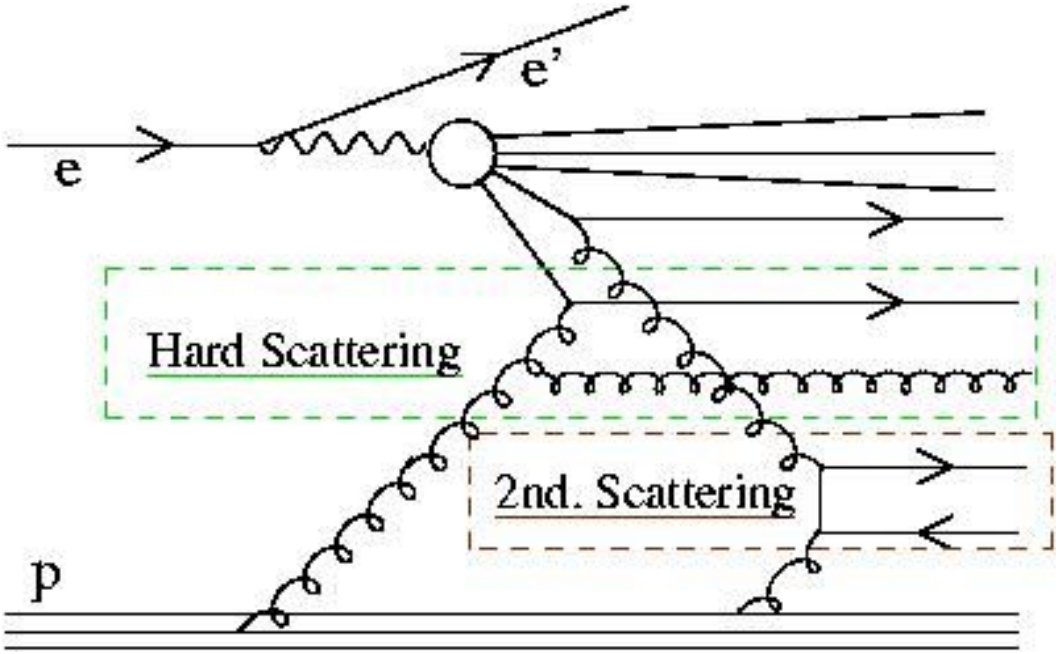
Multiple Interactions (MI)

Contents:

- ✗ Two samples: light flavour and heavy flavour.

For each sample we will see:

- ✗ Jet shapes.
- ✗ Multiplicity and energy flow distributions.



Light flavours Sample.

- Events with: $0.3 < y < 0.65$
- Photoproduction ($Q^2 < 0.01$ GeV^2)
- Jets with: $P_t > 7(6)$ GeV, Jet#1(Jet#2)

  $|\eta| < 1.5$

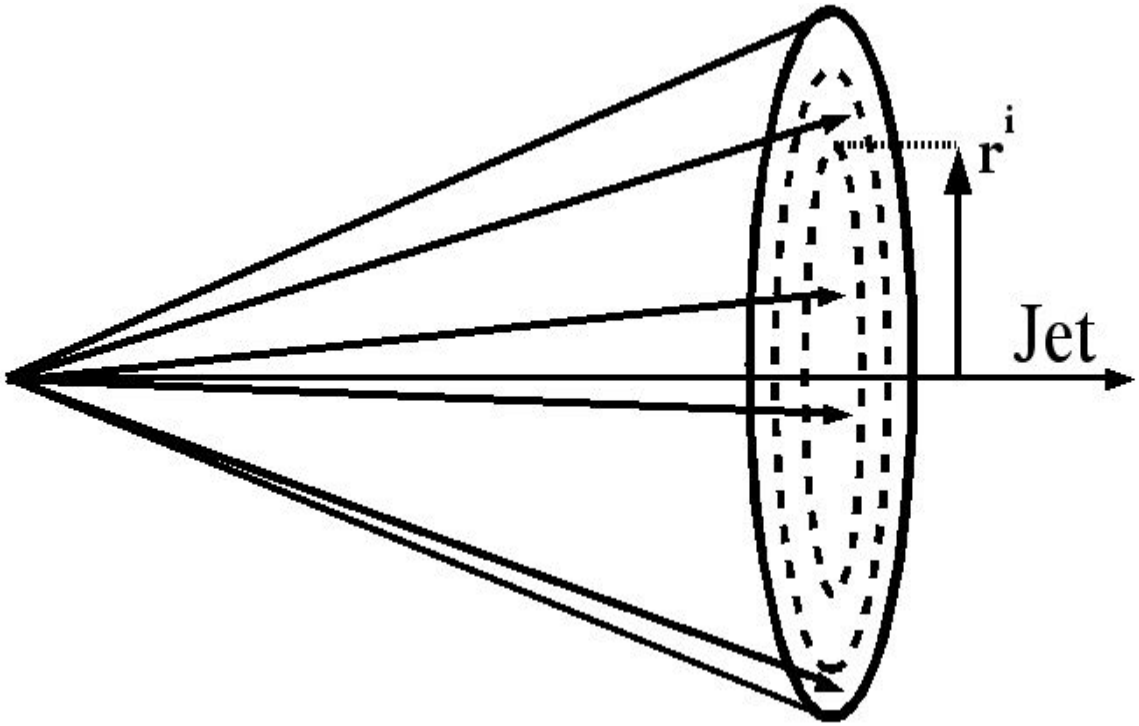
Kt clustering algorithm (p_t weighted recom. scheme)

