Background estimation revisited

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HBD meeting

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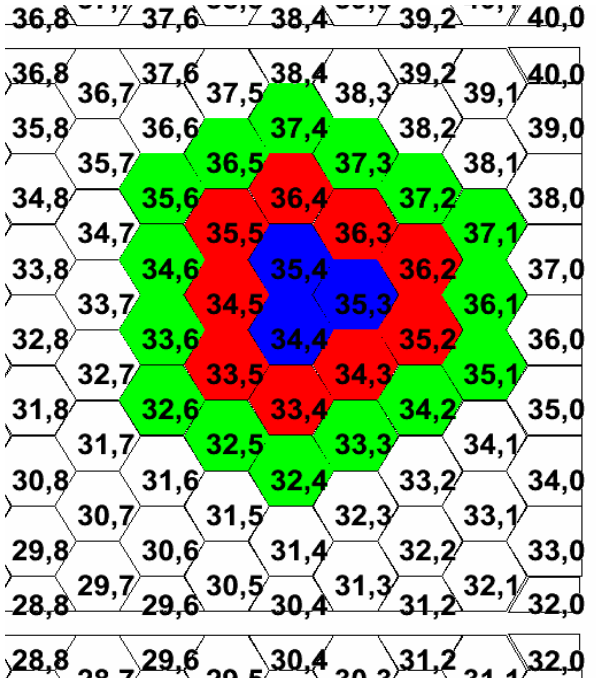
Background estimation

- Background = 0.5 * at * (Bkg1 + Bkg2), where
- Mean based:

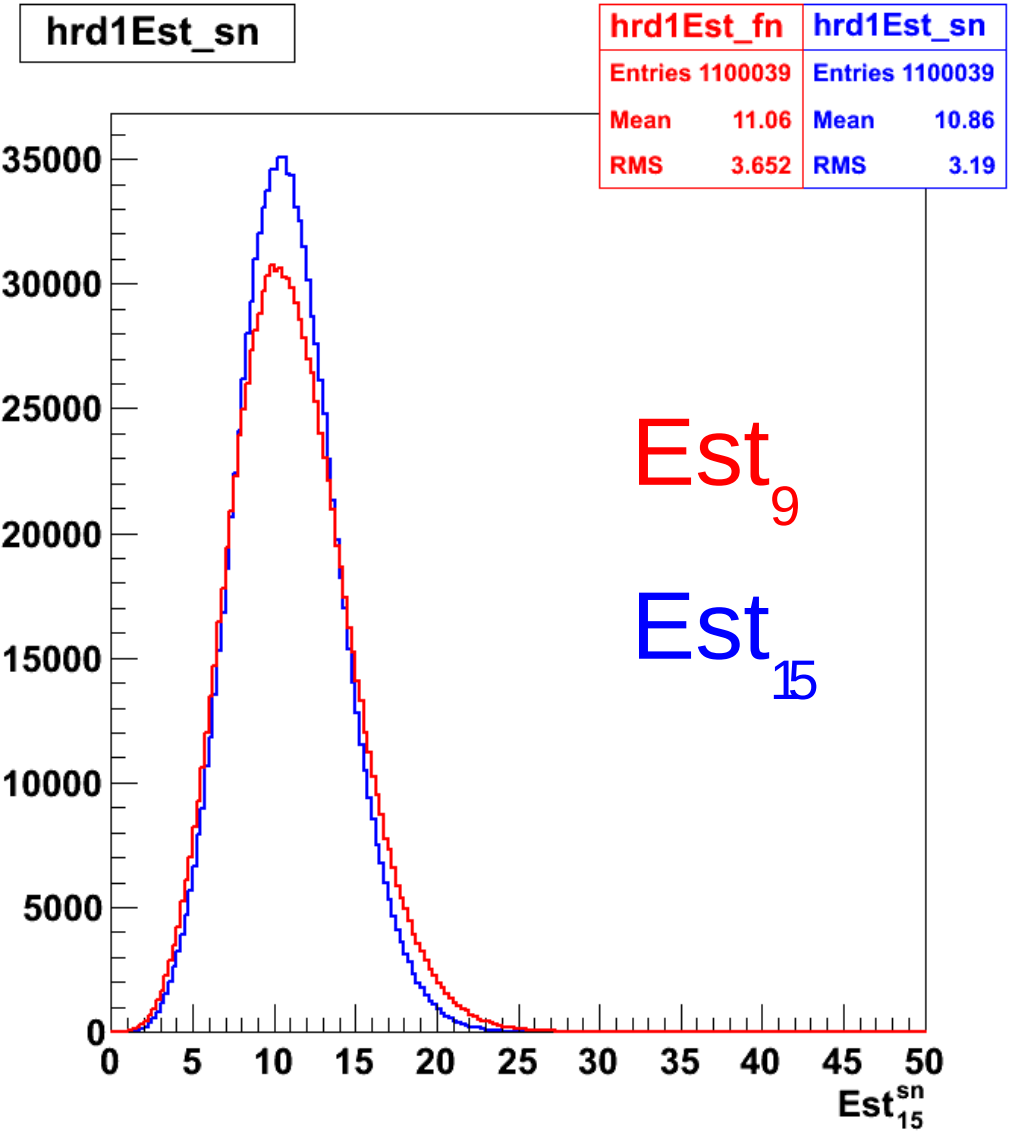
  (1) Bkg1 = (Σqfn) /(Σafn) and Bkg2 = (Σqsn) /(Σasn)
- Median based:

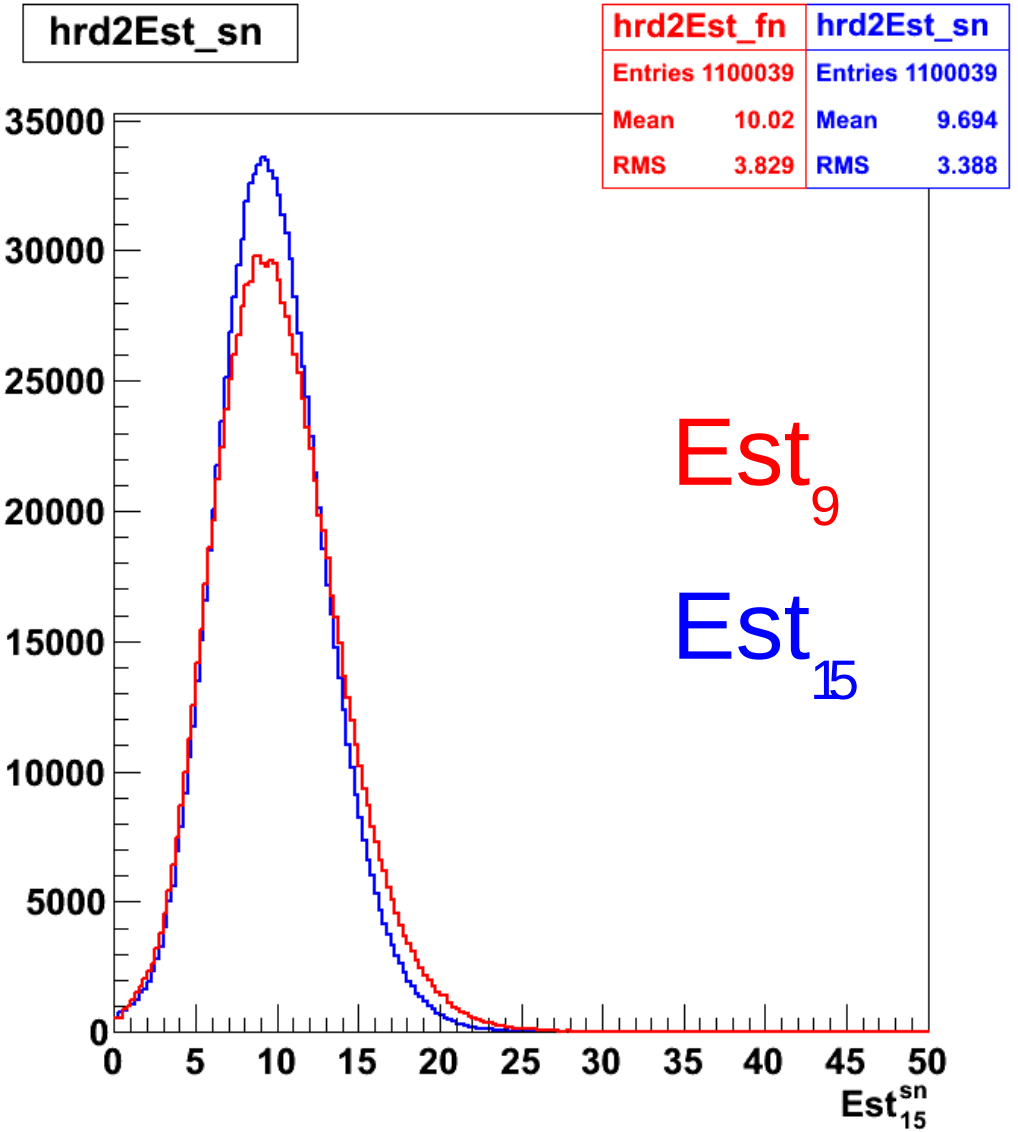
  (2) Bkg1 = Med(qfn/afn) and Bkg2 = Med(qsn/asn)
- Figure of merit in comparison : width of Bkg2-Bkg1 distribution.
- Notation:
  - M_t → Measured total charge in triplet area
  - Est_9 → Estimated background from first neighbors area (9 pads)
  - Est_{15} → Estimated background from second neighbors area (15 pads)



All of the following slides will be on the 10% most central events.

