

Delphes ma5Tune validation: Task V2

New helper class, aka...



Task V2

Validation of the energy/ p_T and eta resolutions

Object selection: reconstructed object closest (in ΔR) to MC particle

For jets, reco ones tagged with closest parton's flavour

For variable X, plot

$$dX = \frac{X^{\text{MC}} - X^{\text{reco}}}{X^{\text{MC}}}$$

Electrons - PT

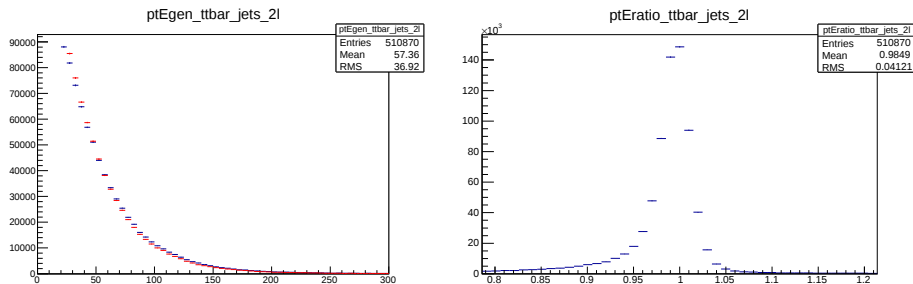


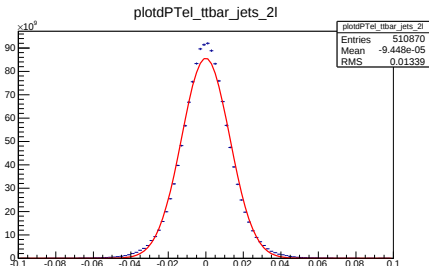
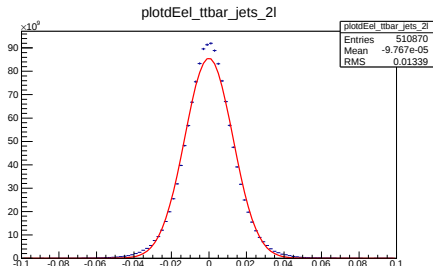
Figure: (Left) Generator level (blue) Reco level (red). (Right) Reco level over MC level

Electrons

Delphes resolution formula:

$$\text{if } |\eta_e| \leq 2.5 \text{ and } E_e > 20 \text{ GeV} \Rightarrow \sqrt{0.007^2 E^2 + 0.07^2 E + 0.35^2}$$

$$(\text{= } 0.56 \text{ for } E = 30 \text{ GeV}) \quad (\text{= } 1.05 \text{ for } E = 100 \text{ GeV})$$



Root gaussian fit:

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	8.56397e+10	1.60846e+08	4.08362e+04	-1.54435e-12
Mean	-6.73037e-05	1.79934e-05	7.14340e-07	8.86812e-01
Sigma	1.27726e-02	1.58656e-05	1.20040e-05	-1.48770e-01

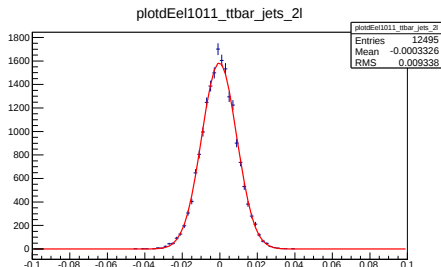
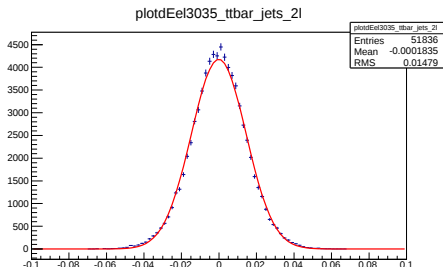
NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	8.56475e+10	1.60868e+08	4.08399e+04	2.51648e-15
Mean	-6.65301e-05	1.79915e-05	7.14919e-07	1.83386e-01
Sigma	1.27713e-02	1.58654e-05	1.20147e-05	4.29967e-03