Both jets are analysed !

Light flavours Sample.

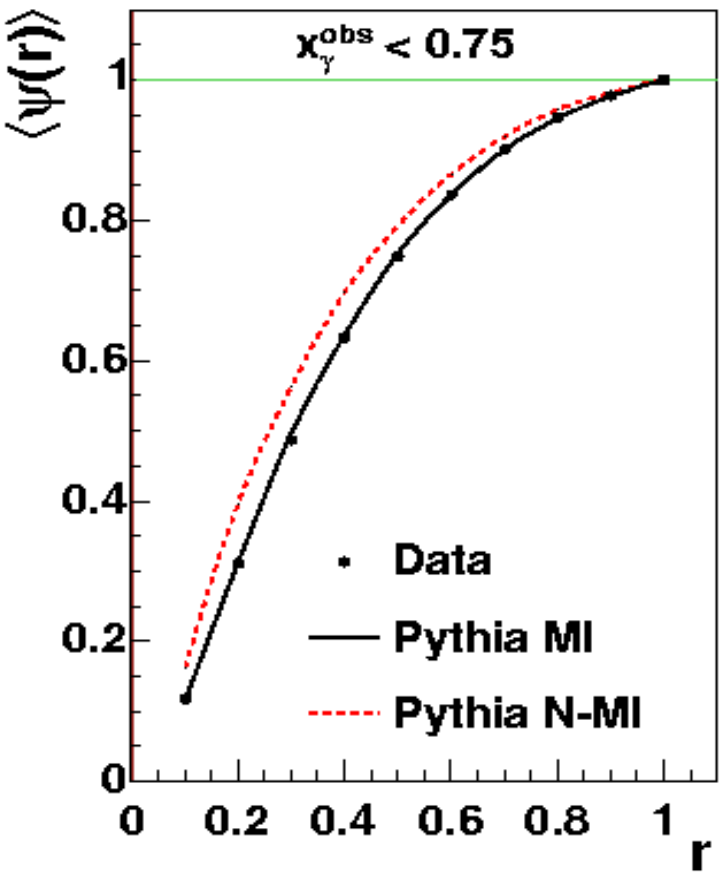
- Jet Shape: average fraction of the total transverse momentum in a given cone of radius r (scalar sum).

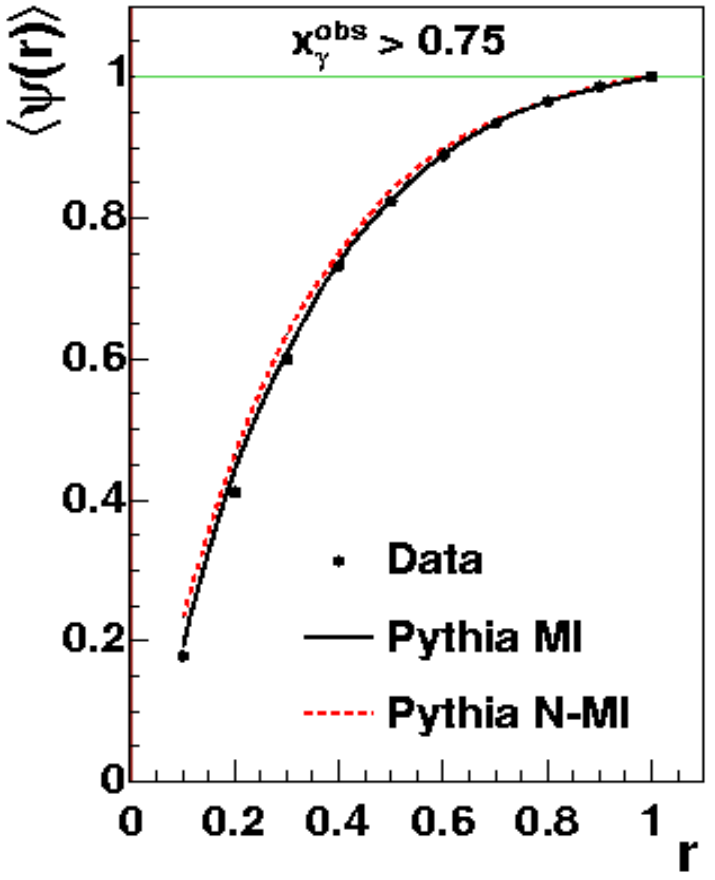
$$\langle \Psi(r) \rangle = \frac{\sum_{r=0}^{r=r^i} P_t^j}{\sum_{r=0}^{r=R} P_t^j}$$



Jet shapes for light flavours.