Real data triplets

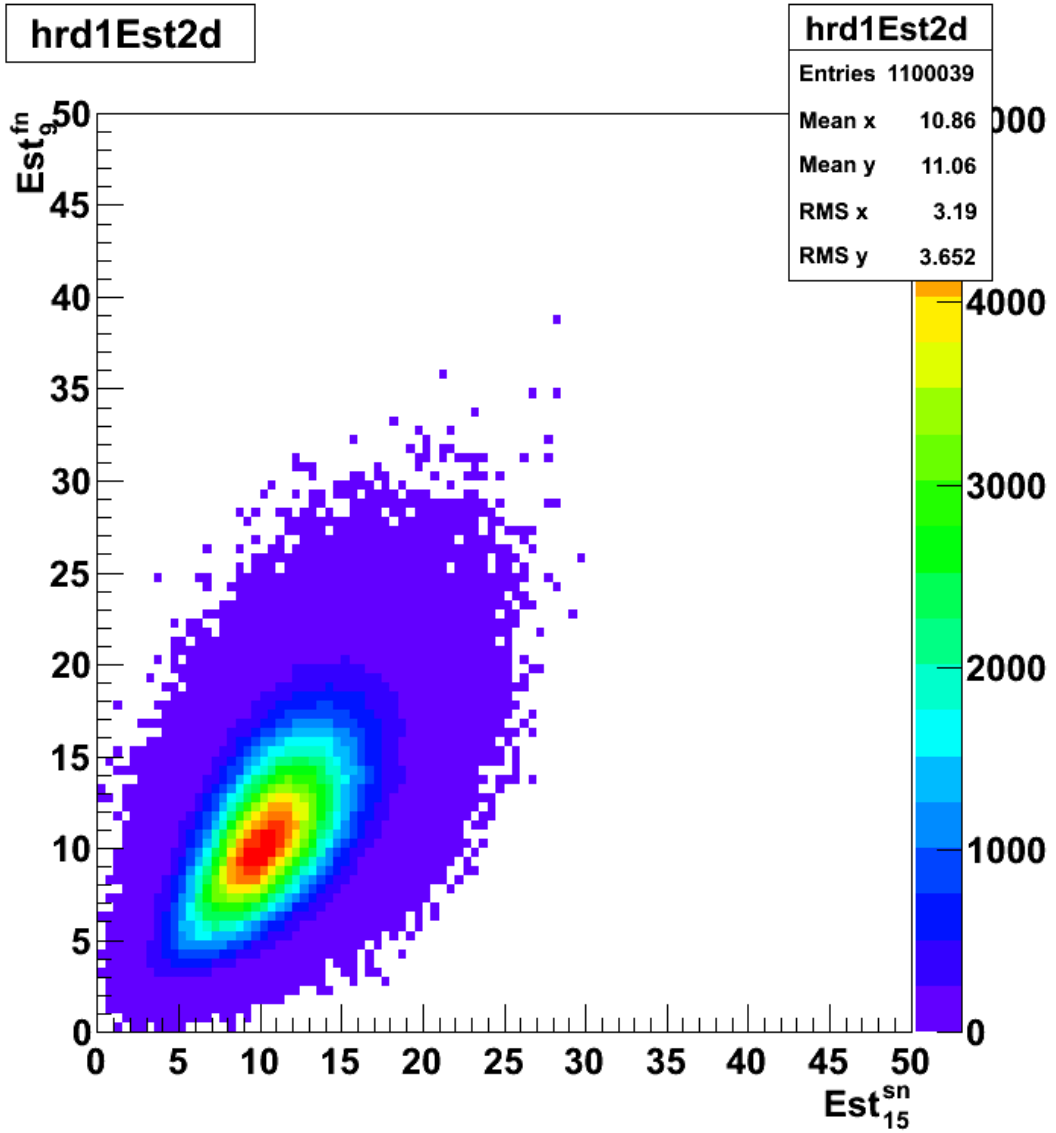


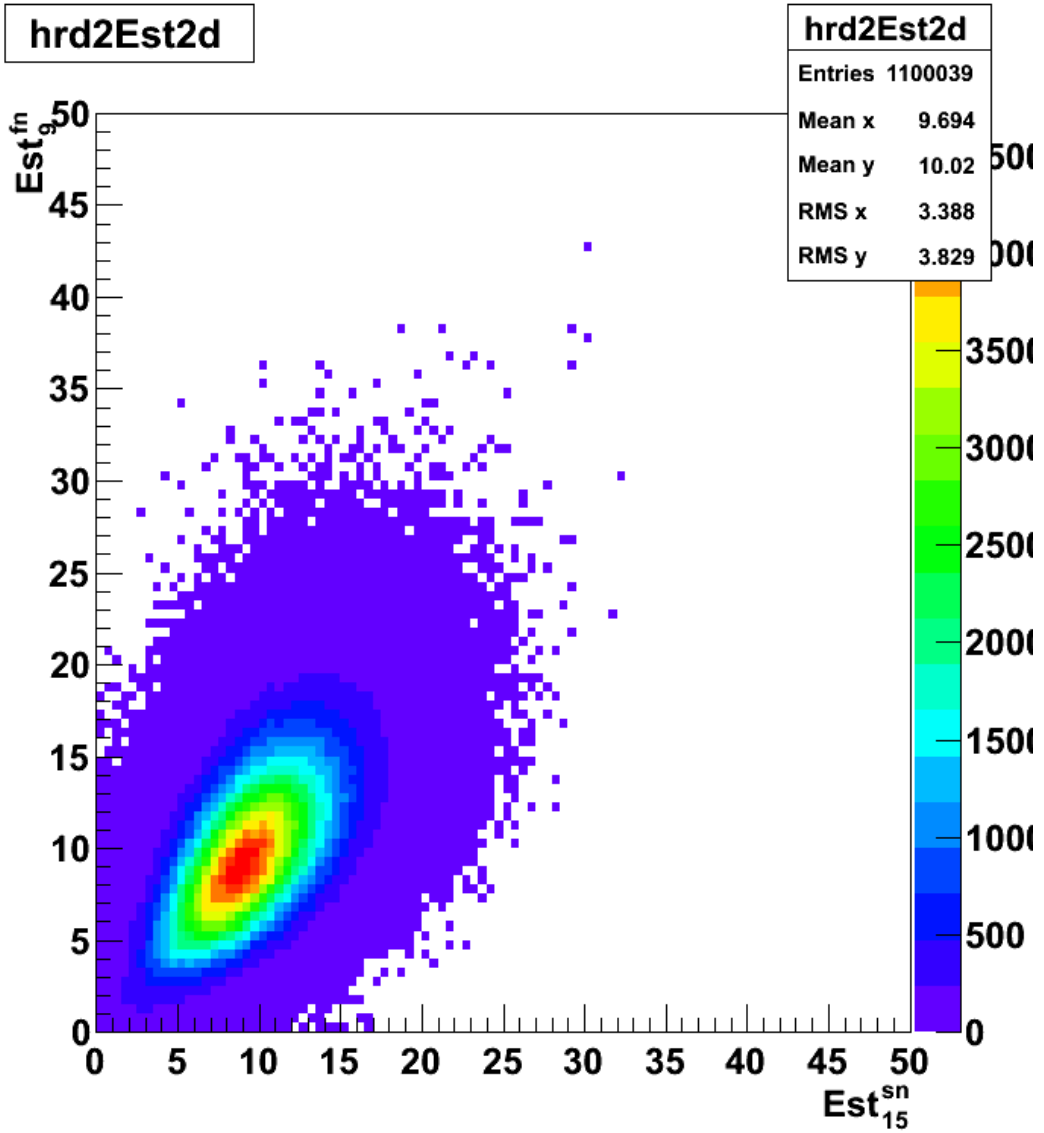


Mean based estimators

Median based estimators

Est_9 vs. Est_{15}

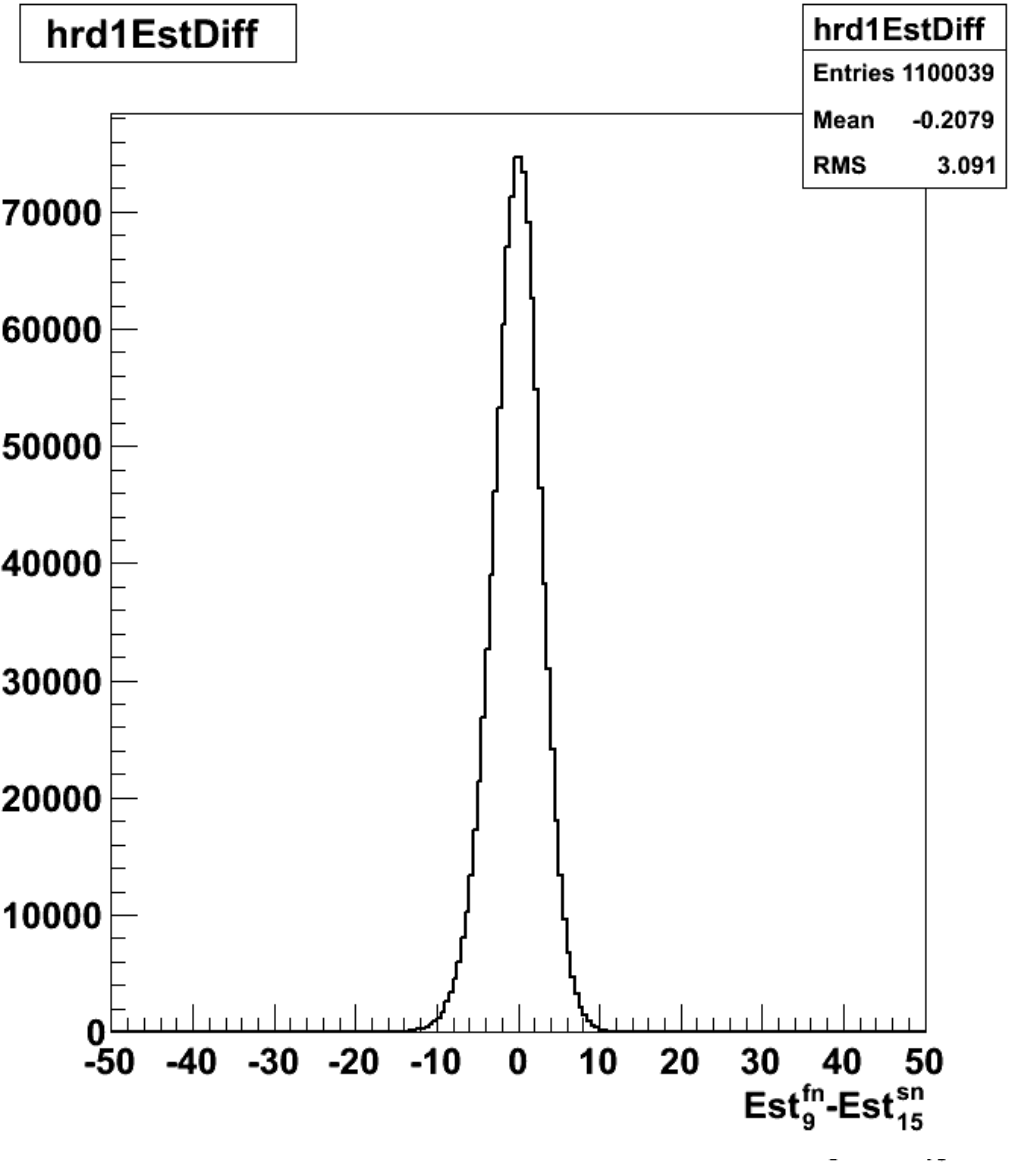


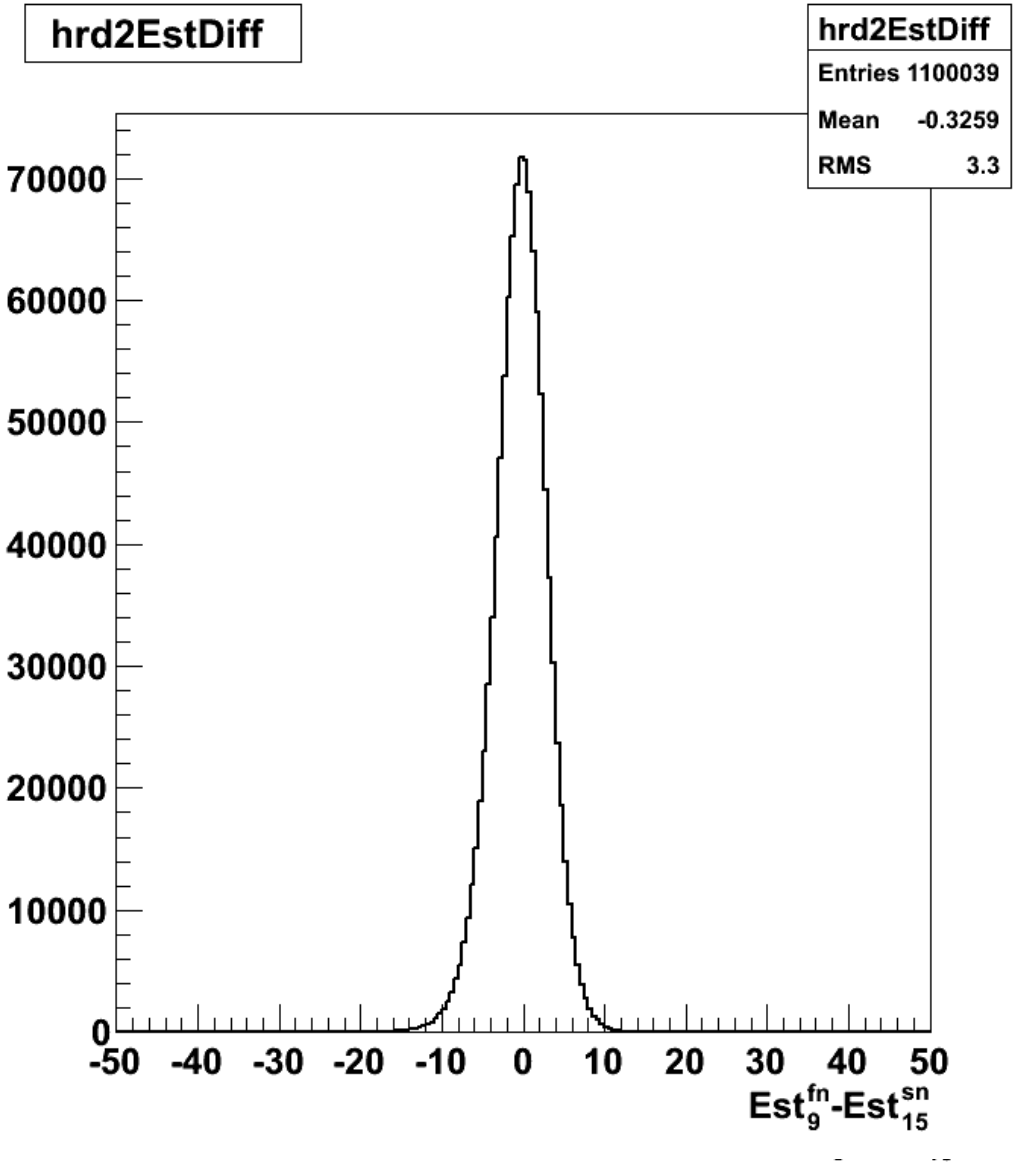


Mean based estimators

Median based estimators

Difference of estimators (Est_9–Est_{15})