Electrons

Delphes resolution formula:

$$\text{if } |\eta_e| \leq 2.5 \text{ and } E_e > 20 \text{ GeV} \Rightarrow \sqrt{0.007^2 E^2 + 0.07^2 E + 0.35^2}$$

(= 0.56 for $E = 30 \text{ GeV}$) (= 1.05 for $E = 100 \text{ GeV}$)



Root gaussian fit:

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	4.17881e+03	2.37235e+01	1.48574e-01	-1.74669e-05
Mean	-1.25011e-04	6.43395e-05	5.19110e-07	6.89271e-01
Sigma	1.45993e-02	5.23053e-05	7.42036e-06	-3.36380e-01

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	1.58630e+03	1.78464e+01	4.75889e-02	-5.32912e-06
Mean	-3.12276e-04	8.32874e-05	2.66748e-07	-4.71777e-02
Sigma	9.28900e-03	6.32501e-05	4.49530e-06	-2.22029e-02

Muons - PT

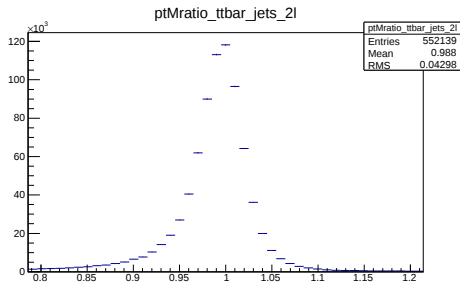
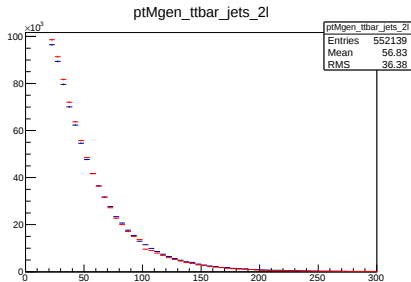
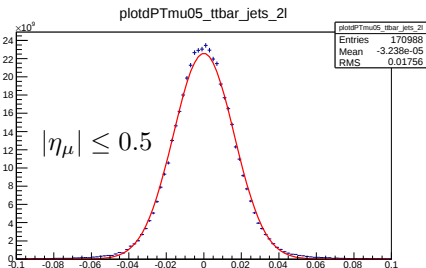
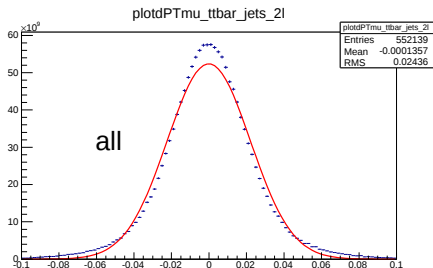


Figure: (Left) Generator level (blue) Reco level (red). (Right) Reco level over MC level

Muons

Delphes resolution formula:

$$\begin{aligned} \text{if } |\eta_\mu| \leq 0.5 \text{ and } p_\mu^T < 100 \text{ GeV} &\Rightarrow 0.015 \\ \text{if } 0.5 < |\eta_\mu| \leq 1.5 \text{ and } p_\mu^T < 100 \text{ GeV} &\Rightarrow 0.02 \\ \text{if } 1.5 < |\eta_\mu| \leq 2.5 \text{ and } p_\mu^T < 100 \text{ GeV} &\Rightarrow 0.035 \end{aligned}$$



Root gaussian fit:

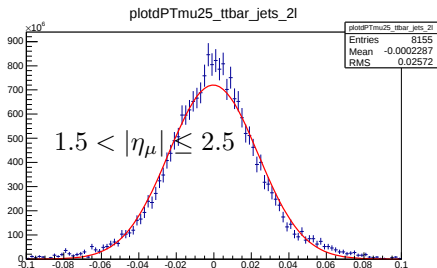
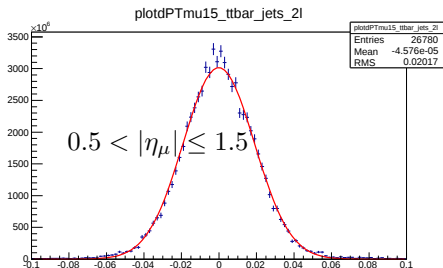
NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	5.23934e+10	9.93323e+07	2.49831e+04	1.40812e-13
Mean	-1.06913e-04	3.02989e-05	1.81381e-06	-1.23263e+01
Sigma	2.21576e-02	2.90998e-05	2.52340e-05	3.87465e-02

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	2.25855e+10	7.14455e+07	1.07696e+04	3.13482e-12
Mean	-3.16468e-05	3.94293e-05	9.13417e-07	8.37919e+00
Sigma	1.61773e-02	3.26205e-05	1.33349e-05	-1.28643e+00

Muons

Delphes resolution formula:

$$\begin{aligned} \text{if } |\eta_\mu| \leq 0.5 \text{ and } p_\mu^T < 100 \text{ GeV} &\Rightarrow 0.015 \\ \text{if } 0.5 < |\eta_\mu| \leq 1.5 \text{ and } p_\mu^T < 100 \text{ GeV} &\Rightarrow 0.02 \\ \text{if } 1.5 < |\eta_\mu| \leq 2.5 \text{ and } p_\mu^T < 100 \text{ GeV} &\Rightarrow 0.035 \end{aligned}$$



Root gaussian fit:

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	3.01627e+09	2.38204e+07	1.43827e+03	7.11279e-13
Mean	-1.09116e-04	1.16893e-04	1.03540e-06	-3.10916e-02
Sigma	1.89900e-02	9.39466e-05	1.38767e-05	1.12580e-02

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	7.19973e+08	1.10466e+07	3.43310e+02	-1.18469e-13
Mean	-2.99491e-04	2.68320e-04	1.95233e-06	-4.52131e-02
Sigma	2.38137e-02	2.48667e-04	2.59085e-05	3.11949e-03

B-jets

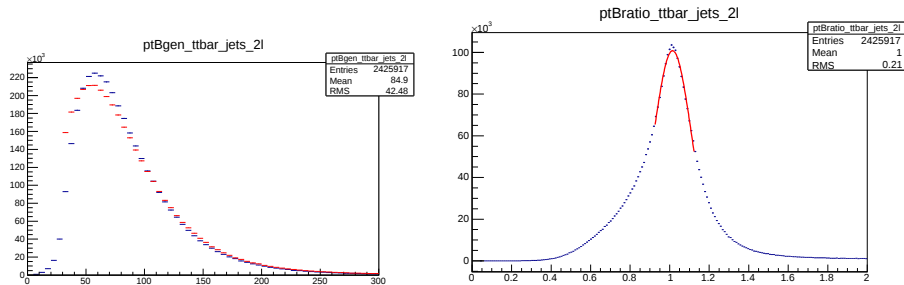
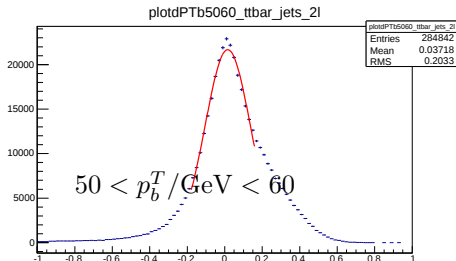
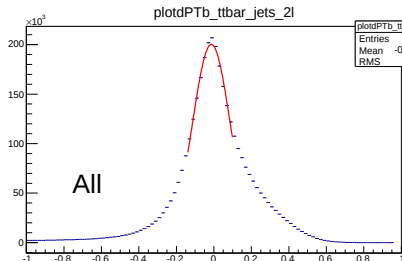


