On the Resolutions of a Dijet Invariant Mass Measurement

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INTRODUCTION

- *Main tasks:*
  1. *improve the angular resolution of the calorimeter jets using info from trackjets;*
  2. *find an event-specific criterion to correct jet energies;*
  3. *find a criterion for including third jet in the invariant mass calculation (on-going);*

Pythia MC Sample

- *Cuts selecting the exclusive two jets MC sample:*
  - WZ->lnuqqbar (no b-quark) @ generator level
  - Et_jet1@L5>25 GeV
  - Et_jet2@L5>15 GeV
  - Et_jet3@L5<5 Gev if we have more than 2 jets
  - |Eta_jet1/2|<2

We use jet correction up to L7: we use L5 correction only to select the events.

Angular Resolution

We observe that ~ 2.4 % more tracker jets match one primary parton at dR < 0.6

We compare inviariant mass built in different ways:

*a) From calorimeter jets, as currently being done (**std**)*

*b) Using quark directions as axes of calorimeter jets (**mix**)*

The study is also performed in the cracks :

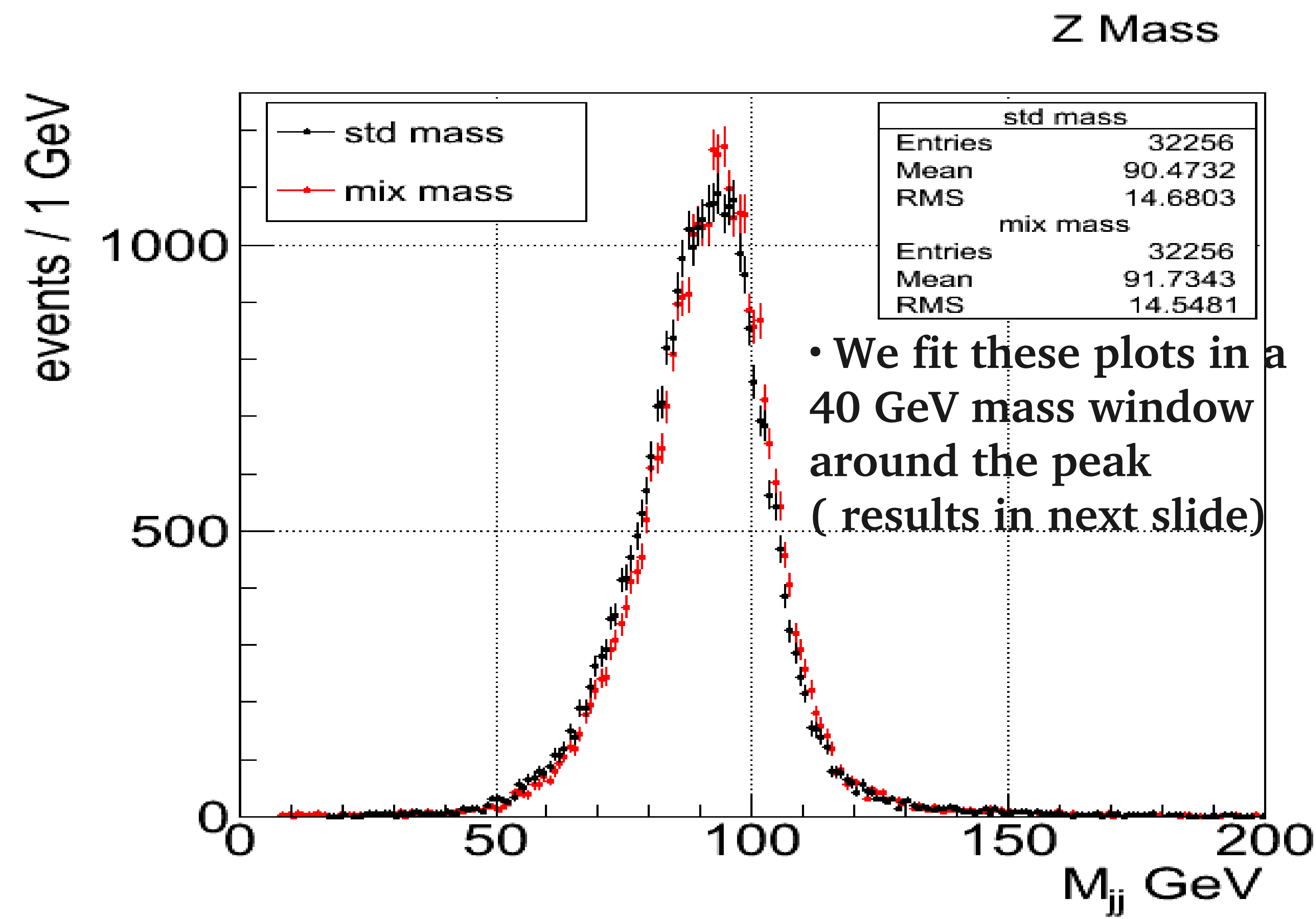
*I. **Cracks**:*

- $|Eta|<0.2;$
- $|Eta|>0.7$ and $|Eta|<1.4;$

*II. **NoCracks**:*

- $|Eta|>0.2$ and $|Eta|<0.7;$
- $|Eta|>1.4$ and $|Eta|<2.0;$

Angular Resolution



- We fit these plots in a 40 GeV mass window around the peak (results in next slide)

Angular Resolution

	ref. values	one jet in cracks	2 jets in nocracks	2 jets in cracks
μ_{std}	91.7	91.5	92.4	90.6
σ_{std}	10.5	10.6	9.8	11.0
$\frac{\sigma_{std}}{\mu_{std}}$	11.4%	11.6%	10.6%	12.2%
μ_{mix}	92.8	92.7	93.5	91.7
σ_{mix}	10.4	10.5	9.8	10.7
$\frac{\sigma_{mix}}{\mu_{mix}}$	11.2%	11.3%	10.5%	11.6%
G	2.1%	2.8%	1.1%	4.4%
Evt/(mass.Wind.)	1.9%	1.8%	1.9%	2.0%

Inclusive

The gain, which is an upper limit to what possibly achievable in practice, is rather small

Scale Factors

We look for an observable sensitive to the bad measurement of jets energy:

- *(k=Pt_closq/Pt_caljet1/2) vs dR(closq,caljet1/2); Parton directions have to be replaced by trackjet axes;*

We study:

- *Invariant mass correcting by k factors (**kmass**);*
- *Combined effect of mix and k mass (**mixk mass**);*

Scale Factors: kmass and Combined Effect of Assuming Parton Directions and Applying k Corrections (mixk mass)

k mass results:

	one jet in cracks	2 jets in nocracks	2 jets in cracks
G	2.7%	2.9%	2.0%
Evt/(mass.Wind.)	2.2%	2.1%	2.1%

- The gain, which is an upper limit to what possibly achievable in practice, is of the same order as the mix method.

mixk mass results:

	one jet in cracks	2 jets in nocracks	2 jets in cracks
G	4.7%	2.3%	4.5%
Evt/(mass.Wind.)	3.4%	3.1%	3.3%

- More progress with two than with only one correction

Using Trackjet Only

Using trackjets info (|eta|<1) to select cracks regions and to improve caljet direction worsen the resolution :

	one jet in cracks	2 jets in nocracks	2 jets in cracks
G	**-10.4%**	**-9.3%**	**-15.6%**
Evt/(mass.Wind.)	**-6.0%**	**-5.3%**	**-7.0%**

Table 7: Effect of assuming trackjet direction as jet axis. The hedear row refear to cracks selection: Crack regions are defined by trackjet directions in the lab frame.

Charge Fraction

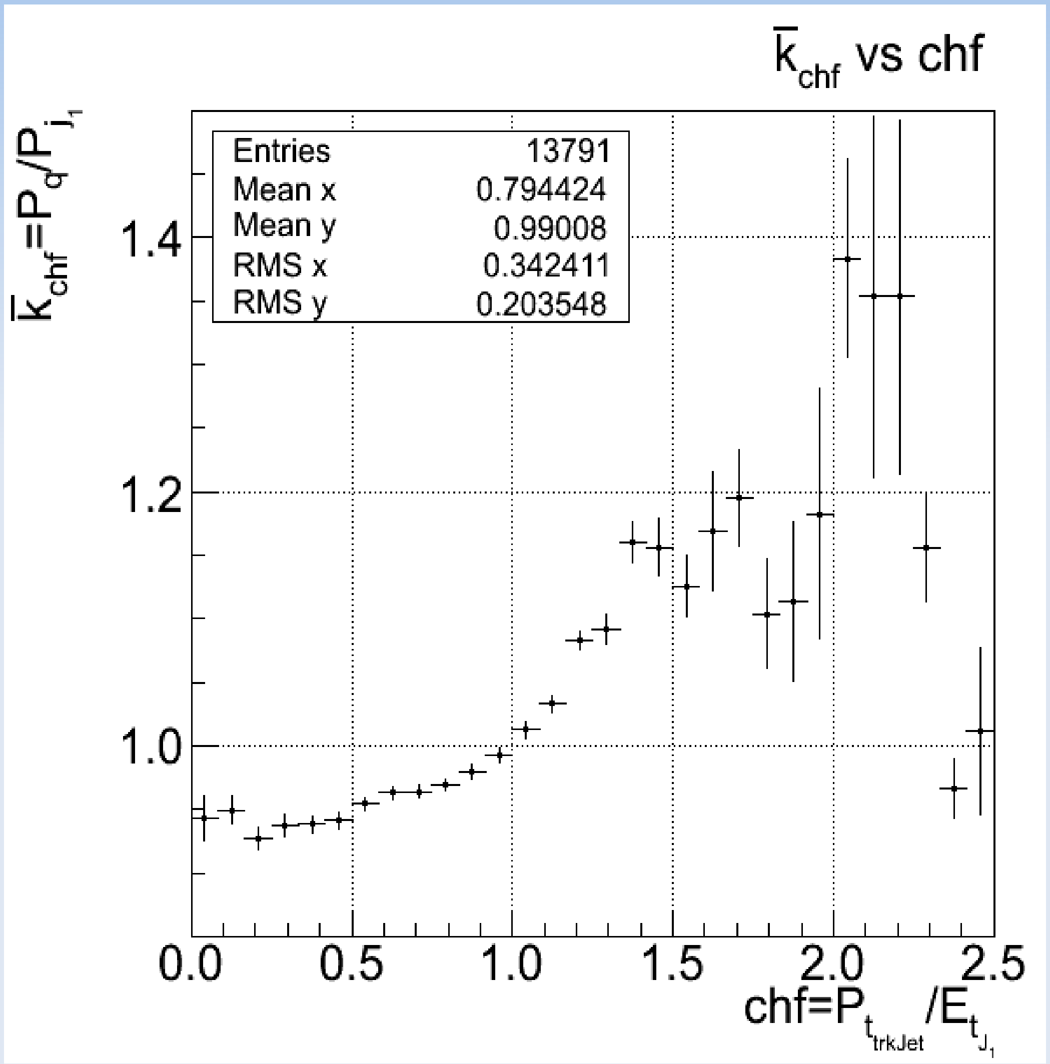
Charge fraction definition:

