

X-ray STAR with gammas from Etas

D Underwood Apr 8, 2008

If you are in a hurry, look at Look at slides 2-5
for result, and 12 for amusement

Plotting number of photons with preshower1 = 0 vs phi over the endcap showed a regular structure, which was suggestive of the material in the TPC.

The overall structure probably has contributions from the acceptance for etas, as well as material, since the finder does not cross sector boundaries.

However, by comparing the number with preshower 1 = 0 vs non-0, we should be able to find the number of radiation lengths in front of the end cap vs position.

We ignore the overall numbers vs position.

This is somewhat crude due to statistics, just two positions, center and edges of a sector.

Note on average over the endcap, about 40 % don't convert before preshower1, and 60 % do convert.

Number with preshower1 = 0

$\text{Exp}(x / (9/7X_0)) = 0.41$ gives $x/X_0 = 1.14$

two plots folded in phi to the width of 1 sector
show big variation, probably from TPC vanes

(fewer with pre1=0 -> more radiation length)
 $N(\text{pre}=0) = \exp(-x/(9/7*x_0))$ gives

$x/X) = 1.03$ at $\text{phi}=0$

$X / X_0 = 1.52$ at $\text{phi} = .2618$ (half a sector)

Cut on $E > 10$

$x/X) = 1.19$ at $\text{phi}=0$

$X / X_0 = 1.73$ at $\text{phi} = .2618$ (half a sector)

Larger statistical errors here, at least 10%

two plots folded in phi to the width of 1 sector
show big variation, probably from TPC vanes

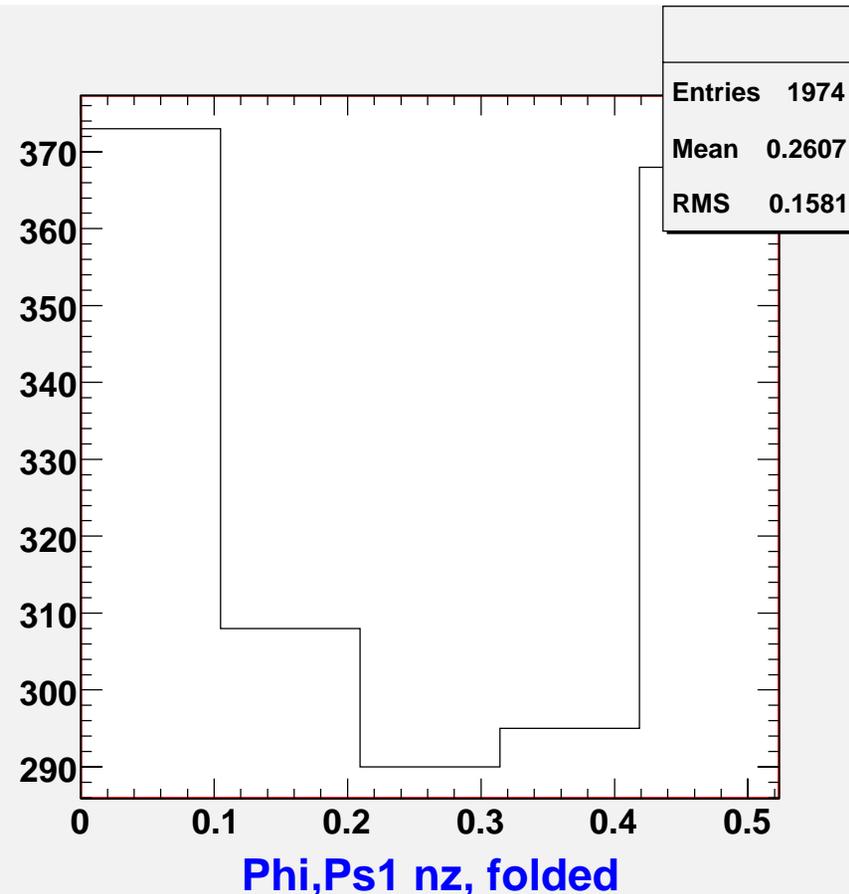
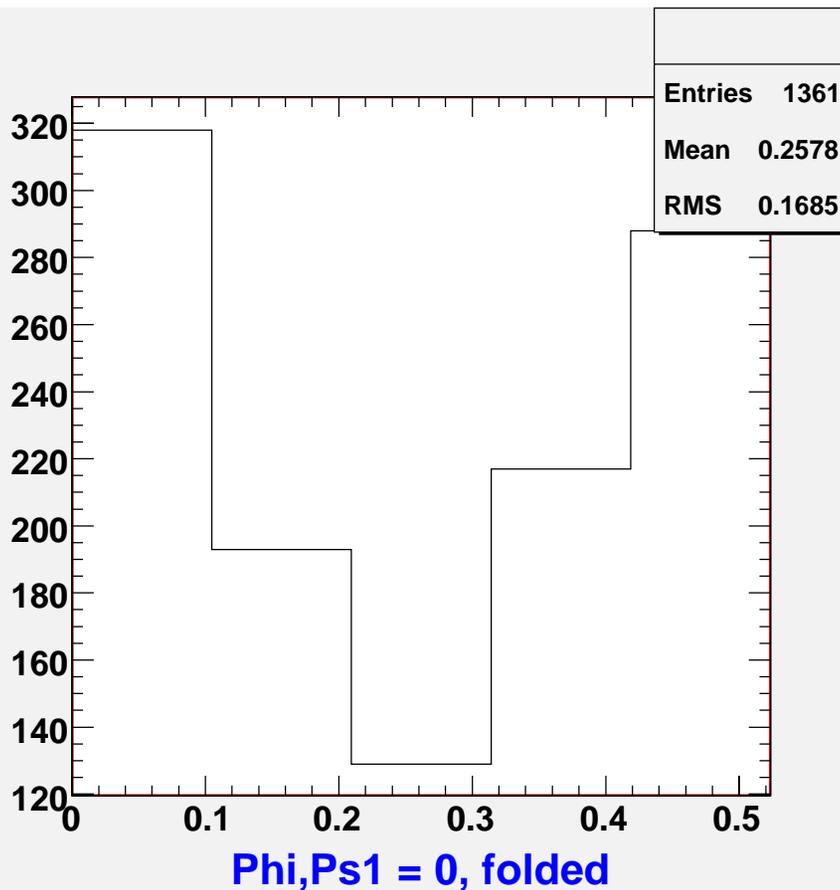
(average over all eta)