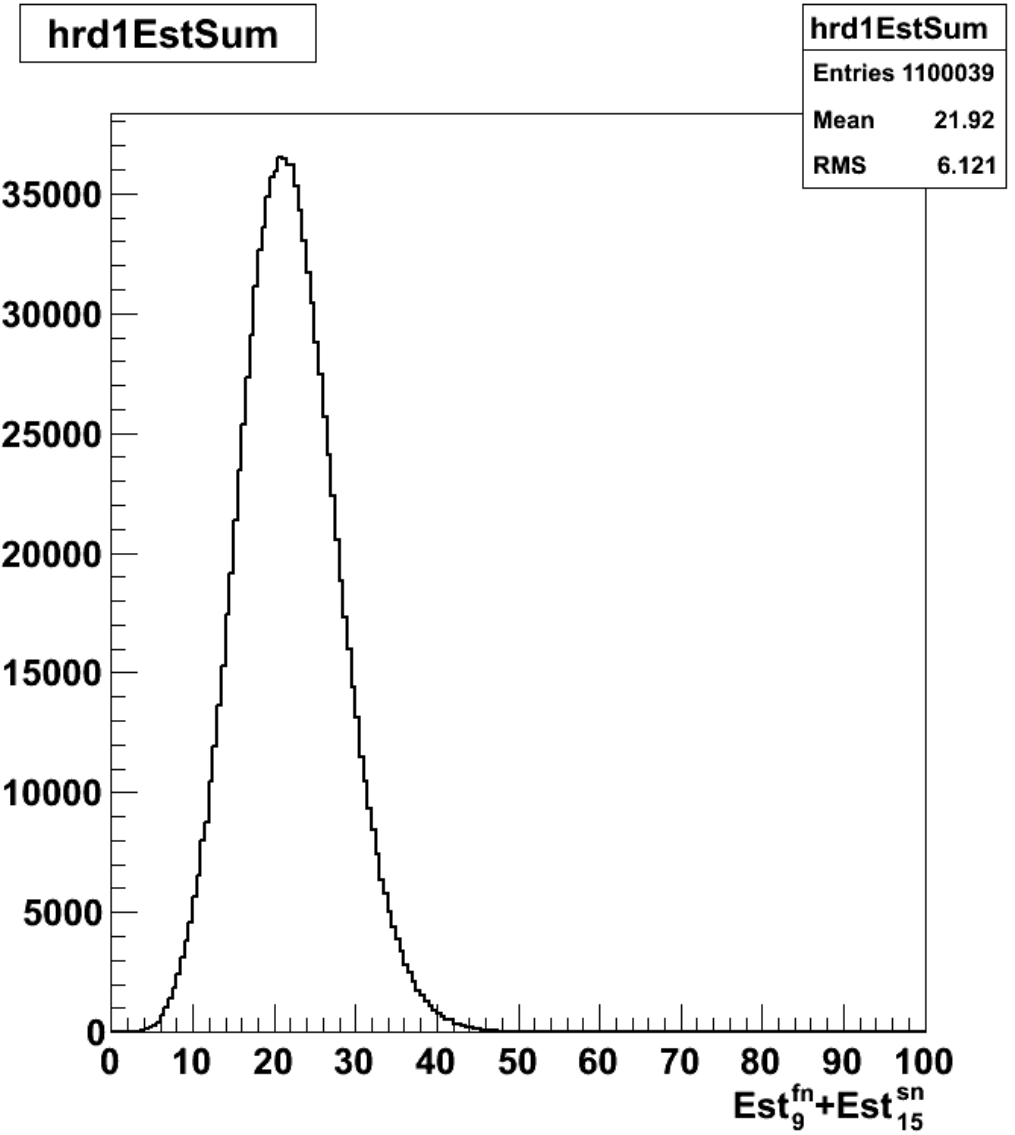




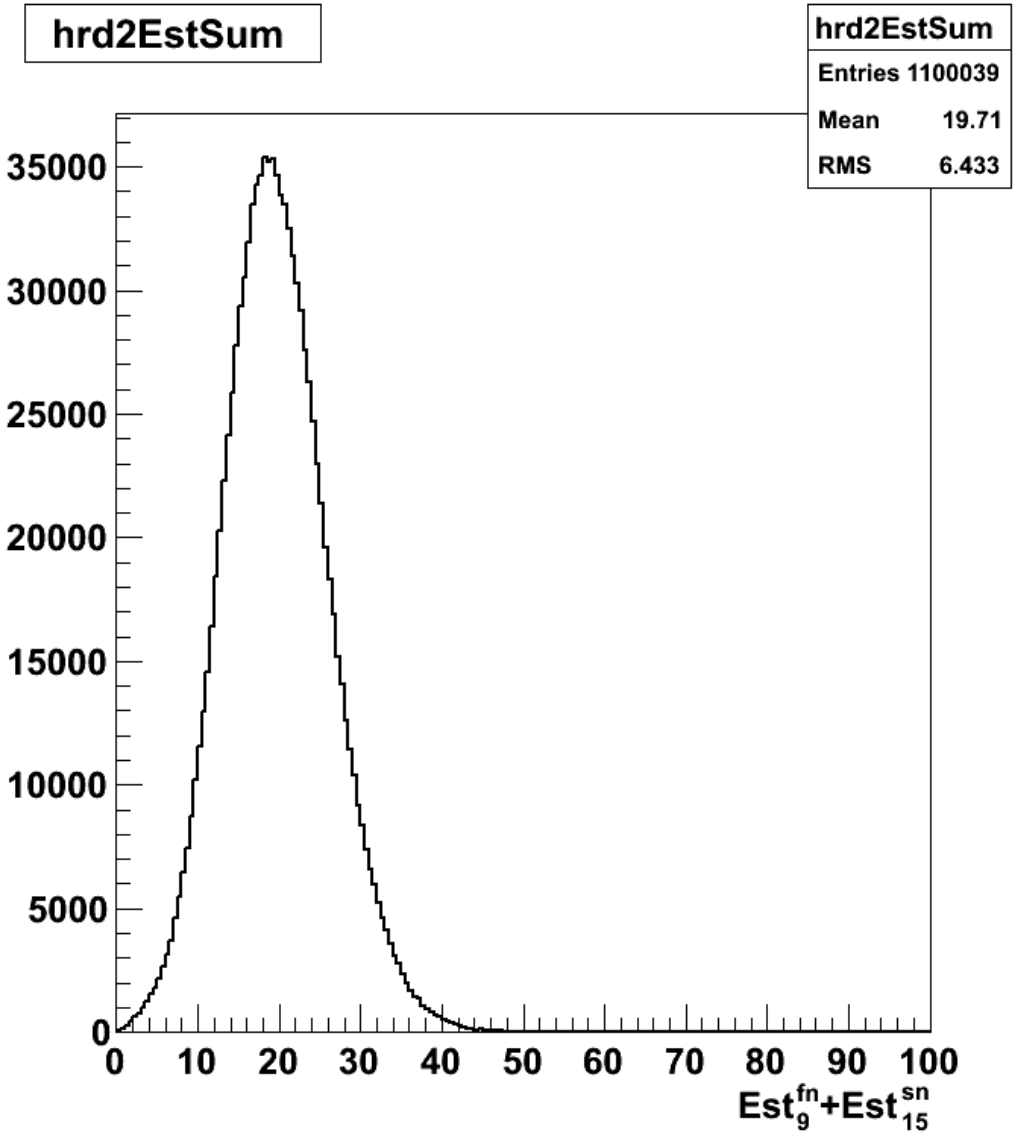
Mean based estimators

Median based estimators

Sum of estimators (Est_9+Est_{15})

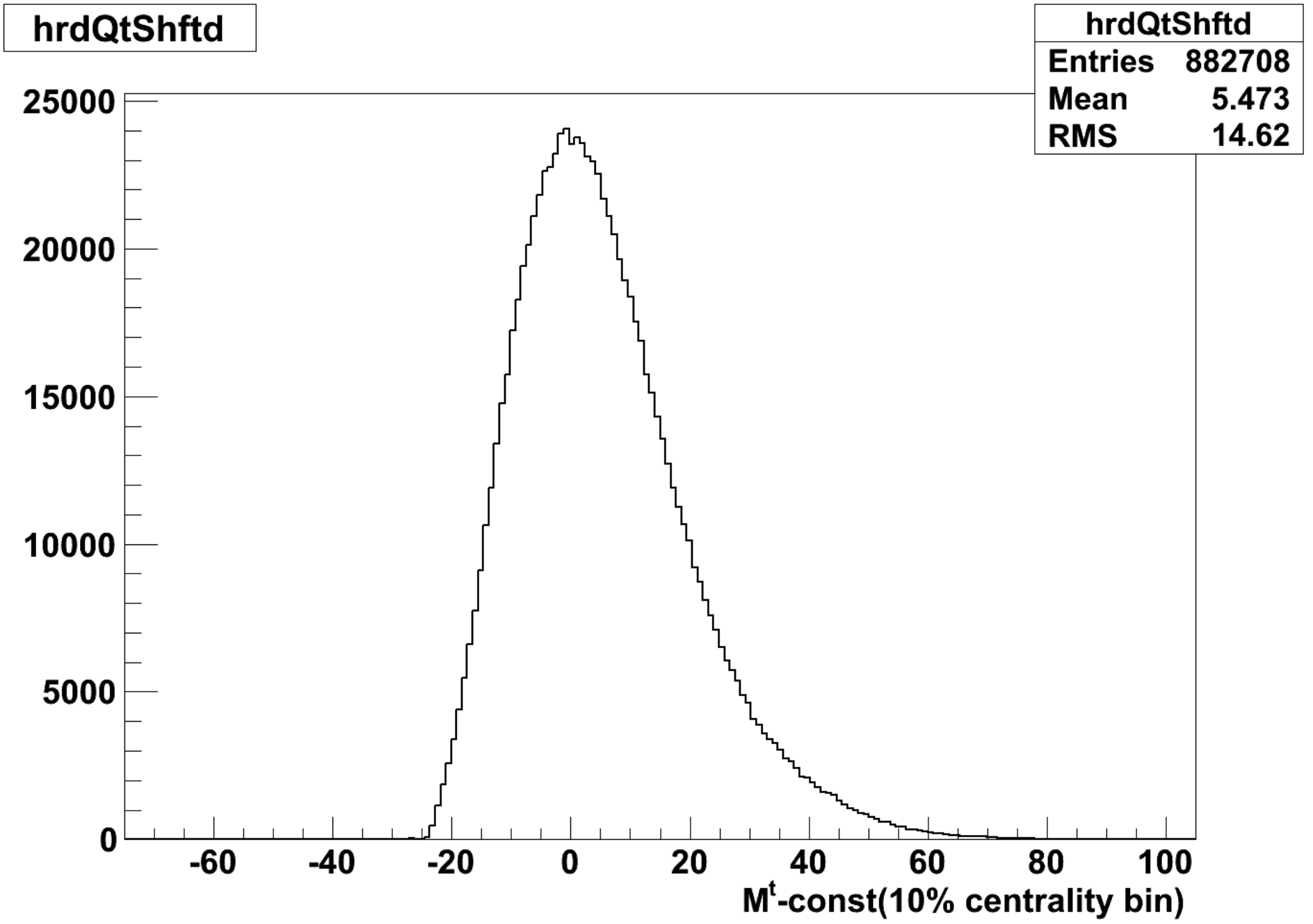


Mean based estimators

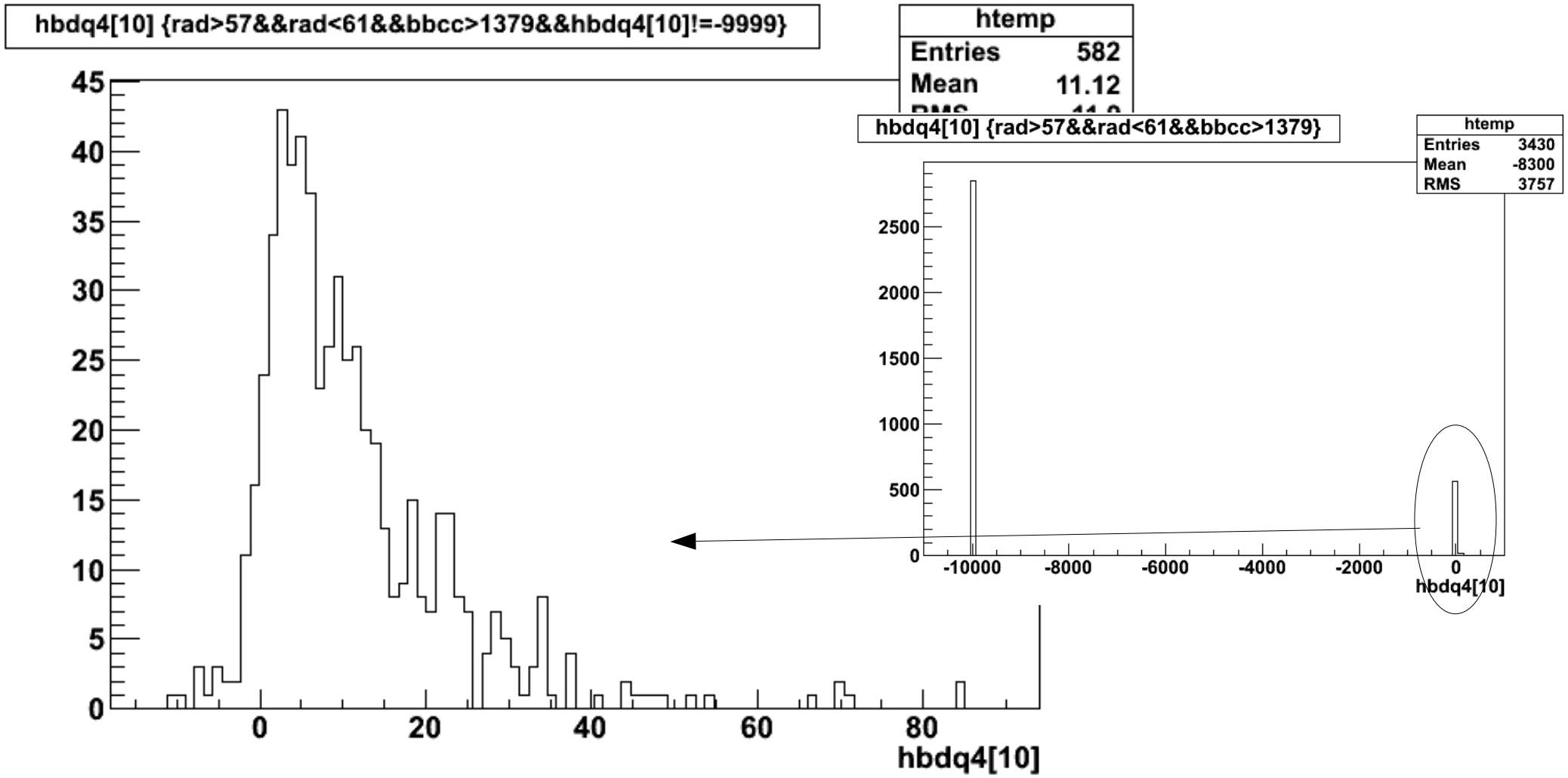


Median based estimators

Measured charge in a triplet (M_t)