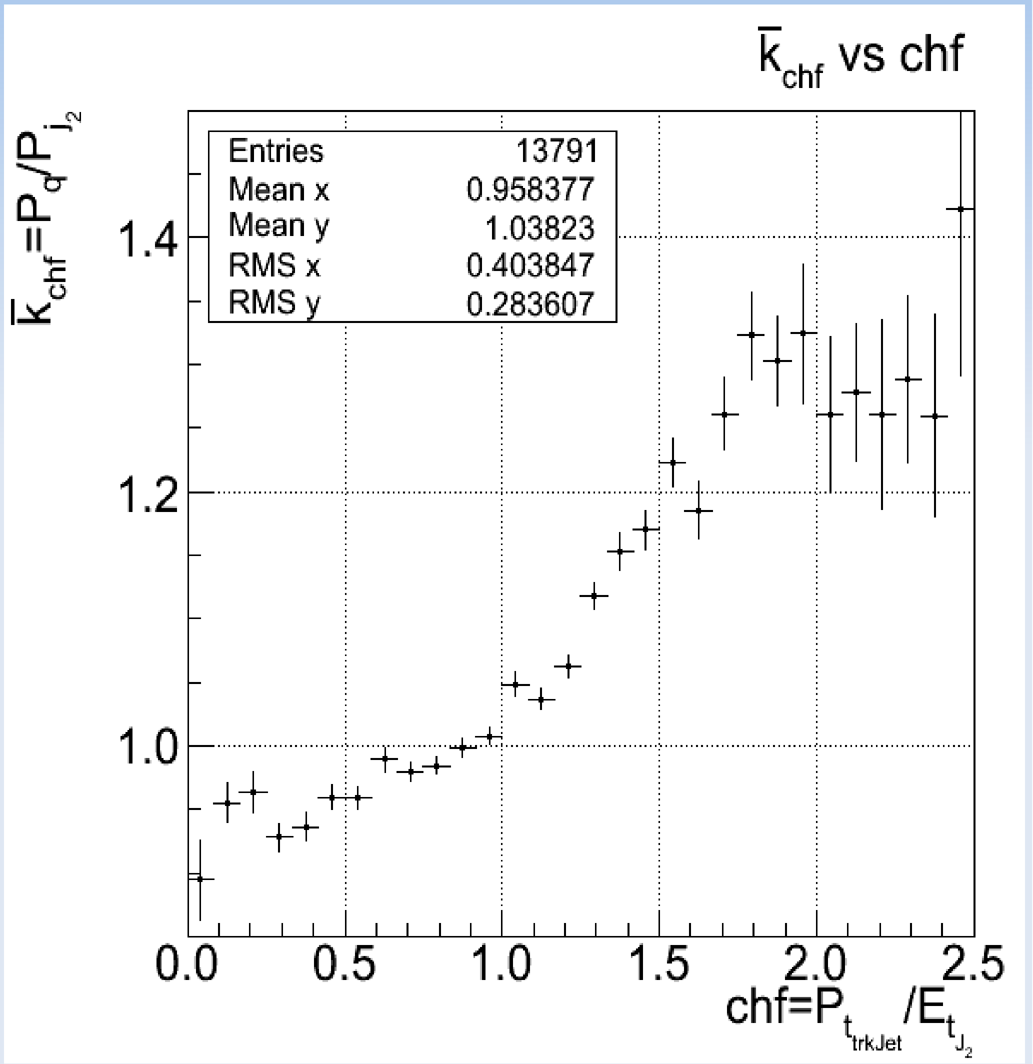
- *chf=Pt_closTrk/Et_caljetRaw: 0.4 matching in dR is required;*

We study:

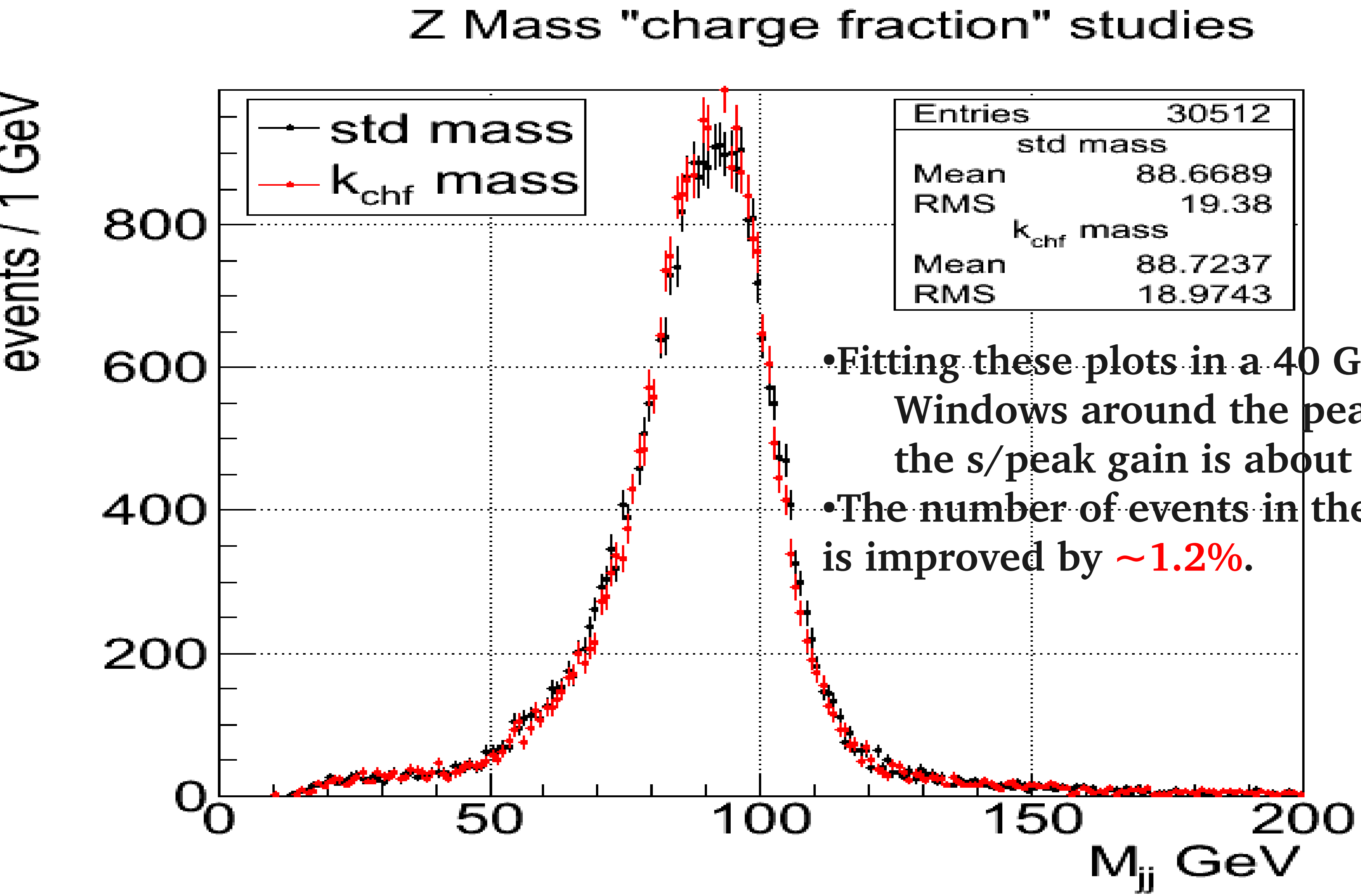
- *a kchf-dependent correction to jet energy;*
- *the dijet invariant mass corrected by kchf.*

Scale factors using chf





Chf results

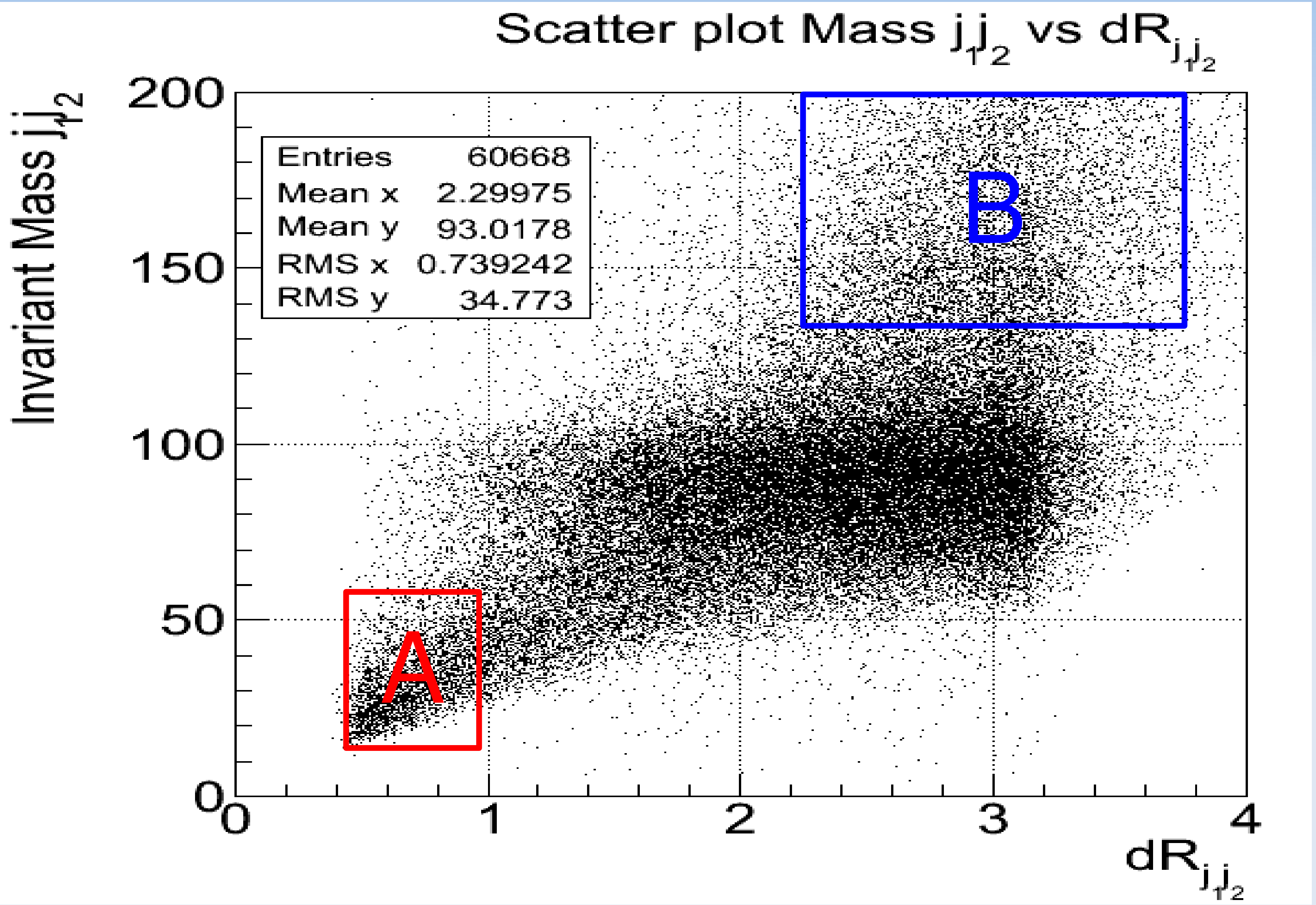


- Fitting these plots in a 40 GeV mass Windows around the peak, the s/peak gain is about **3.7%**
- The number of events in the mass window is improved by **~1.2%**.

Extrajets Studies: cuts definition

- *Cuts selecting the exclusive two jets MC sample:*
  - WZ->lnuqqbar (no b-quark) @ generator level
  - Et_jet1@L5>25 GeV
  - Et_jet2@L5>15 GeV
  - Et_jet3@L5>15 Gev and |Eta_jet3|<2
  - |Eta_jet1/2|<2

Extrajets Studies



Extrajets Studies

We separately study Region A and Region B.

Region B: studies in progress.

