry

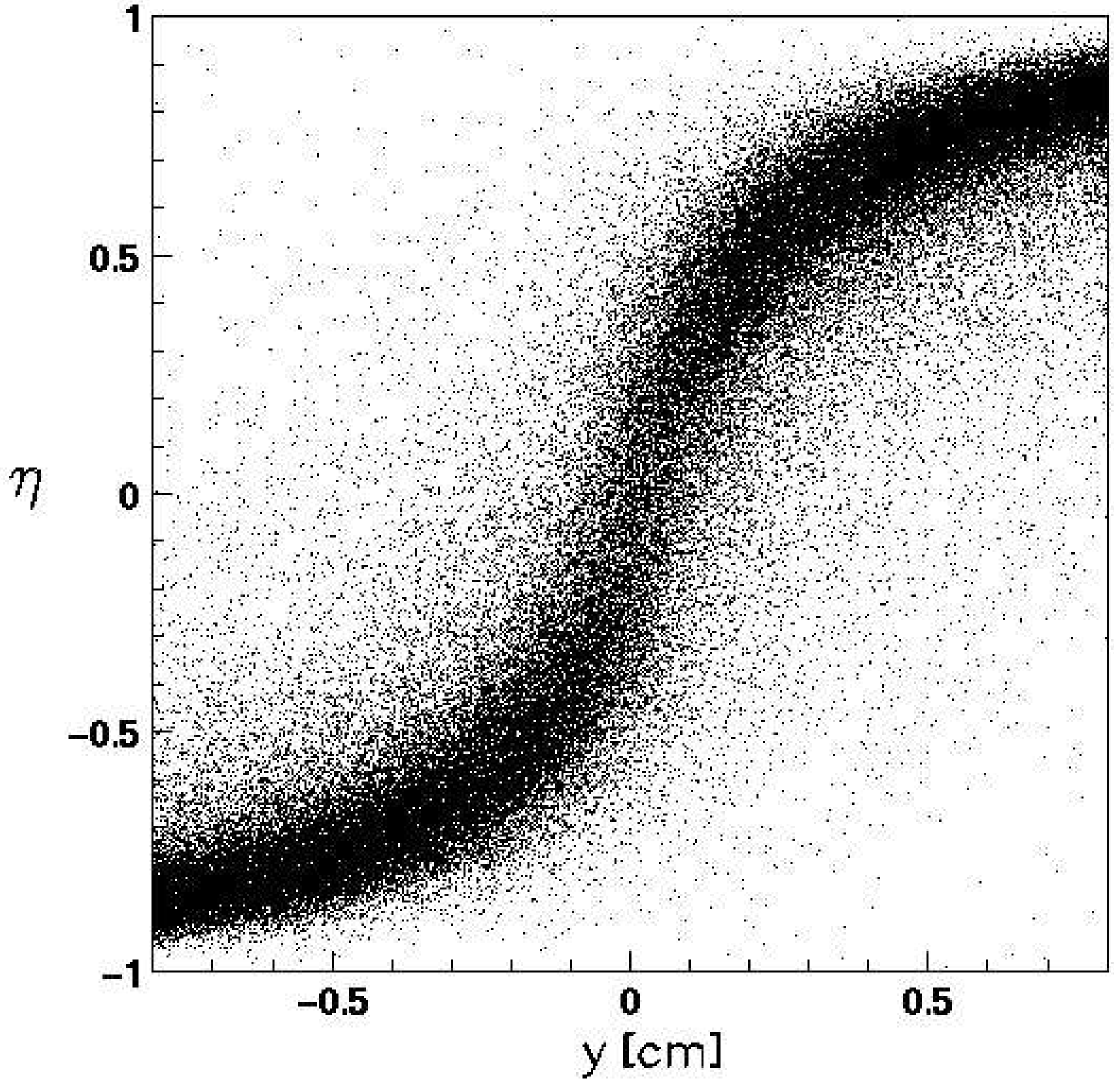
$$\eta = \frac{E_u - E_d}{E_u + E_d}$$

E_u, E_d energies measured by the calorimeter upper and lower parts.

