Jiří Kvita

Institute of Particle and Nuclear Physics
Charles University, Prague
Czech Republic

Z+jet Closure Test JetCorr v5.3

JES Meeting

21st July 2004

Closure Test in Z+jet events

- Data: CSskim 2EMhighpt: p14.05.02, p14.06.00, p14.06.00-postNov2003, p13.0x-DST-p14.05.02-p14.06.00, all-p14.03-p14.fixtmb.01, will add p14.05.00-p14.fixtmb.02
- MC: Higgs group alpgen+pythia Z+jet$\rightarrow e^+e^-$+jet (req. IDs 11302-4).
- Cuts:
  - Exactly 1 jet and at least 2 EMs (trouble: in data I see only 1/3 of events with nEMs$\geq$2, although 2EM skim! Will investigate...)
  - Top Analyze EM criteria (loose): $|\eta_{\rm det}| < 2.5$, Emf$>$ 0.9, isolation$<$0.15, hmx7$<$50.0
  - Jet criteria – standard (Emf$\in$ (0.05, 0.95), chf$<$0.4, HotF$<$10, n90$>$1, E$>$0 ...)
  - Cut on all three objects' p_Ts of 15 GeV.
  - Both EMs: trackmatch, in EC or CC, in fiducial volume.
  - For Z 10 GeV mass window around the pole mass.
  - Back–to–backness of Z and jet: "$\Delta\phi \geq 2.9$".
  - Only good runs (any MUO, good JET, MET, any CTT, not bad CFT, SMT, CAL)

Analysis

- Top Analyze Stradivarius compiled with JetCorr v5.3
- t42 applied on MC and data (already fixed TMBs), smearing ON for MC.
- Studied two imbalance variables as functions of p_T^Z and $\eta_{\rm jet}^{\rm det}$:
  - $\Delta\mathcal{S} \equiv \dfrac{p_{\rm T}^{\rm jet} - p_T^Z}{p_T^Z}$
  - According to Ia (JES 3/17/04) I projected the *vector sum* of p_Ts onto the bisector of two EMs:

$$\Delta\mathcal{B} \equiv -\frac{p_{\rm T}^{\rm jet}\cos(\phi_a' - \phi_{\rm jet}) + p_T^{e1}\cos(\phi_a' - \phi_{e1}) + p_T^{e2}\cos(\phi_a' - \phi_{e2})}{p_T^Z}$$

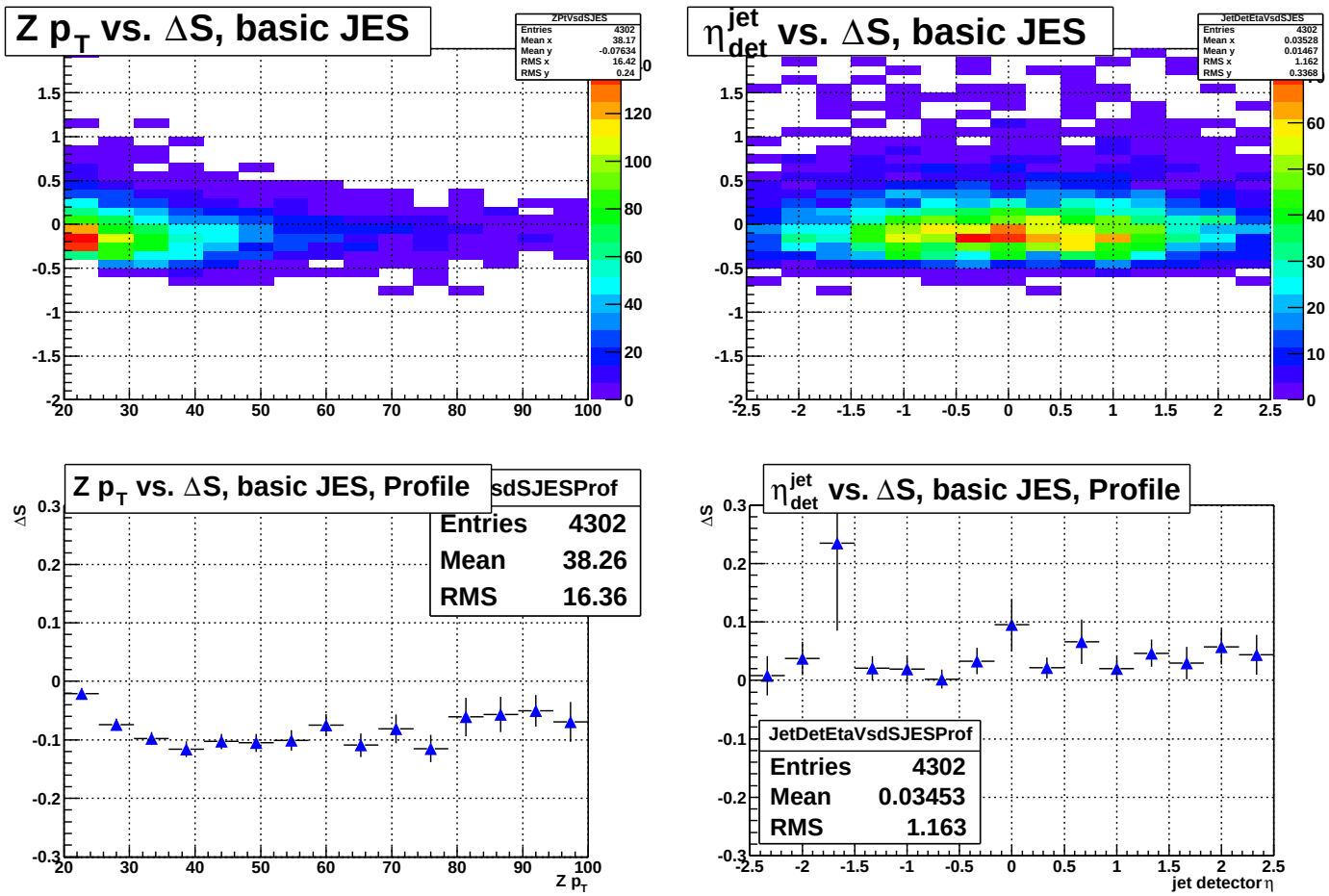
where $\phi_a' \equiv \tan^{-1}\dfrac{p_T^{e1}\sin\phi_{e1} + p_T^{e2}\sin\phi_{e2}}{p_T^{e1}\cos\phi_{e1} + p_T^{e2}\cos\phi_{e2}}$

- One would expect a perfect balance if not for radiation, 8 GeV cut on jets and JES error.