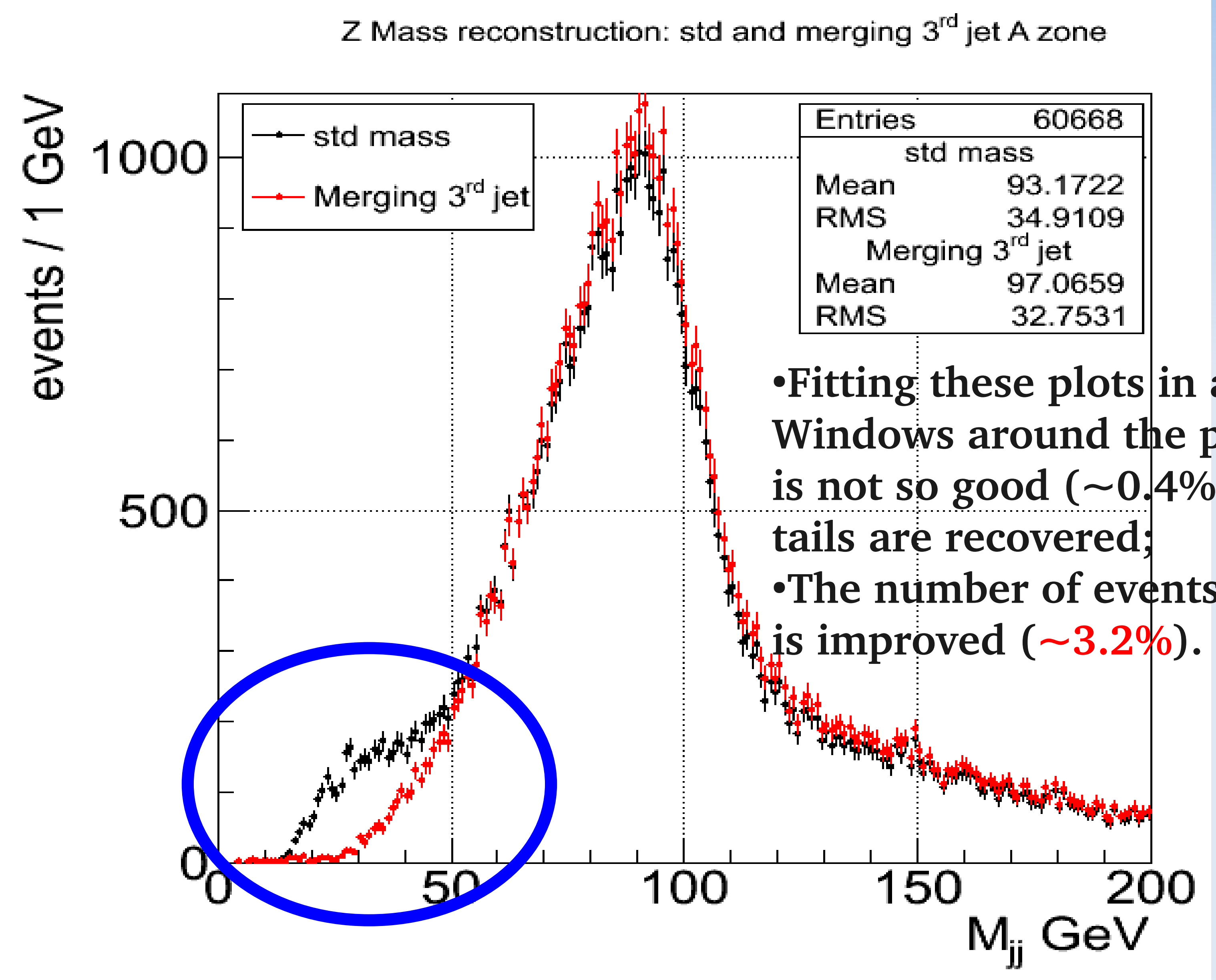
Region A:

- ***We try to improve the Z-mass reconstruction using 3 jets.***

Inclusive:

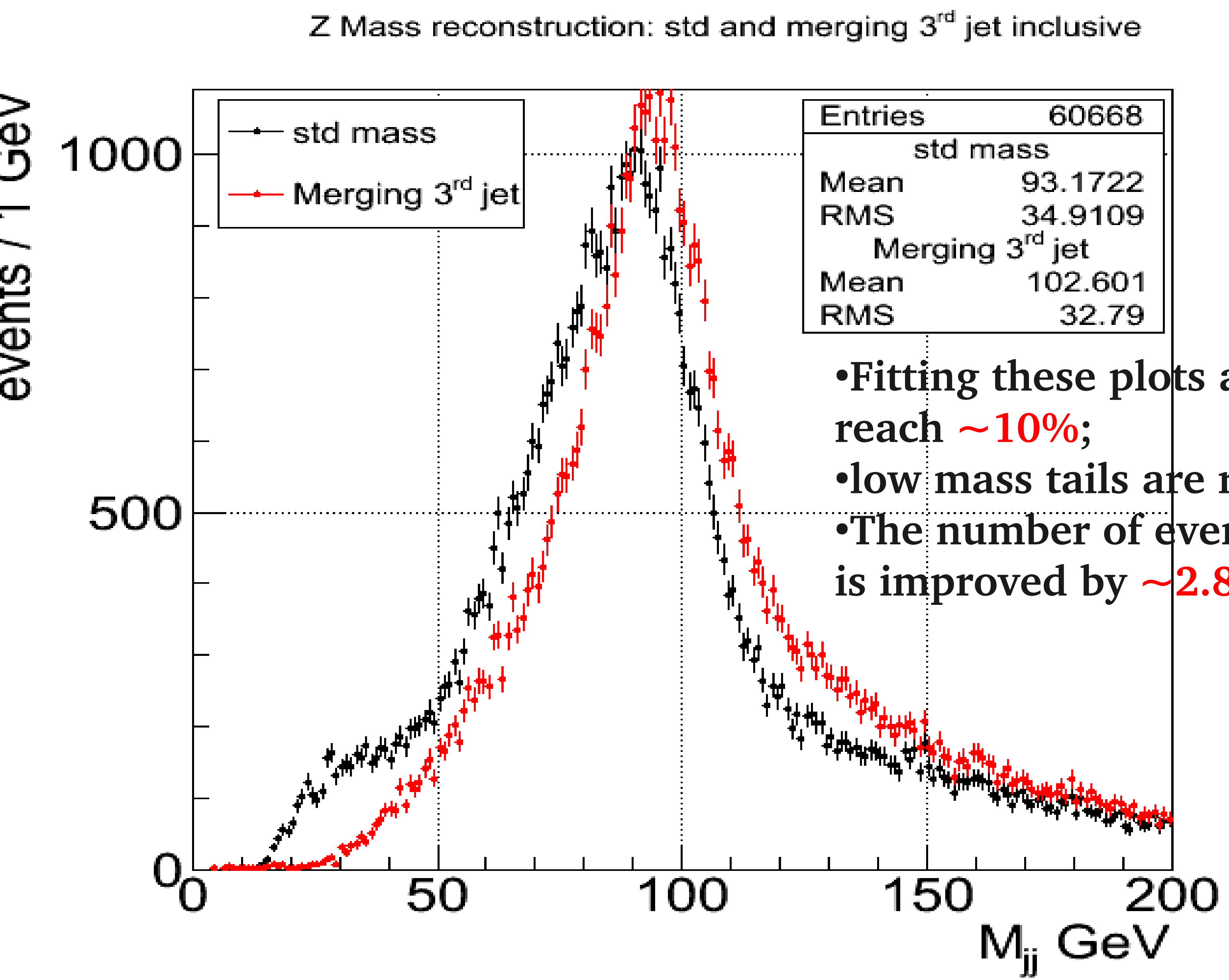
- ***We try to improve the Z-mass reconstruction using 3 jets when two of them are close enough ($dR<1$).***

Extrajets Studies: low mass



- Fitting these plots in a 40 GeV mass Windows around the peak, the s/peak gain is not so good (~0.4%) but the low mass tails are recovered;
- The number of events in the mass window is improved (~3.2%).

Extrajets Studies: inclusive



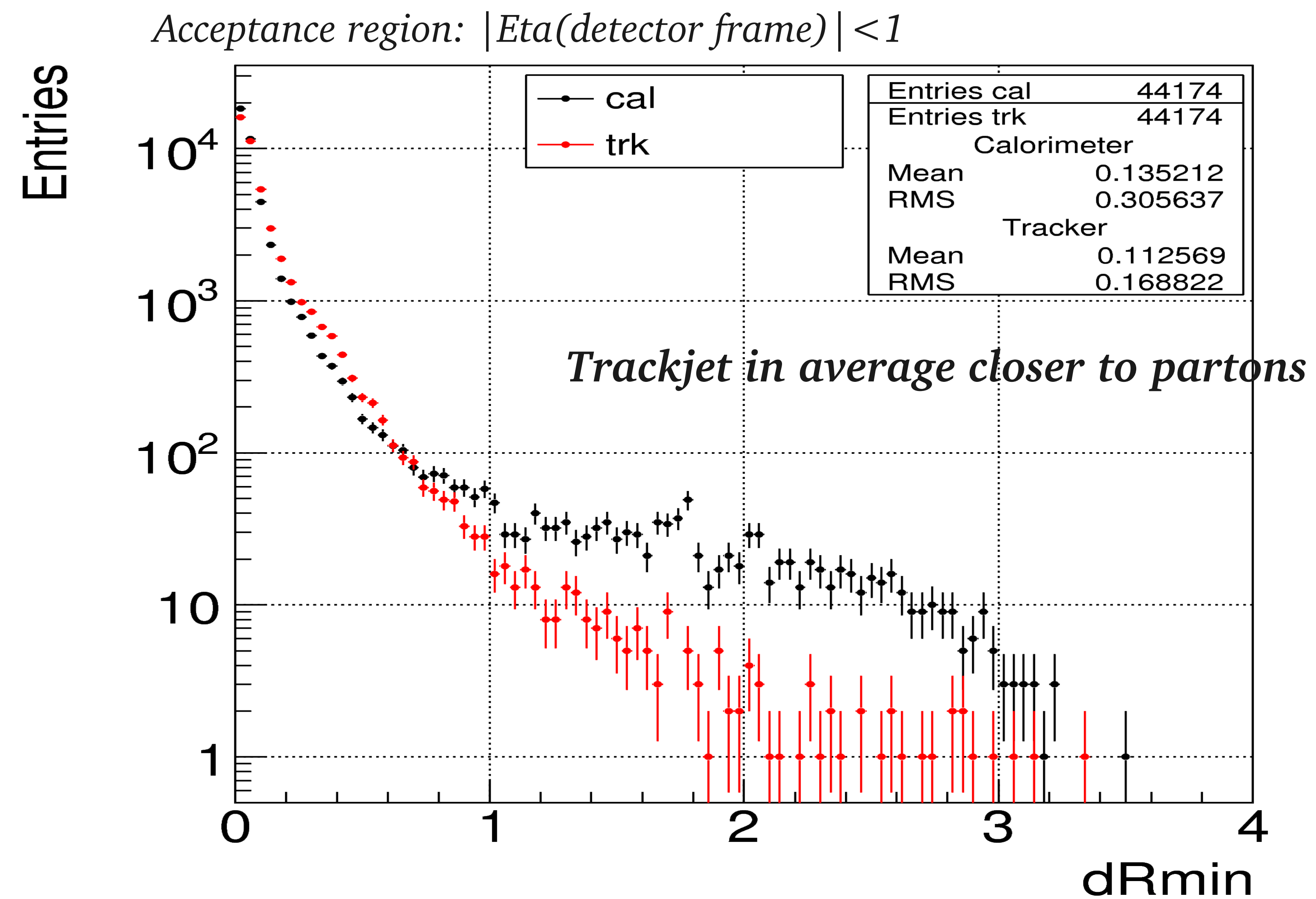
- Fitting these plots as above, the s/peak reach ~10%;
- low mass tails are recovered;
- The number of events in the mass window is improved by ~2.8%.