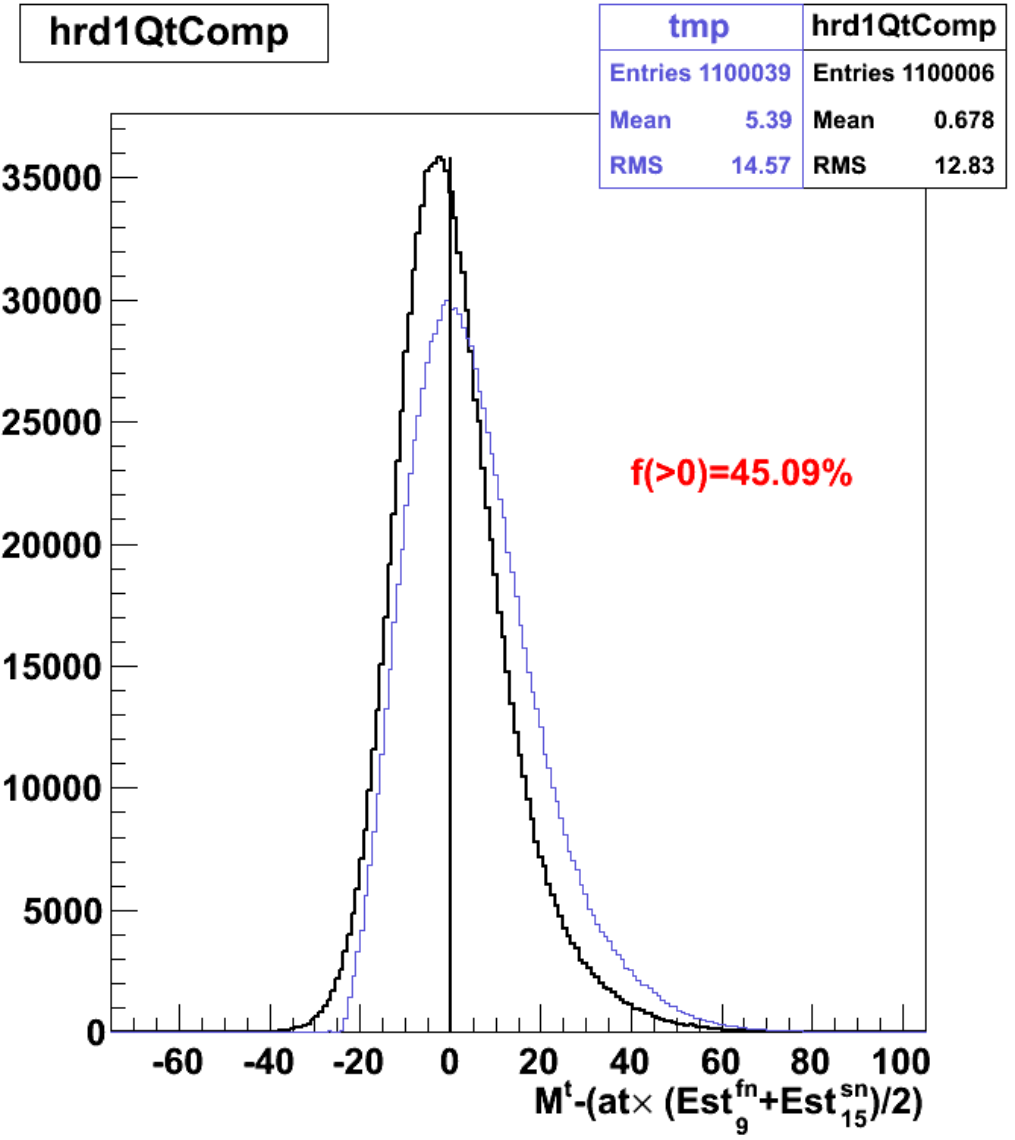


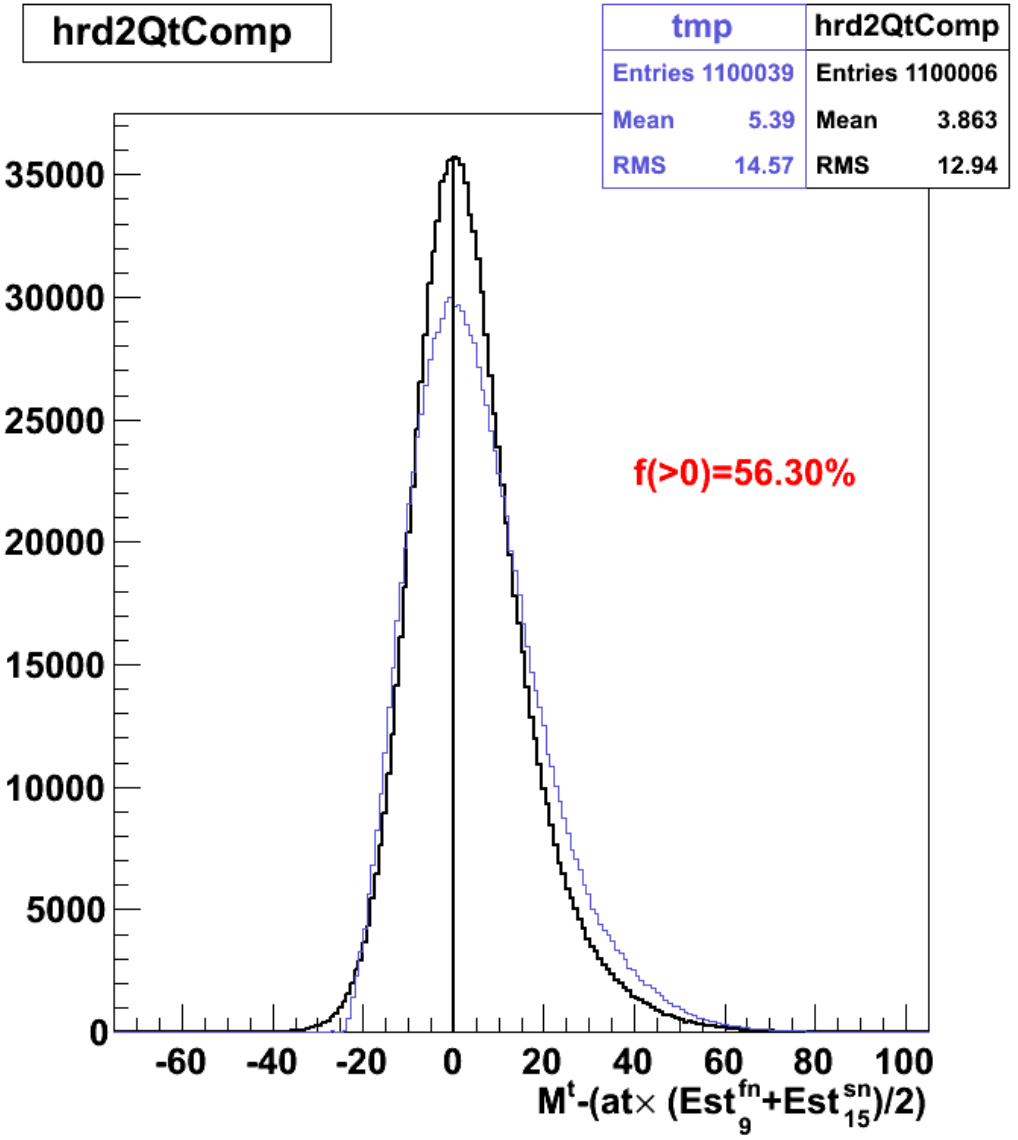
Random cluster charge after merging



- Most of the rejection comes from the screening of preclusters
- Once merging done, the charge distribution for background electron follows a very similar trend to $M_t - at * E_{9\times15}$

