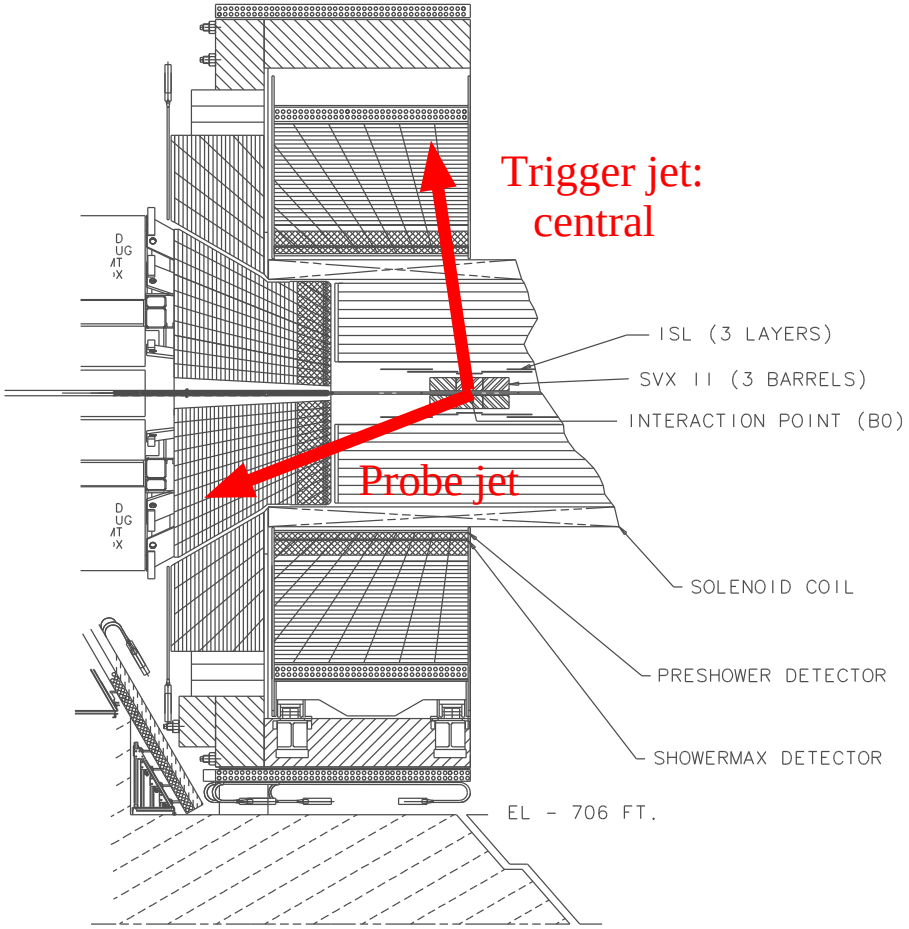
Warning notice: nasty bug in **PhysicsTower** class

Description: individual tower variables correction for z-vertex is wrong (flawed θ,η,E_T and derived functions)

Dijet balancing



Runs # 138425–140888

Jet_20 sample / R_{cone}=0.7

Cuts:

- |z-vertex| < 40 cm (FastZ)
- $0.2 < |\eta_{trigger}| < 0.8$
- E_T trigger jet > 20 GeV
- E_T 3rd jet < 15 GeV
- E_T trigger+probe > 40 GeV
- $\Delta\phi_{jj} > 2.7$