(fewer with pre1=0 -> more radiation length)

$N(\text{pre}=0) = \exp(-x/(9/7*x_0))$ gives

$x/X) = 1.03$ at $\text{phi}=0$

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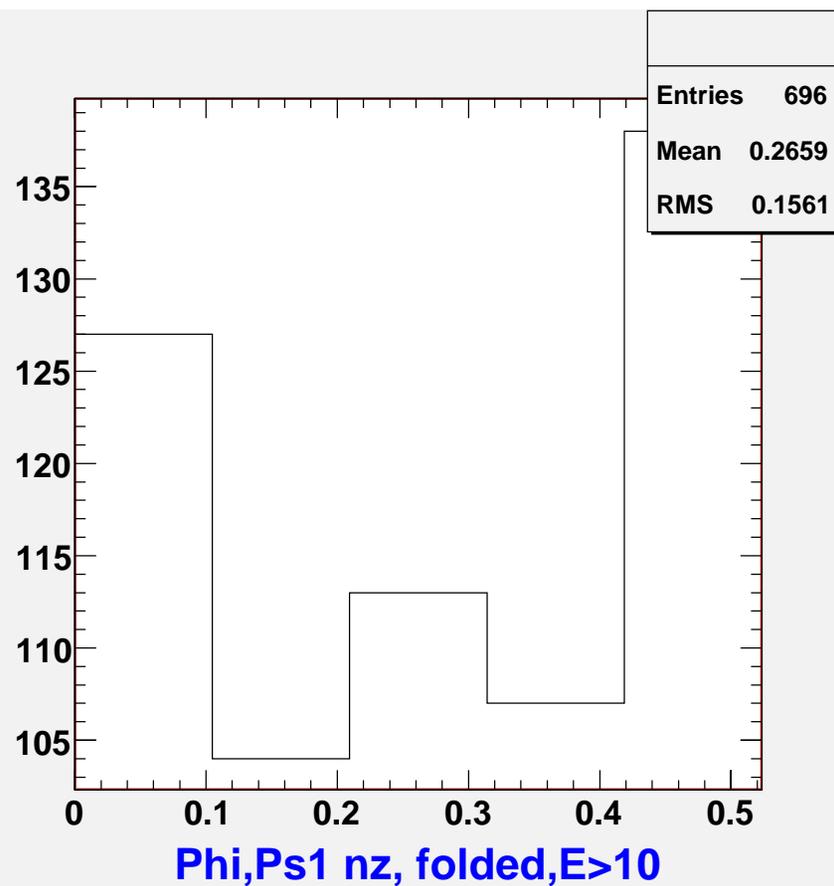
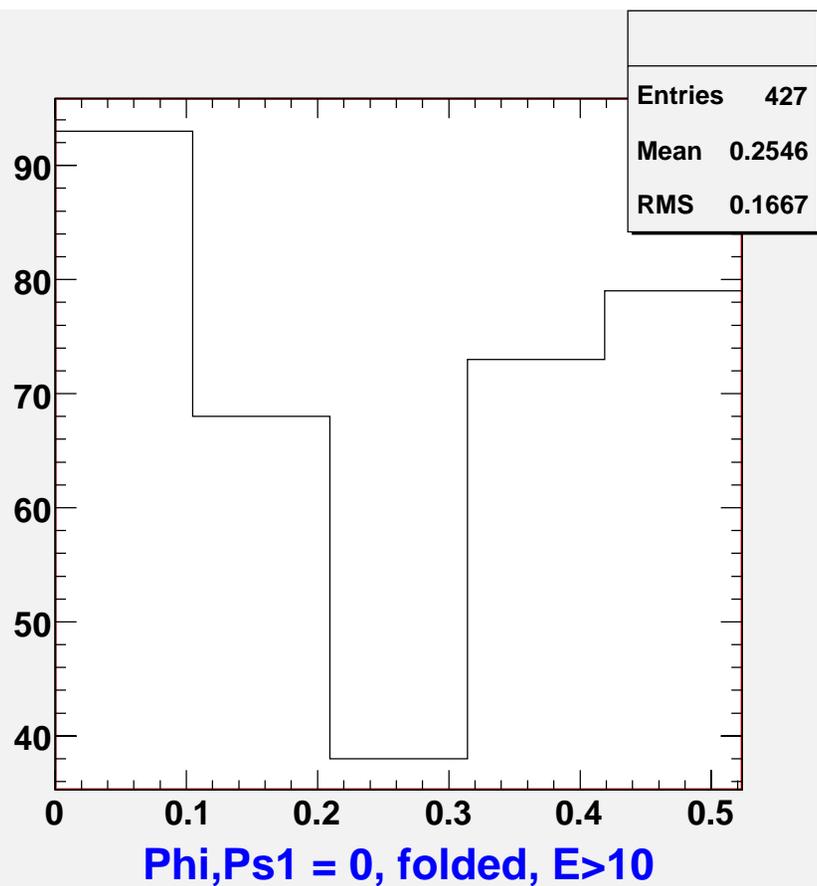