Figure: (Left) Generator level (blue) Reco level (red). (Right) Reco level over MC level

B-jets

Delphes resolution formula jets, from HCAL:

$$\text{if } |\eta_j| \leq 3.0 \Rightarrow \sqrt{0.05^2 E_j^2 + 1.5^2 E_j} \quad (= 12 \text{ for } E = 60 \text{ GeV})$$



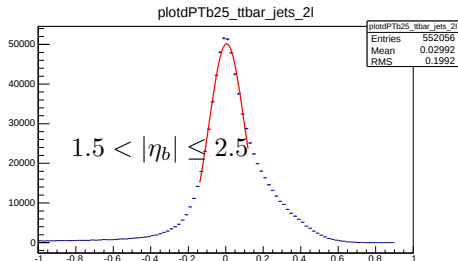
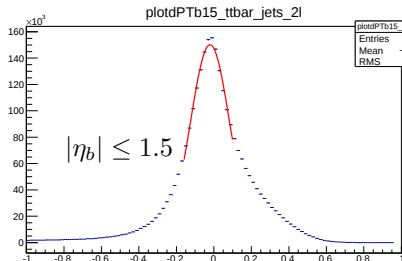
Root gaussian fit:

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	2.00293e+05	2.50984e+02	2.44871e+00	2.72057e-07
Mean	-1.35751e-02	1.41519e-04	1.94390e-06	2.05765e-01
Sigma	9.99265e-02	2.28337e-04	4.92832e-06	2.10230e-01

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	2.16710e+04	7.01791e+01	-2.20300e-03	1.50760e-07
Mean	1.59457e-02	4.35919e-04	1.04175e-06	1.80287e-01
Sigma	1.20781e-01	5.62751e-04	1.28734e-06	1.62243e-03

Delphes resolution formula jets, from HCAL:

$$\text{if } |\eta_j| \leq 3.0 \Rightarrow \sqrt{0.05^2 E_j^2 + 1.5^2 E_j} \quad (= 12 \text{ for } E = 60 \text{ GeV})$$



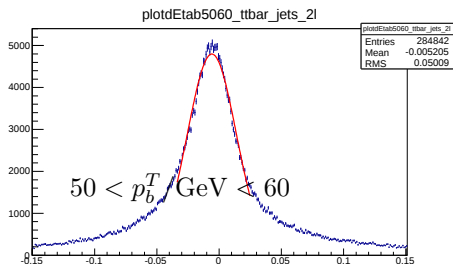
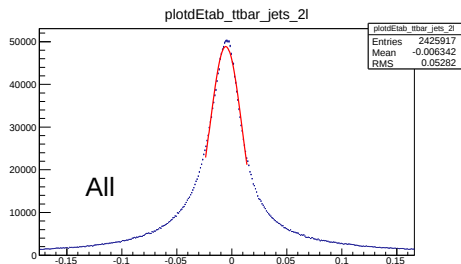
Root gaussian fit:

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	1.50189e+05	2.09355e+02	2.07852e+00	4.08533e-07
Mean	-2.06089e-02	1.62825e-04	2.24372e-06	2.36301e-01
Sigma	1.04741e-01	2.52227e-04	5.38039e-06	2.32719e-01

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	5.01433e+04	1.22097e+02	8.62212e-01	-3.25457e-06
Mean	5.00385e-03	2.44966e-04	2.25522e-06	-5.25911e+00
Sigma	9.29440e-02	3.25341e-04	5.06570e-06	-6.24069e-01

B-jets - ETA

No track smearing, spread due to hadronisation



Root gaussian fit:

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	4.88524e+04	7.00450e+01	7.00614e-01	-2.62436e-06
Mean	-5.45099e-03	2.29126e-05	3.24018e-07	6.72175e+00
Sigma	1.48952e-02	3.49591e-05	1.97748e-06	-1.50890e+00

