Jet resolutions with ORCA4

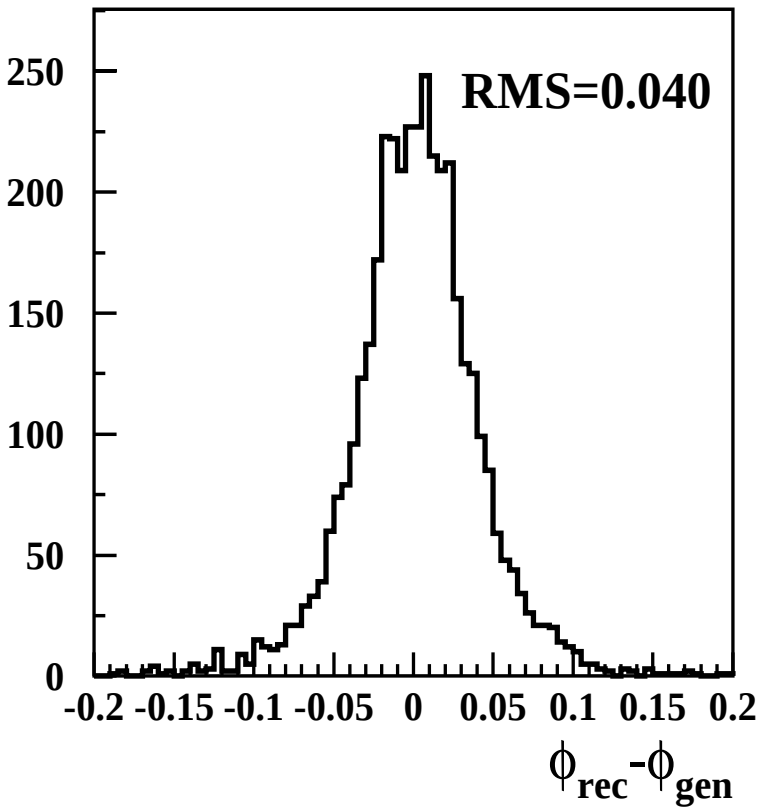
Using QCD 2-jet events at low luminosity

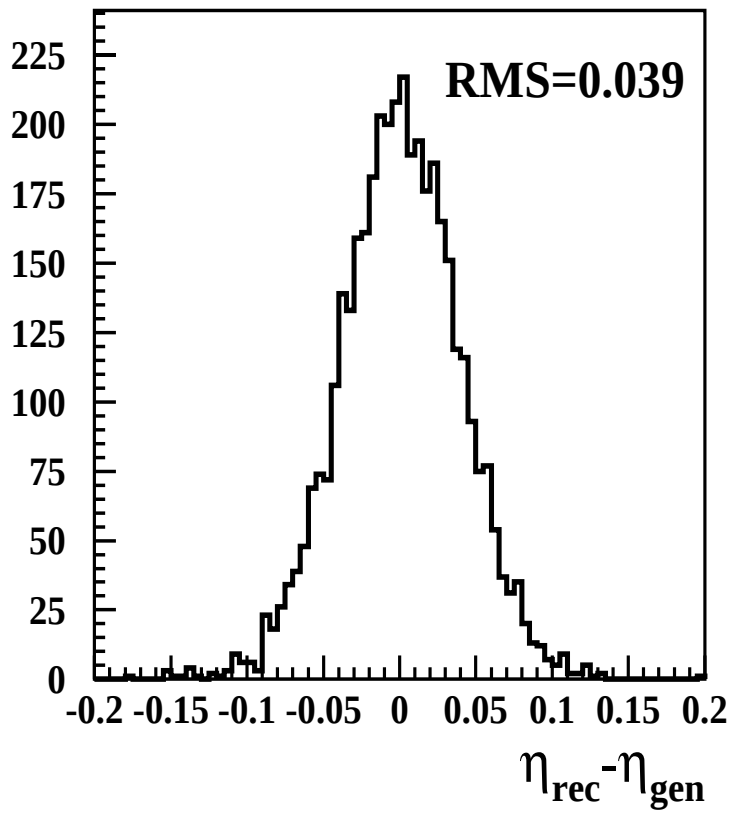
Generator particle jets and calorimeter jets are found with the standard ORCA iterative cone algorithm (cone 0.5)