Do the same for $E > 10$ GeV

(still average over all eta)

$x/X) = 1.19$ at $\text{phi}=0$

$X / X_0 = 1.73$ at $\text{phi} = .2618$ (half a sector)



Next, we attempted to look in two different ways:

- 1) The plots vs ETA of number in pre1= 0 or non0 don't show any significant structure, probably because the vertex has a large range, and the structure between vertex and Endcap shower max gets washed out if we plot vs eta.

However, we can plot vs position near the TPC and Endcap, by using
The shower centers at the SMD

This shows some structure, but the statistics are not so good in fine bins.

+/- 10 % of radiation length

- 2) Try our own phi calculation using Ucent, Vcent just as a cross check.

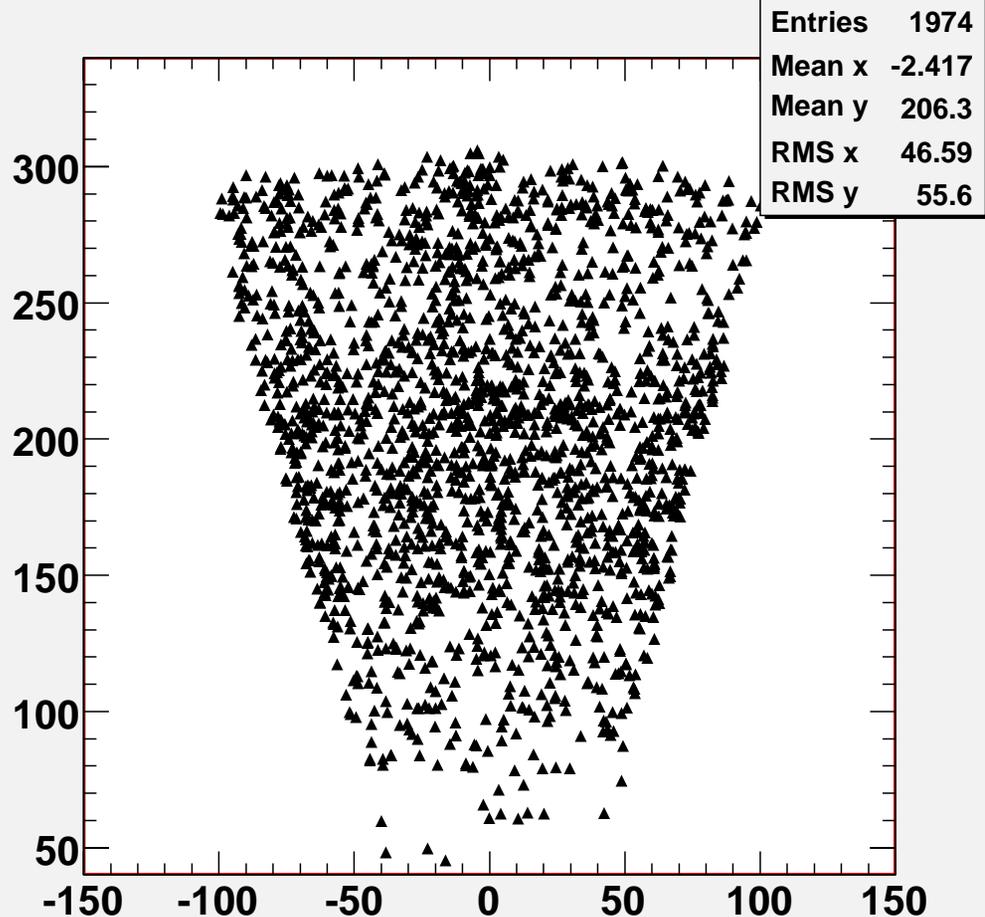
May be OK, but some question of where phi=0 is with respect to a sector.