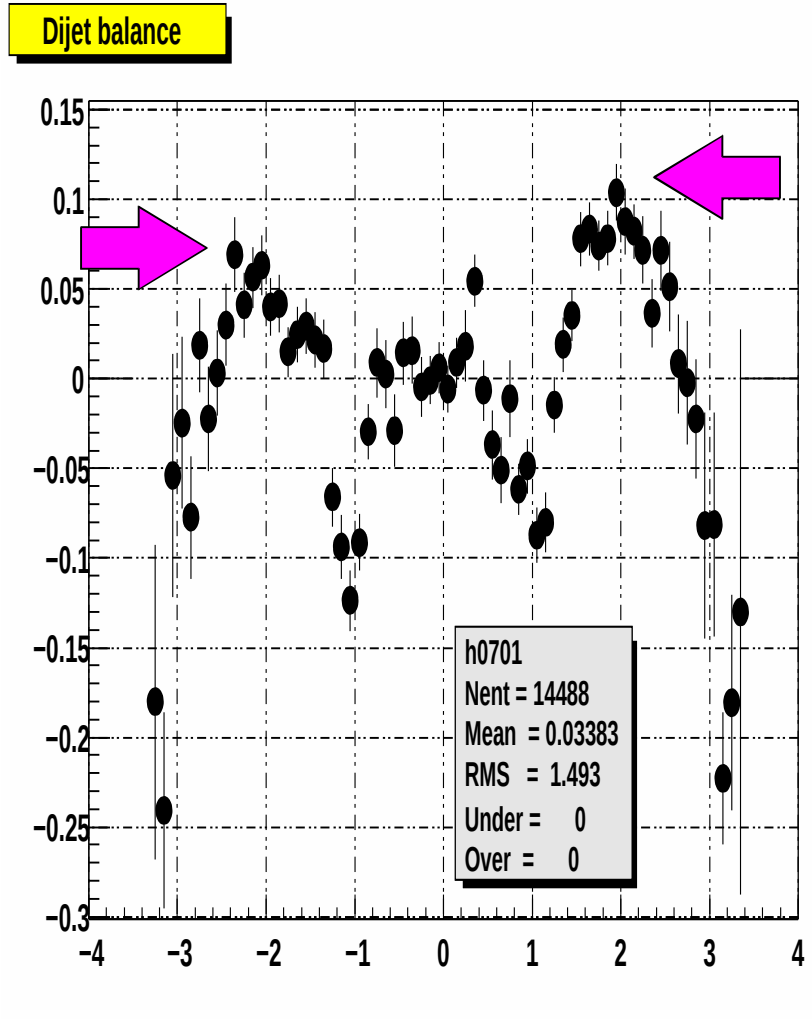
Probe jet randomly assigned when both jets are central

$$MPF = \frac{2\cdot\left(P_T^{probe} - P_T^{trigger}\right)}{P_T^{probe} + P_T^{trigger}}$$

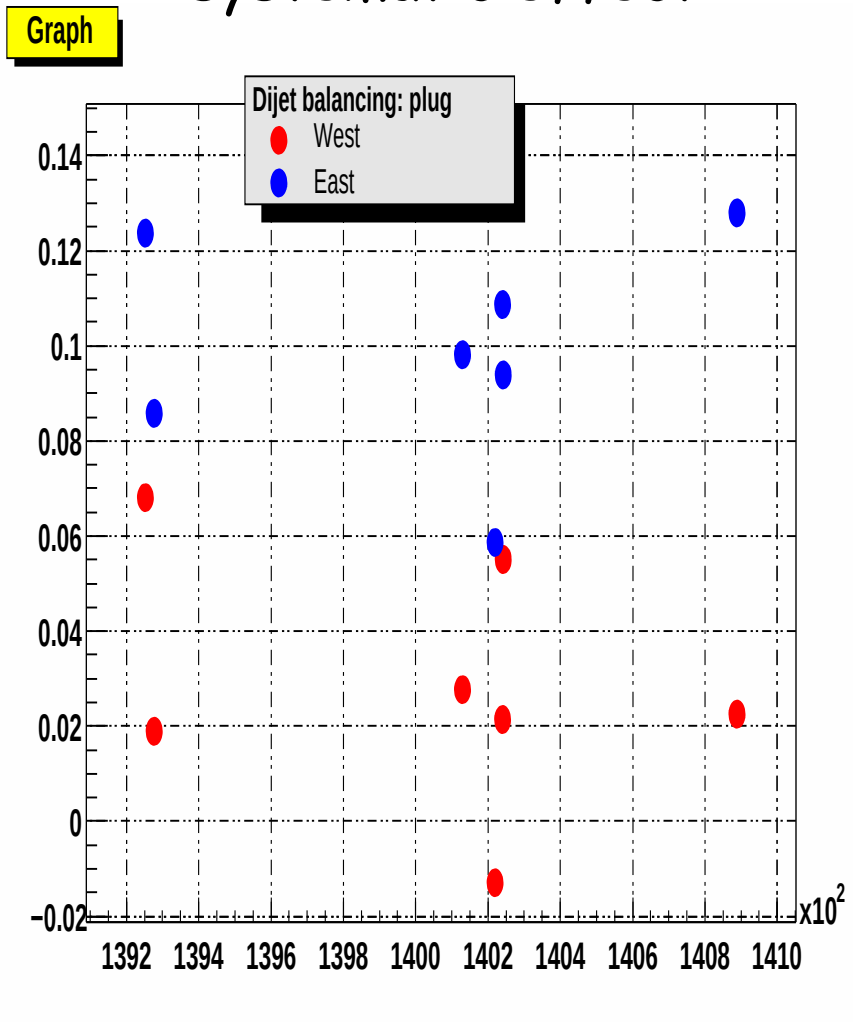
(cf e.g. CDF note #1513)