Calorimeter jets are matched to particle level jets if $\Delta r < 0.2$

Spatial resolution

70 GeV < Et_{gen} < 110 GeV, $|\eta_{gen}| < 0.4$





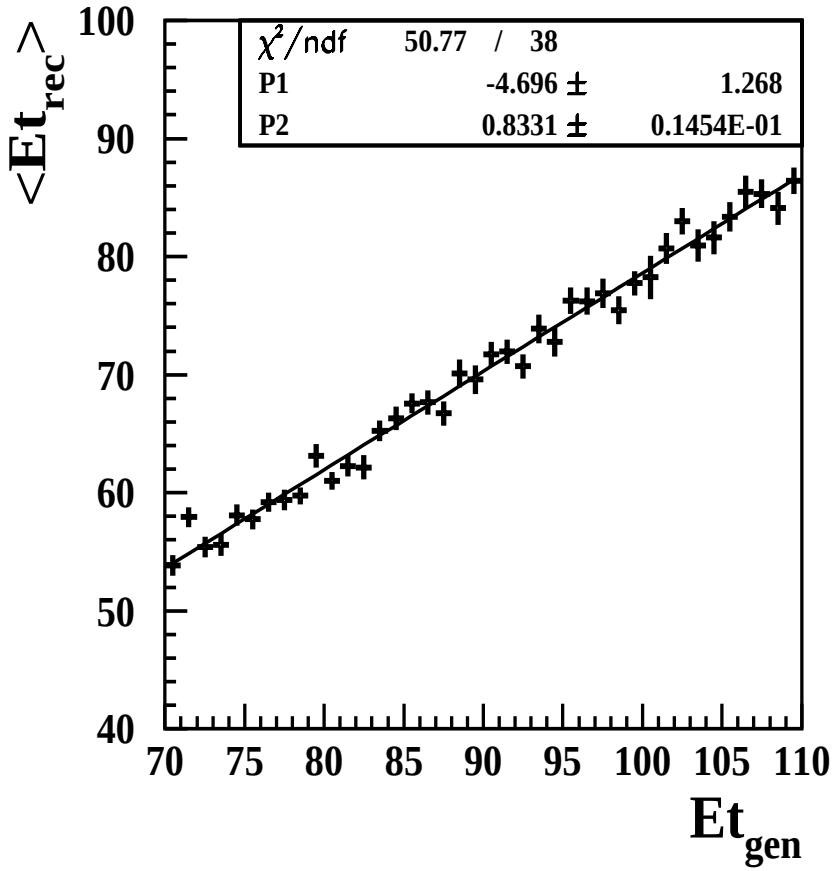
Reconstructed jet 4-momentum (in Barrel):

$$P_{\mathrm{rec}} = w_{\mathrm{e}} P_{\mathrm{ecal}} + w_{\mathrm{h0}} \left(\frac{118}{72} P_{\mathrm{hcal0}} \right) + w_{\mathrm{h}} \left(P_{\mathrm{hcal}} + \frac{150}{200} P_{\mathrm{outer}} \right)$$

Now $w_{\mathrm{e}}, w_{\mathrm{h0}}, w_{\mathrm{h}} = 1$ **corresponds to the CMSIM120 weights**

$$Et_{\mathrm{rec}}(w) = E_{\mathrm{rec}}(w) \sin\theta_{\mathrm{rec}}(w)$$

Jet energy scale calibration



$$\langle Et_{\mathrm{rec}} \rangle = p1 + p2 \cdot Et_{\mathrm{gen}}$$

Energy scale is calibrated for each set of weights used in the further minimization procedure.