Using cluster centers U_{cent} , V_{cent} , we find X_{cent} and Y_{cent} in SMD

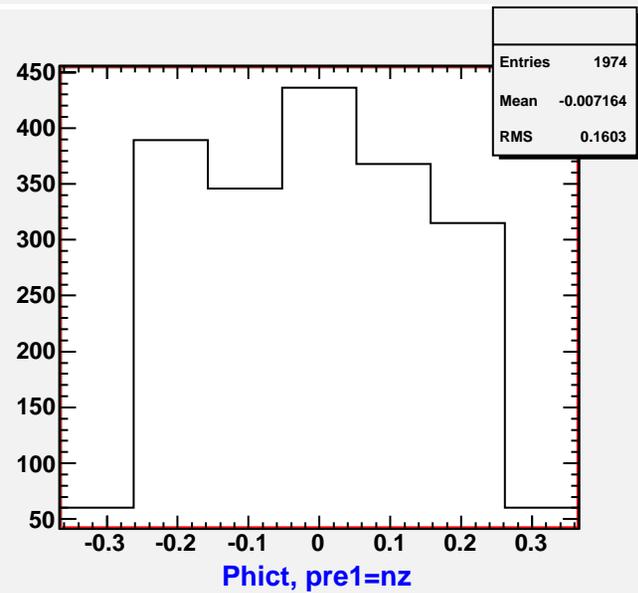
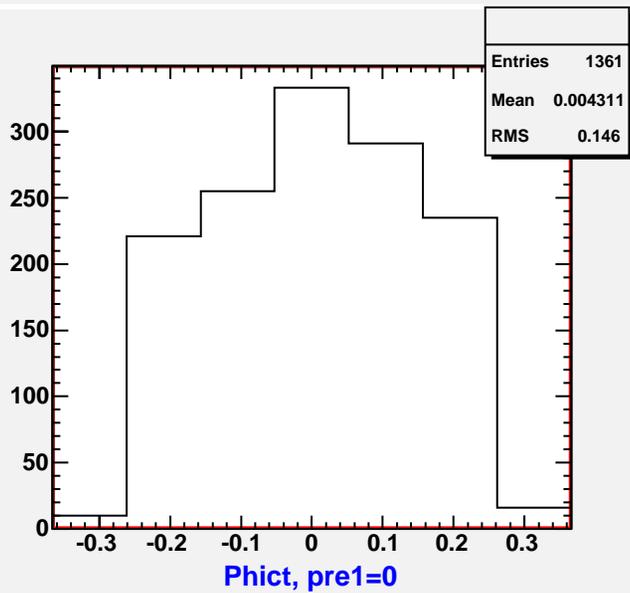
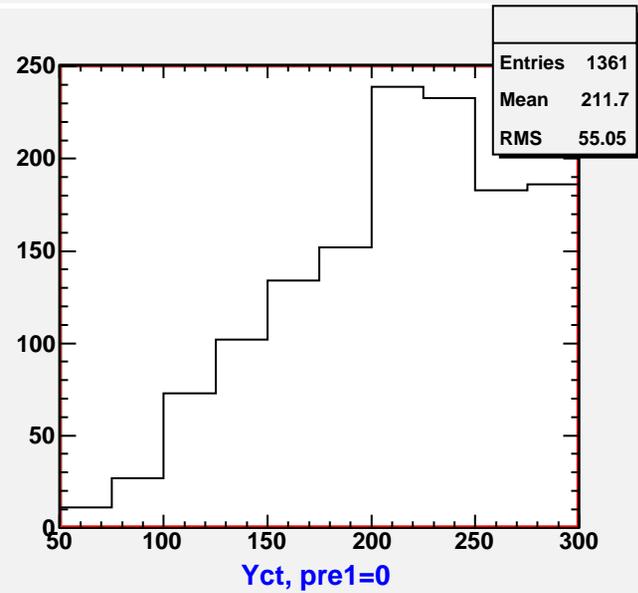
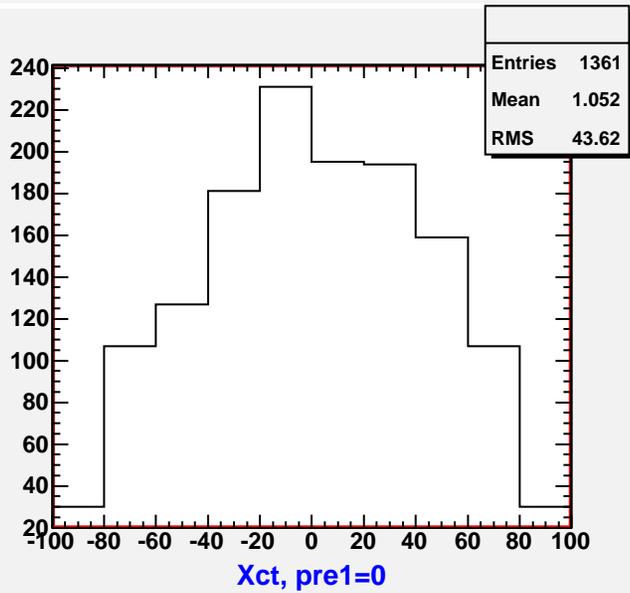
This particular picture is summed over all SMD sectors