- Average fraction of the total transverse momentum in a given cone of radius r (scalar sum).





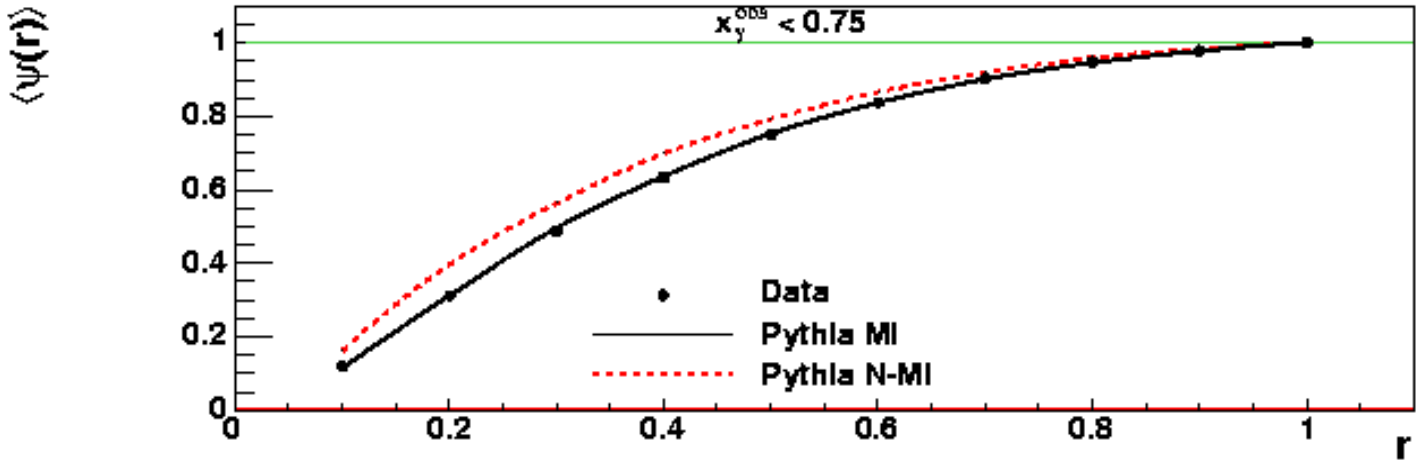
Statistical uncertainties shown

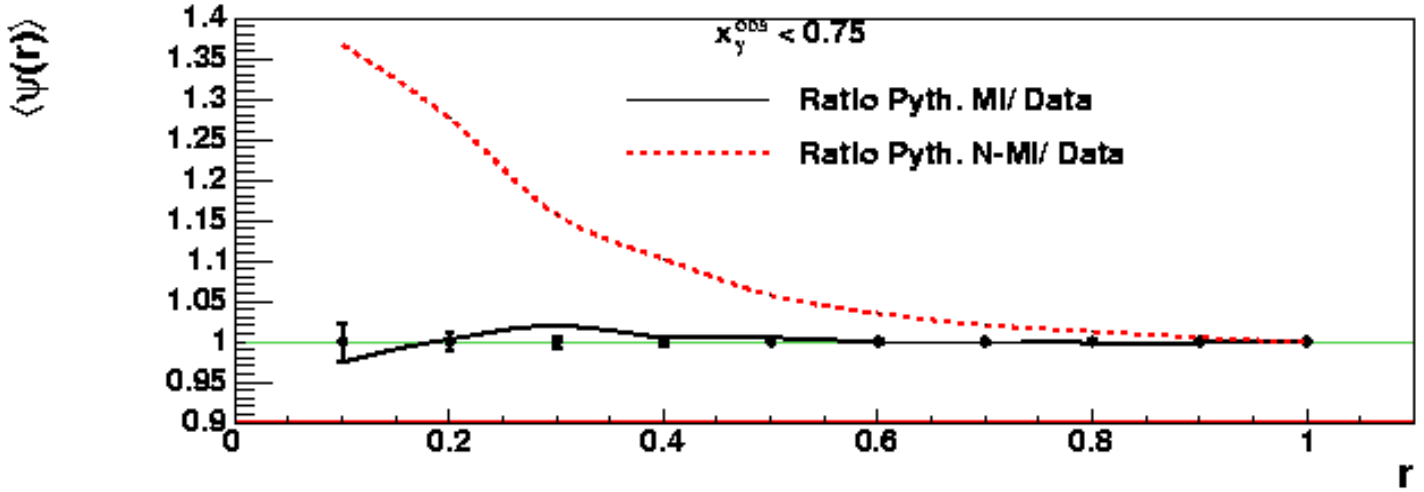
No MI in PYTHIA for high X_γ.