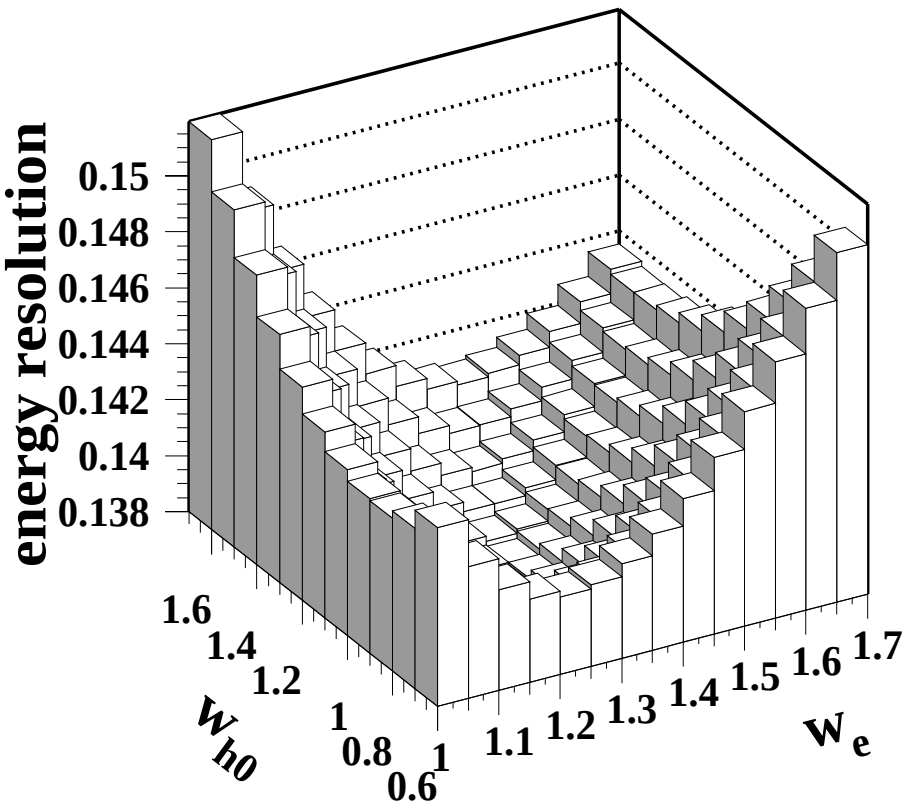
$$Et_{\mathrm{corr}}(w) = \frac{Et_{\mathrm{rec}}(w) - p1(w)}{p2(w)}$$

As a result of calibration Et_{corr} **depends only on the ratios of the initial weights**

Keep $w_{\mathrm{h}} = 1$ **and vary** w_{e} and w_{h0} **to minimize the jet energy resolution:**

$$\mathrm{RESOLUTION}(w) = \frac{\mathrm{RMS}(Et_{\mathrm{corr}}/Et_{\mathrm{gen}})}{\langle Et_{\mathrm{corr}}/Et_{\mathrm{gen}}\rangle},$$