Conclusions

- *Using tracker info to improve caljet direction gives no progress:*
  - *Depends on the criteria we choose the trackjet to be considered;*
  - *Depends on tracker resolution;*
- *"Charge fraction" scale factor gives an improvement on s/peak of ~ 4%*
  - *will be used as one of the input in a MultiVariate Analisys (in progress);*
- *Extrajets studies: promising (to be continued..)*

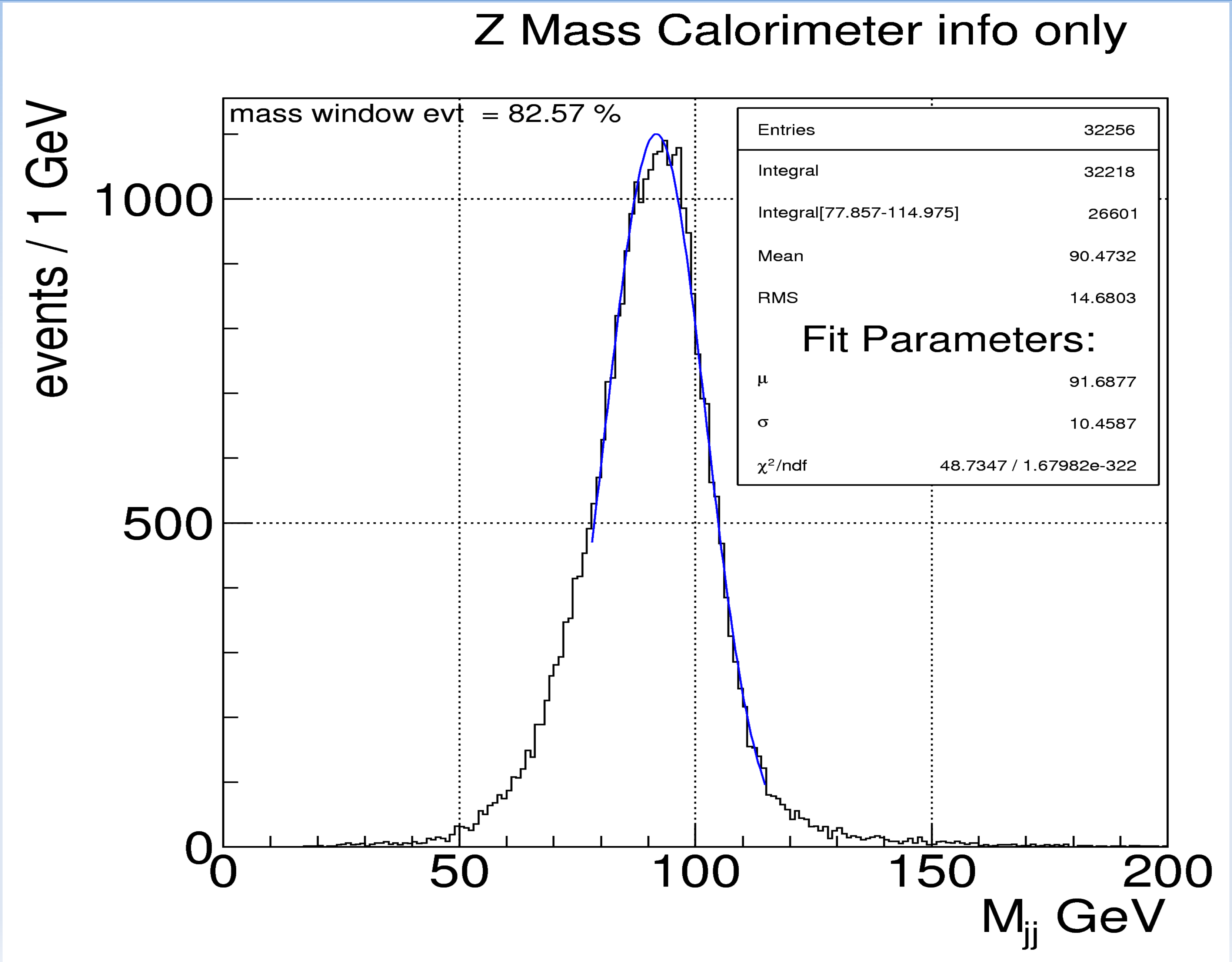
BackUp Slides

Angular Resolution

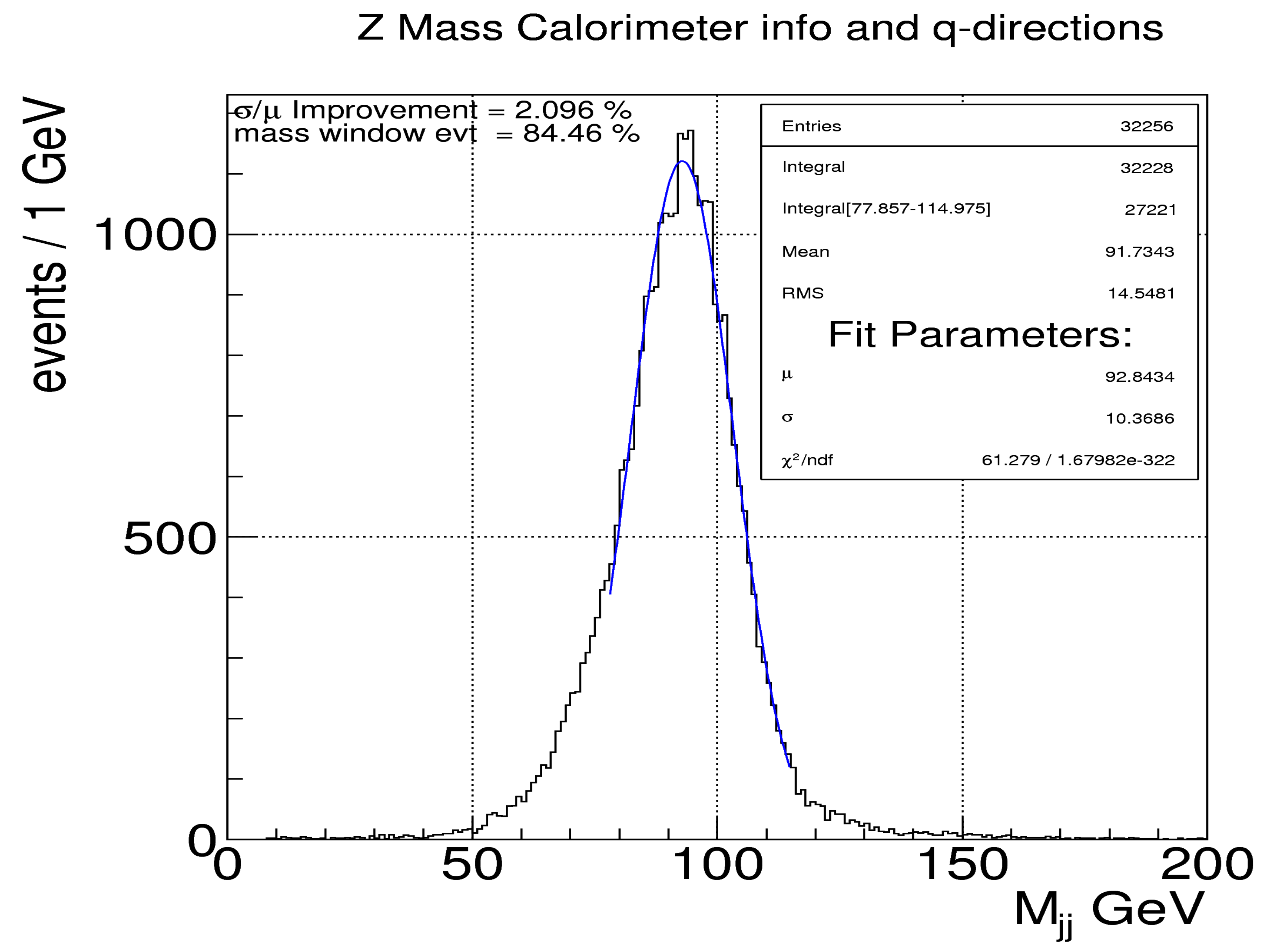


We observe that ~ 2.4 % more tracker jets match one primary parton at dR < 0,6.

Angular Resolution



Angular Resolution



Angular Resolution

	ref. values	one jet in cracks	2 jets in nocracks	2 jets in cracks
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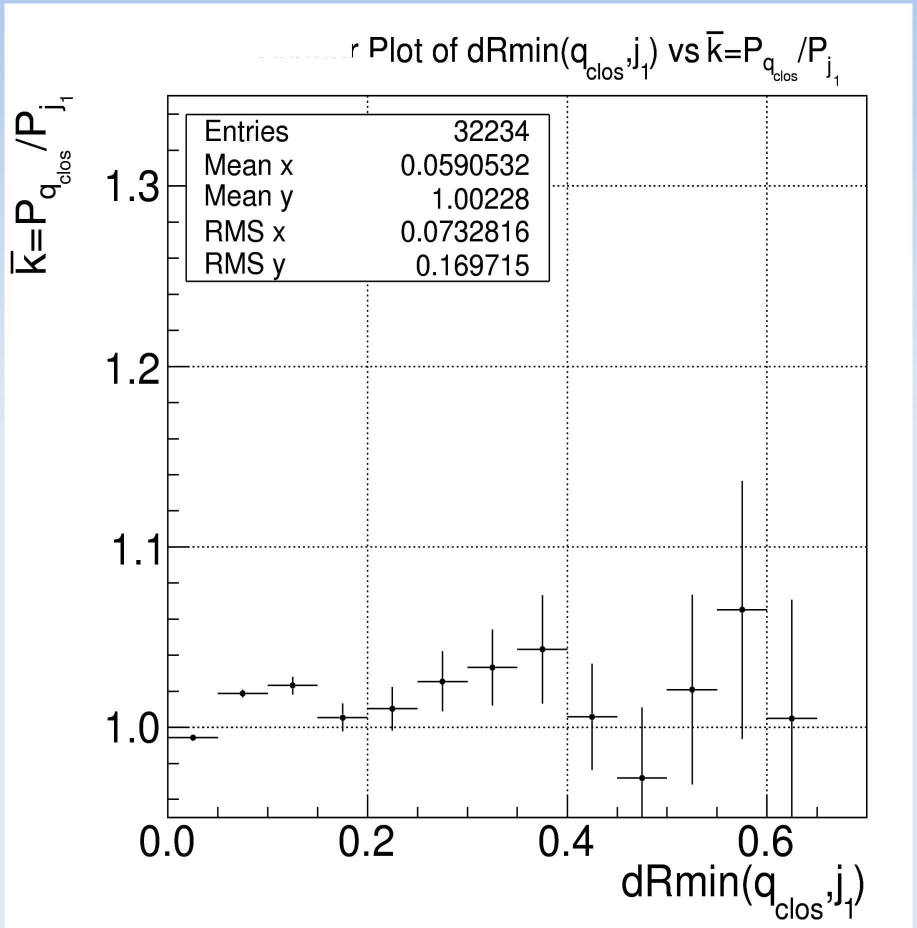
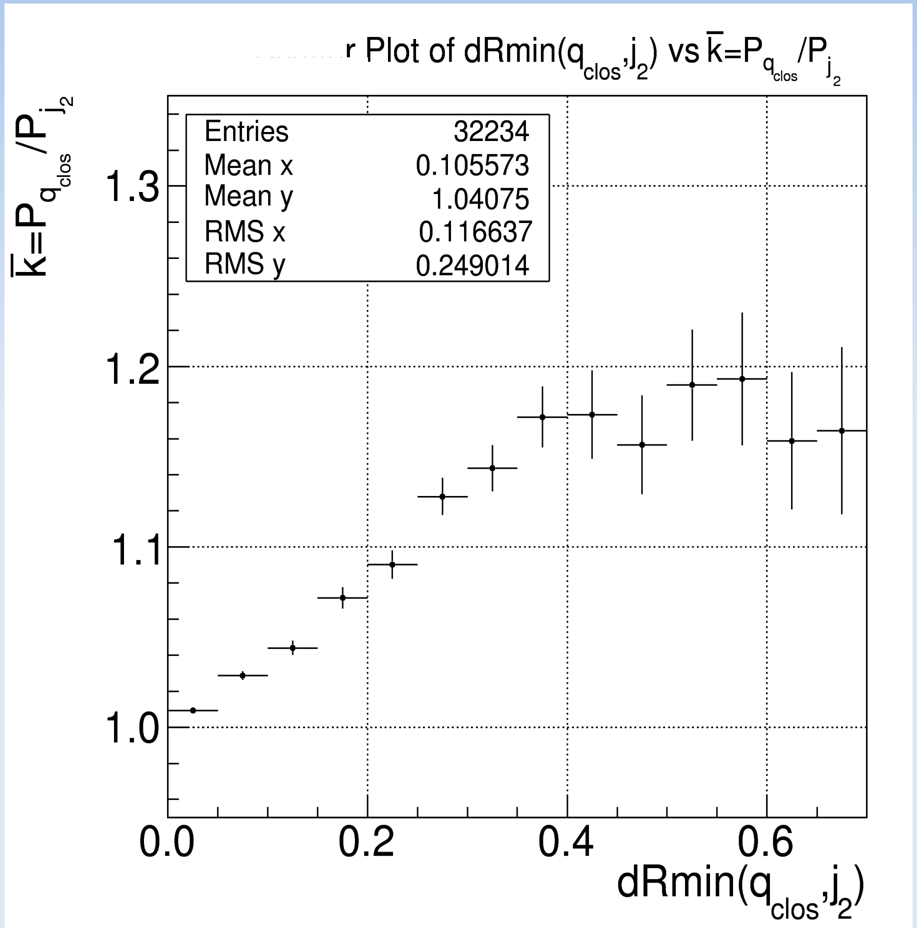
σ_{cal}	10.5	10.6	9.8	11.0
$\frac{\sigma_{cal}}{\mu_{cal}}$	11.4%	11.6%	10.6%	12.2%
μ	92.8	92.7	93.5	91.7
σ	10.4	10.5	9.8	10.7
$\frac{\sigma}{\mu}$	11.2%	11.3%	10.5%	11.6%
G	2.1%	**2.8%**	**1.1%**	**4.4%**
Evt/(mass.Wind.)	1.9%	**1.8%**	**1.9%**	**2.0%**