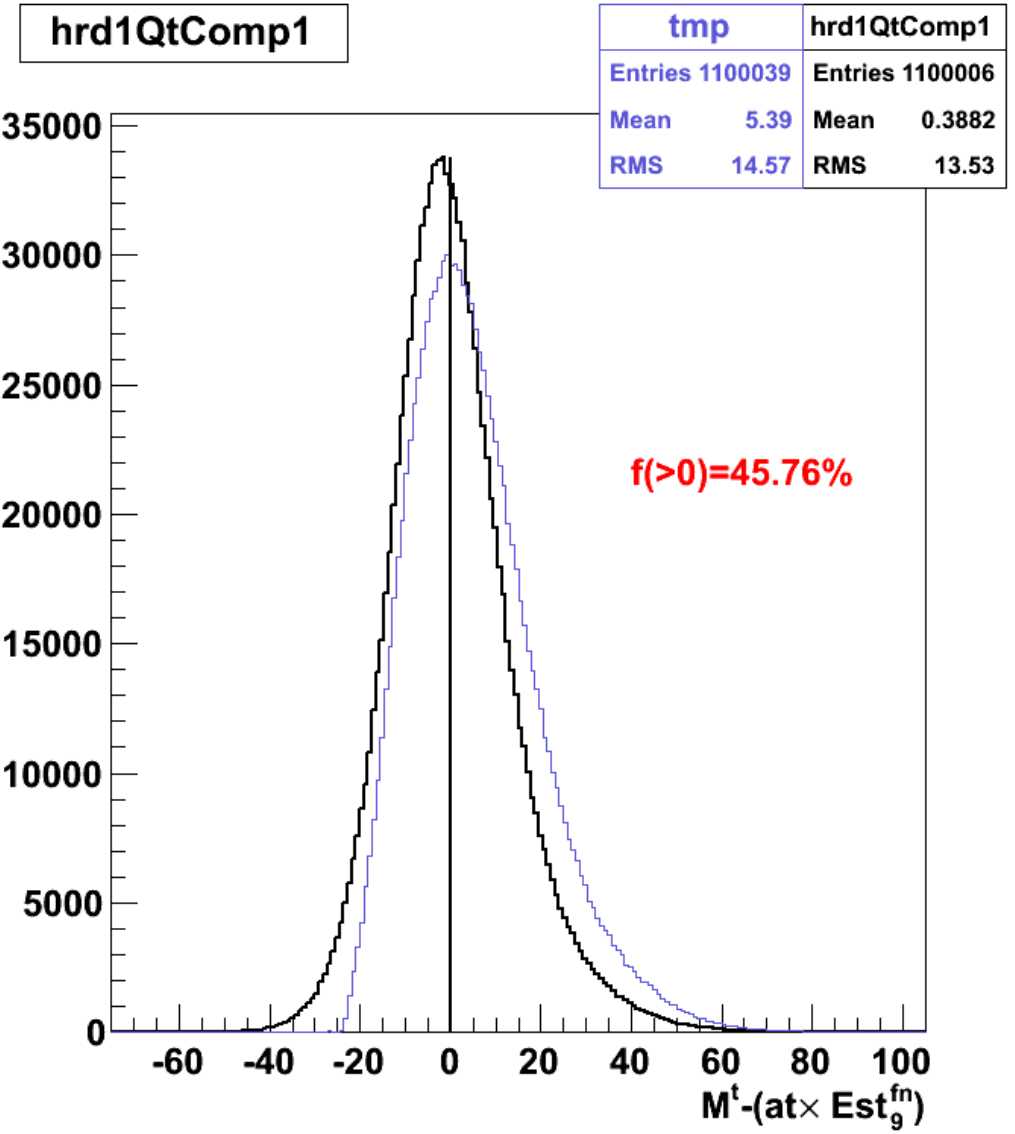
$M_t - Est_{9+15}$

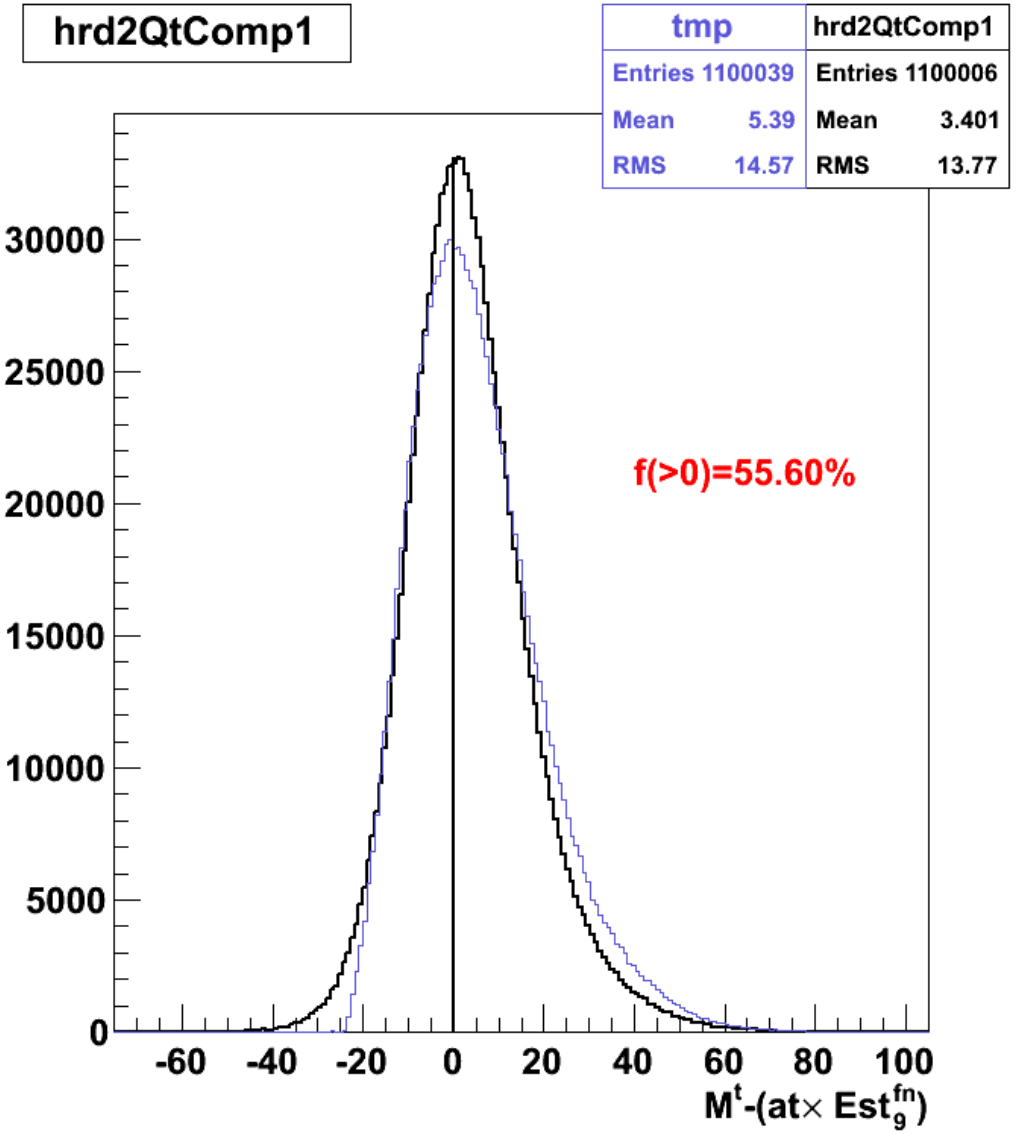




Mean based estimators **Median based estimators**

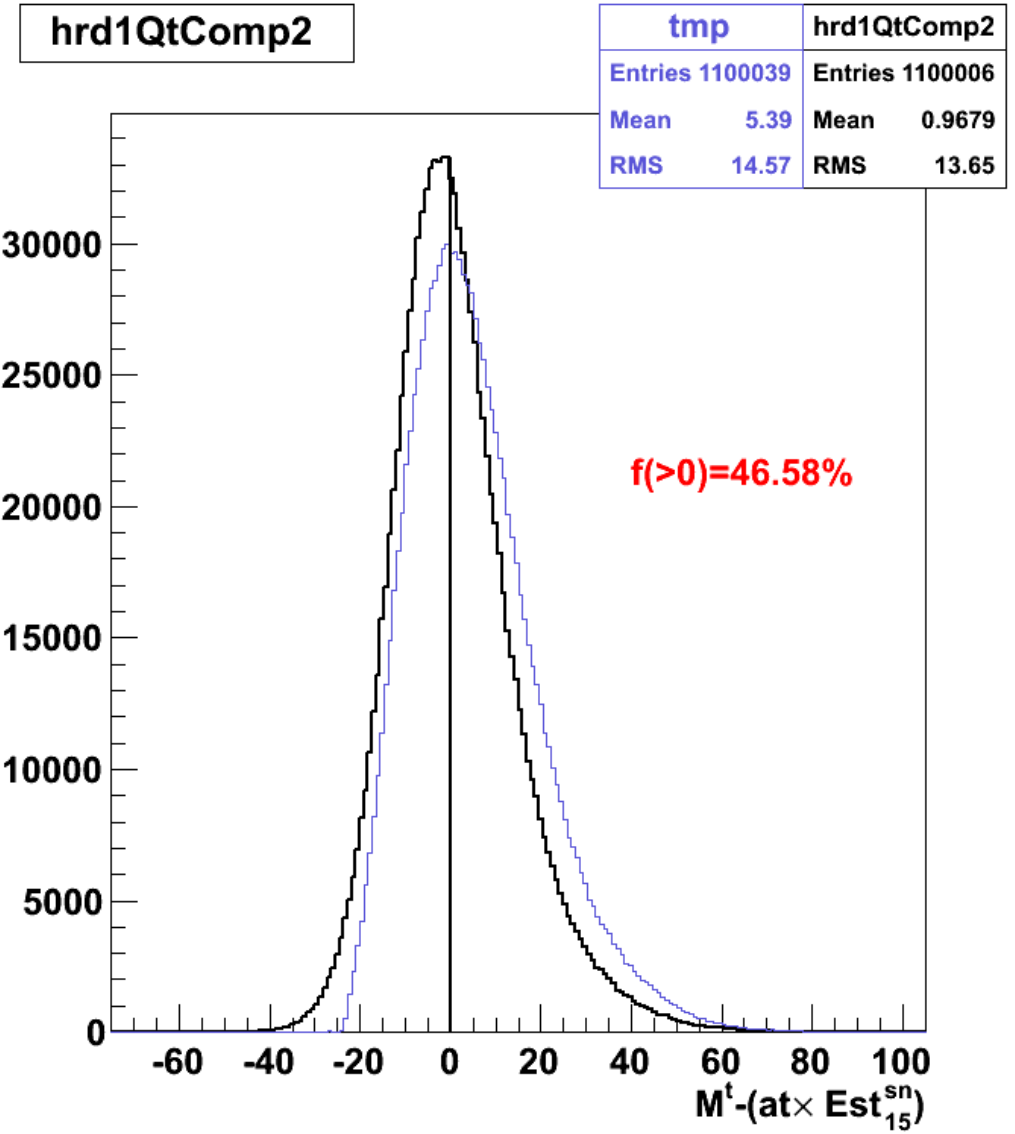
$M_t - Est_9$

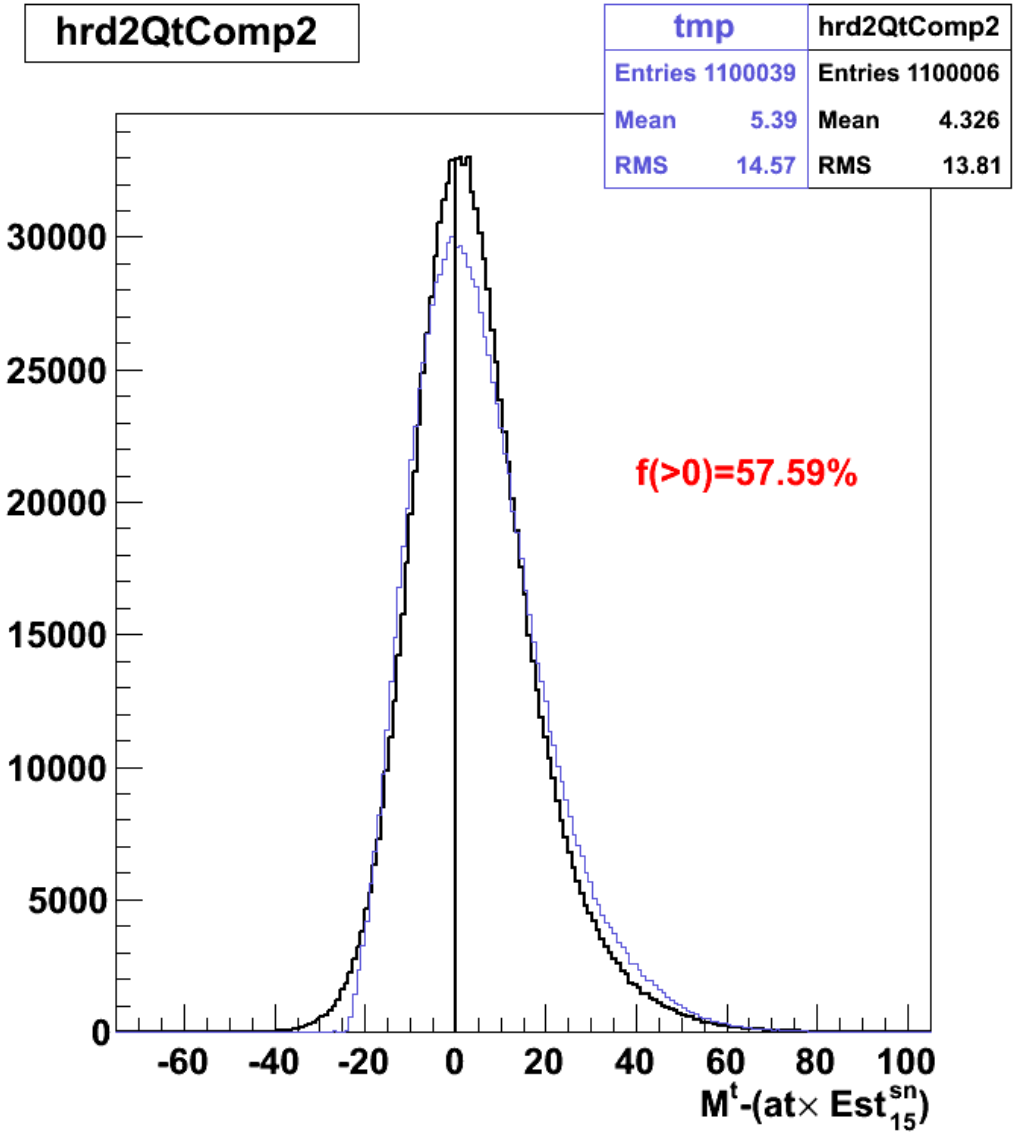




Mean based estimators **Median based estimators**

$M_t - Est_{15}$





Mean based estimators **Median based estimators**

Trying to understand the numbers

- Observed width (RMS) is due to two components
  - Purely statistical fluctuation (proportional to $1/\sqrt{n}$) : σ_n
  - Unknown correlated part : σ_s

$\sigma_{fn}^2=\sigma_9^2+\sigma_s^2$ where $\sigma_9^2=1.7\sigma_{15}^2$ $\Rightarrow \sigma_{15}^2=(\sigma_{fn}^2-\sigma_{sn}^2)/0.7$ && $\sigma_s^2=1.7\sigma_{sn}^2-\sigma_{fn}^2$

$\sigma_{sn}^2=\sigma_{15}^2+\sigma_s^2$ && $\sigma_3^2=\sigma_t^2-\sigma_s^2$

$\sigma_t^2=\sigma_3^2+\sigma_s^2$ and $\sigma_3^2=3\sigma_9^2$

If the unknown correlated part was approximately the same between fn, sn and t, then, $\sigma_3^2=3\sigma_9^2$ should be approximately equal to $\sigma_3^2=\sigma_t^2-\sigma_s^2$

σ_{fn}	σ_{sn}	σ_t	$\sigma_{t-(Est9+15)/2}$	σ_9	σ_{15}	σ_s	$\sigma_3=\sqrt{(3\times\sigma_9)}$	$\sigma_3=\sqrt{(\sigma_t^2-\sigma_s)}$
3.68	3.2	14.62	12.85	2.82	2.17	2.36	8.47	14.43
3.84	3.31	14.62	12.96	3.02	2.33	2.37	9.07	14.43