East/West asymmetry ??

systematic effect

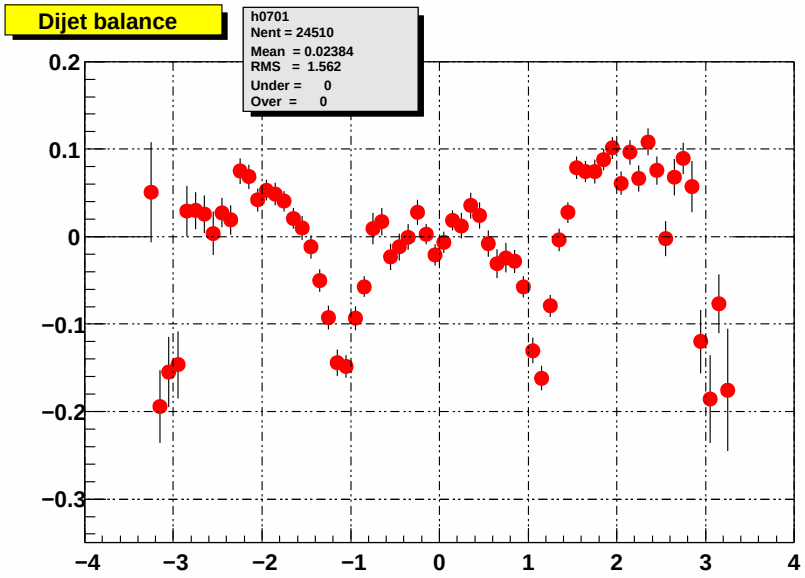


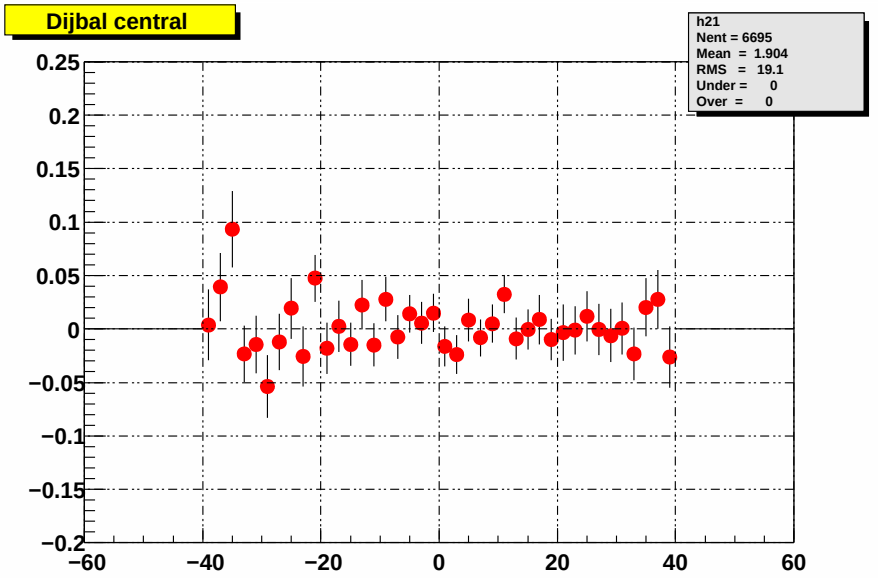
η probe