Table 1: Effect of assuming parton direction as jet axis. The hedear row refear to cracks selection: Crack regions are defined by parton directions in the lab frame. The 3 top lines give the mass and width of the mass fits using calorimeter jets, the 3 next lines give the results of the fit to the same sample with parton directions as jet axes. The next to the last line "G" gives the relative decrease of the σ/μ ratio, and the last line "Evts in fitted mass window" gives the difference in the percentage of event in the selected mass window.

The gain, which is an upper limit to what possibly achievable in practice, is rather small

Scale Factors

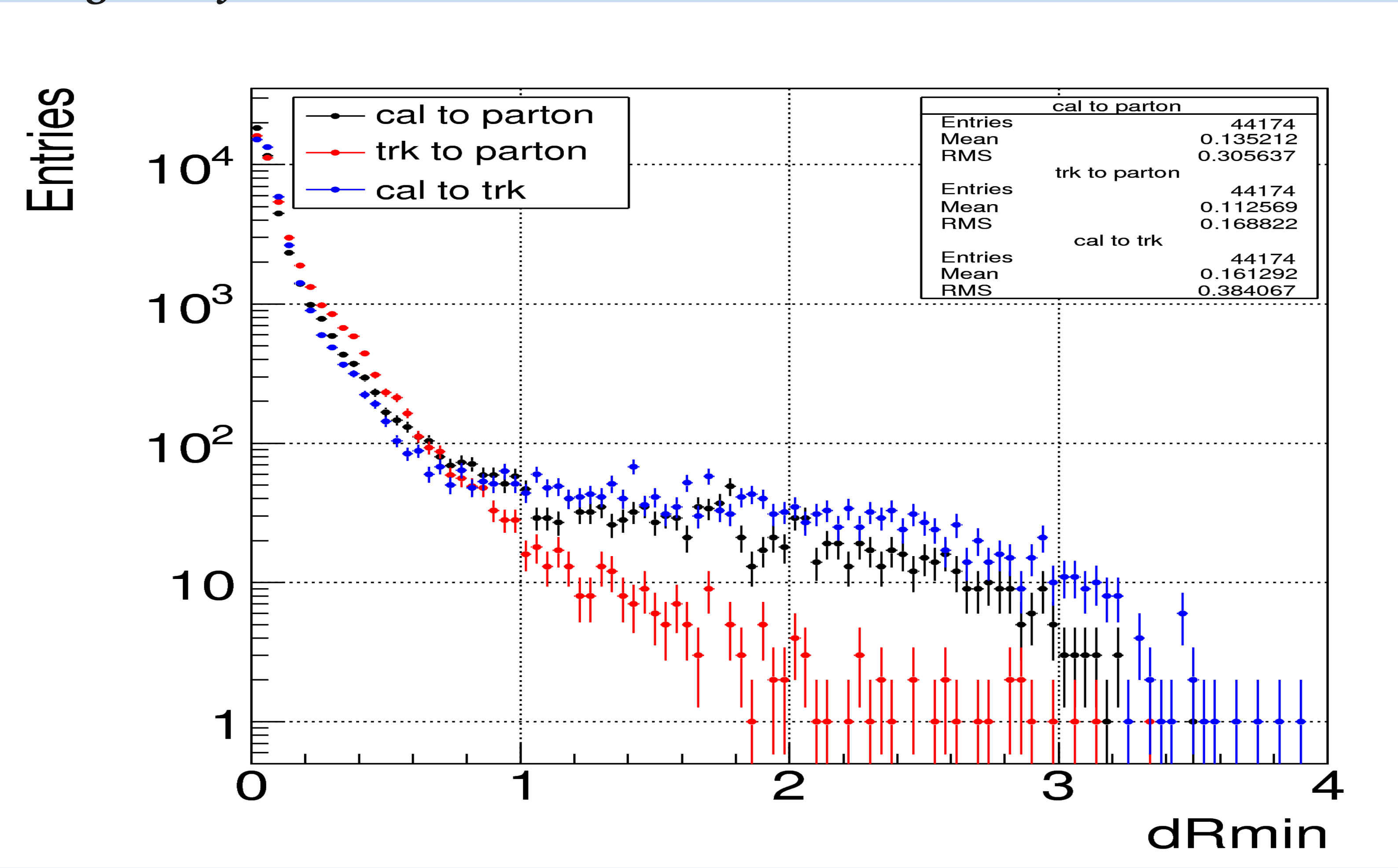




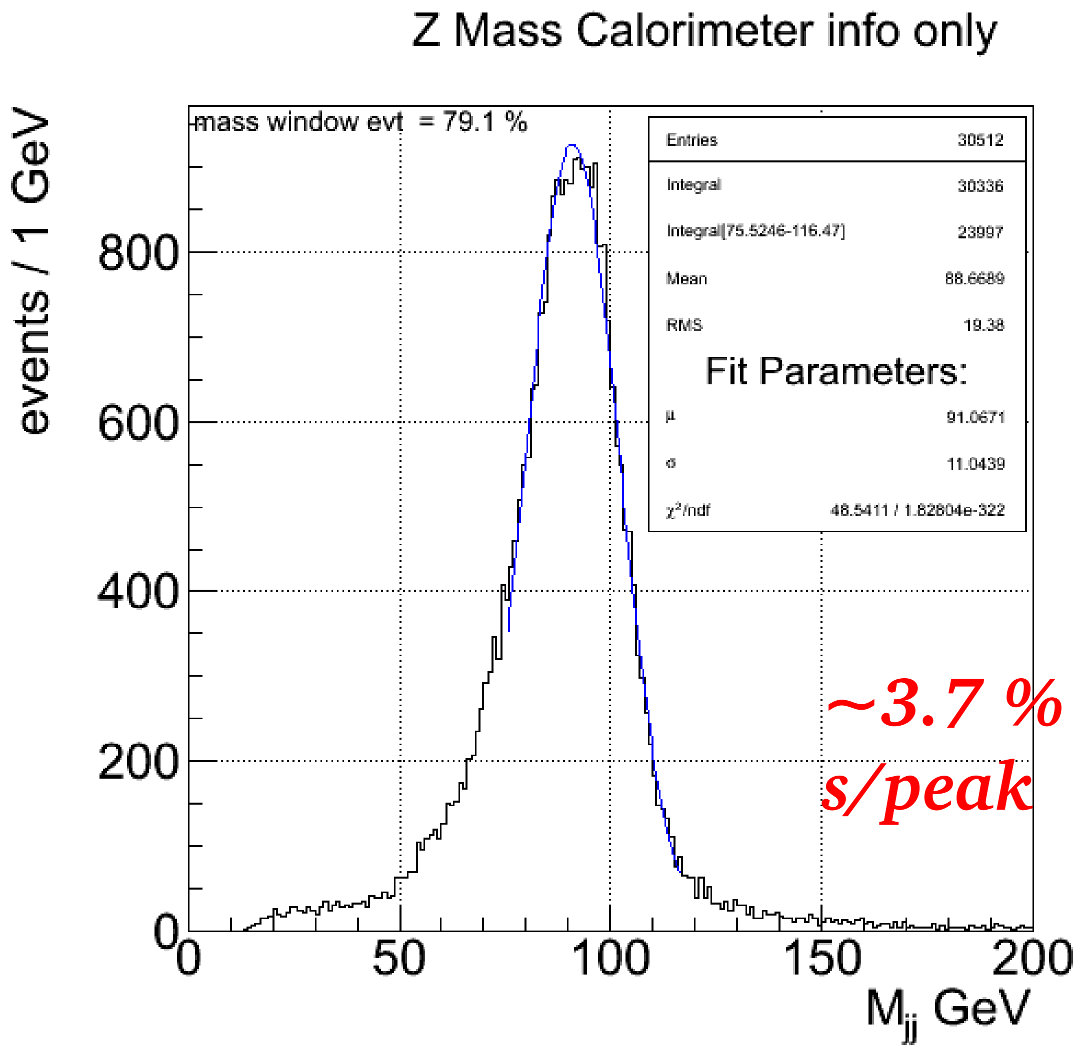
Why the Worsening?

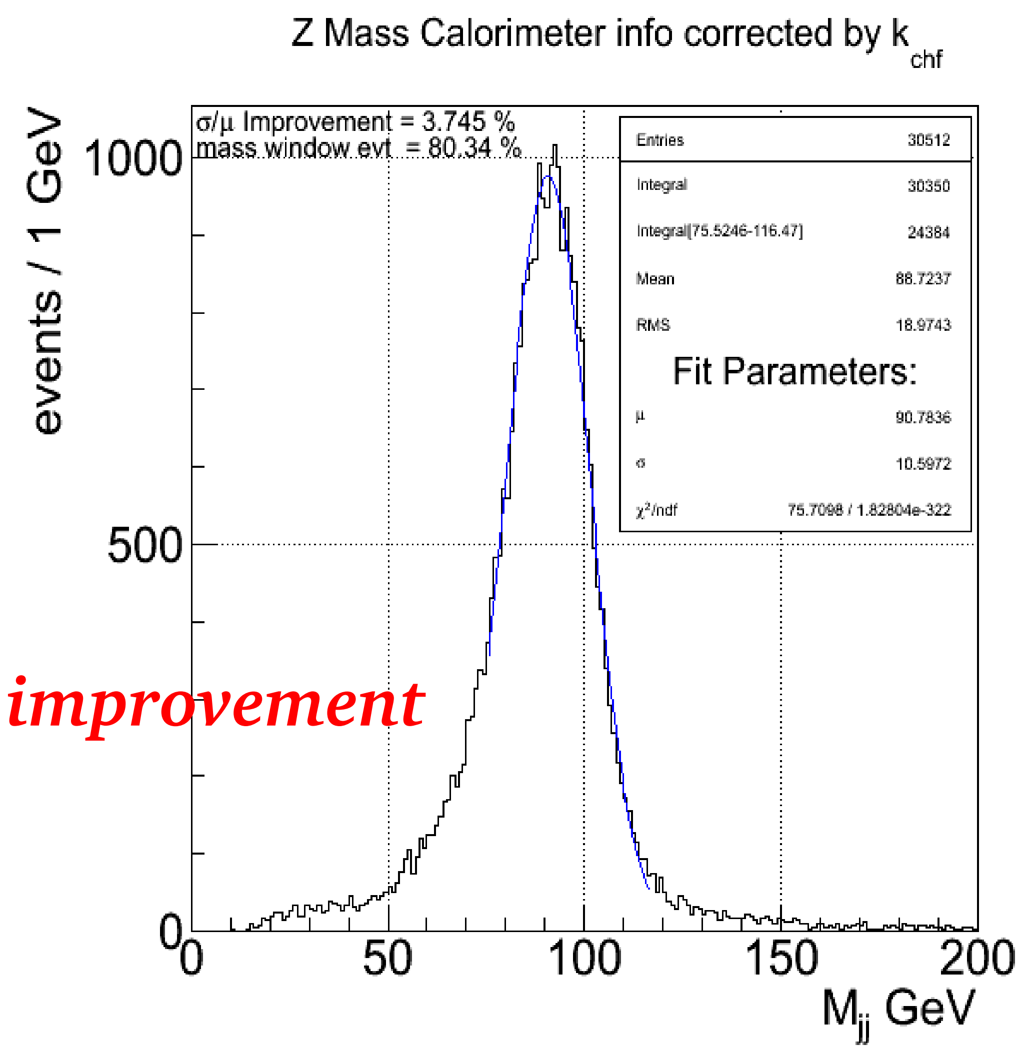
We performe the studies considering the closer trackjet to caljet (first or second leading):