PYTHIA MI describes data for the light flavour sample.

Jet shapes for light flavours (2)

- Average fraction of the total transverse momentum in a given cone of radius r (scalar sum).

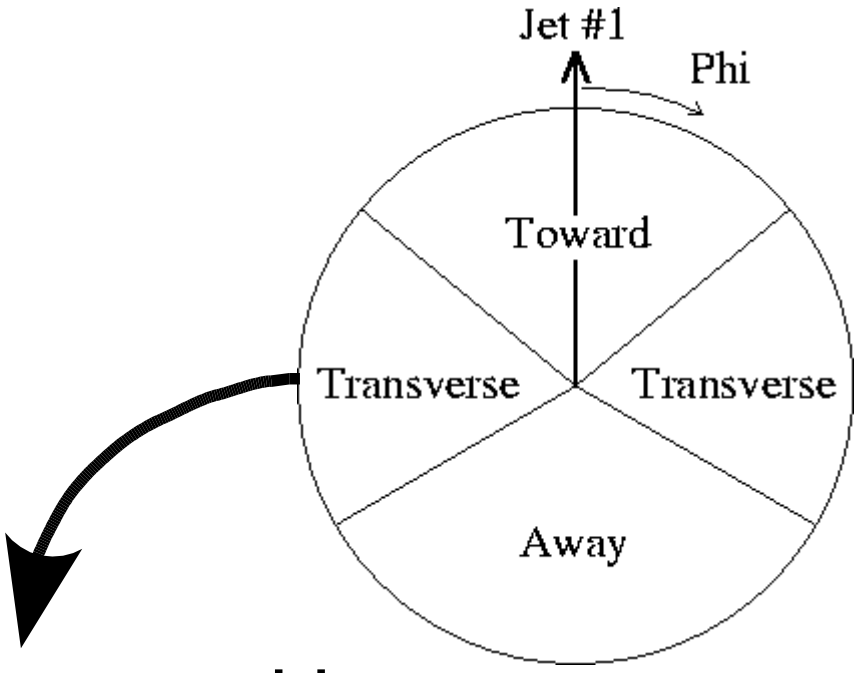




Statistical uncertainties shown

Light flavours multiplicity (1)

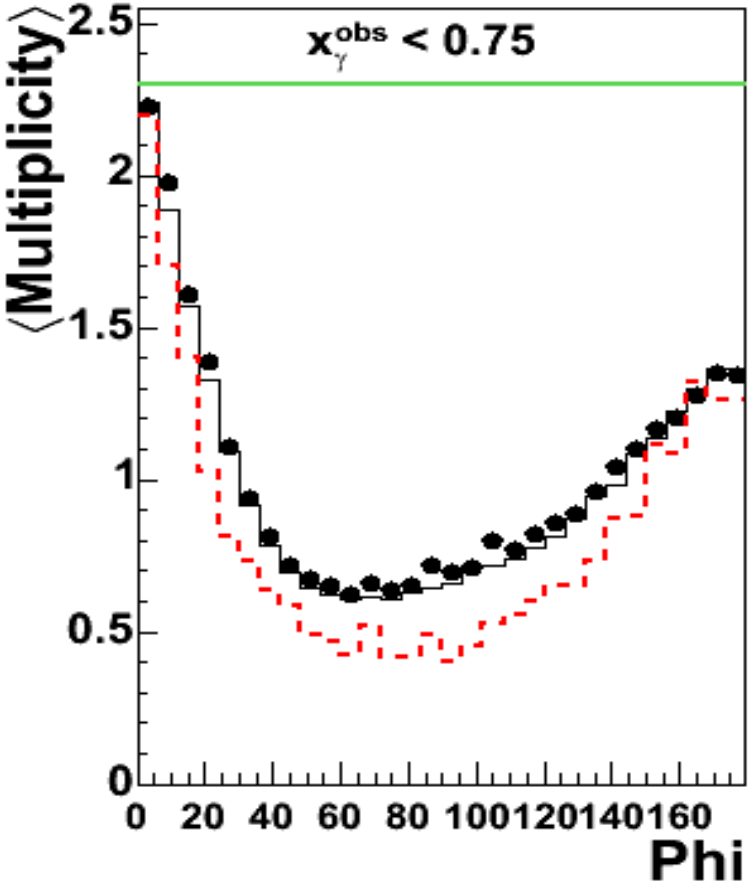
- Particle multiplicity: average number of particles measured per event ($|\eta| < 1.5$)
- In 1 Jet + 1 Jet events the highest Pt jet, Jet #1, defines the origin in φ.
- Three regions in Φ:
  - Toward: $|\varphi| < 60°$
  - Transverse: $60° < |\varphi| < 120°$
  - Away: $120° < |\varphi|$