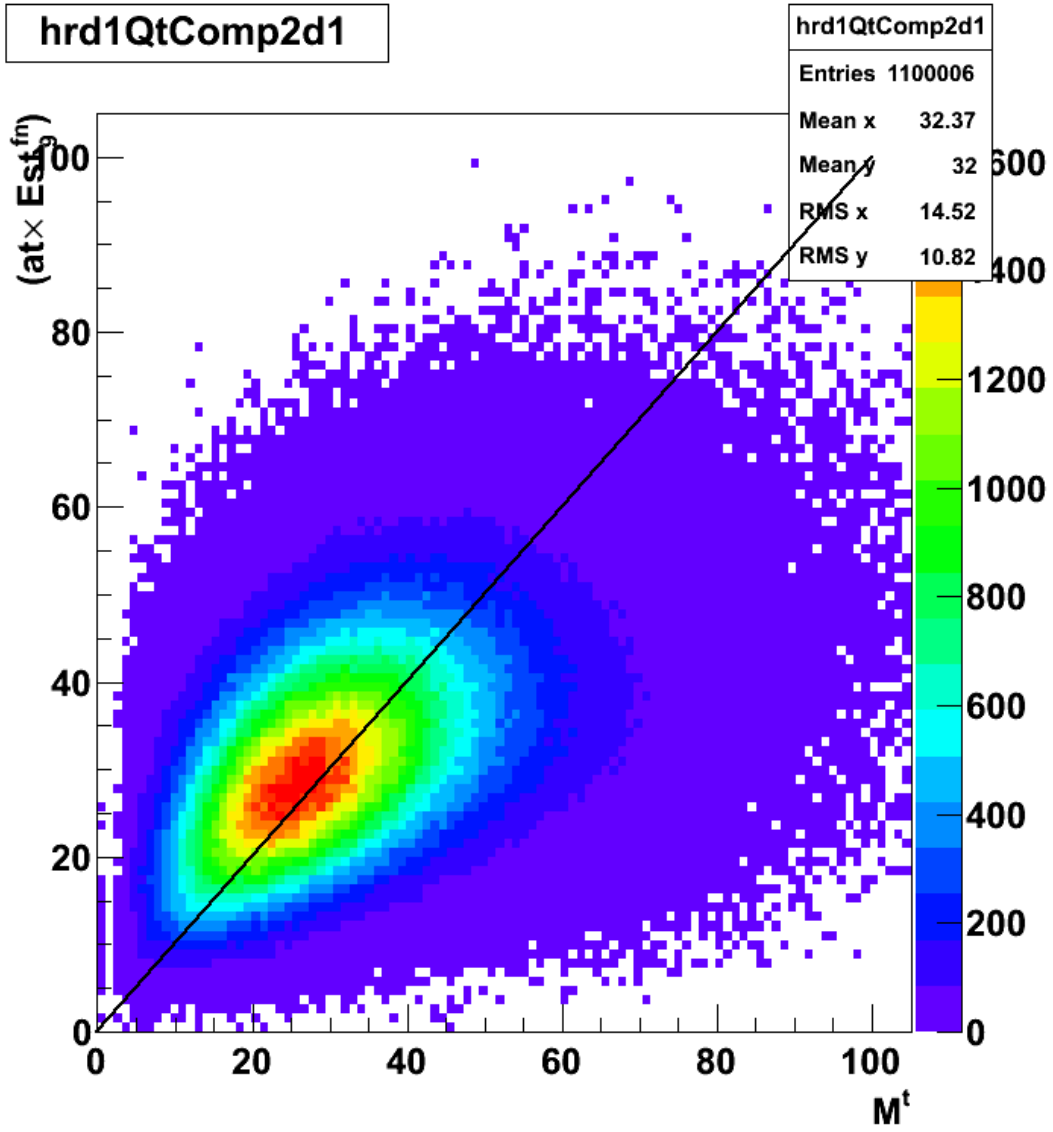
But these two values turn out to be different, so it seems like the correlated part between 1st neighbors and triplet is stronger than that between 2nd neighbors and triplet.

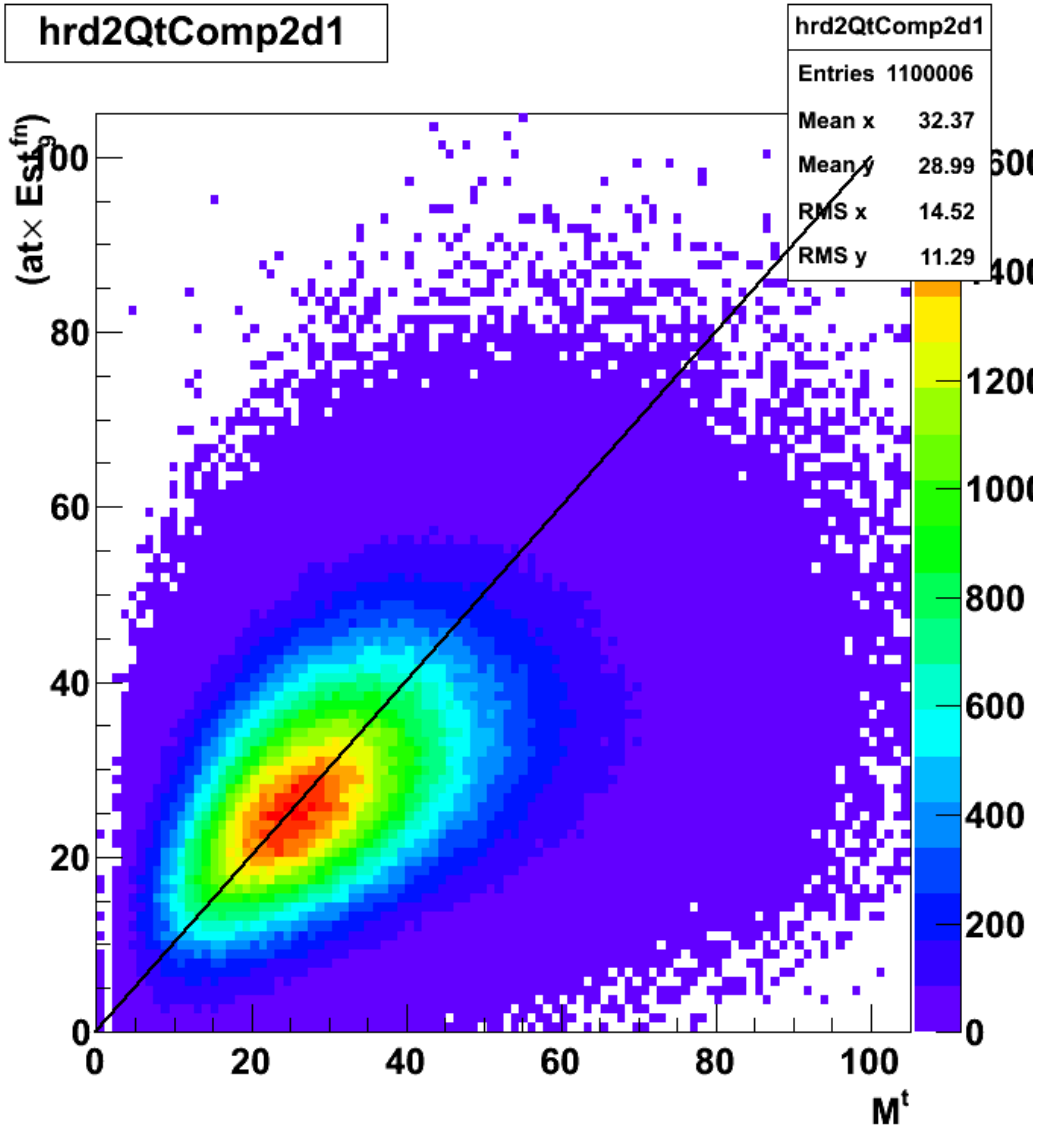
This conclusion is supported by σ(Mt-Est9) ≈ σ(Mt-Est15) which can Hold true only if 1st neighbors were a more correct estimator of the Background under triplet area (b/c $\sigma_9^2=1.7\sigma_{15}^2>\sigma_{15}^2$)

Conclusion

- Tried to revisit the basis of our method (background estimation using neighbors)
  - The gain in fluctuation from using neighbors seems to be marginal compared to just subtracting a number
  - The background correlation seems to die off quickly as one goes away from point of interest
  - Caveat: There can be additional fluctuation that comes from going over to other gems, will look if restricting background estimation to the gem where the track projection hits helps
- Median estimator seems to match better the peak of the triplet charge distribution, and using it alleviates the over subtraction issue that we had in the charge distributions of central events.