- *Black and blue distributions overlap, i.e. there is no appreciable gain using trackjet axes*



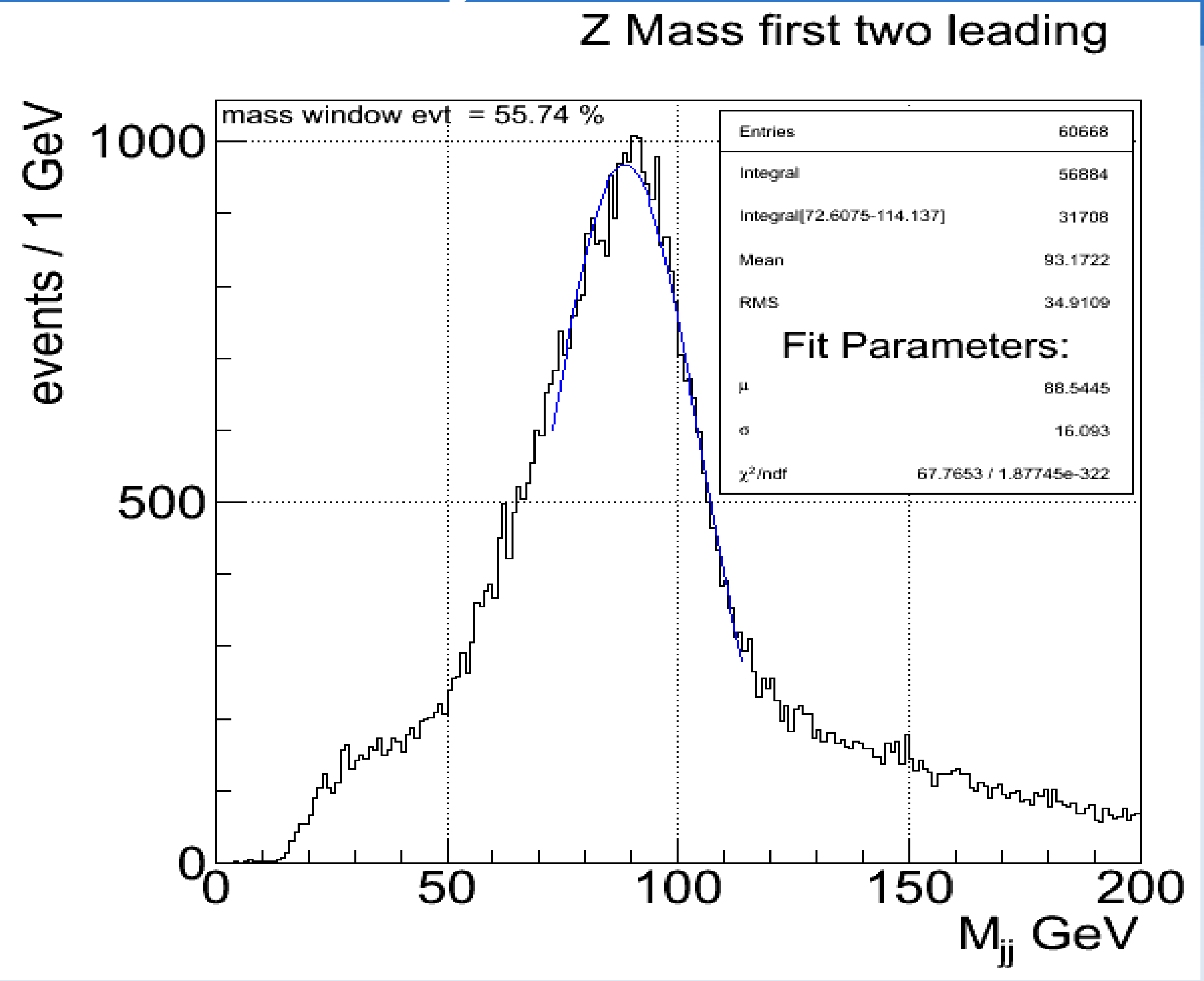
Chf results



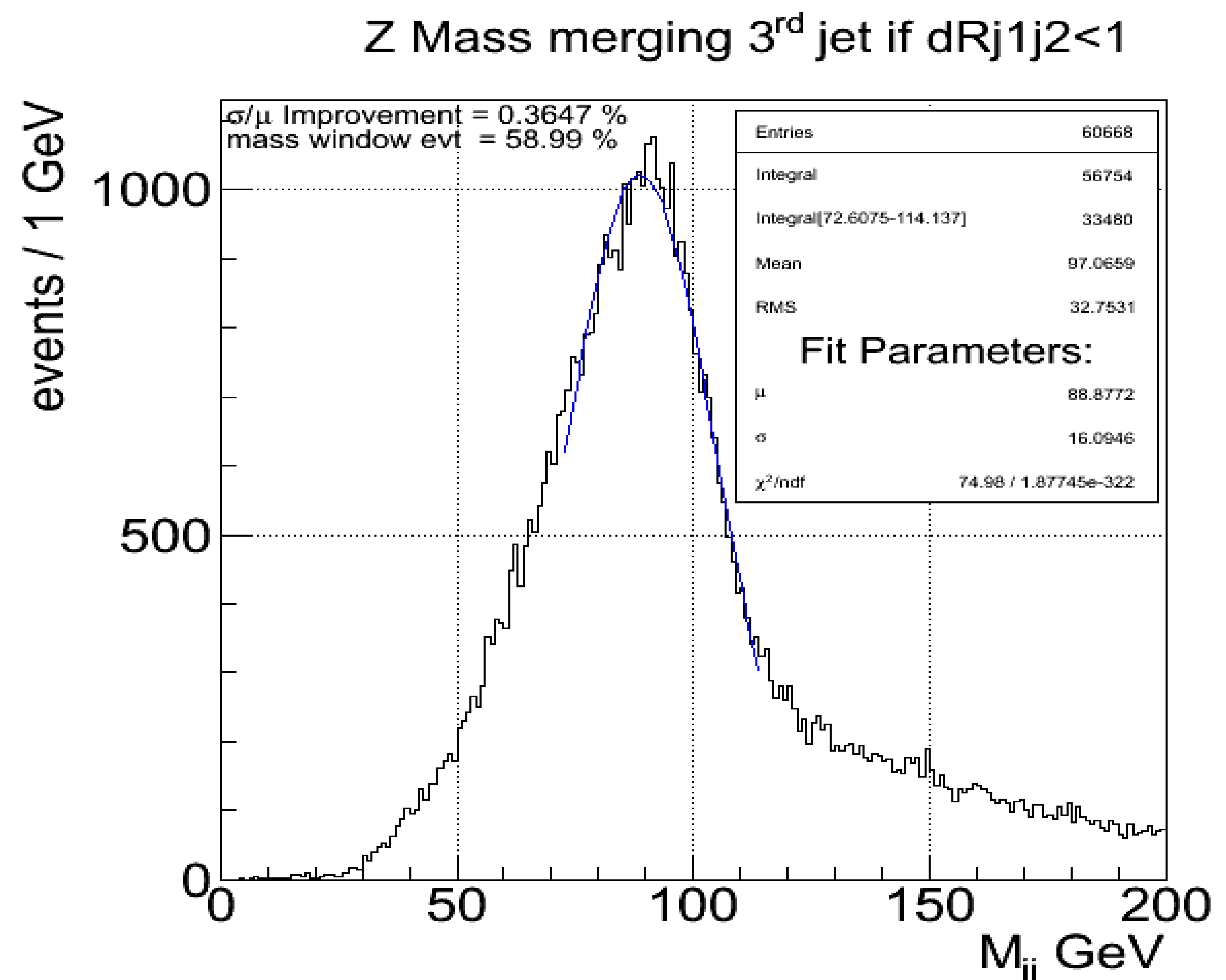


~3.7 % improvement s/peak

Extrajets Studies

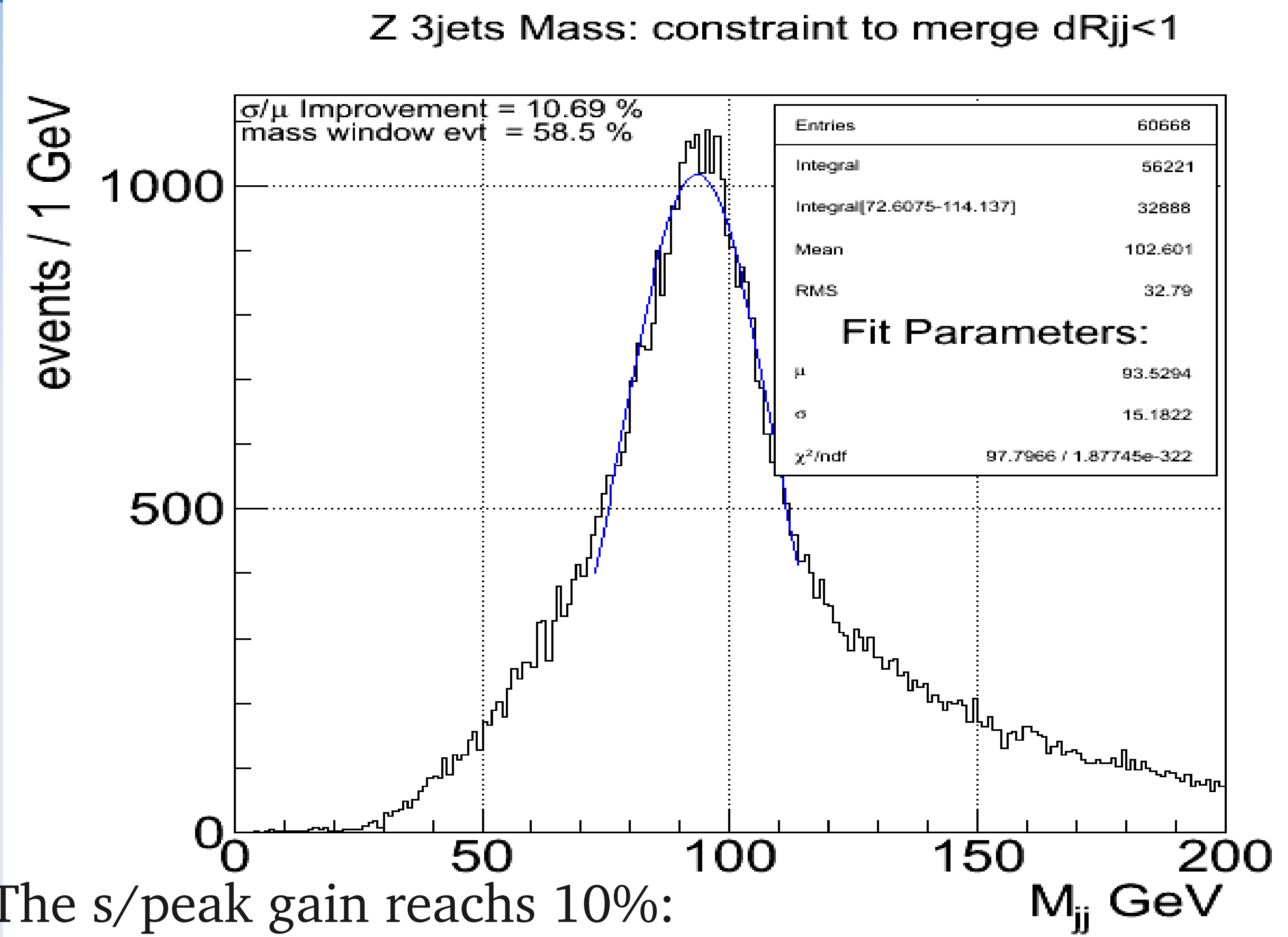


Extrajets Studies: low mass



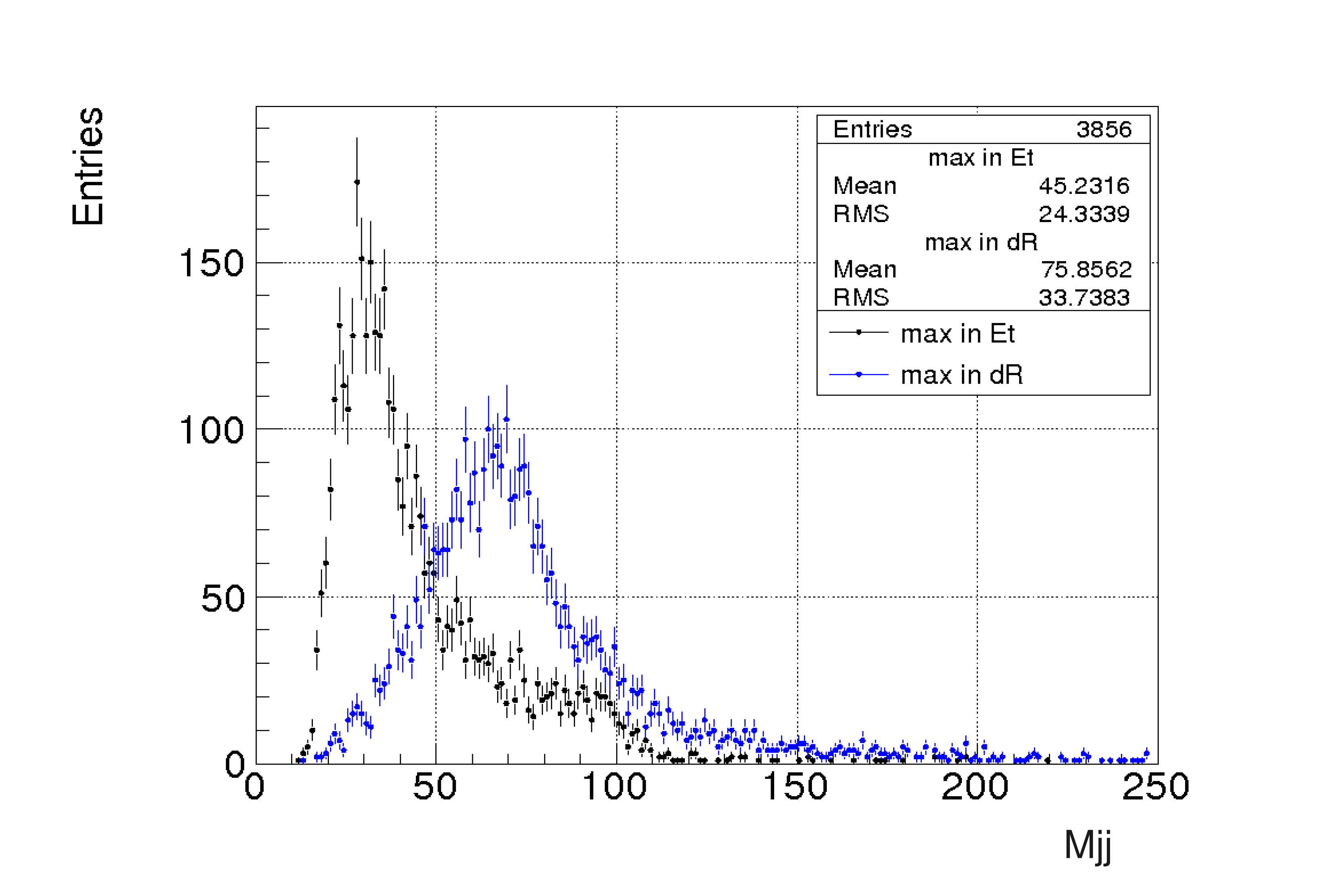
- The s/peak gain is not so good but the low mass tails are recovered;