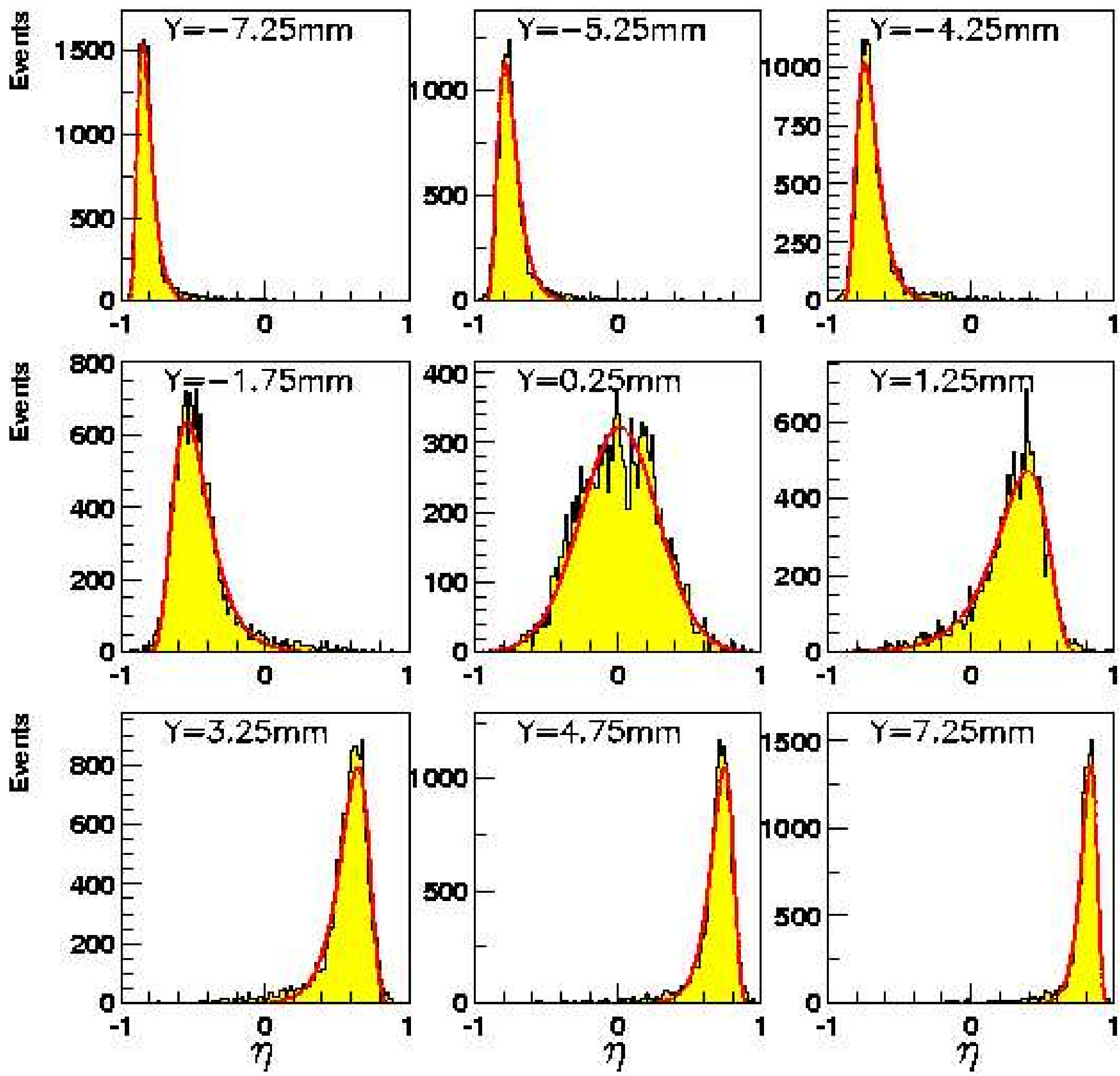
$M(\eta)$ measured distribution

$$M(\eta) = \int \Sigma(y) S(y, \eta) dy$$

$S(y, \eta)$ detector spatial response
$\Sigma(y)$ is parent distribution



$y-\eta$ distribution in energy range of 8-14 GeV, measured at CERN X1 beam in 1997