calculated over 20% range of Et_{gen}**.**



For each set of weights

1. Et_{rec} **is calculated**
2. **Energy scale is calibrated**

$$\langle Et_{\mathrm{corr}}(Et_{\mathrm{rec}})\rangle = Et_{\mathrm{gen}}$$

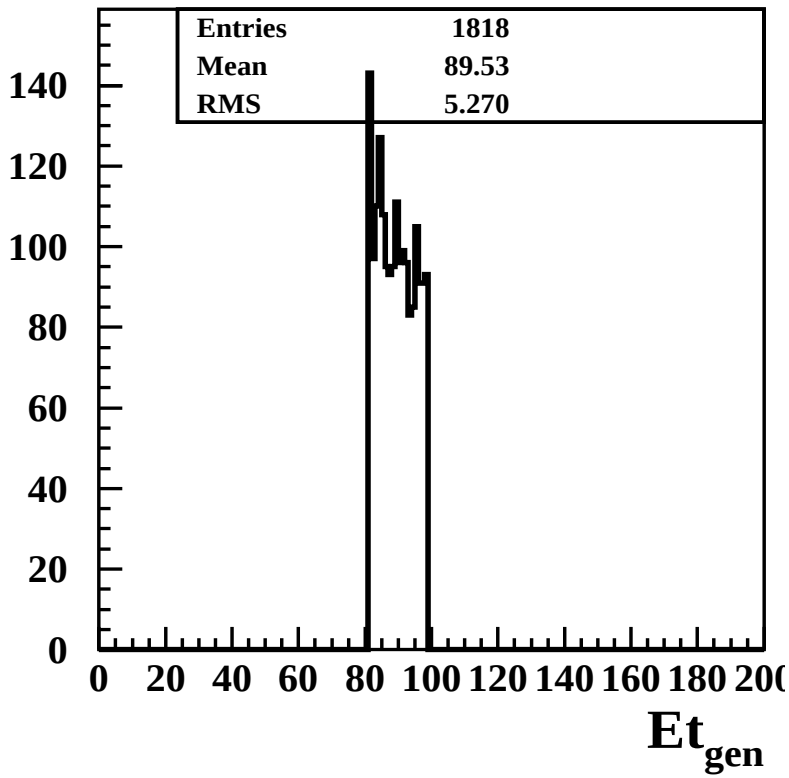
3. **Resolution is calculated**

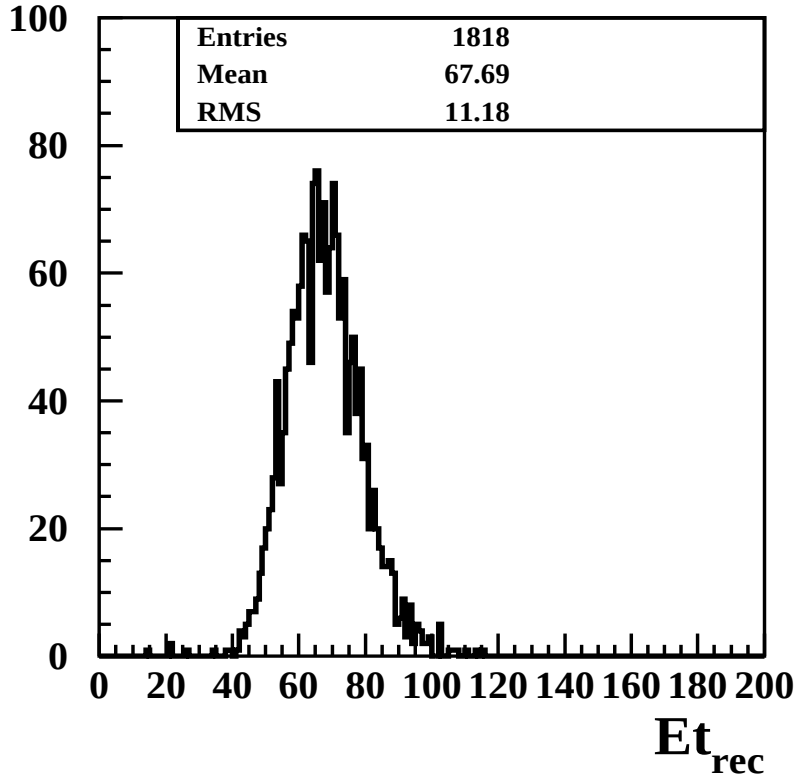
$$\frac{\mathrm{RMS}(Et_{\mathrm{corr}}/Et_{\mathrm{gen}})}{\langle Et_{\mathrm{corr}}/Et_{\mathrm{gen}}\rangle}$$