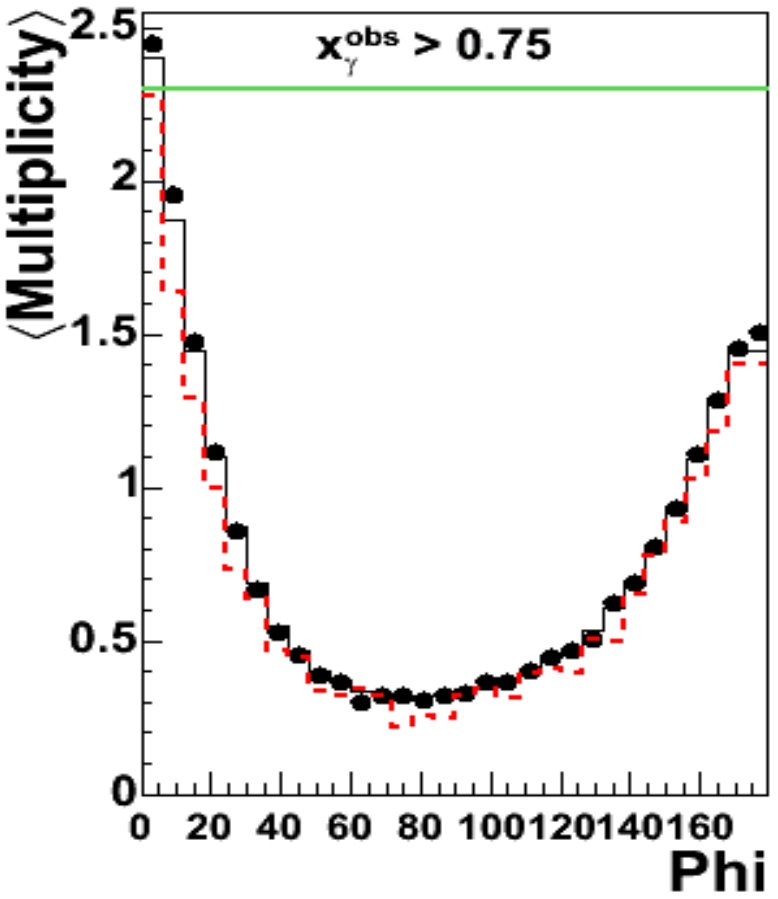


The <u>transverse</u> region is <u>very sensitive</u> to multiple parton interactions !!

Light flavours multiplicity (2)