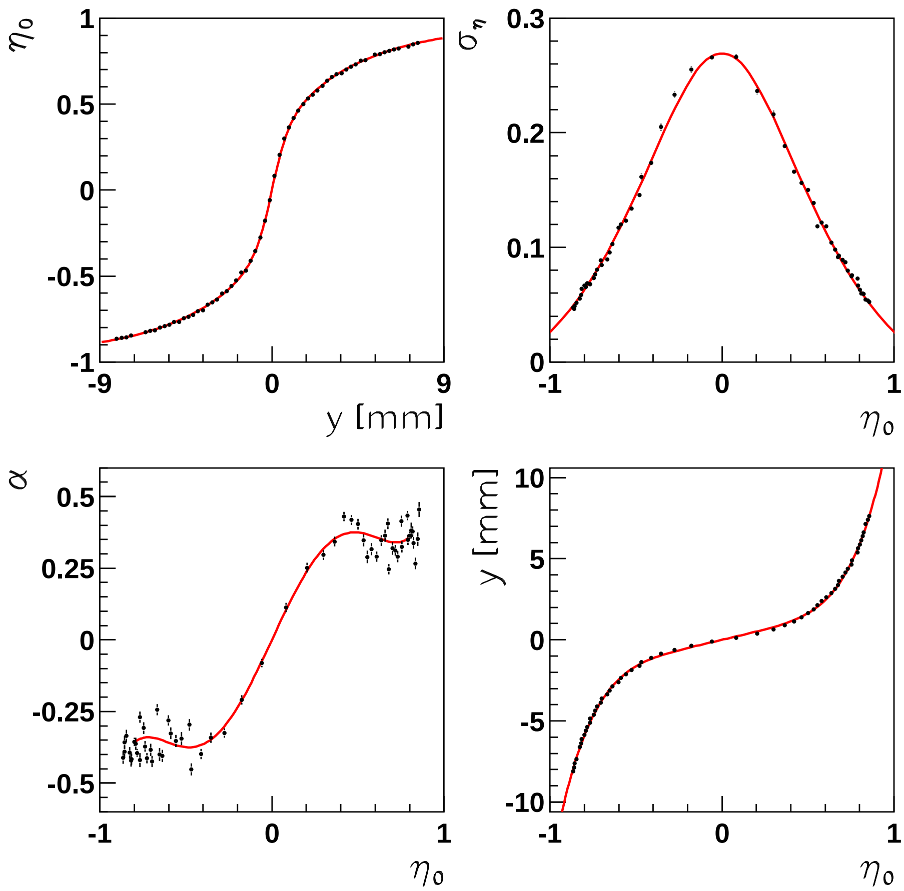
Fitted samples of the 0.5 mm y-slices for y range from -8 mm to 8 mm

Logarithmic Gaussian function

$$s(\eta) = \frac{N}{\sigma_\eta} exp(-\frac{\sigma_0^2}{2} - \frac{1}{2\sigma_0^2} \ln\left(1 - \frac{\eta - \eta_0}{\sigma_\eta}\alpha\right))$$