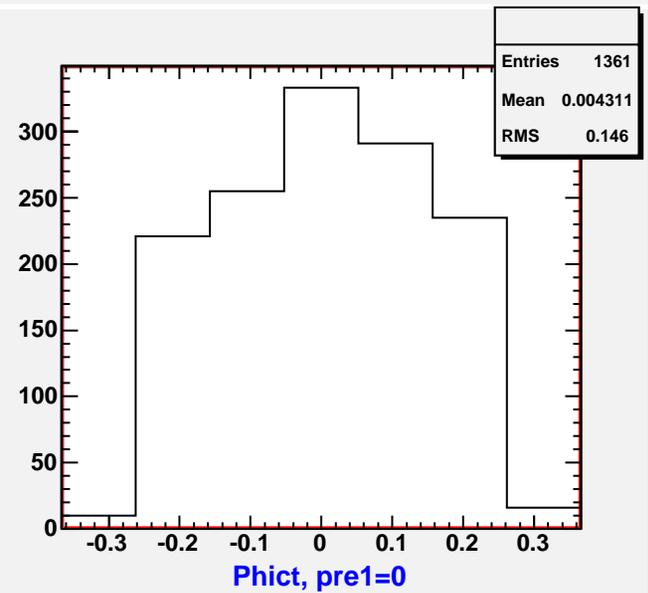
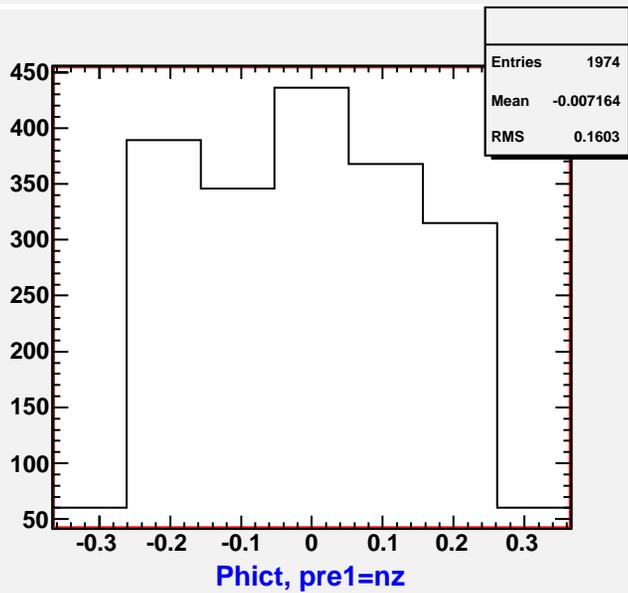
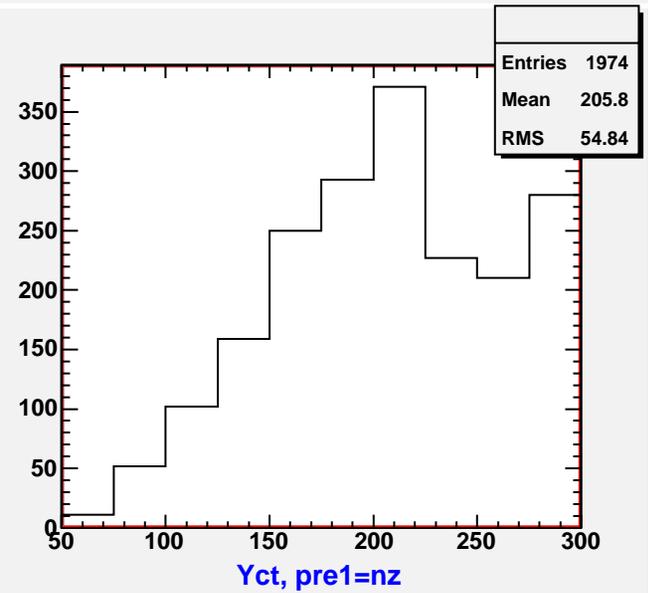
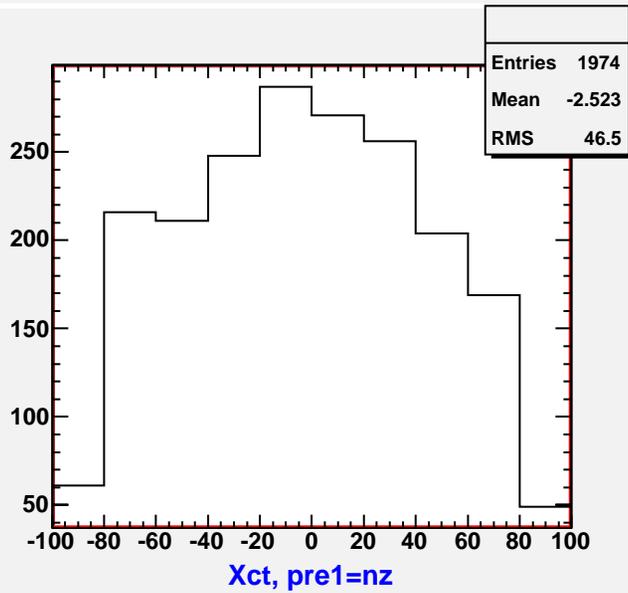
From X and Y we can get R , ϕ , but Y is more useful than R