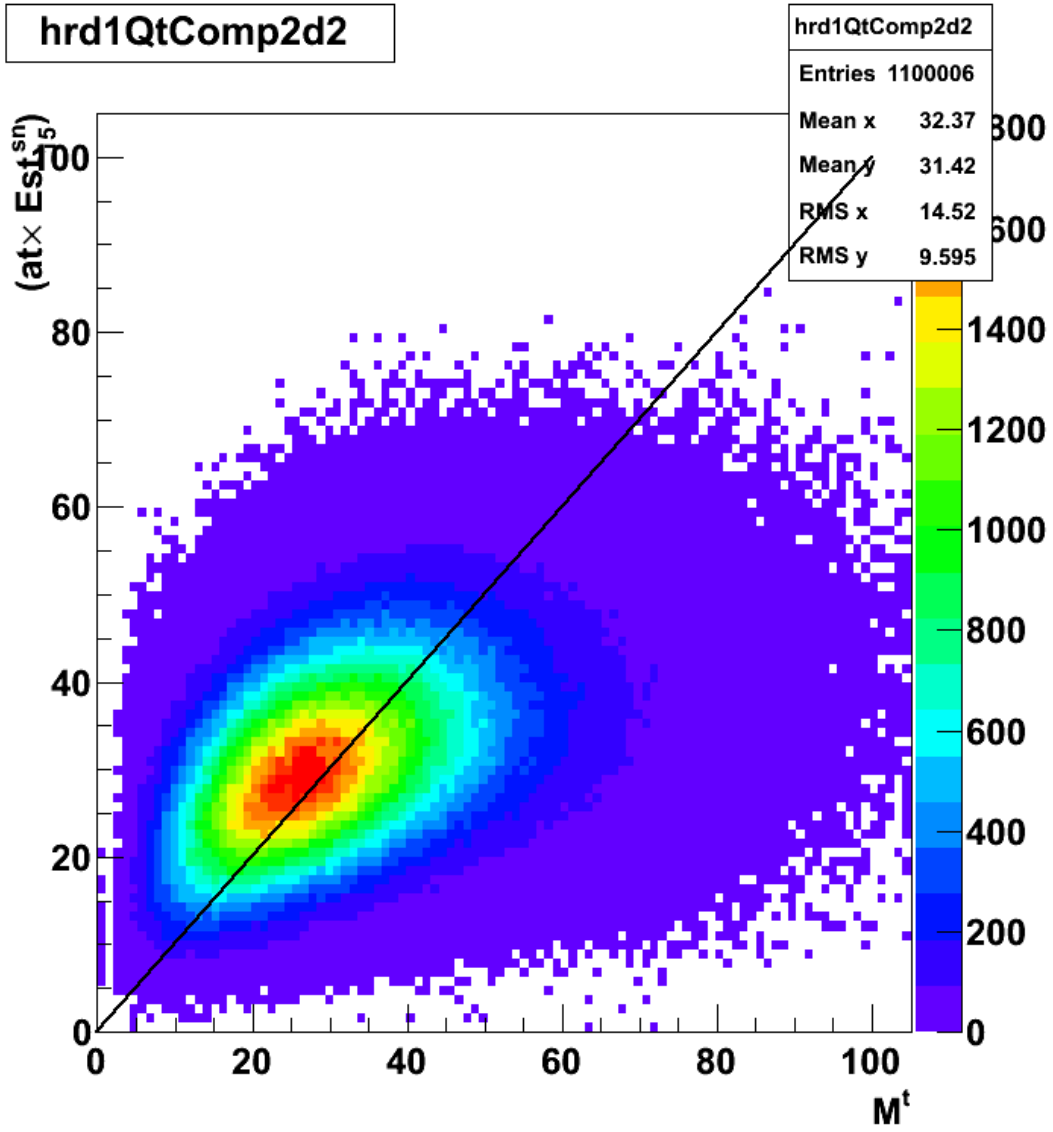
backup

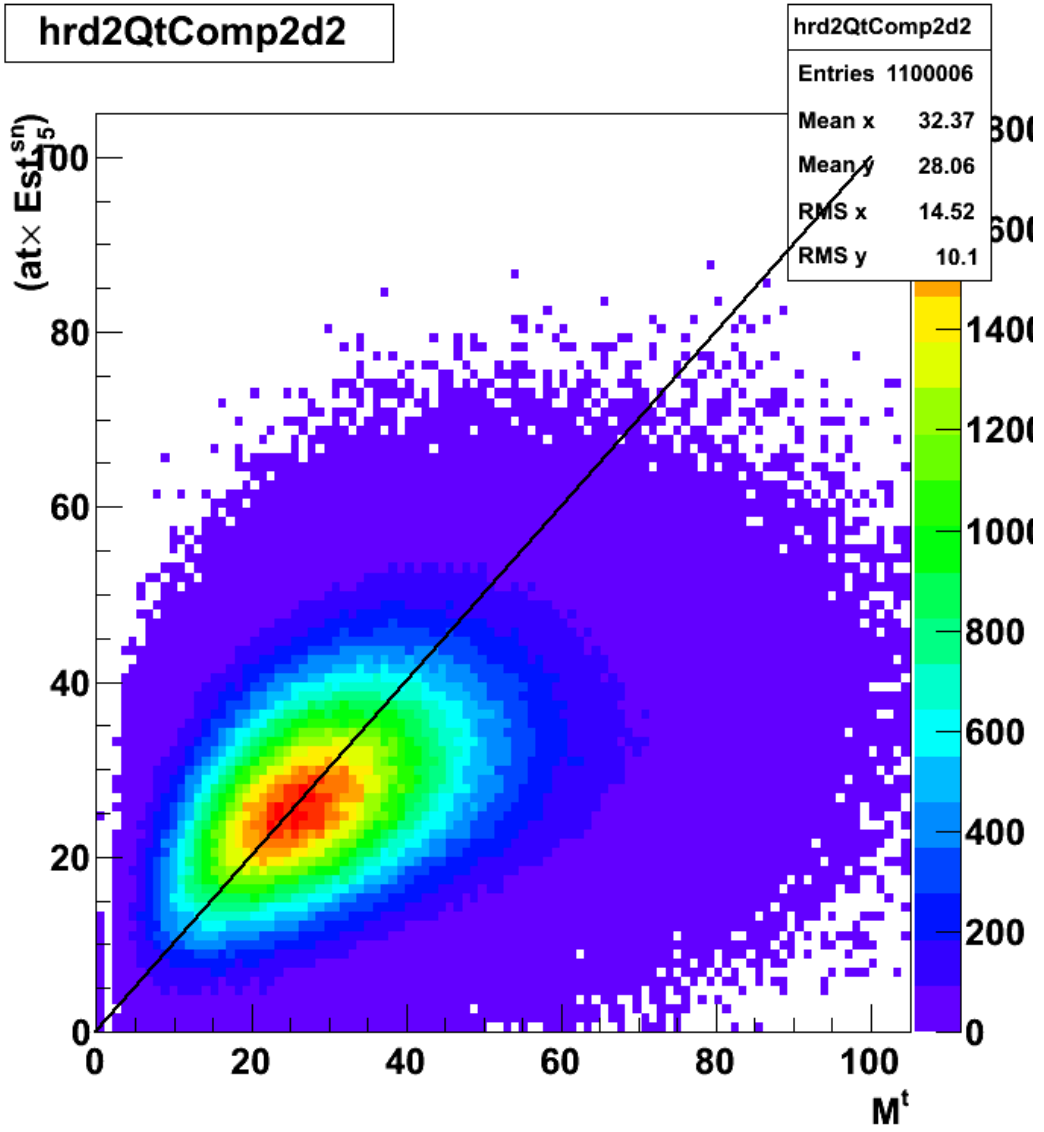




Mean based estimators

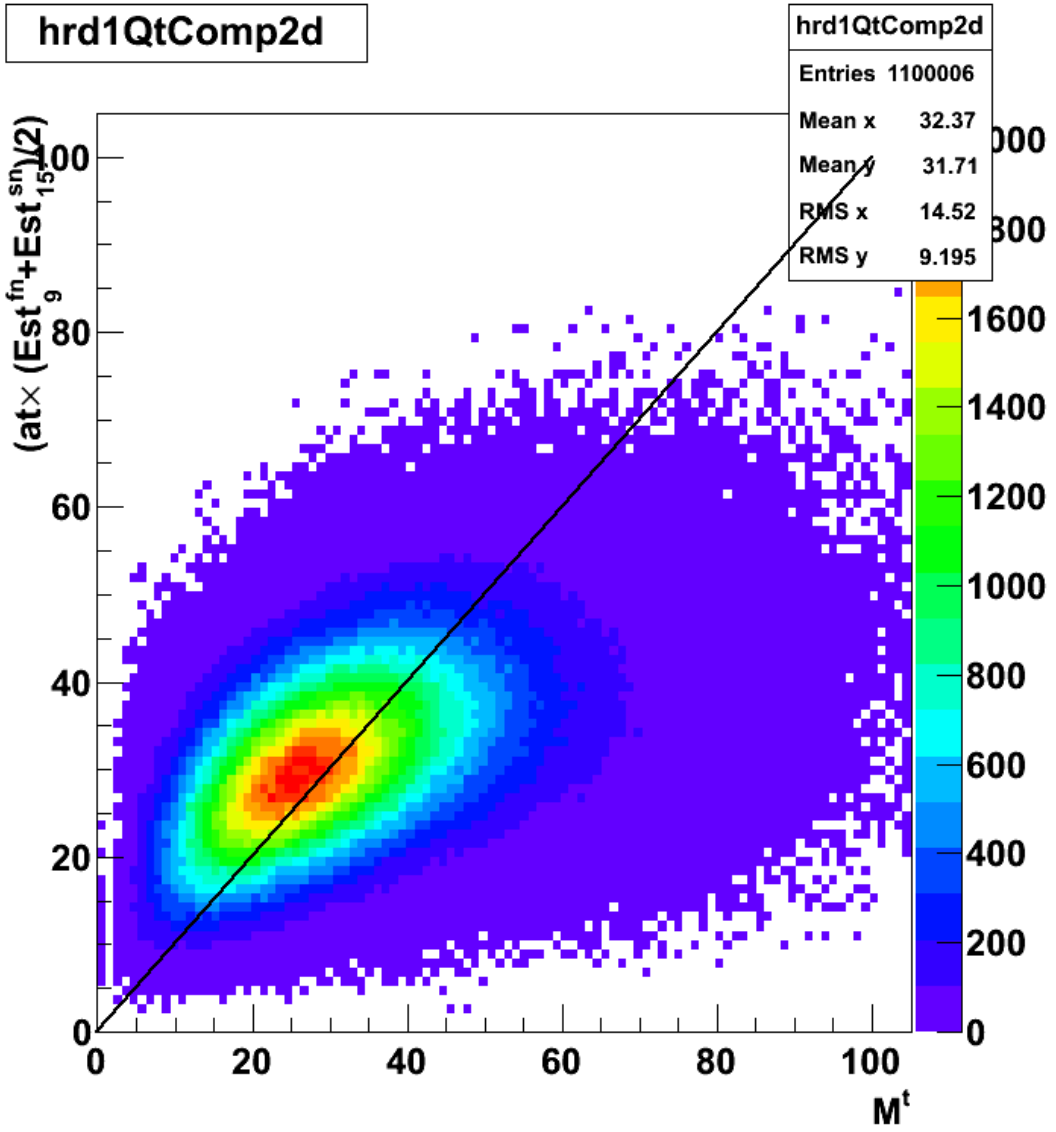
Median based estimators

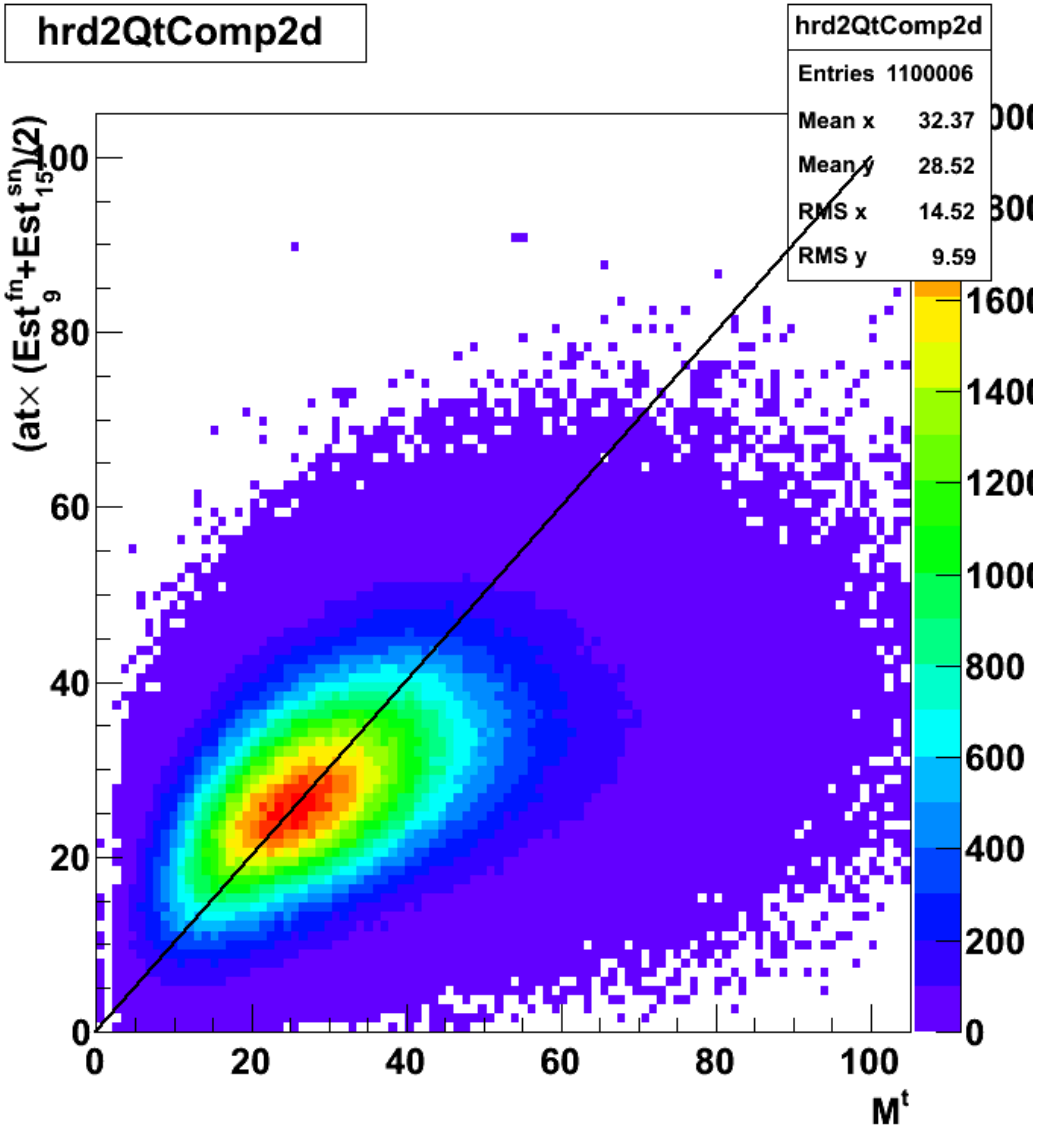




Mean based estimators **Median based estimators**

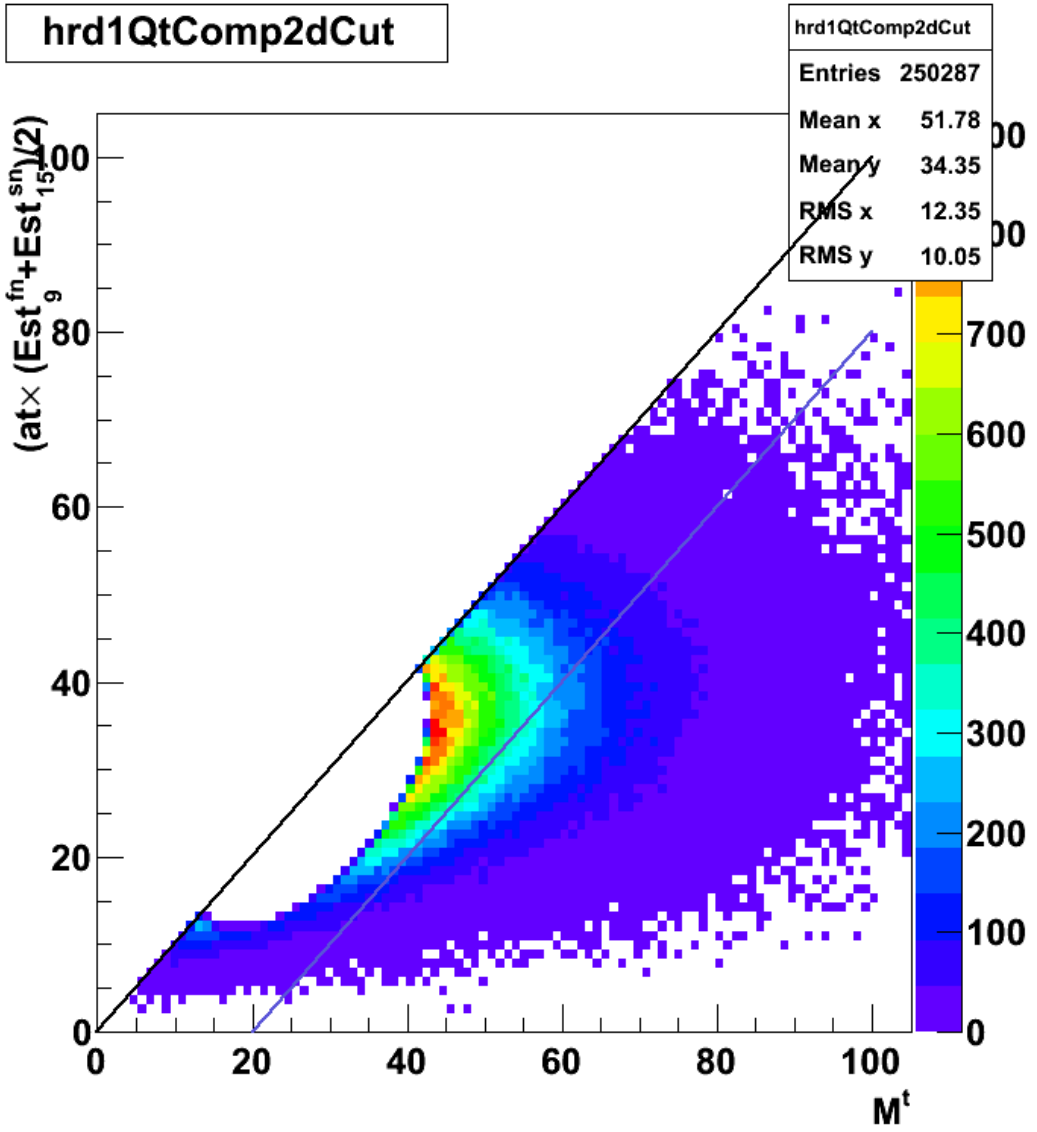
$M_t : Est_{9+15}$