$$\sigma_0 = \frac{1}{\sqrt{\ln 4}} \sinh^{-1}\left(\alpha\sqrt{\ln 4}\right)$$

N normalization factor, η_0 average
σ_η width, α asymmetry coefficient



Response Function Parameters

$$\eta_0 = p\frac{y}{\sqrt{y^2 + R_C^2}} + (1-p)\frac{y}{\sqrt{y^2 + R_T^2}}$$

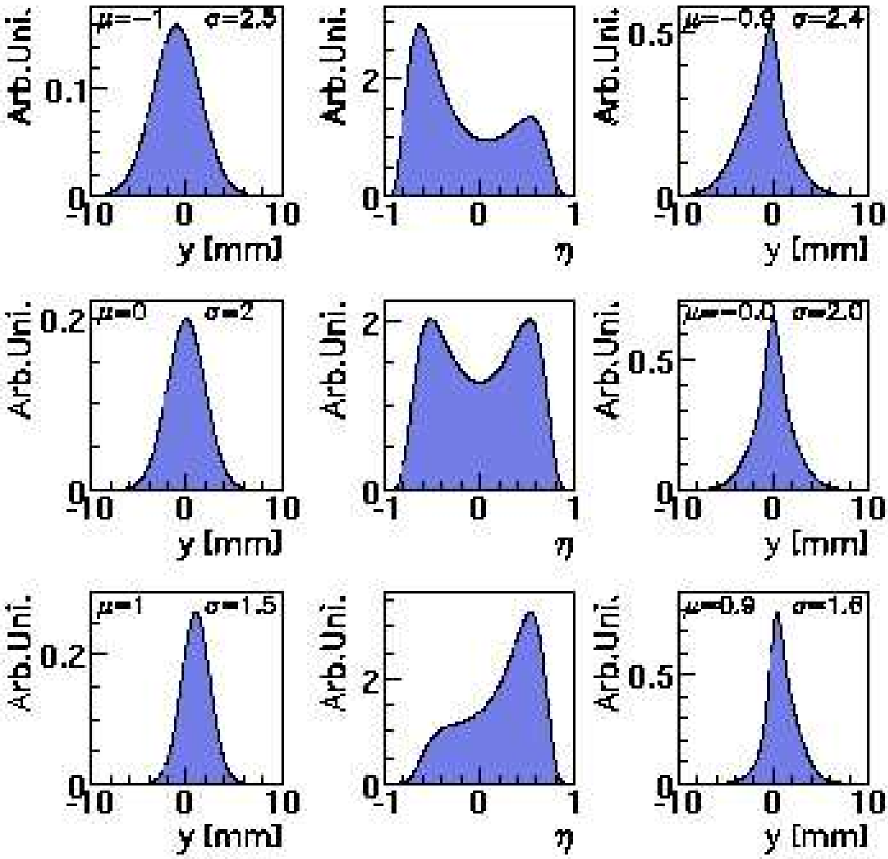
$0 \leq p \leq 1$ weight

R_C (R_T) median of the shower core (tail)

$$y = g(\eta_0) = a\eta_0 + b\eta_0^5$$

$$\sigma_\eta = \left(\frac{S_1}{\sqrt{S_2 + \eta_0^2}} + \frac{S_4}{S_3 + \eta_0^2}\right)\sqrt{\frac{11}{E[GeV]}}$$

$$\alpha = A_1\eta_0 + A_2\eta_0^3 + A_3\eta_0^5$$



Parent, ‘Detected’ and Reconstructed Distributions

HERA-I Yoffset Focus

. $\bar{y} = g(\bar{\eta})$ $\sigma_y = g(\sigma_\eta)$

HERA-II Focus

. $\sigma_y = g(\sigma_\eta) f'(\bar{y})$

$f' = d\eta/dy$ Jacobian for $\eta = f(y)$

Distributions				Deconvolution Methods				
Parent		Folded		HERA I		II	δ-Response	
$\bar{y}$ mm	σ_y mm	$\bar{\eta}$	σ_η	$\bar{y}$ mm	σ_y mm	σ_y mm	$\bar{y}$ mm	σ_y mm
-1	2.5	-0.17	0.48	-0.44	1.50	0.62	-0.88	2.45
0	2.0	-0.00	0.45	0.00	1.36	0.70	0.00	2.01
1	1.5	0.22	0.38	0.55	1.04	0.39	0.87	1.62

δ-Response method (still fast)

$$S(y,\eta) = \delta(y - g(\eta))$$

$$\Sigma(y) = M(f(y))f'(y)$$