Generator level and reconstructed jet energy distributions

81 GeV < Et_{gen} < 99 GeV, $|\eta_{gen}| < 0.4$

CMSIM120 WEIGHTS

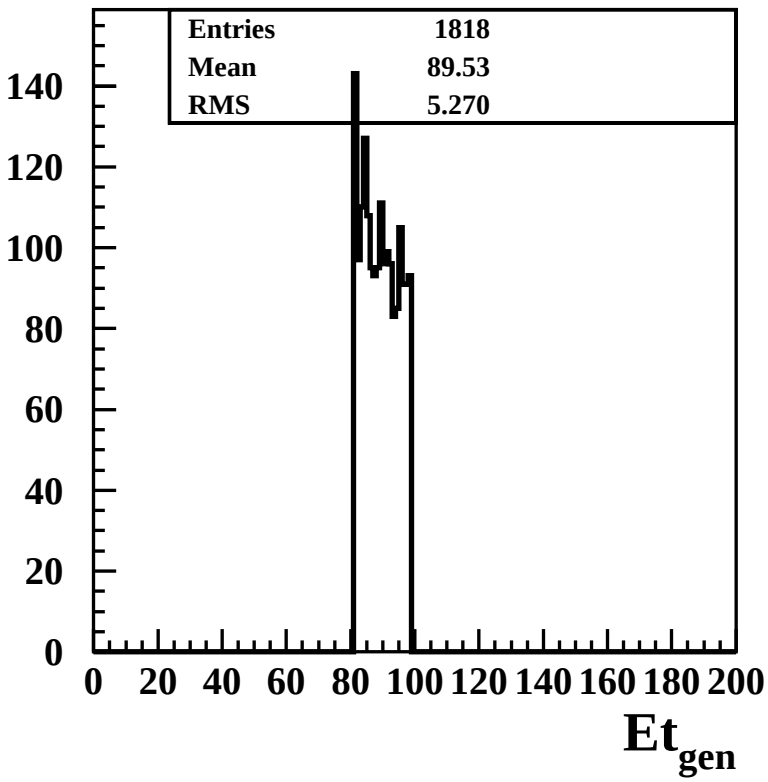


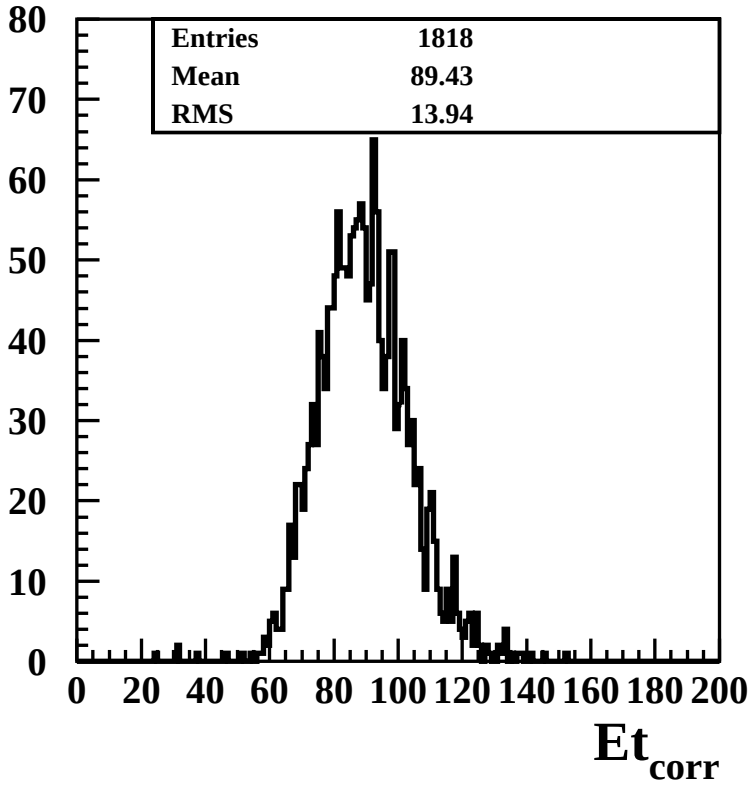


Generator level and reconstructed jet energy distributions