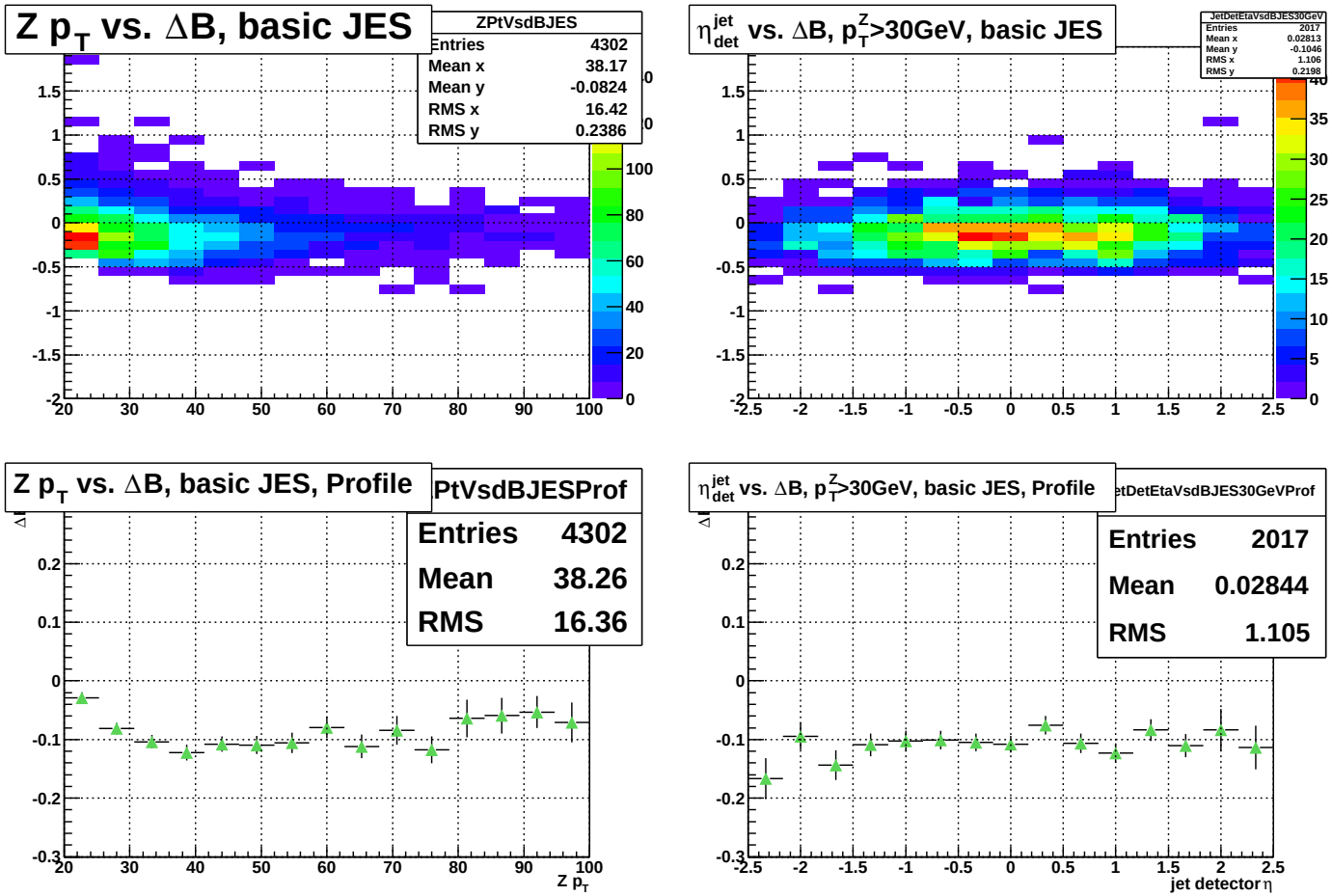
Analysis (continued:)

- Data:
  - Events to be processed: 2.4M
  - With both track–matched EMs only 309 events survived.
  - With at least 1 trkmatch 566 events...
- MC:
  - Events to be processed: 123k
  - With both track–matched EMs 4302 events survived.
  - With at least 1 trkmatch 5782 events.
- Problem with tails to large $\Delta\mathcal{B}$ values at low p_T^Z. This treated in $\Delta\mathcal{B}(\eta_{\rm jet}^{\rm det})$ dependence as follows:
  - For MC created the η profile with $p_T^Z > 30\,\mathrm{GeV}$.
  - As this is still running on Data, I used TH3Fs I already had ($\Delta\mathcal{B} - p_T^Z - \eta_{\rm jet}^{\rm det}$, $\Delta\mathcal{B} - \phi_{\rm jet}^{\rm det} - \eta_{\rm jet}^{\rm det}$) and made appropriate projections and profiles. However, I got different results depending on type of parentage TH3F; will investigate.

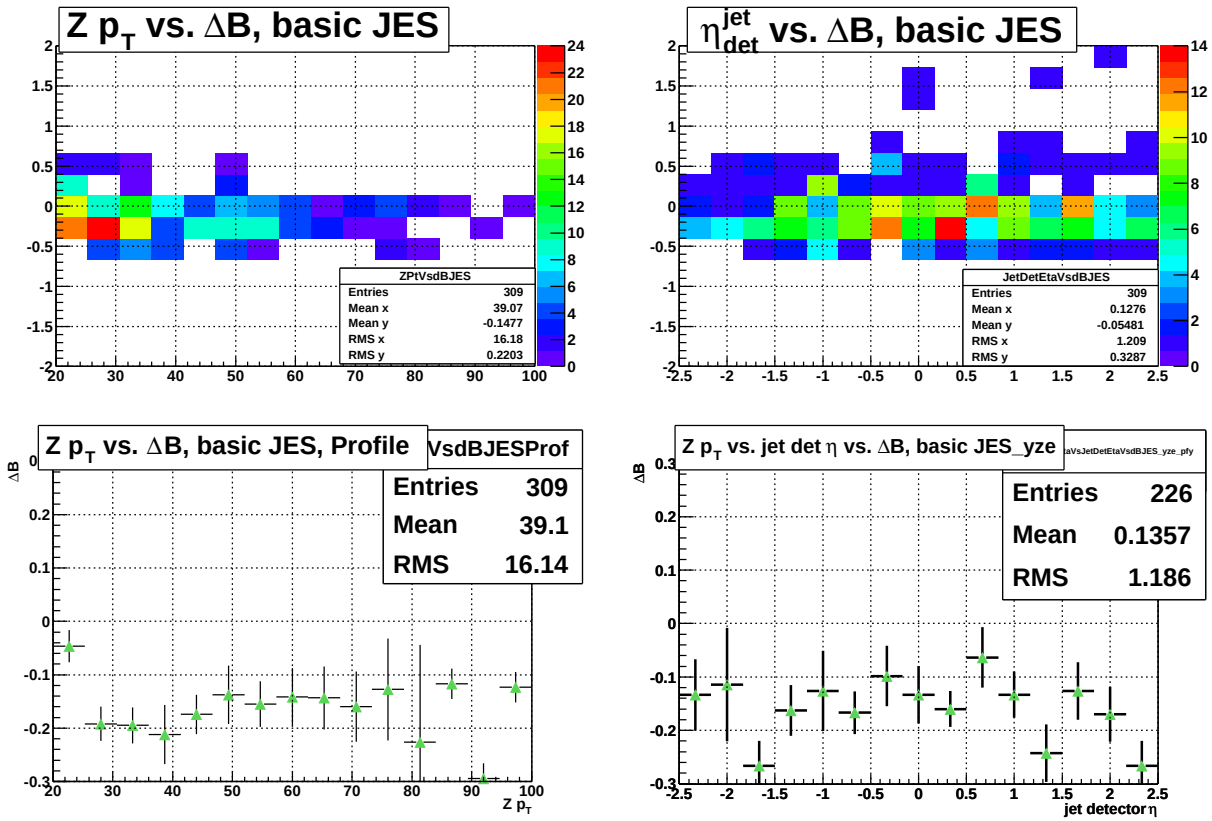
MC $\Delta\mathcal{S}$ without the 30 GeV cut on p_T^Z



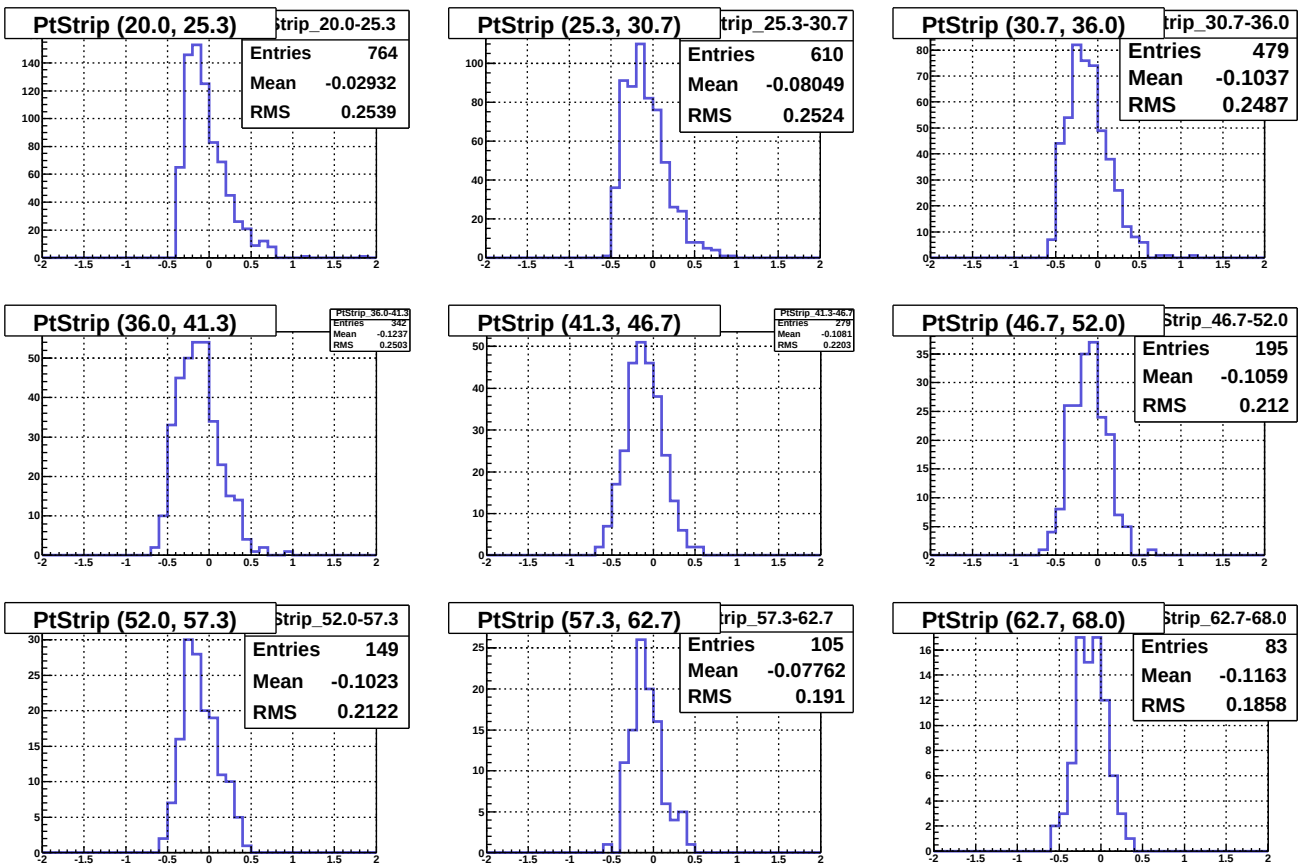
MC $\Delta\mathcal{B}$ with 30 GeV cut on p_T^Z in η dependence