Because all the TPC structure is straight lines perp. to radius in center of sector.



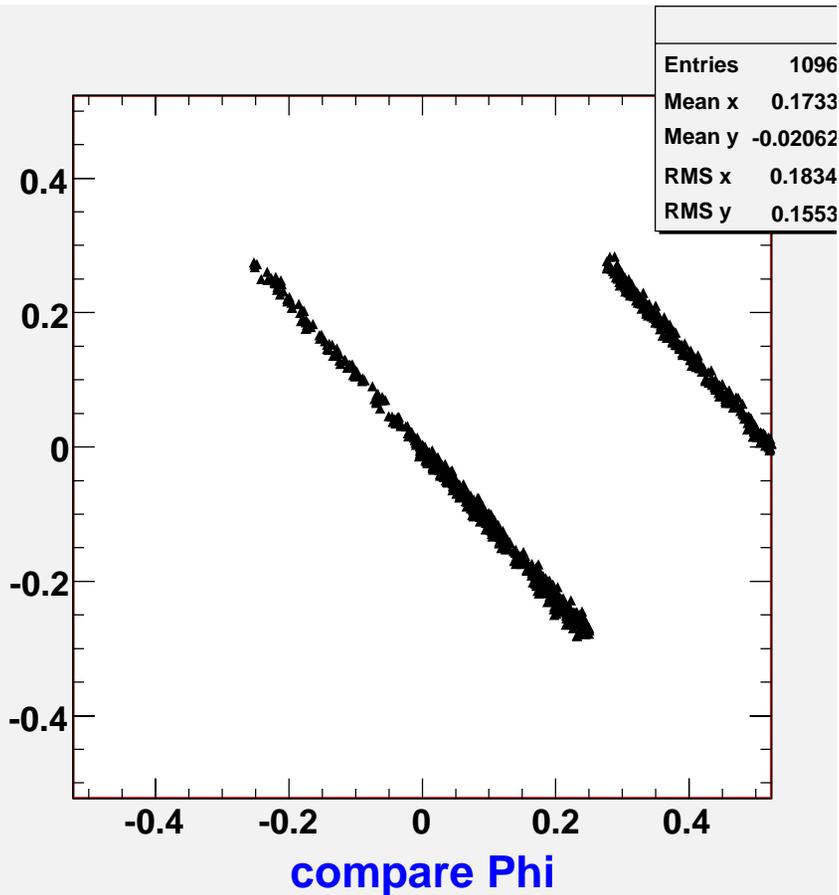
Xct vs Yct pre1=0, E>10



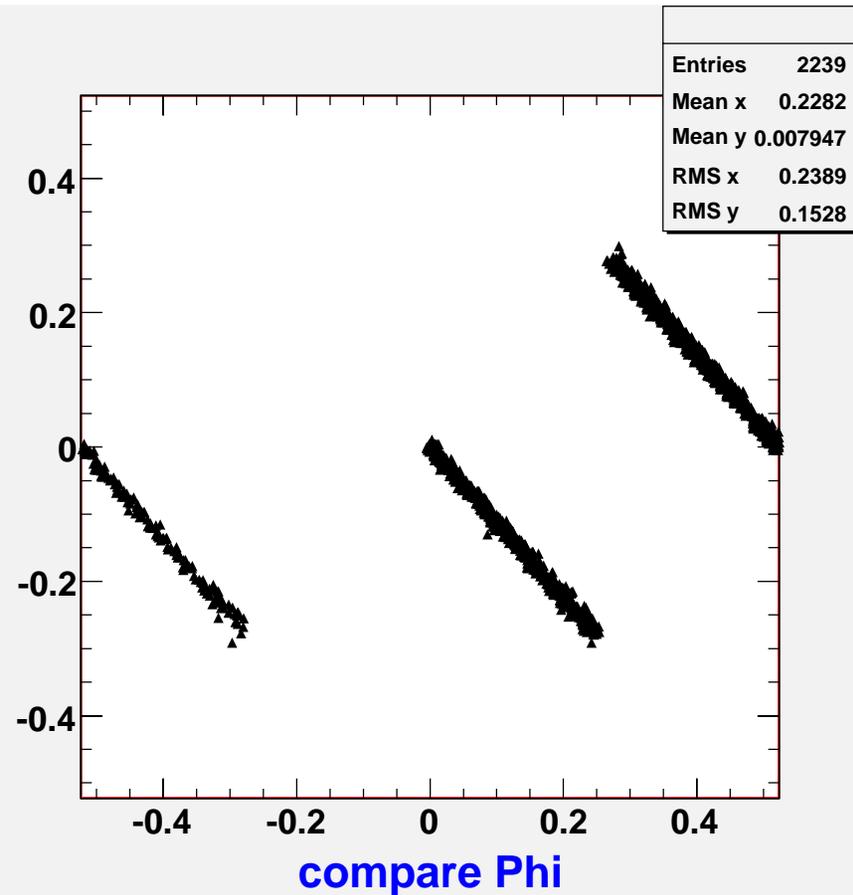


Phi from Ucent, Vcent vs phi in gammas from etas text file

V SMD in front



U SMD in front

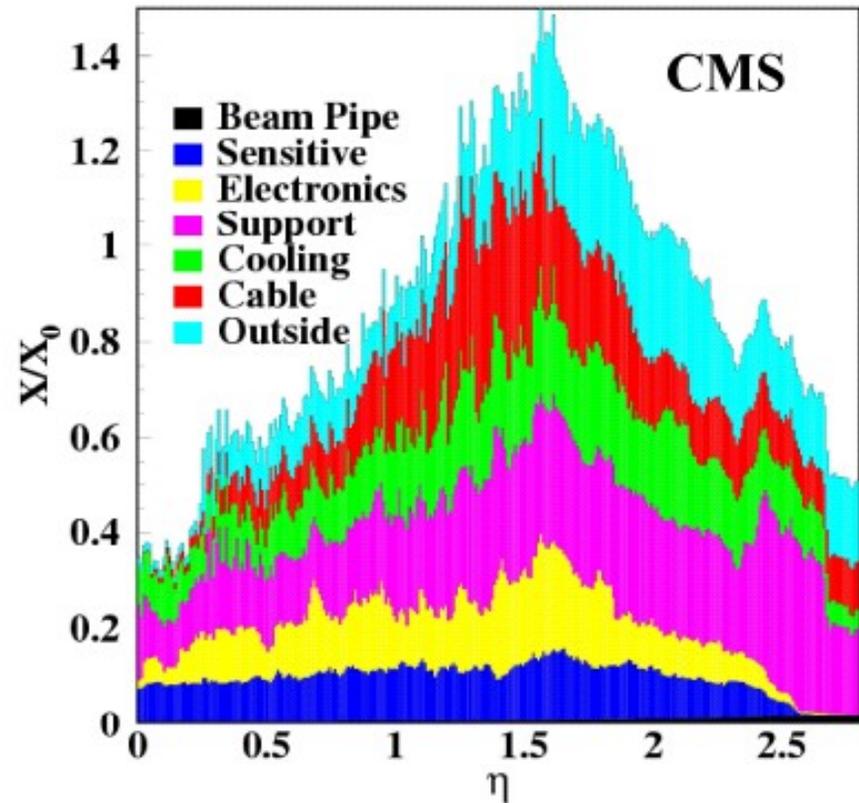
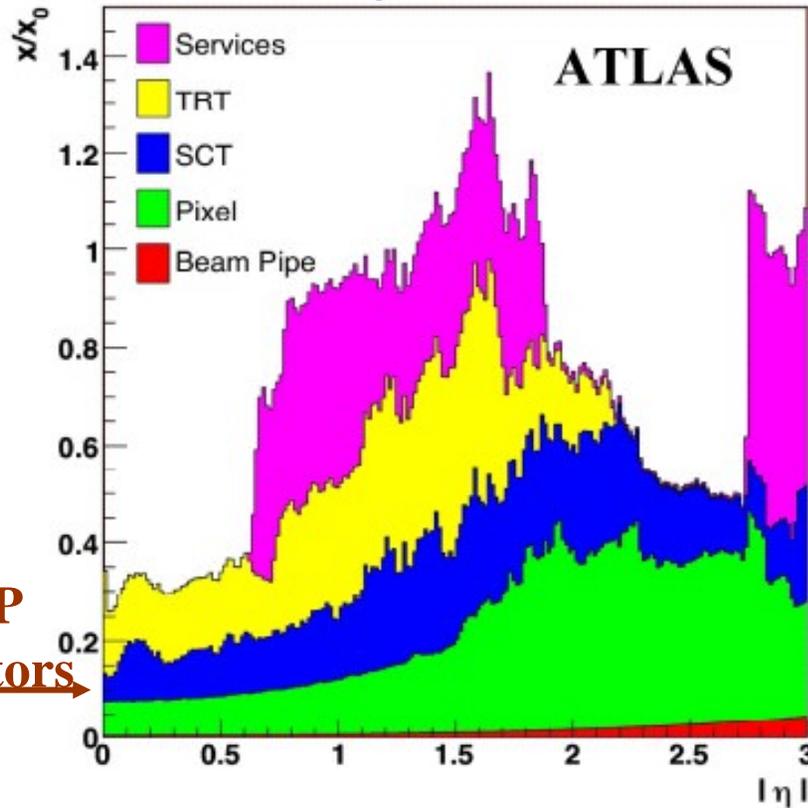


ATLAS/CMS: from design to reality

Amount of material in ATLAS and CMS inner trackers

Weight: 4.5 tons

Weight: 3.7 tons



- Active sensors and mechanics account each only for $\sim 10\%$ of material budget
- Need to bring 70 kW power into tracker and to remove similar amount of heat
- Very distributed set of heat sources and power-hungry electronics inside volume: this has led to complex layout of services, most of which were not at all understood at the time of the TDRs