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	4.79789e+03	1.81199e+01	1.11170e-01	2.7
Mean	-5.82980e-03	7.71404e-05	6.08176e-07	1.11553e+00
Sigma	1.95674e-02	9.35790e-05	2.82592e-06	3.2

C-jets - PT

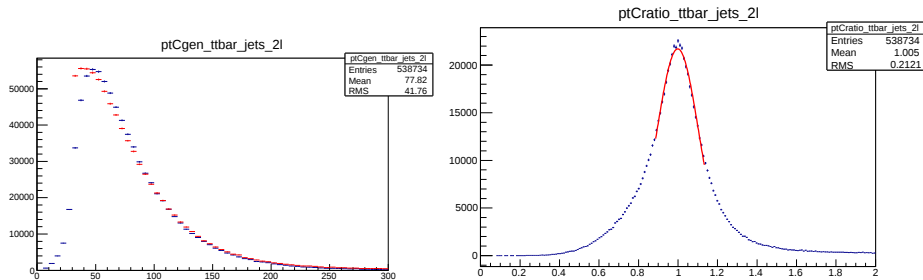
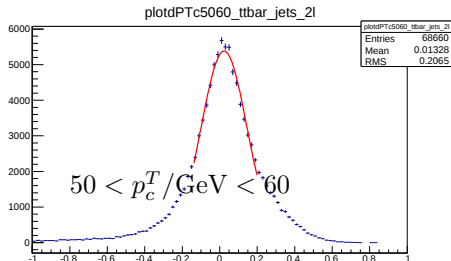
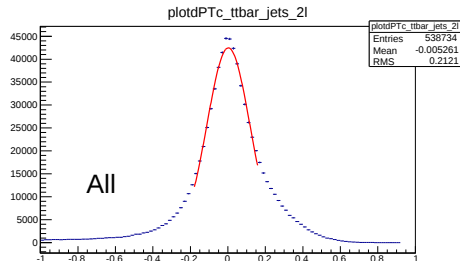


Figure: (Left) Generator level (blue) Reco level (red). (Right) Reco level over MC level

Delphes resolution formula jets, from HCAL:

$$\text{if } |\eta_j| \leq 3.0 \Rightarrow \sqrt{0.05^2 E_j^2 + 1.5^2 E_j} \quad (= 12 \text{ for } E = 60 \text{ GeV})$$



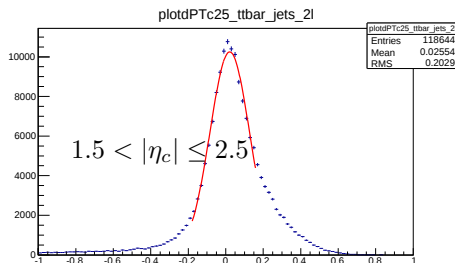
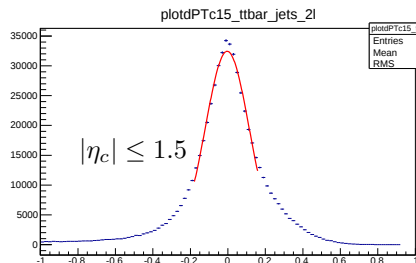
Root gaussian fit:

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	4.24613e+04	1.00040e+02	8.57662e-01	4.19191e-07
Mean	2.67411e-03	2.66637e-04	3.13370e-06	1.35071e-02
Sigma	1.14483e-01	3.50794e-04	6.20979e-06	3.53910e-03

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	5.38127e+03	3.52610e+01	1.11319e-01	8.85812e-06
Mean	2.29439e-02	8.02095e-04	3.55792e-06	3.77239e-01
Sigma	1.21557e-01	1.12699e-03	7.23398e-06	5.10420e-01

Delphes resolution formula jets, from HCAL:

$$\text{if } |\eta_j| \leq 3.0 \Rightarrow \sqrt{0.05^2 E_j^2 + 1.5^2 E_j} \quad (= 12 \text{ for } E = 60 \text{ GeV})$$