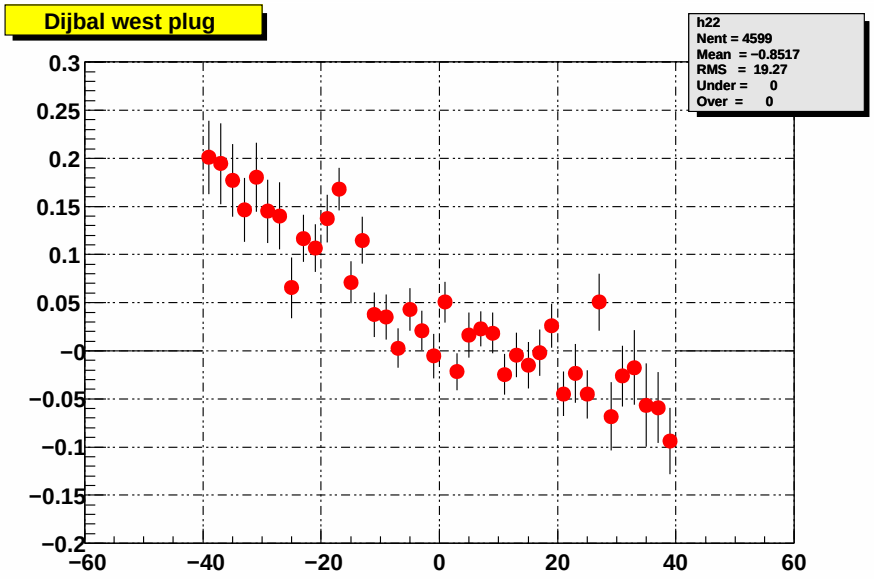


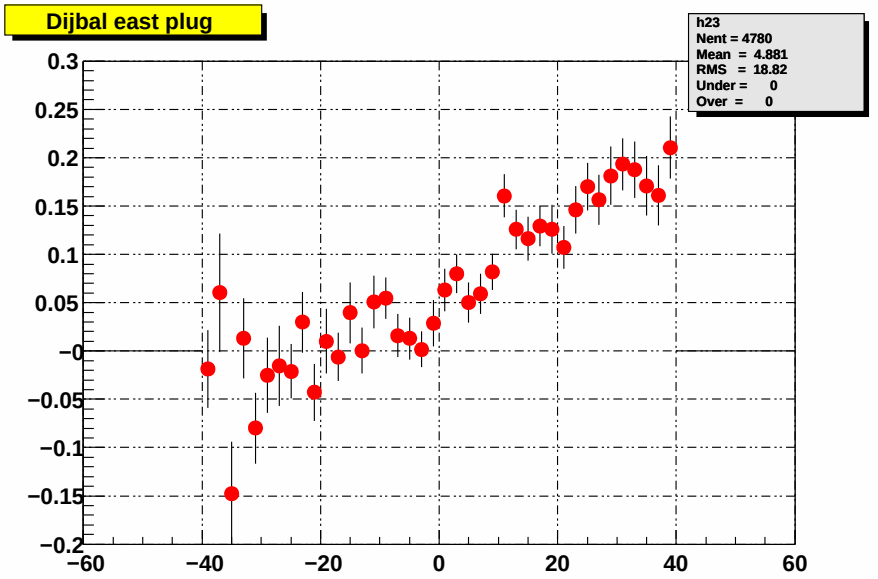
run number

East ≠ West & z-vertex dependence









z-vertex

The bug ...