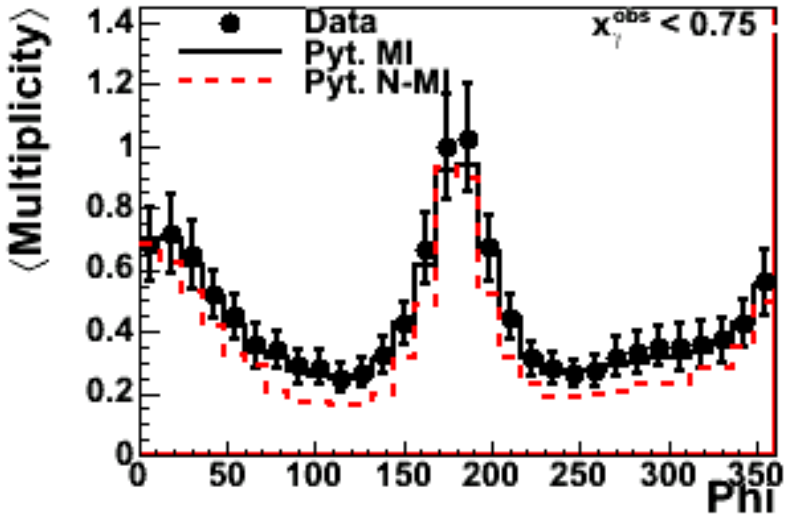
Statistical uncertainties shown

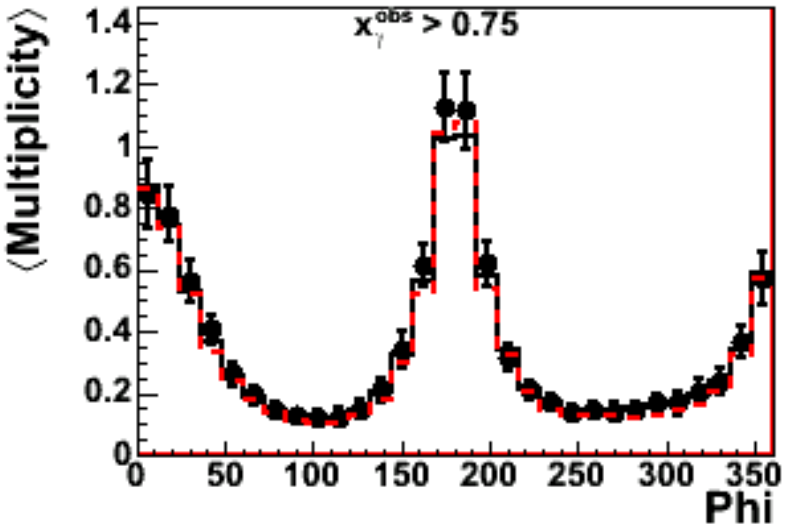




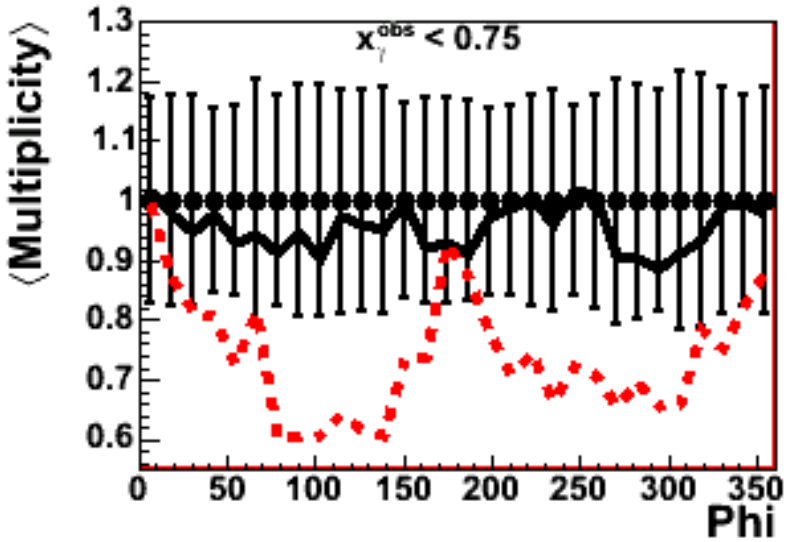
PYTHIA MI describes all regions for light flavours

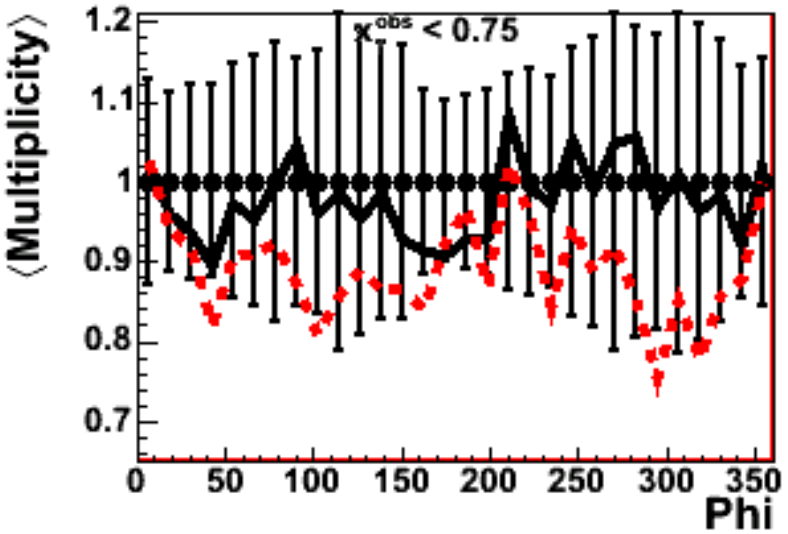
Light flavours multiplicity (3)