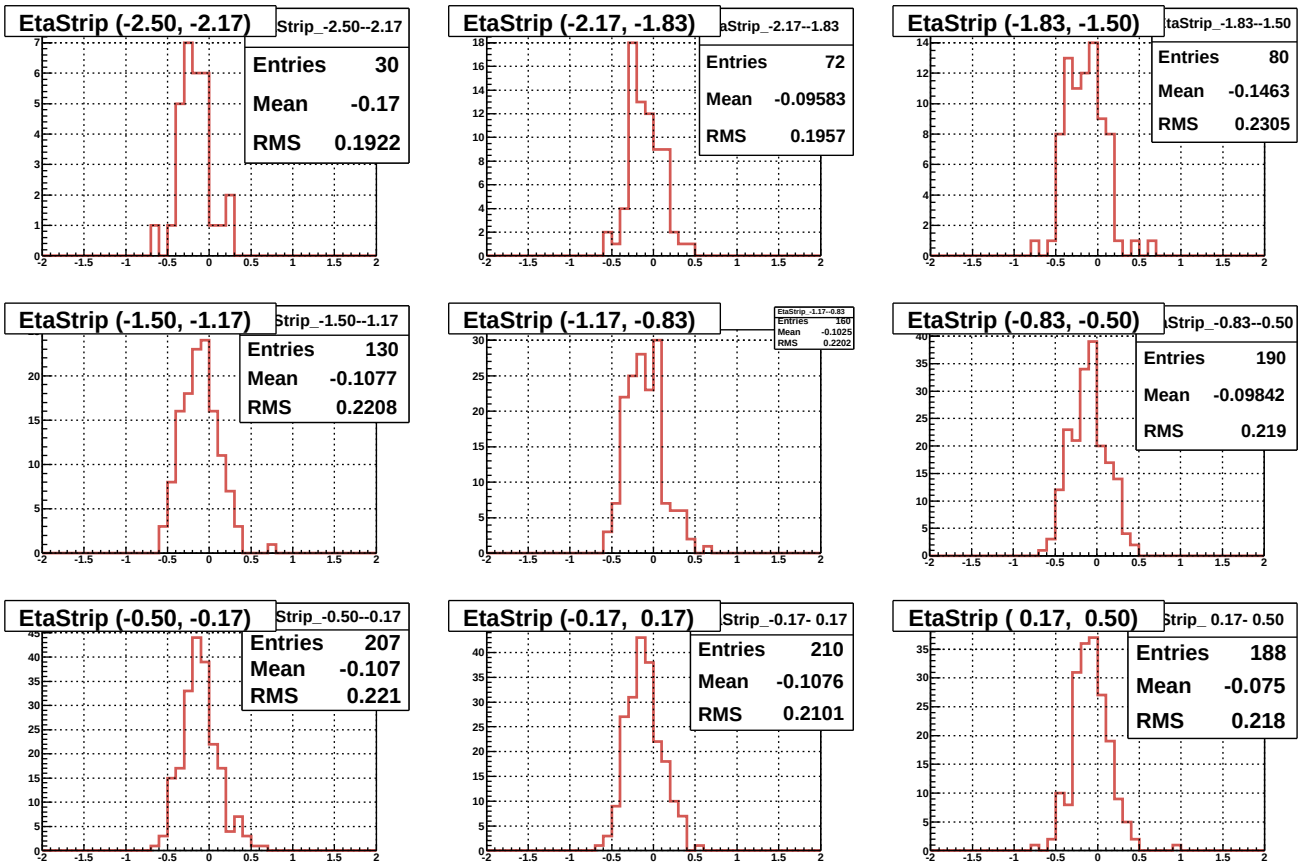
Data $\Delta\mathcal{B}$, η dependence corrected from TH3Fs