- The number of events in the mass windows is improved.

Extrajets Studies: inclusive

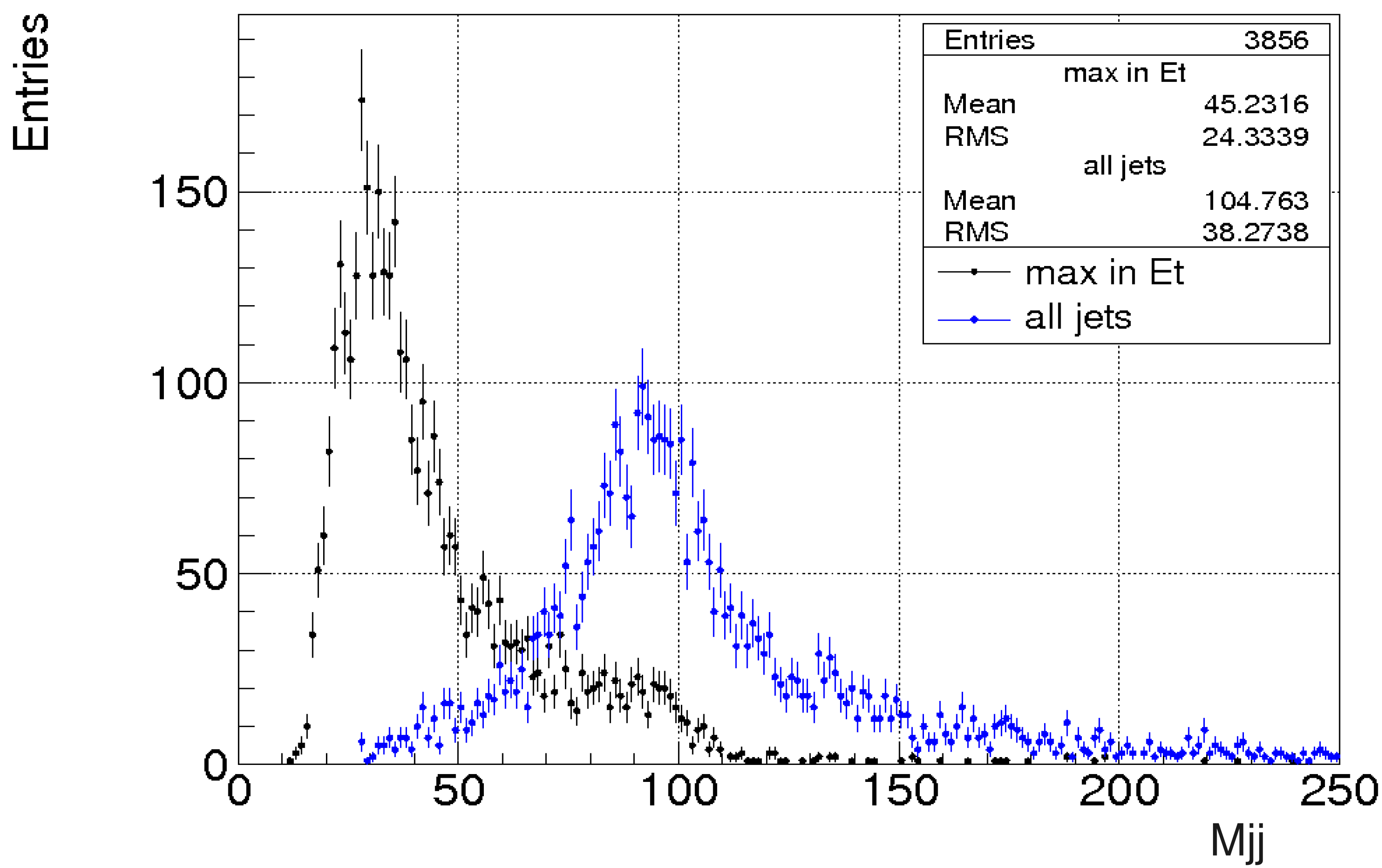


- The s/peak gain reaches 10%:
  - the low mass tails are recovered;
  - Also the number of events in the mass windows is improved.

Extrajets Studies



Extrajets Studies



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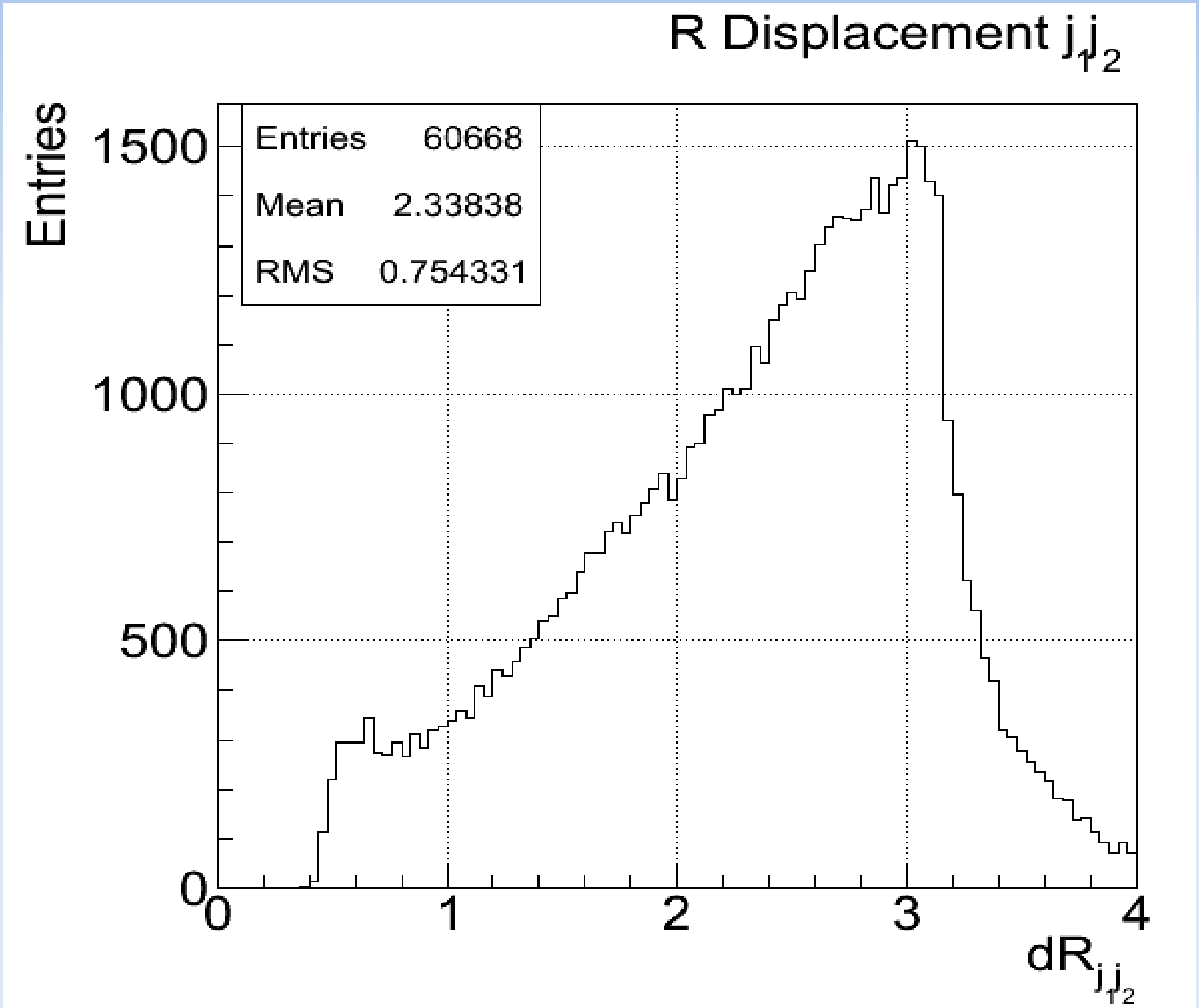