... was located in **`CalorGeometry/src/Locations.cc`**

problem in the determination of the (y,z) coordinates of the shower max at tower level (erroneous π offset in the definition of the polar angle θ)

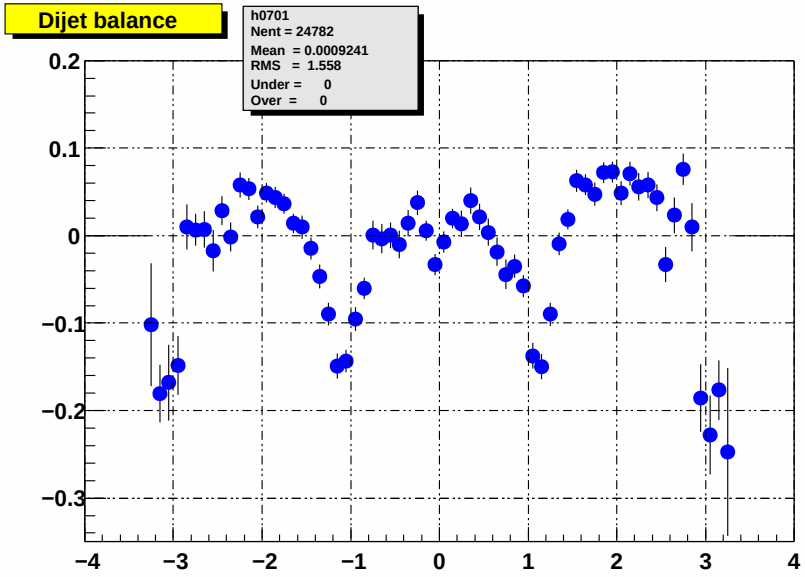
ALL towers in BOTH xEM and xHAD compartments are concerned

Potentially affects any study dealing with `PhysicsTowers` since v. `3.5.0` ... !!

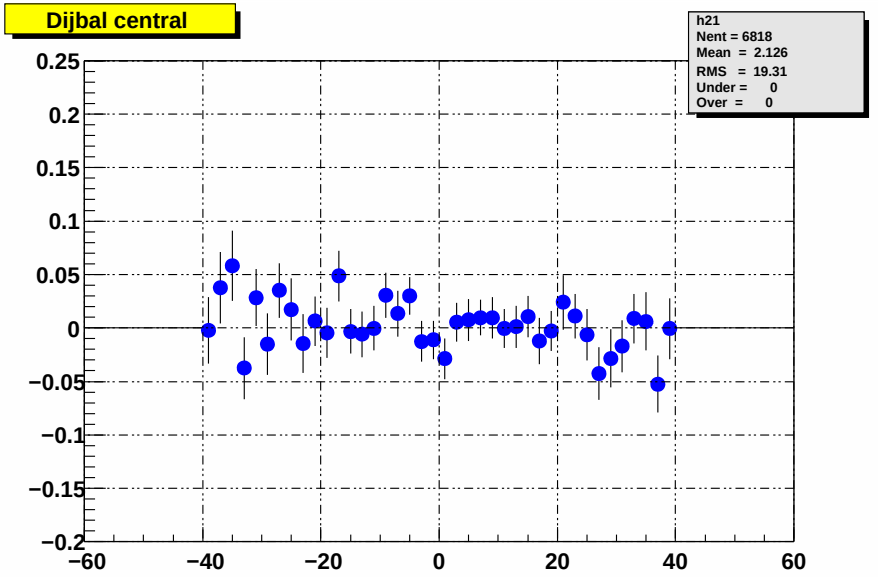
NB: Test beam / Gflash tuning studies not affected (`CalTower`)