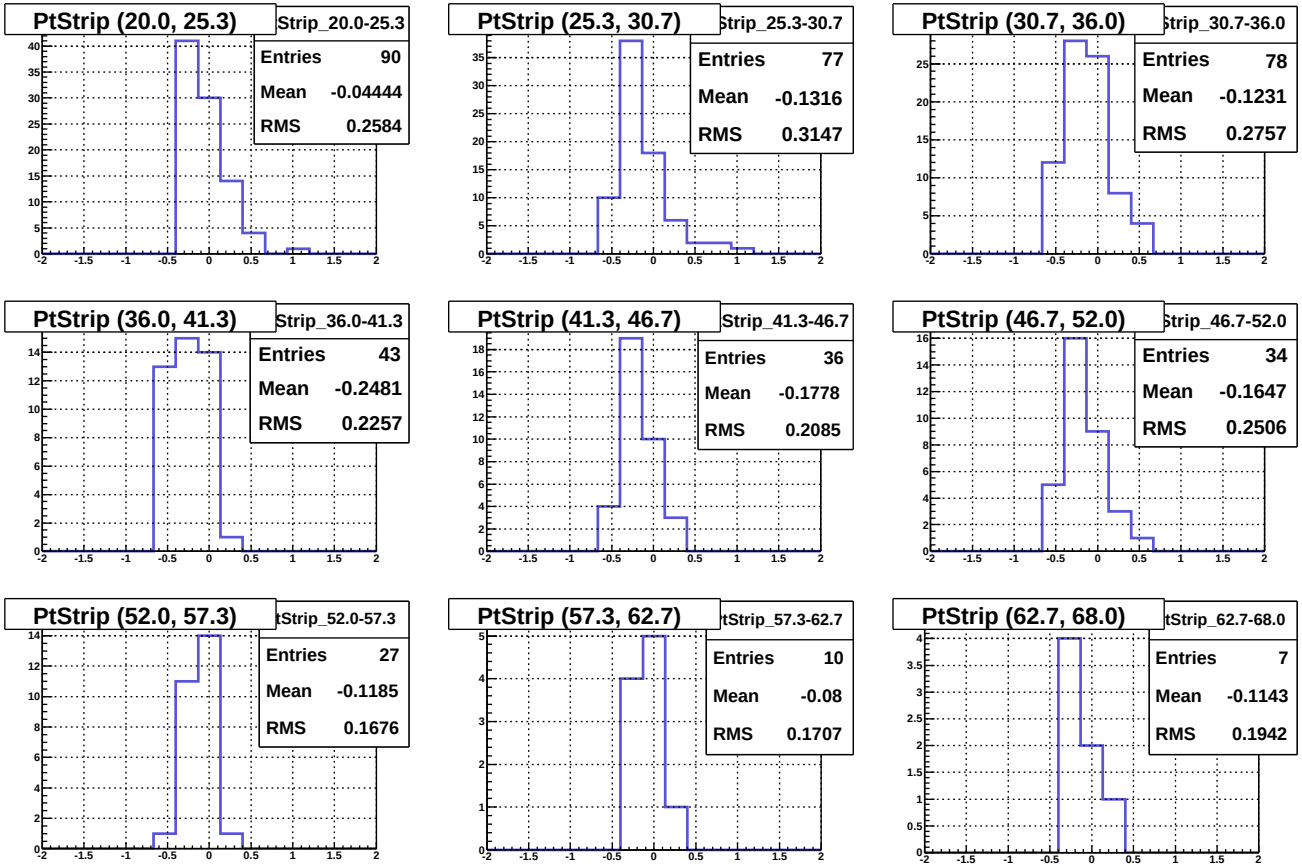
MC, Strips in p_T^Z



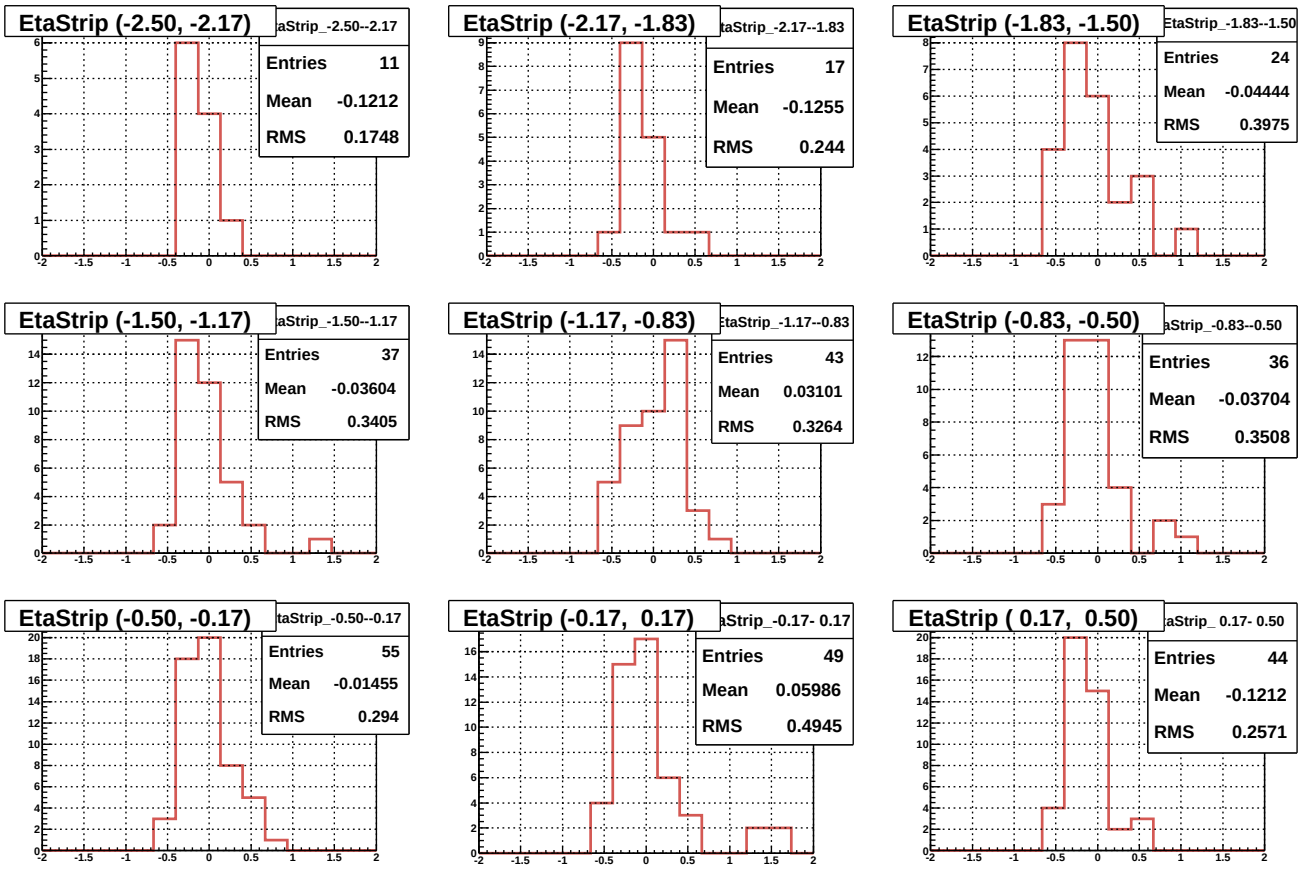
MC, Strips in $\eta_{\rm jet}^{\rm det}$



Data, Strips in p_T^Z, one trkmatch



Data, Strips in $\eta_{\rm jet}^{\rm det}$, one trkmatch



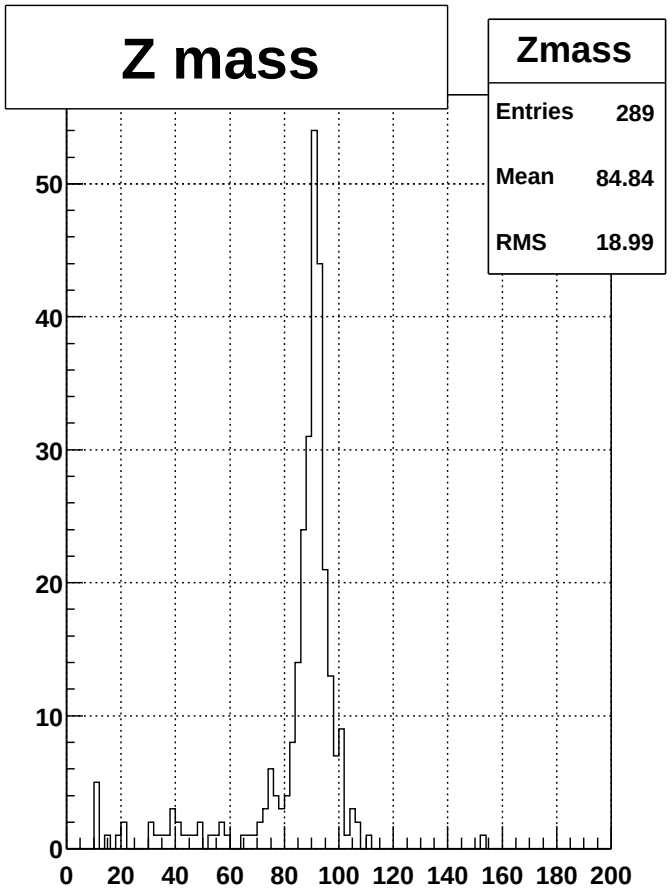
Observations

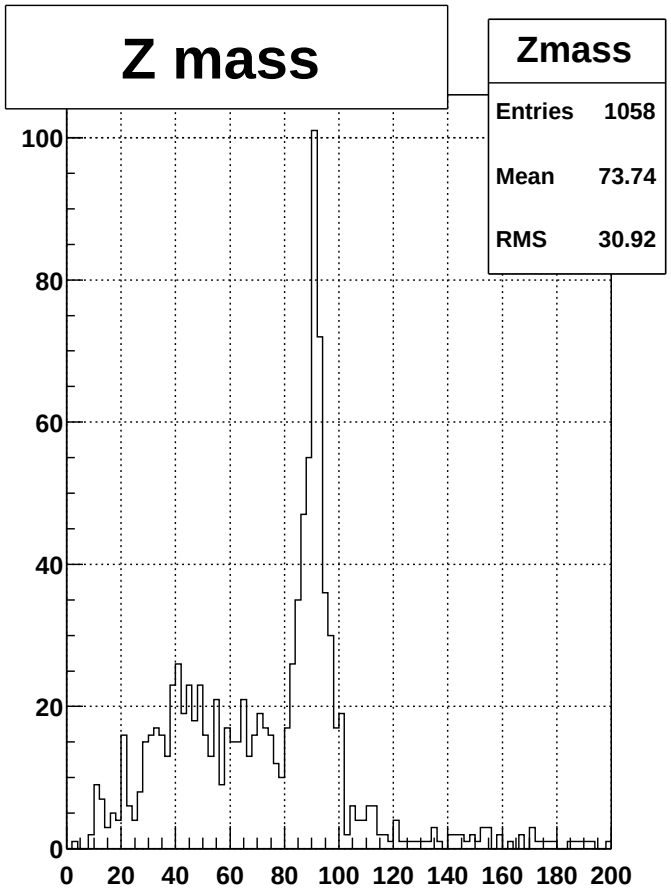
- Observations:
- Data seem to be in 15–20% bands – unacceptable?
- Correlations of $\Delta\mathcal{B}$ and $\Delta\mathcal{S}$ is 0.9997 (doesn't matter which to use).
- MC:
  - Without 30 GeV cut, η dependence is brought to ZERO by tail events.
  - After the cut, one gets $\Delta\mathcal{B}$ and $\Delta\mathcal{S}$ within 10–15% band UNDER ZERO (undercorrected jet), as expected from p_T dependence. Similar feature seen in Data. Also, the cut removes one third to one half events...
- Where are my Zs?! DØ has already seen almost 6k, but I see about 1.2k requiring only at least one trkmatch...