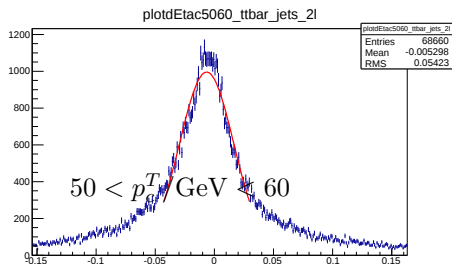
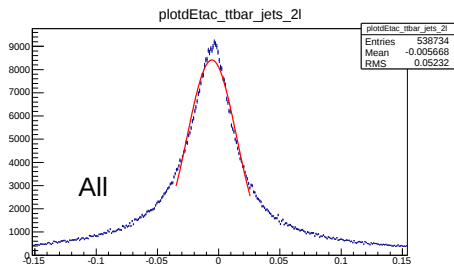
Root gaussian fit:

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	3.24410e+04	8.73130e+01	6.31300e-01	-1.36843e-08
Mean	-3.65010e-03	3.07984e-04	3.11668e-06	4.69644e-01
Sigma	1.16604e-01	4.17706e-04	6.25429e-06	6.76252e-01

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	1.02499e+04	4.92662e+01	2.37607e-01	7.90103e-07
Mean	2.11713e-02	5.35183e-04	3.12978e-06	1.01270e-02
Sigma	1.05330e-01	6.01160e-04	5.80376e-06	-6.08948e-03

C-jets - ETA

No track smearing, spread due to hadronisation



Root gaussian fit:

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	8.41280e+03	2.37731e+01	2.49229e-01	-1.13737e-06
Mean	-5.56240e-03	5.46862e-05	8.03552e-07	8.55857e-01
Sigma	2.02225e-02	7.27968e-05	3.70185e-06	-1.39928e-01

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	9.95376e+02	7.57807e+00	4.45014e-02	1.95155e-07
Mean	-6.58609e-03	1.62004e-04	1.34256e-06	-2.53444e-03
Sigma	2.30985e-02	2.09952e-04	5.62419e-06	1.15041e-02

Light jets - PT

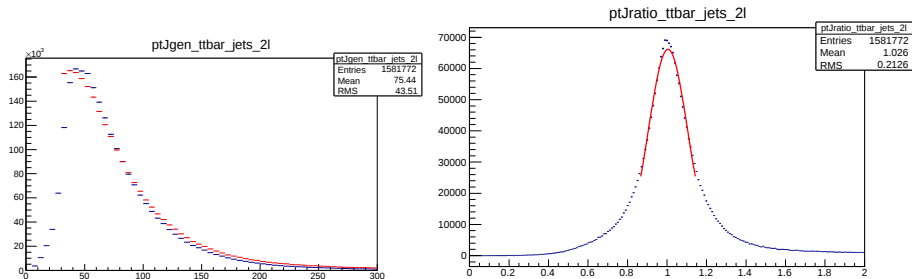
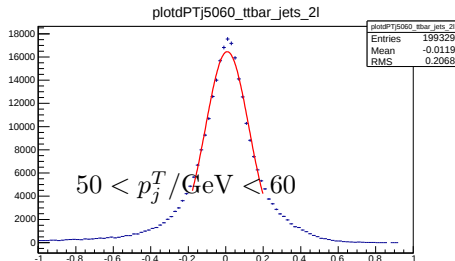
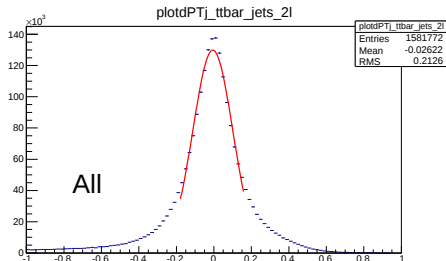