Same runs & analysis w/bug fix

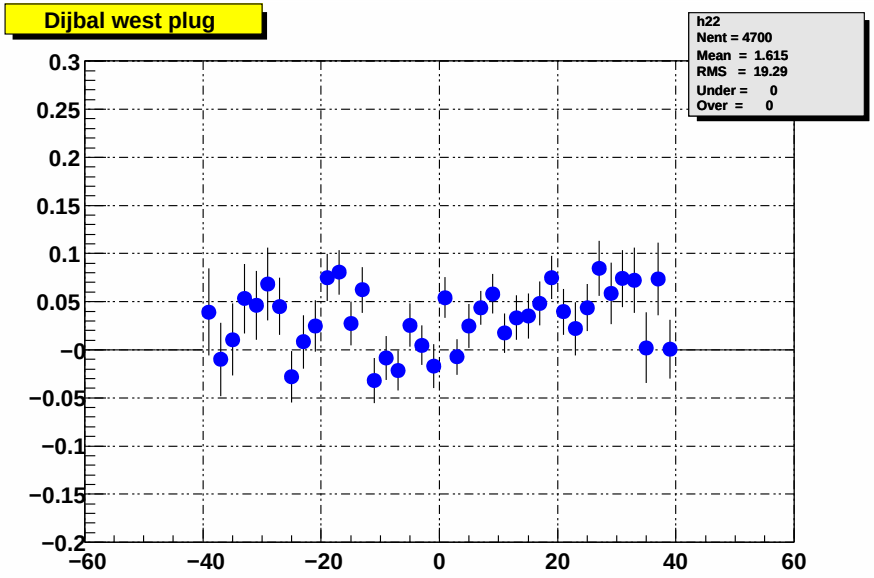
Dijet balance



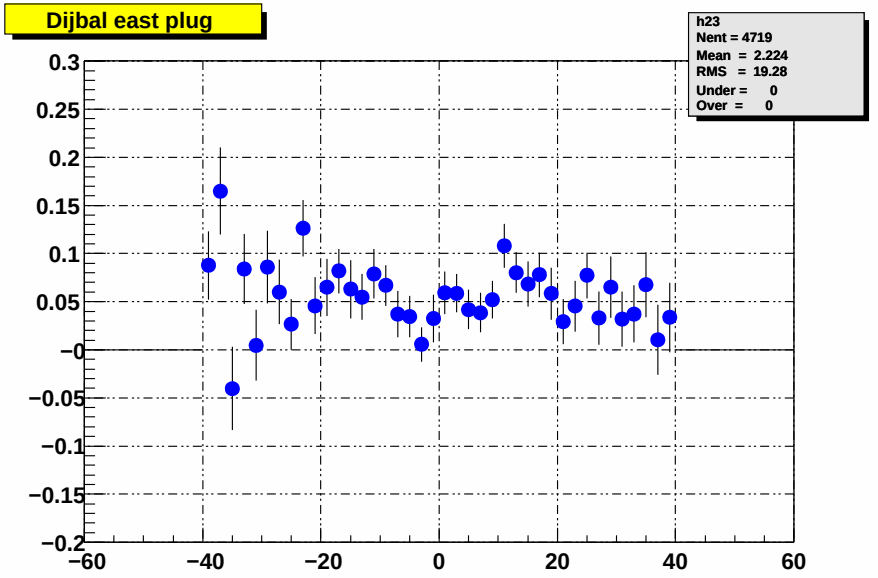
Dijbal central



Dijbal west plug



Dijbal east plug



z-vertex

Fallout

☞ Effect up to 20% for large z-vertex (>1 σ_z beam spot)

- Bug fixed in v. `development` (v. `4.6.0` will be OK)
- Double-checks are still going on / needed :
  - requests with z-vertex $\neq$ 0 obviously gave wrong output
  - P. Savard: z-vertex $\equiv$ 0 remained correct ...
- Maybe a note should address the issue and give an exhaustive list of the affected packages