To Do

- Enlarge statistics in data.
- I didn't do η corrections as plots not fuly understand, low statistics and flat curve in MC.
- Reshape MC p_T spectra according to data?
- Tighten back–to–backness cut (now looser due to statistics)?
- Triggers
- Misc.: using *at least one track match* instead of two - see support slides
- Study my cuts further, mainly topology.

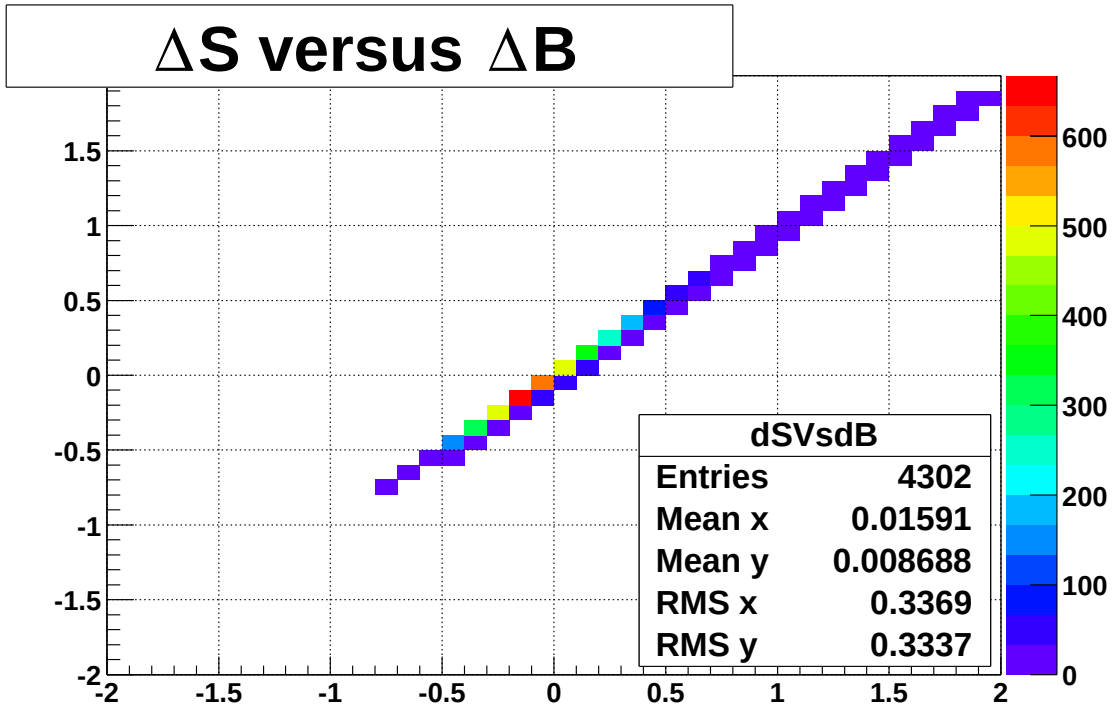
Support Slides – Two And One trkmatch Z



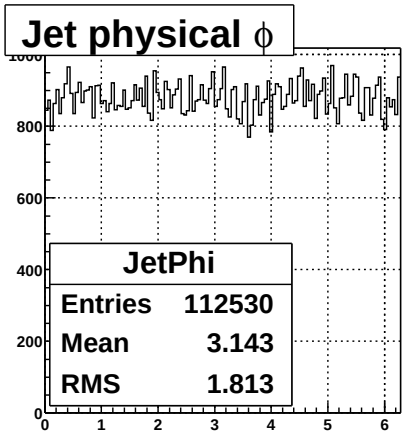


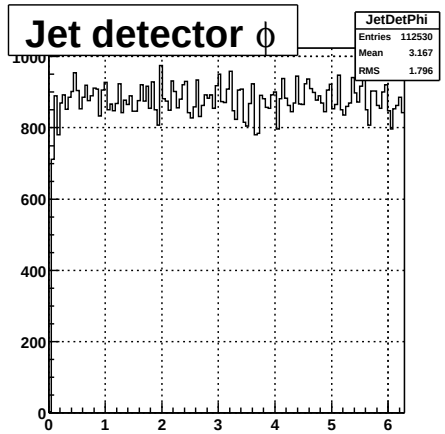
Correlation in $\Delta\mathcal{B}$ and $\Delta\mathcal{S}$ in MC