Figure: (Left) Generator level (blue) Reco level (red). (Right) Reco level over MC level

Light jets

Delphes resolution formula jets, from HCAL:

$$\text{if } |\eta_j| \leq 3.0 \Rightarrow \sqrt{0.05^2 E_j^2 + 1.5^2 E_j} \quad (= 12 \text{ for } E = 60 \text{ GeV})$$



Root gaussian fit:

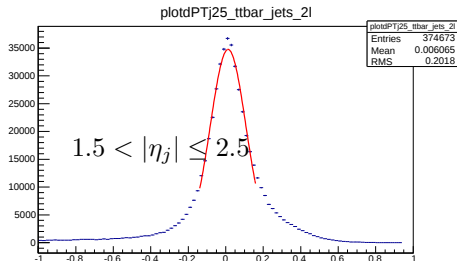
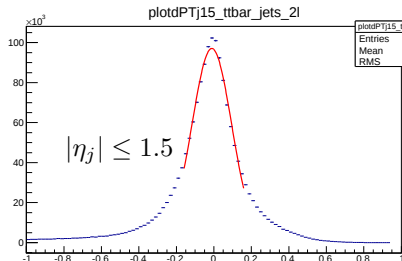
NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	1.29888e+05	1.78187e+02	3.34890e+00	-7.93254e-08
Mean	-5.75057e-03	1.34344e-04	3.52717e-06	-2.54612e-01
Sigma	1.06135e-01	1.69000e-04	6.90051e-06	-9.25736e-02

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	1.64580e+04	6.02265e+01	4.11757e-01	2.14615e-06
Mean	7.89763e-03	3.83919e-04	3.64704e-06	-3.84020e-01
Sigma	1.15238e-01	4.69119e-04	6.69985e-06	8.39693e-01

Light jets

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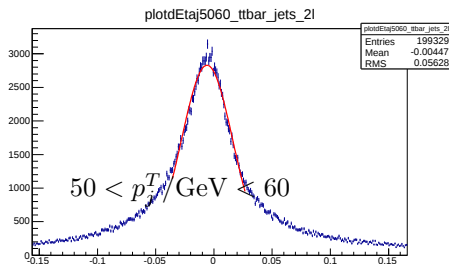
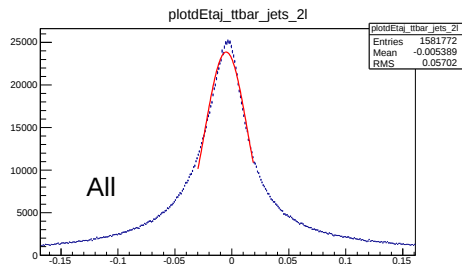
Root gaussian fit:

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	9.70813e+04	1.56600e+02	2.15729e+00	-3.41072e-06
Mean	-1.09741e-02	1.67169e-04	3.16792e-06	-4.82543e+00
Sigma	1.06216e-01	2.18335e-04	6.44751e-06	1.28530e+00

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	3.47622e+04	9.76806e+01	8.09283e-01	-7.17618e-07
Mean	1.25251e-02	2.48587e-04	2.86873e-06	5.28522e-01
Sigma	9.48321e-02	3.14347e-04	5.96003e-06	-2.42166e-01

Light jets - ETA

No track smearing, spread due to hadronisation



Root gaussian fit:

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	2.38657e+04	4.34084e+01	5.00135e-01	6.35922e-07
Mean	-4.99420e-03	3.62372e-05	5.94857e-07	2.54747e+00
Sigma	1.89277e-02	5.51858e-05	3.20213e-06	7.12139e-01

NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
Constant	2.83029e+03	1.33681e+01	7.09423e-02	-2.65495e-06
Mean	-5.89559e-03	1.04068e-04	7.71164e-07	4.44986e-01
Sigma	2.20705e-02	1.43680e-04	3.53297e-06	-8.73467e-02