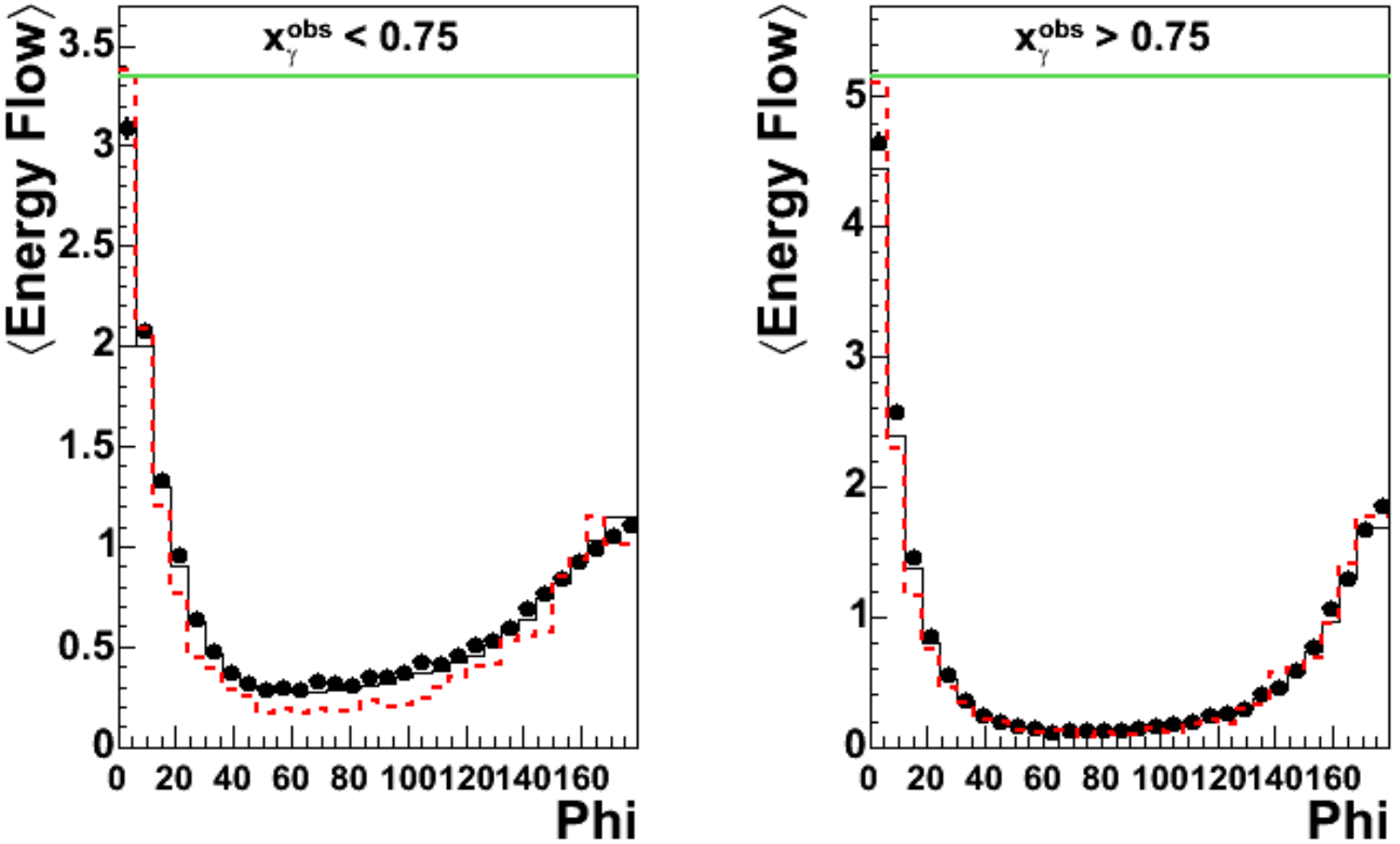
Statistical + systematics uncertainties (some) shown





Light flavours energy flow

Statistical uncertainties shown



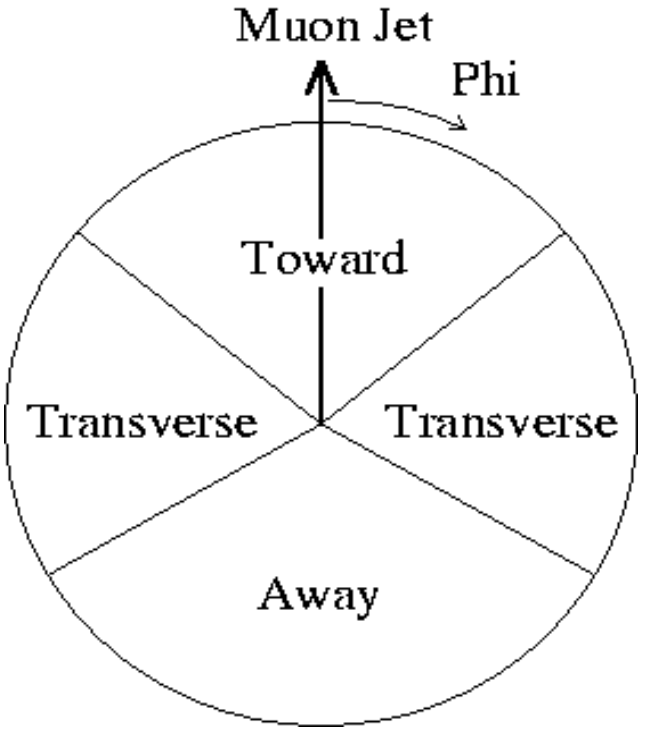
PYTHIA MI describes the transverse region and in general better than PYTHIA w/o MI.