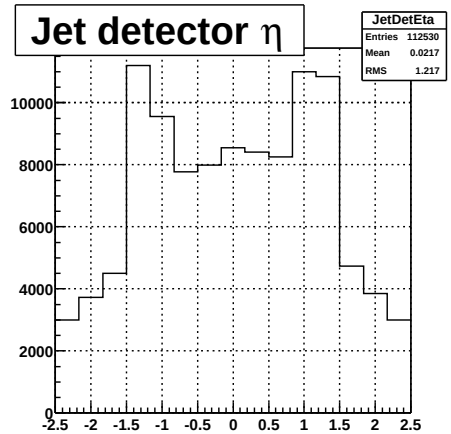
- Correlation coeficient: 0.9997

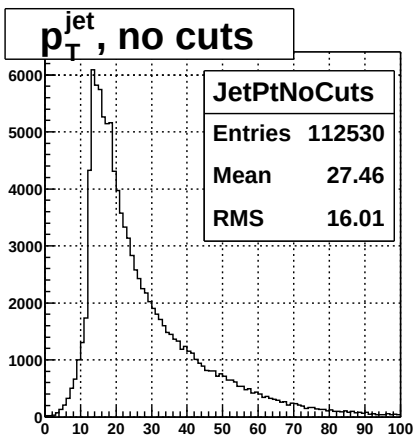


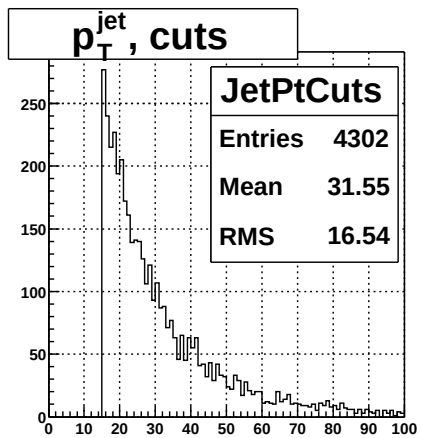
MC Jets, no cuts

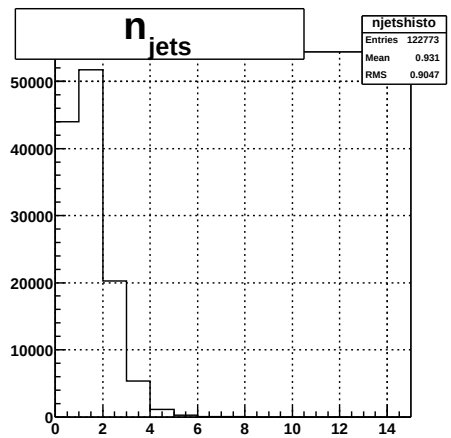




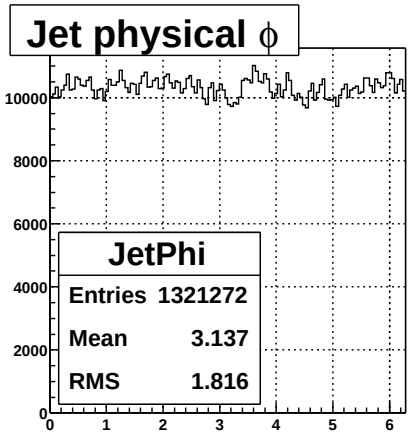


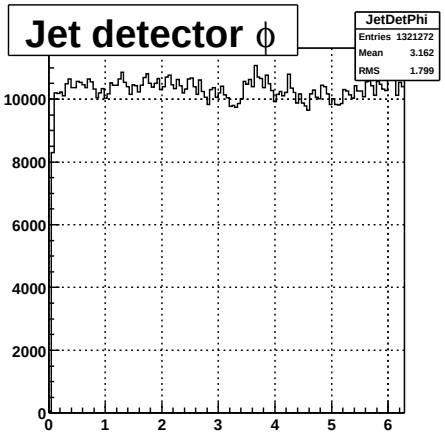


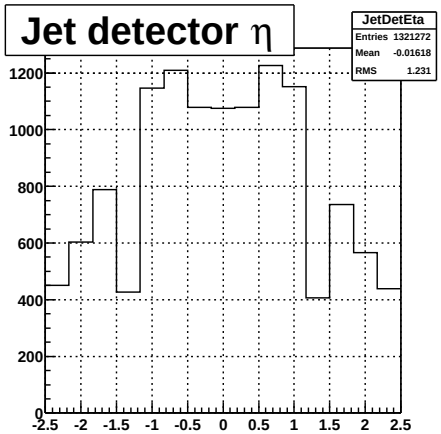


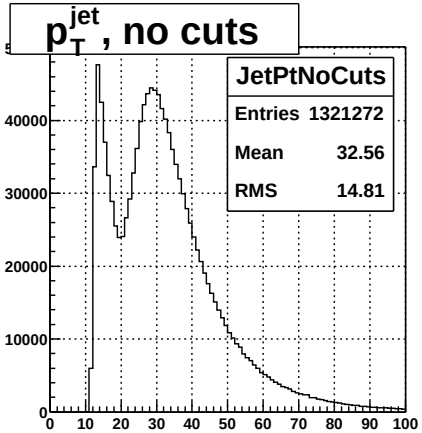


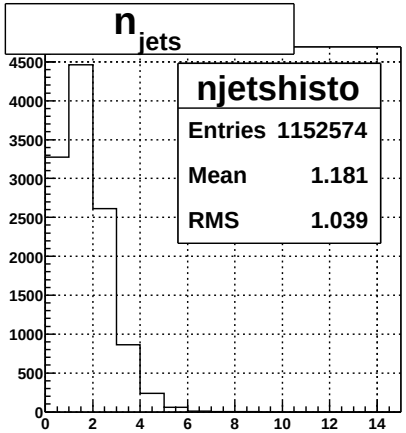
Data Jets, no cuts



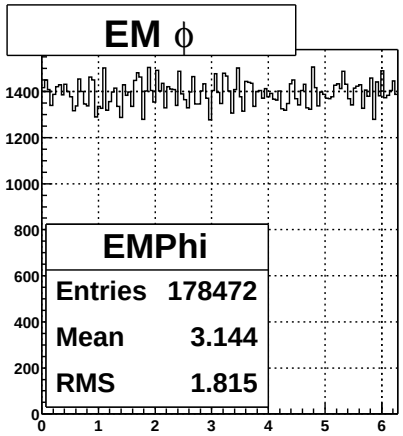


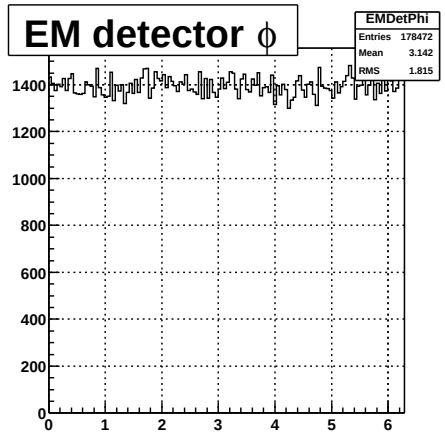


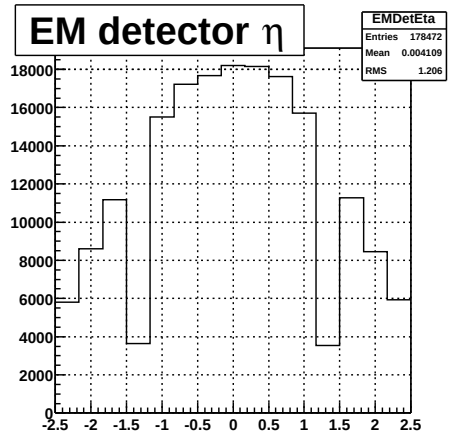


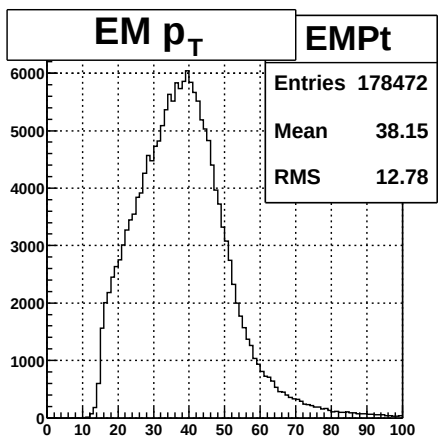


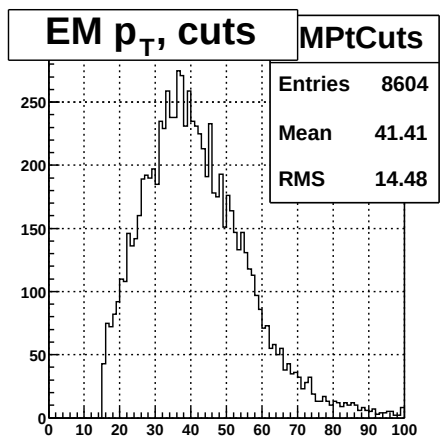
MC EMs, no cuts

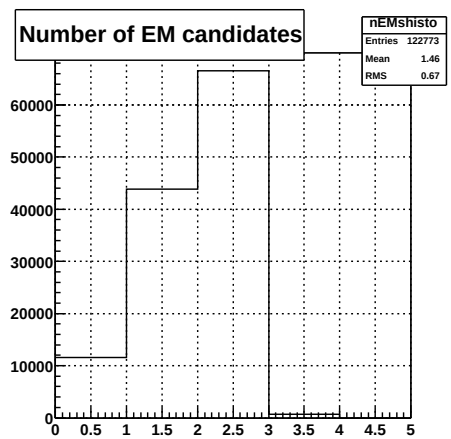




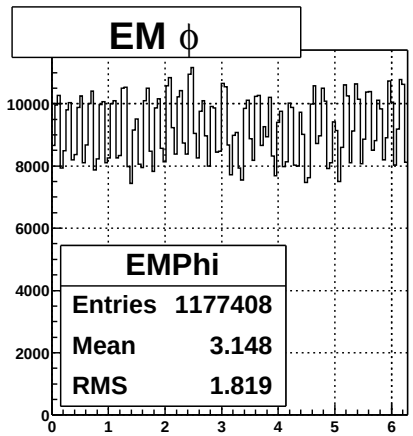


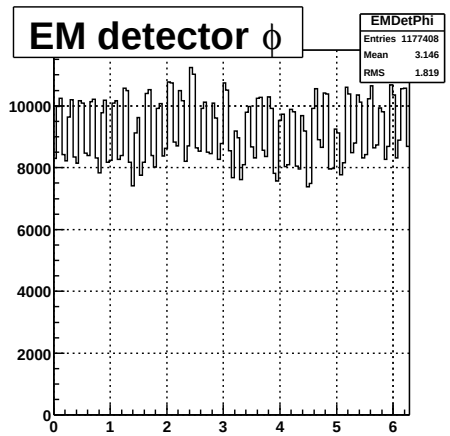