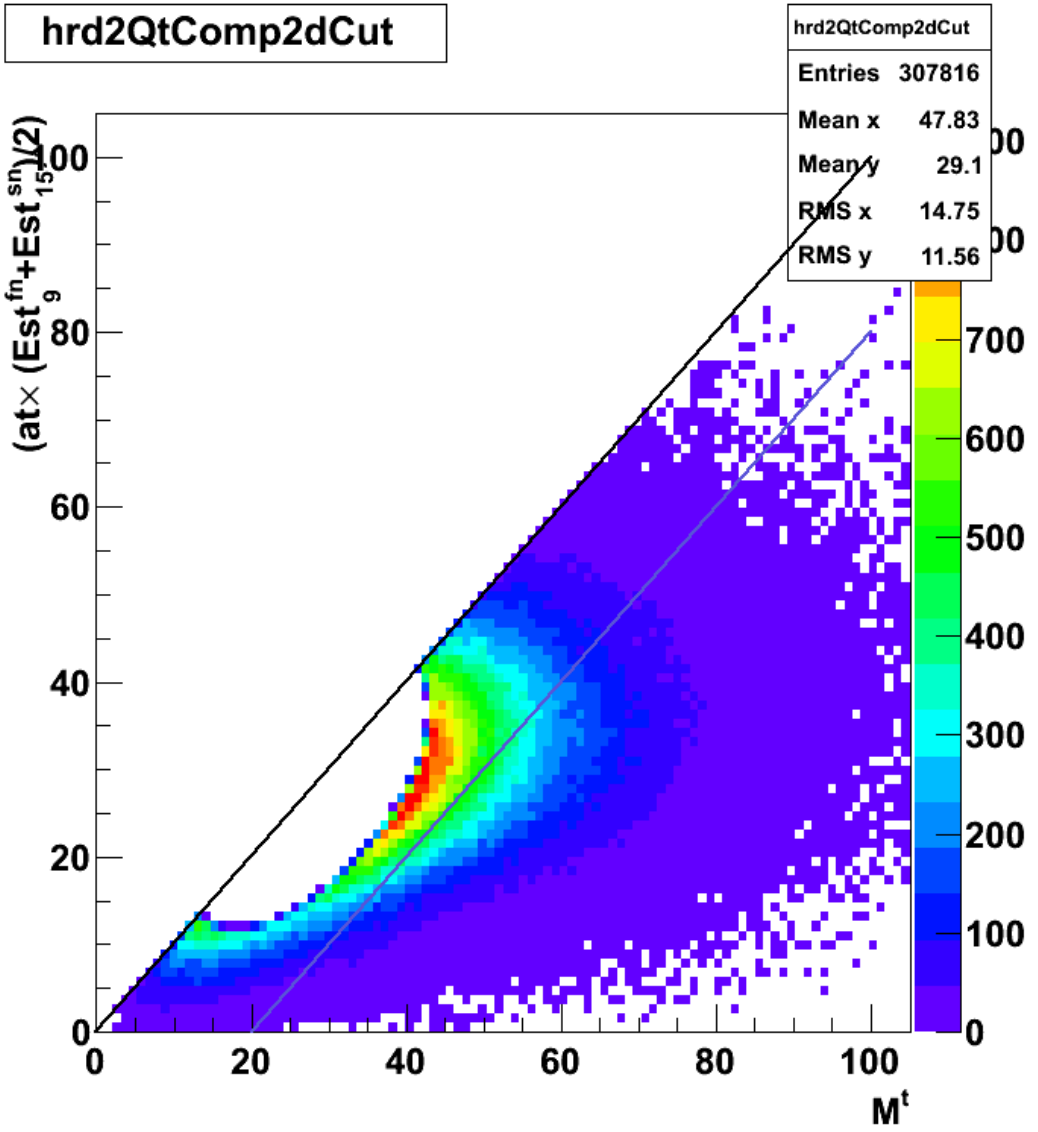




Mean based estimators **Median based estimators**

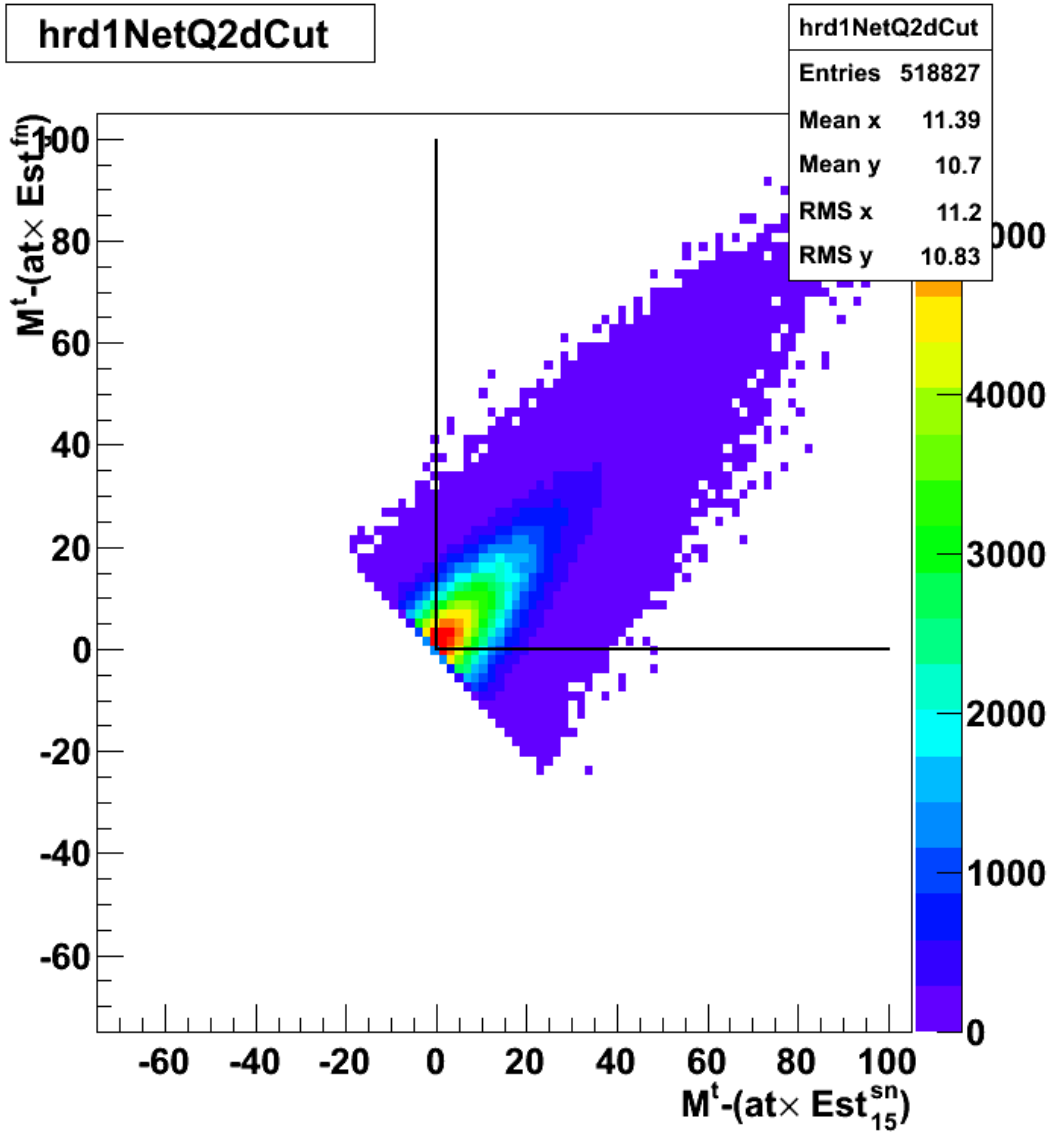
Alternative cut 1 (M_t:Est_{9+15})

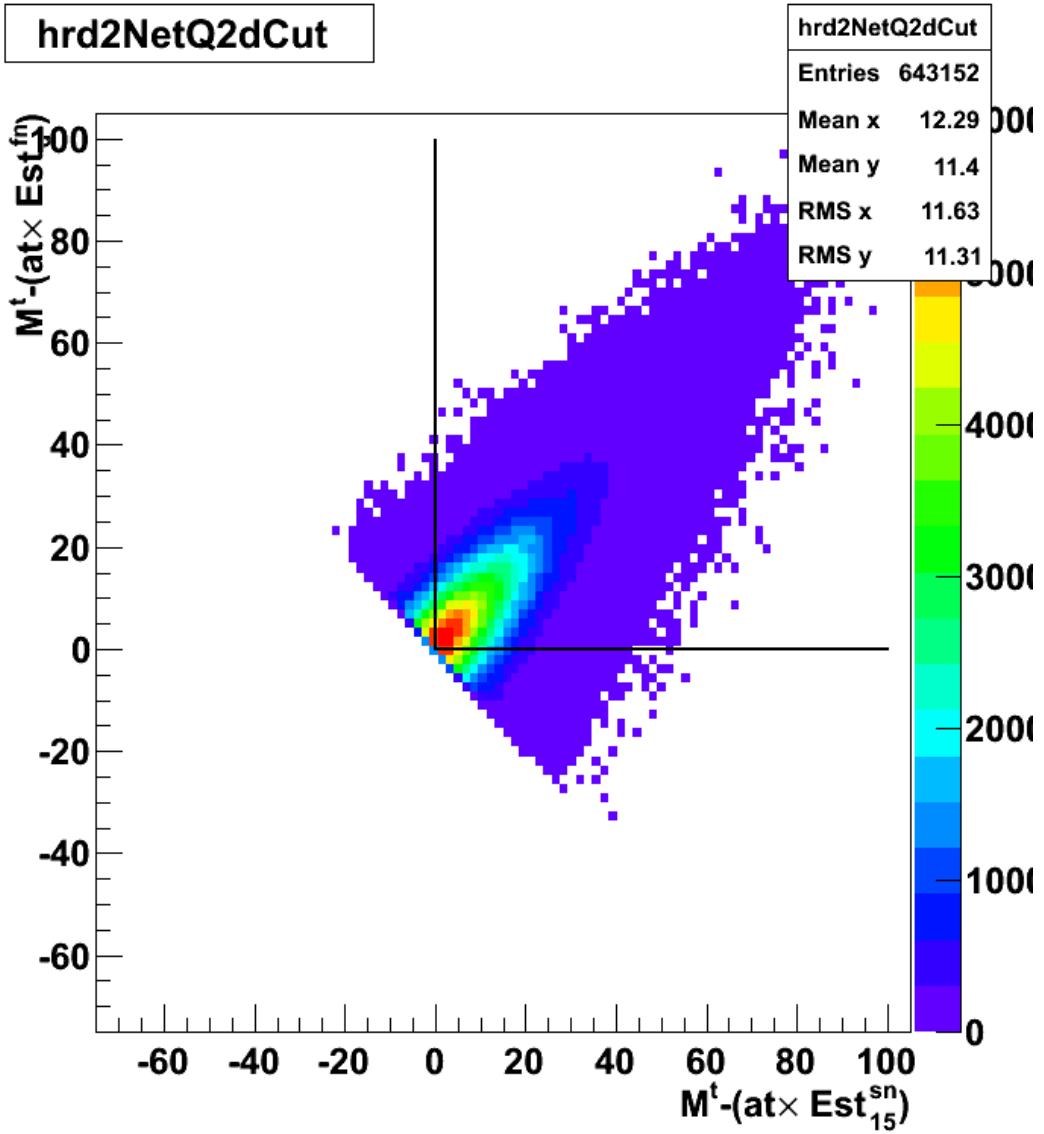




Mean based estimators **Median based estimators**

Alternative cut 2 (M_t-Est_9:M_t-Est_{15})





Mean based estimators **Median based estimators**