81 GeV < Et_{gen} < 99 GeV, $|\eta_{gen}| < 0.4$

CMSIM120 WEIGHTS + energy scale calibration



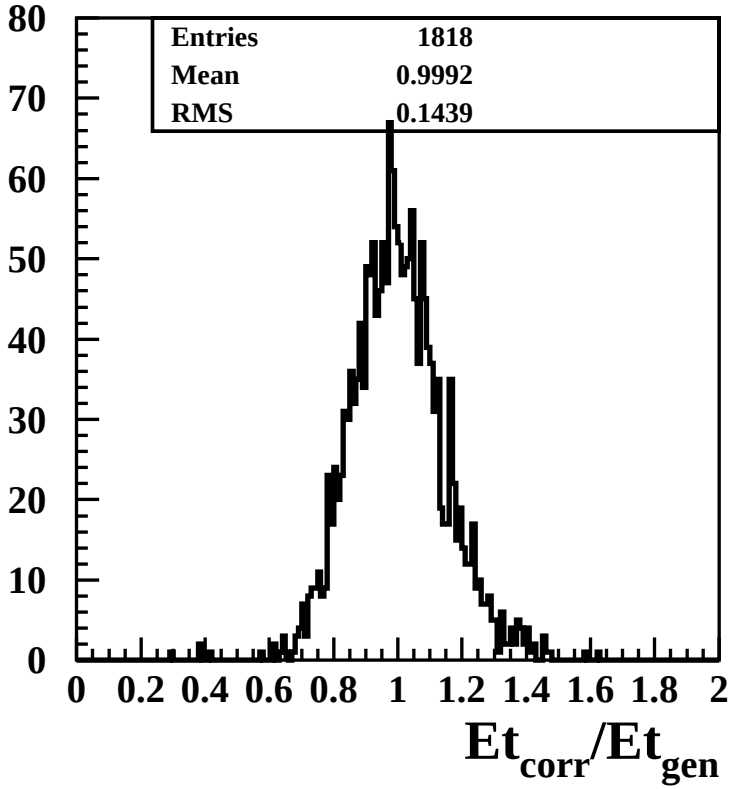


Jet energy resolution

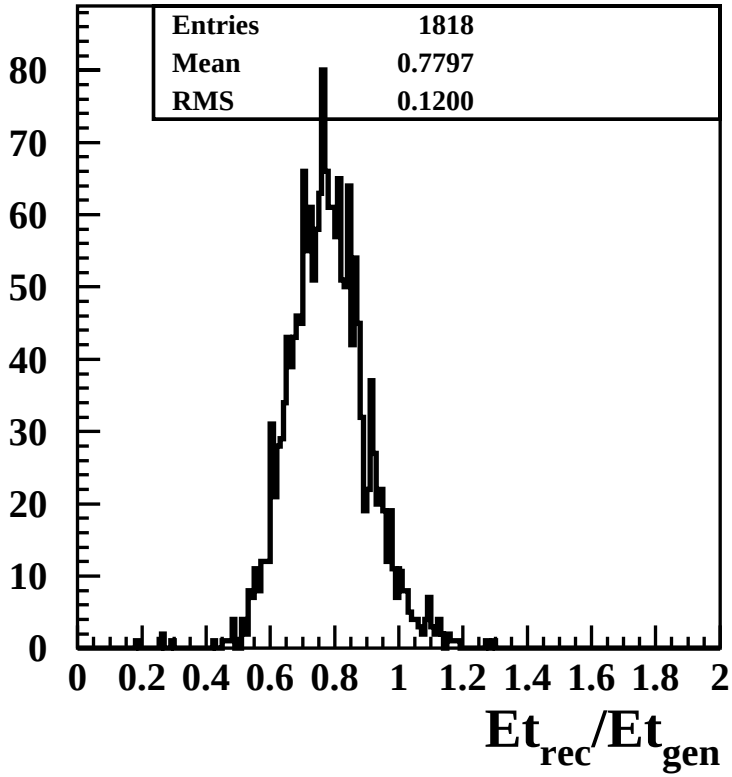
81 GeV < Et_{gen} < 99 GeV, $|\eta_{gen}| < 0.4$