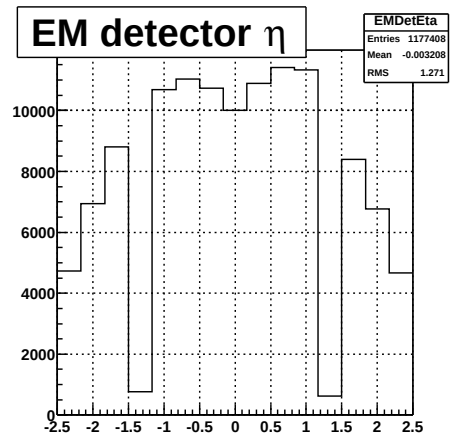


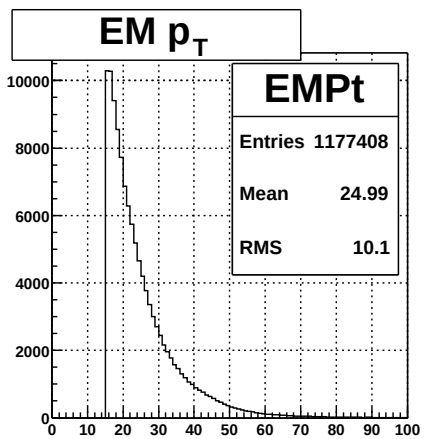


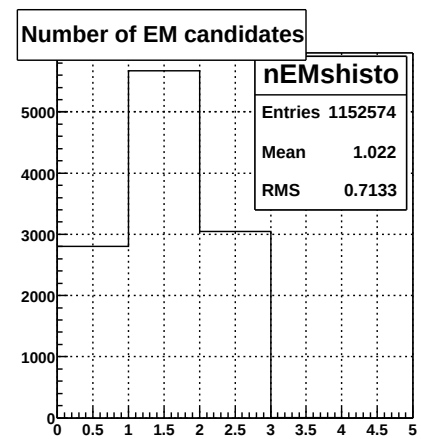
Data EMs, no cuts



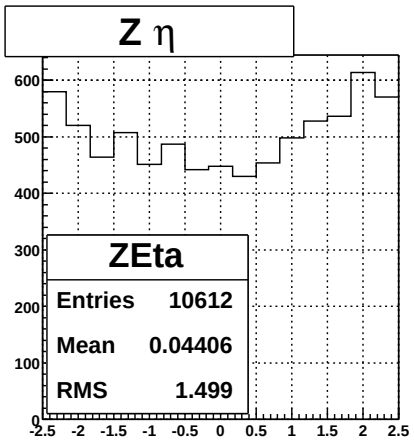


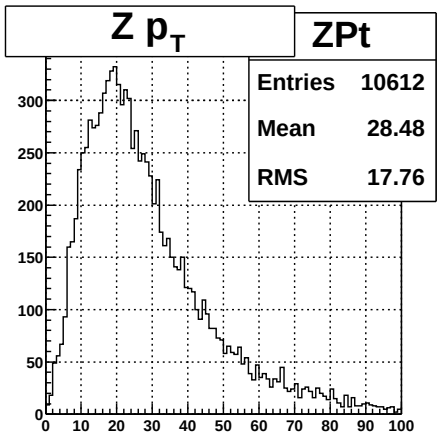


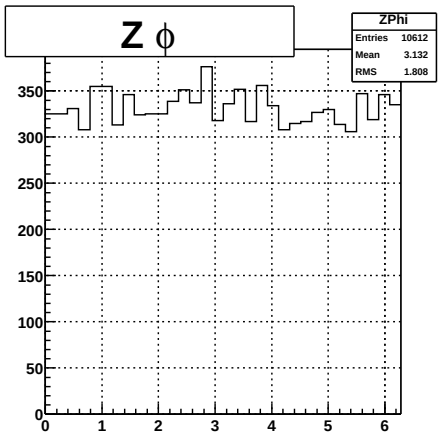


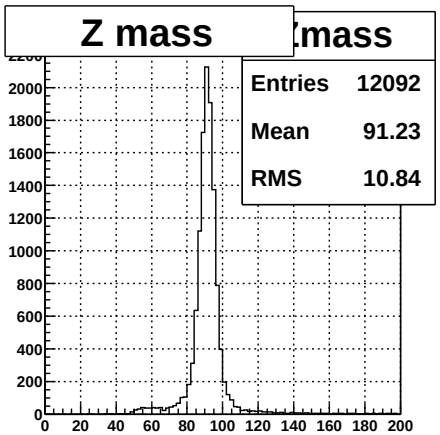


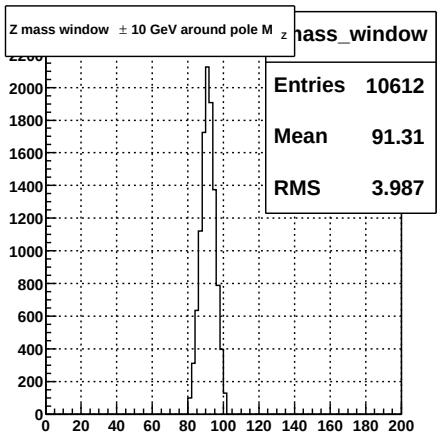
MC Z


Z η
ZEta
Entries 10612
Mean 0.04406
RMS 1.499

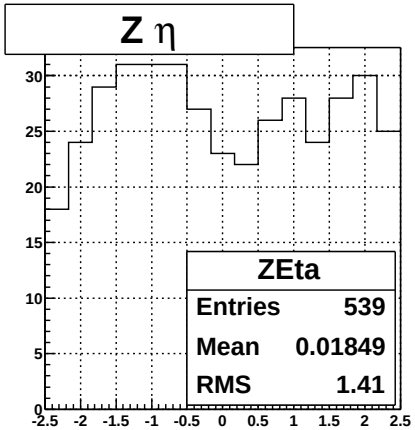

Z p_T
ZPt
Entries 10612
Mean 28.48
RMS 17.76

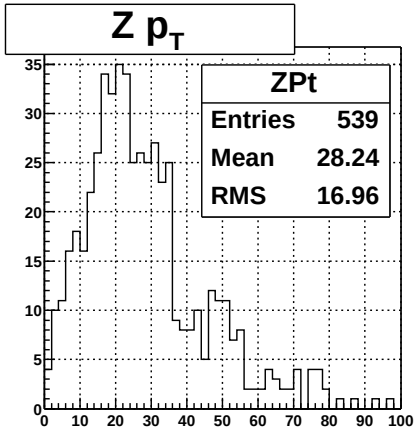

Z ϕ
ZPhi
Entries 10612
Mean 3.132
RMS 1.808

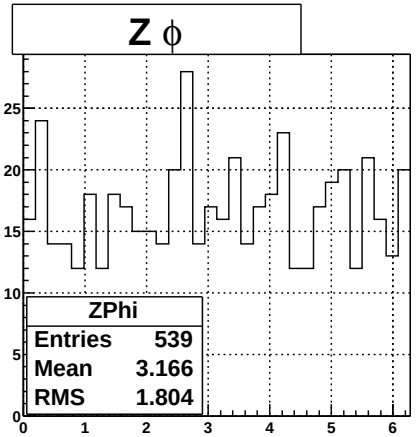

Z mass
Zmass
Entries 12092
Mean 91.23
RMS 10.84

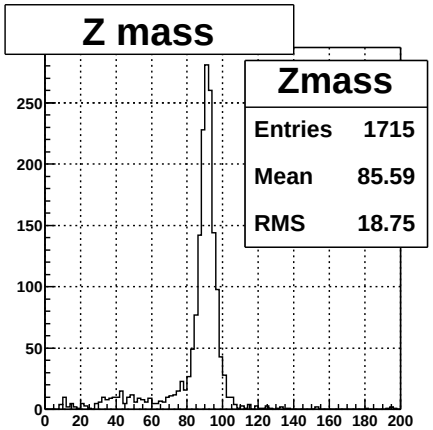

Z mass window ± 10 GeV around pole M z
mass_window
Entries 10612
Mean 91.31
RMS 3.987