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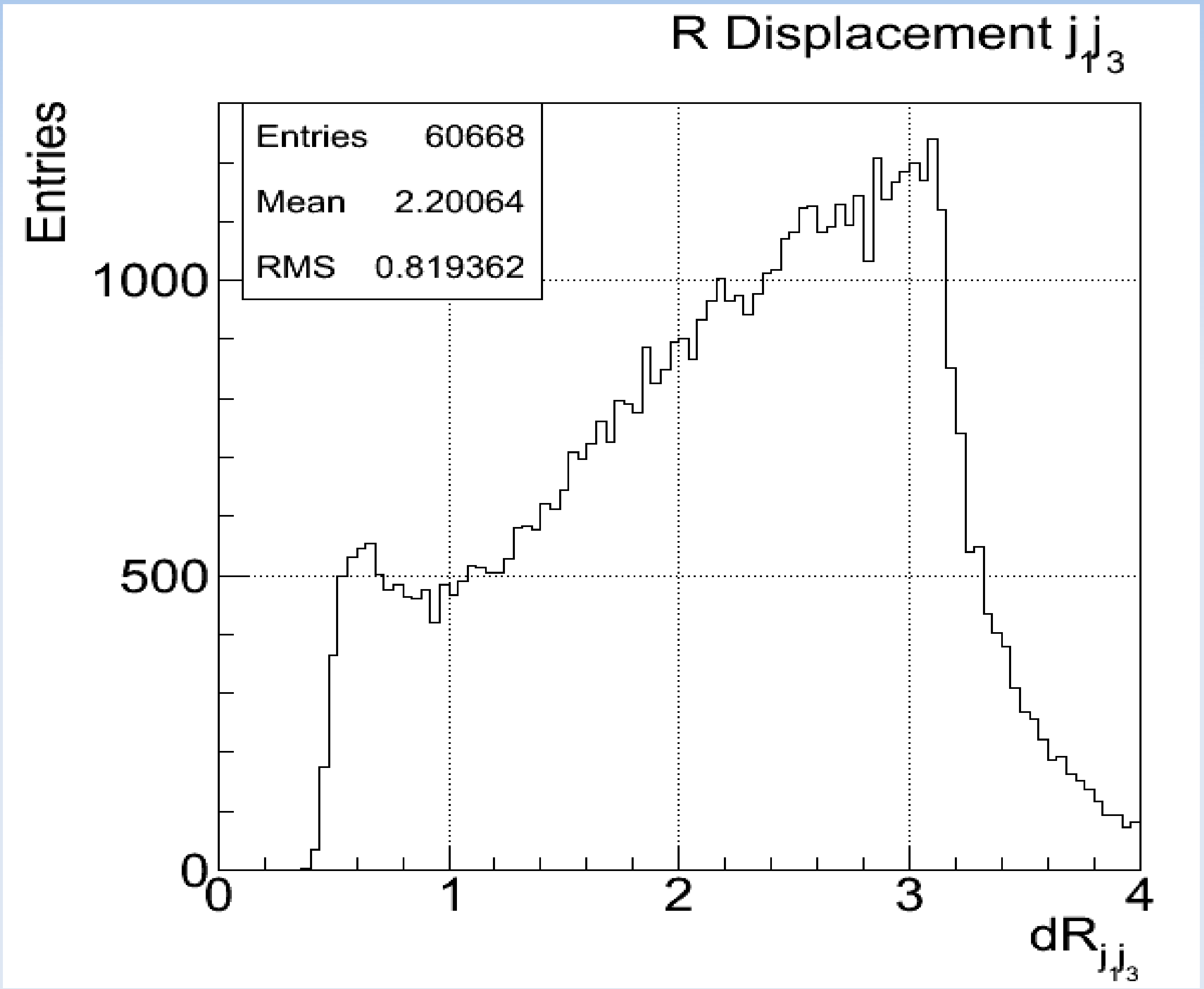

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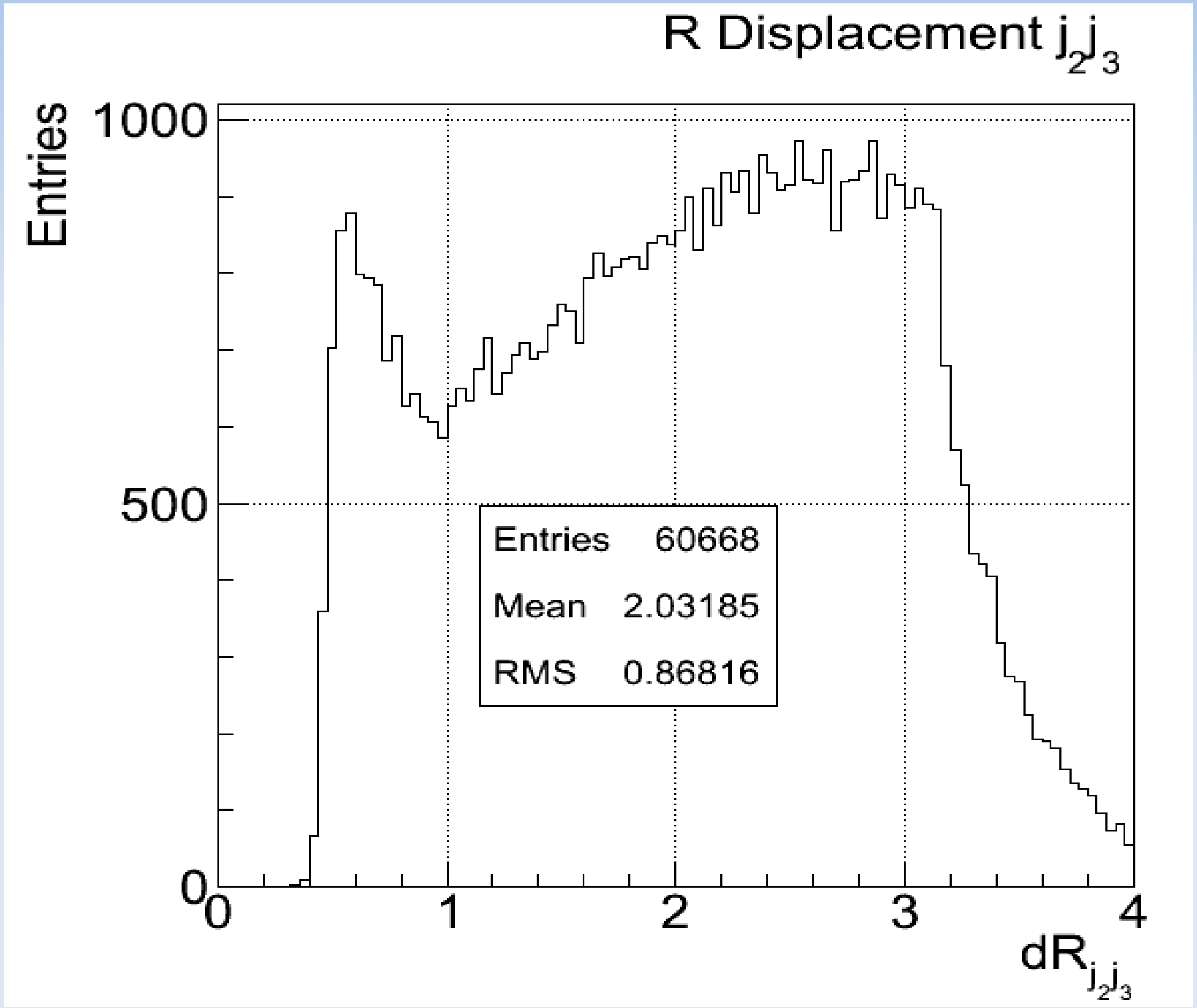

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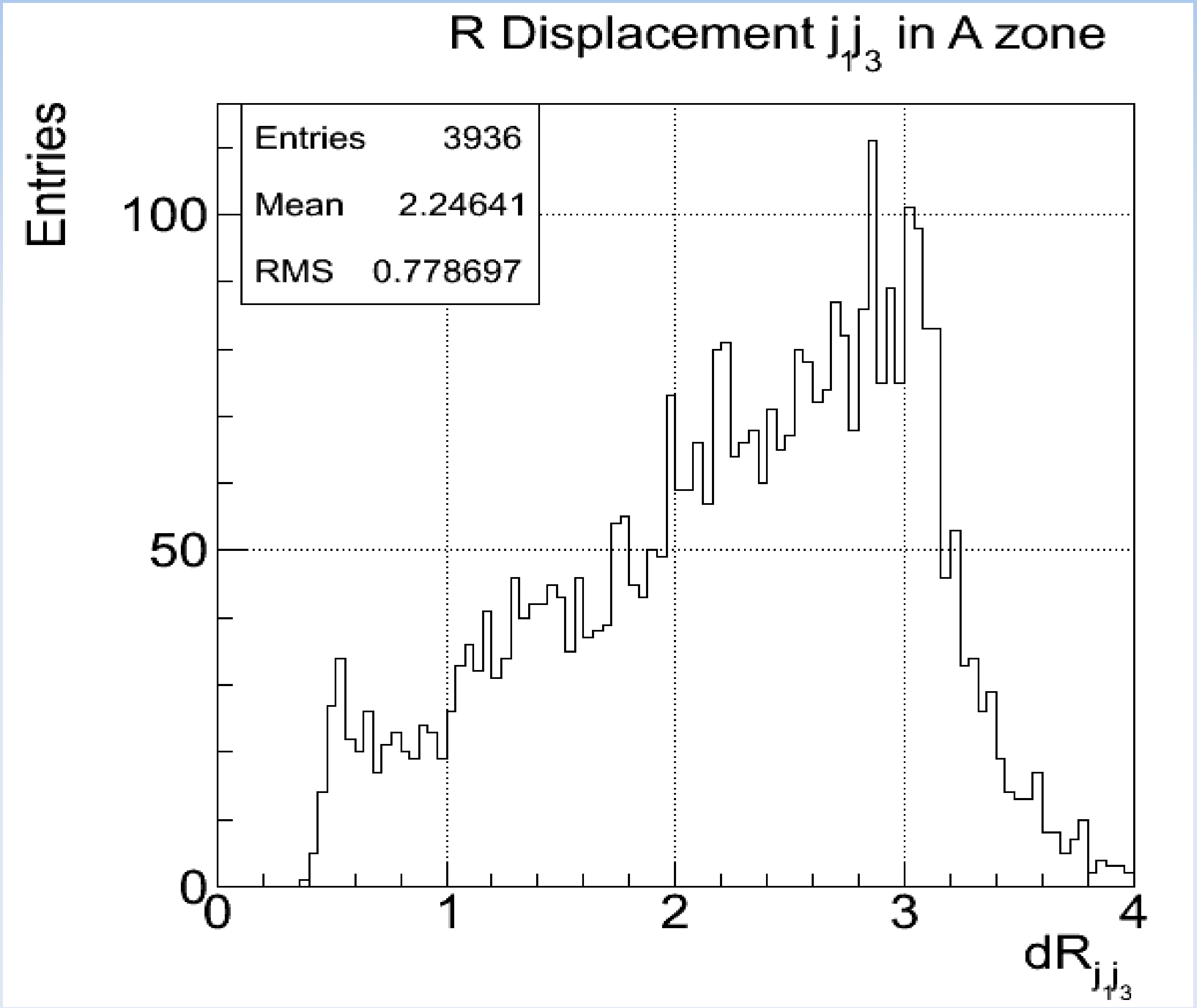

Extrajets Studies