ATLAS/CMS: from design to reality

TABLE 5 Evolution of the amount of material expected in the ATLAS and CMS trackers from 1994 to 2006

Date	ATLAS		CMS	
	$\eta \approx 0$	$\eta \approx 1.7$	$\eta \approx 0$	$\eta \approx 1.7$
1994 (Technical Proposals)	0.20	0.70	0.15	0.60
1997 (Technical Design Reports)	0.25	1.50	0.25	0.85
2006 (End of construction)	0.35	1.35	0.35	1.50

The numbers are given in fractions of radiation lengths (X/X_0). Note that for ATLAS, the reduction in material from 1997 to 2006 at $\eta \approx 1.7$ is due to the rerouting of pixel services from an integrated barrel tracker layout with pixel services along the barrel LAr cryostat, to an independent pixel layout with pixel services routed at much lower radius and entering a patch panel outside the acceptance of the tracker (this material appears now at $\eta \approx 3$). Note also that the numbers for CMS represent almost all the material seen by particles before entering the active part of the crystal calorimeter, whereas they do not for ATLAS, in which particles see in addition the barrel LAr cryostat and the solenoid coil (amounting to approximately $2X_0$ at $\eta = 0$), or the end-cap LAr cryostat at the larger rapidities.

- **Material increased by ~ factor 2 from 1994 (approval) to now (end constr.)**
- **Electrons lose between 25% and 70% of their energy before reaching EM calo**
- **Between 20% and 65% of photons convert into e^+e^- pair before EM calo**
- **Need to know material to ~ 1% X_0 for precision measurement of m_W (< 10 MeV)!**