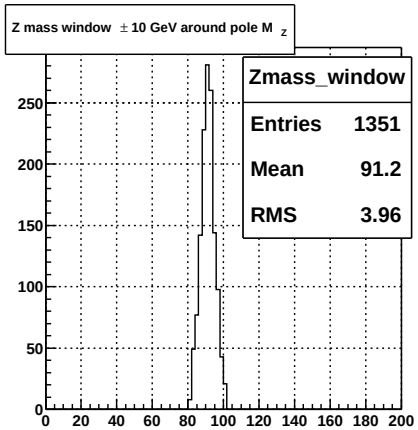
Data Z


Z η
ZEta
Entries 539
Mean 0.01849
RMS 1.41

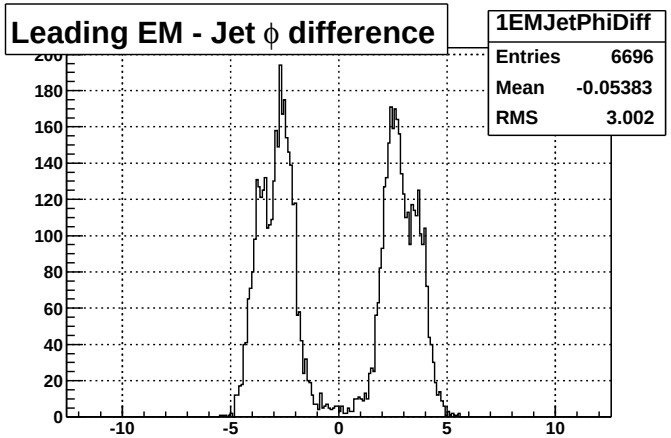

Z p_T
ZPt
Entries 539
Mean 28.24
RMS 16.96

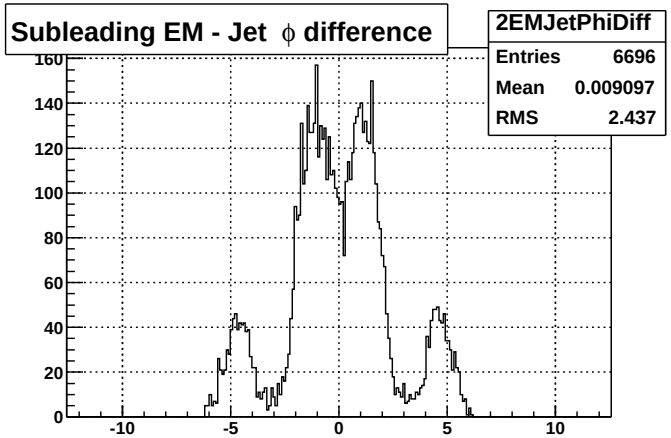

Z ϕ
ZPhi
Entries 539
Mean 3.166
RMS 1.804

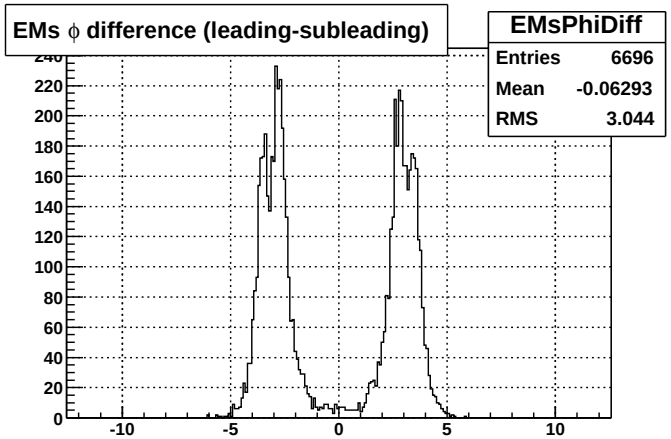

Z mass
Zmass
Entries 1715
Mean 85.59
RMS 18.75


Z mass window ±10 GeV around pole M z
Zmass_window
Entries 1351
Mean 91.2
RMS 3.96

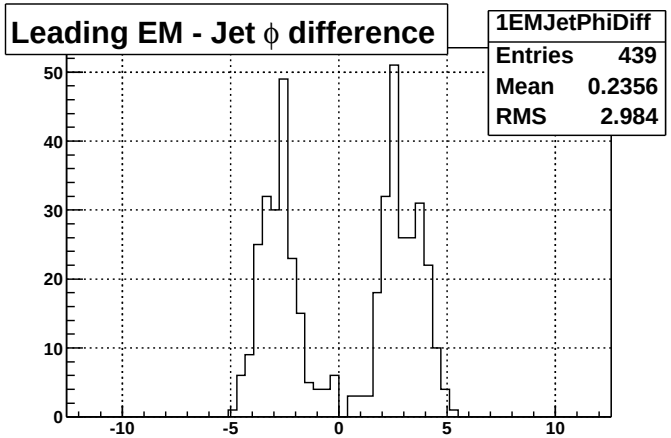
MC EMs ϕ study

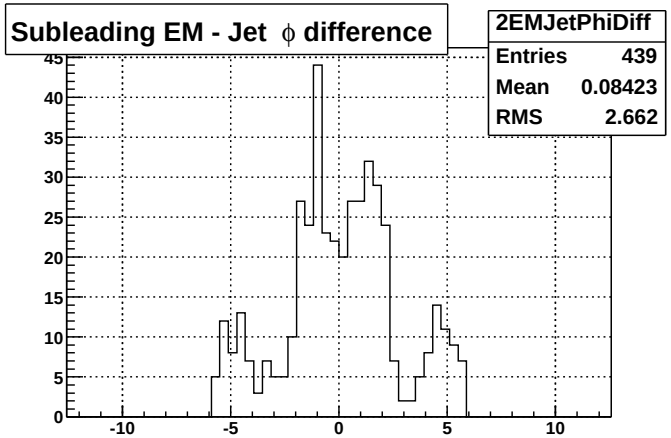


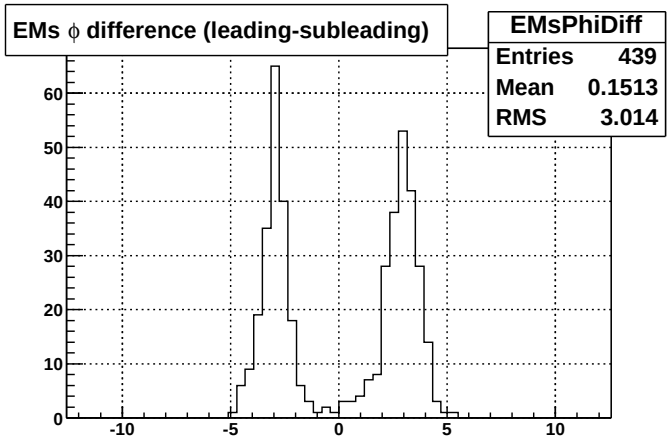
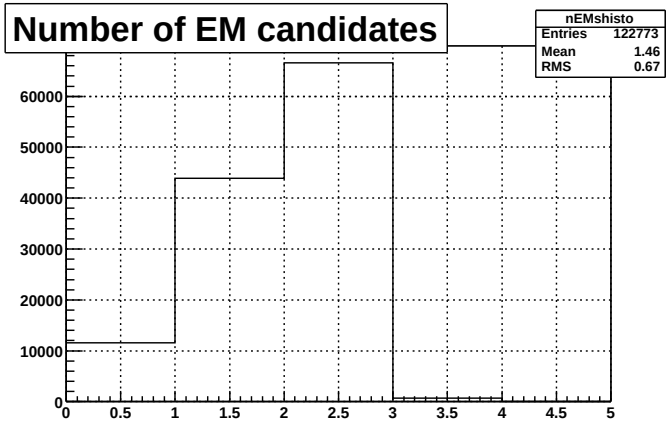
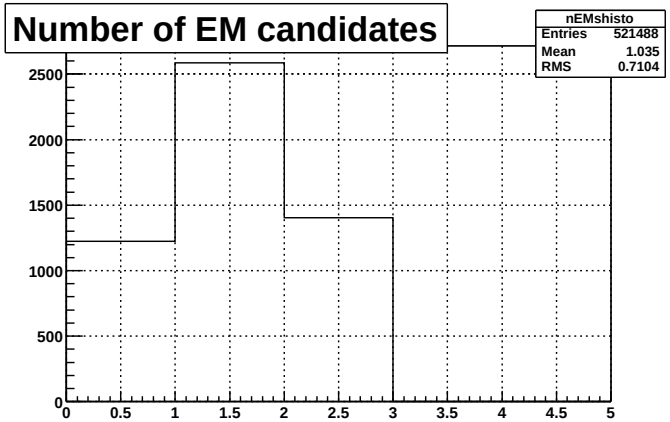




Data EMs ϕ study







Problem with nEMs in MC (left) and data