CMSIM120 WEIGHTS

calibrated energy scale



no energy scale calibration

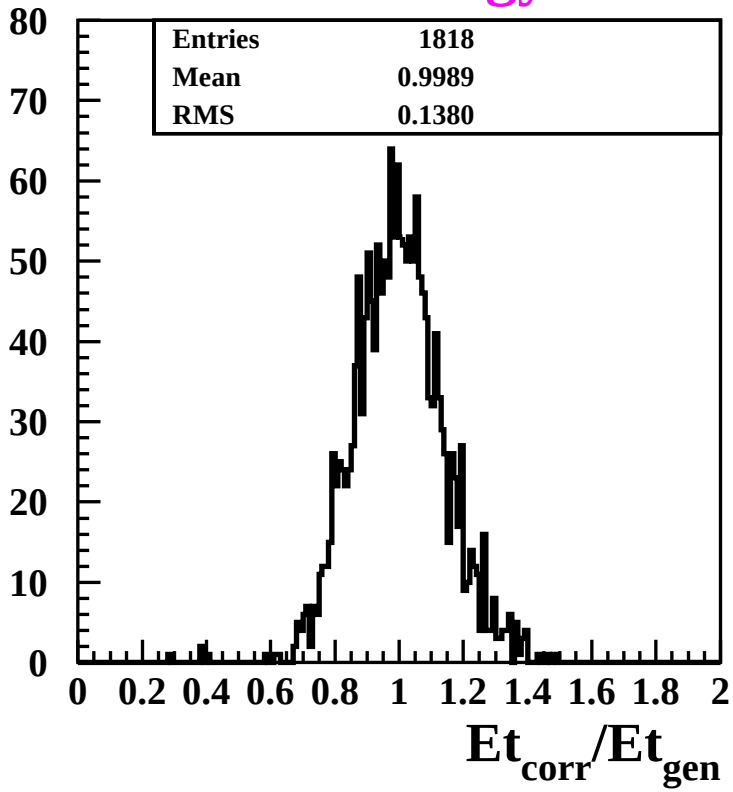


Jet energy resolution

81 GeV < Et_{gen} < 99 GeV, $|\eta_{gen}| < 0.4$

OPTIMUM WEIGHTS

calibrated energy scale



no energy scale calibration

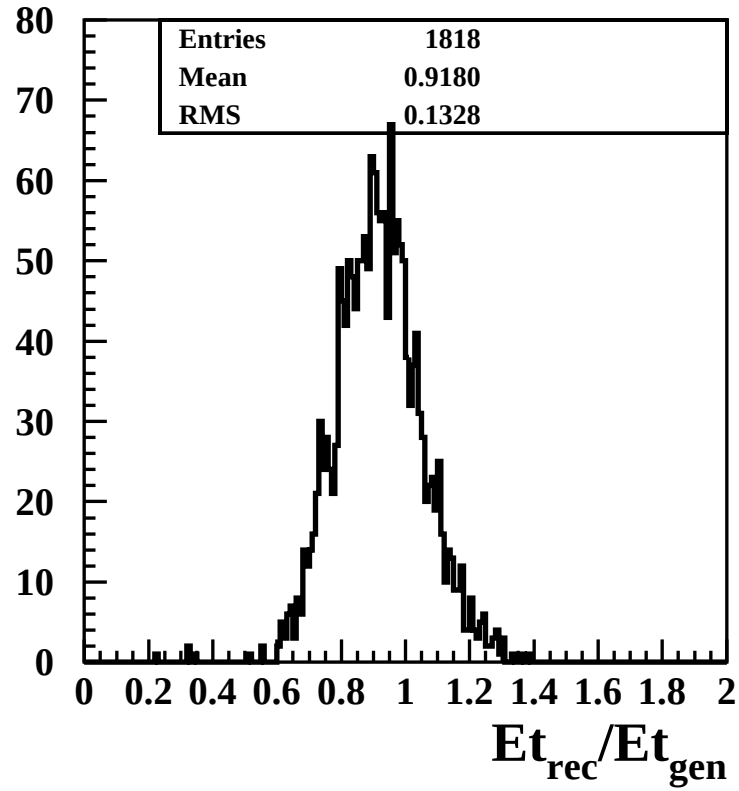


Table 1: Energy resolution for Et=90 GeV jets in ORCA4 with the CMSIM120 and optimized weights

Eta	w_e	w_{h0}	ETcorr / ETrec	RMS(ETcorr/ETgen) / <ETcorr/ETgen>	RMS(ETrec/ETgen) / <ETrec/ETgen>
0.0-0.4	1.0 cms120	1.0 cms120	1.28	0.144+-0.004	0.154+-0.003
	1.3+-0.1 optimum	1.1+-0.2 optimum	1.09+-0.05	0.138+-0.004	0.145+-0.003
0.4-0.8	1.0 cms120	1.0 cms120	1.29	0.142+-0.004	0.152+-0.003
	1.3+-0.1 optimum	1.1+-0.2 optimum	1.10+-0.05	0.135+-0.004	0.143+-0.003

Comparison with Irina's CMSIM results

- **Average reconstructed jet energy is considerably lower in ORCA: 78% vs 93% with the same weights (CMSIM120) and the same cone 0.5. Thus larger additional weights are obtained in ORCA.**
- **Jet energy resolution with ORCA is 20% worse than the resolution obtained by Irina.**
- **The optimum weight ratios for 90 GeV jets agree within statistic errors.**