Charm enriched sample

- Events with: $0.2 < y < 0.8$
- Photoproduction ($Q^2 < 1$ GeV^2)
- Jets cuts: $P_t > 7(6)$ GeV

  $|\eta| < 1.5$
- Muon cuts: $P_t > 2.5$ GeV

  $35° < \theta < 135°$

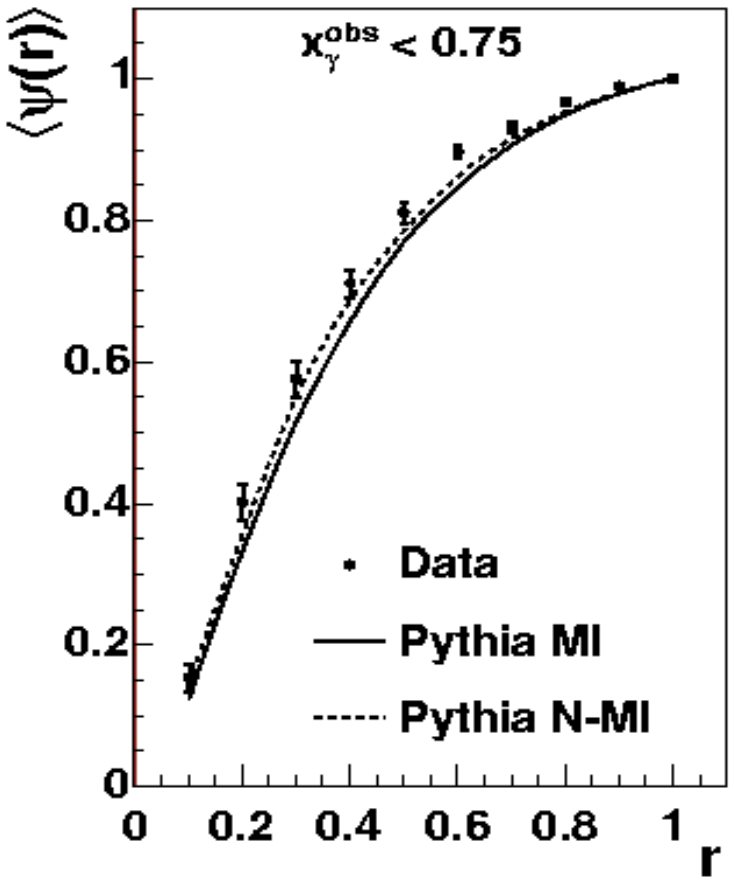


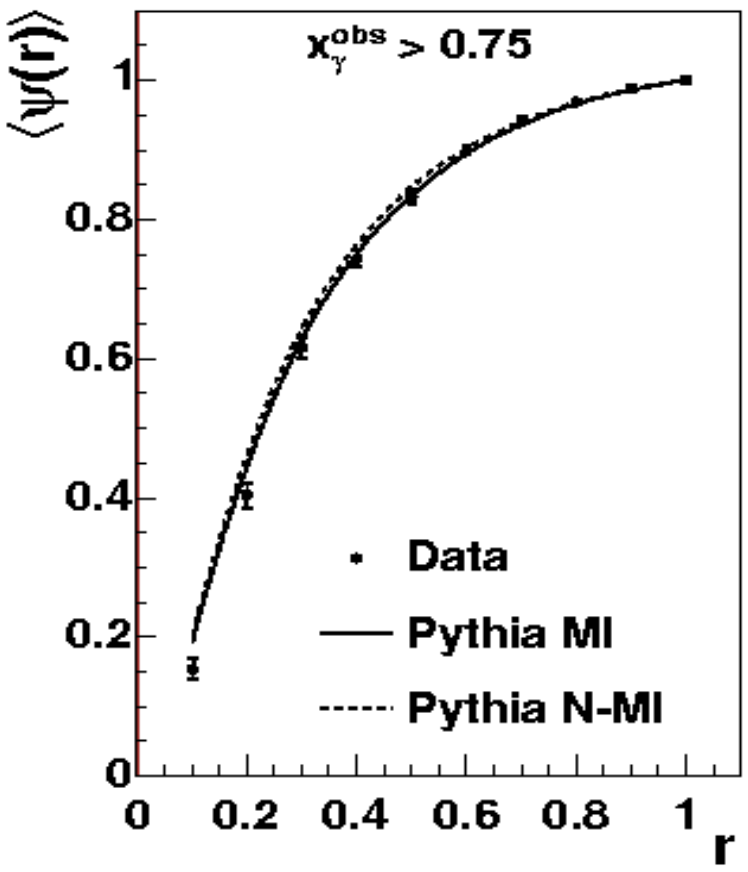
Kt clustering algorithm (p_t weighted recom. scheme)

Here we also have two jets but one contains a muon.

Jet shapes for the charm enriched sample

- Average fraction of the total transverse momentum in a given cone of radius r (scalar sum). Only the "other Jet" is shown.





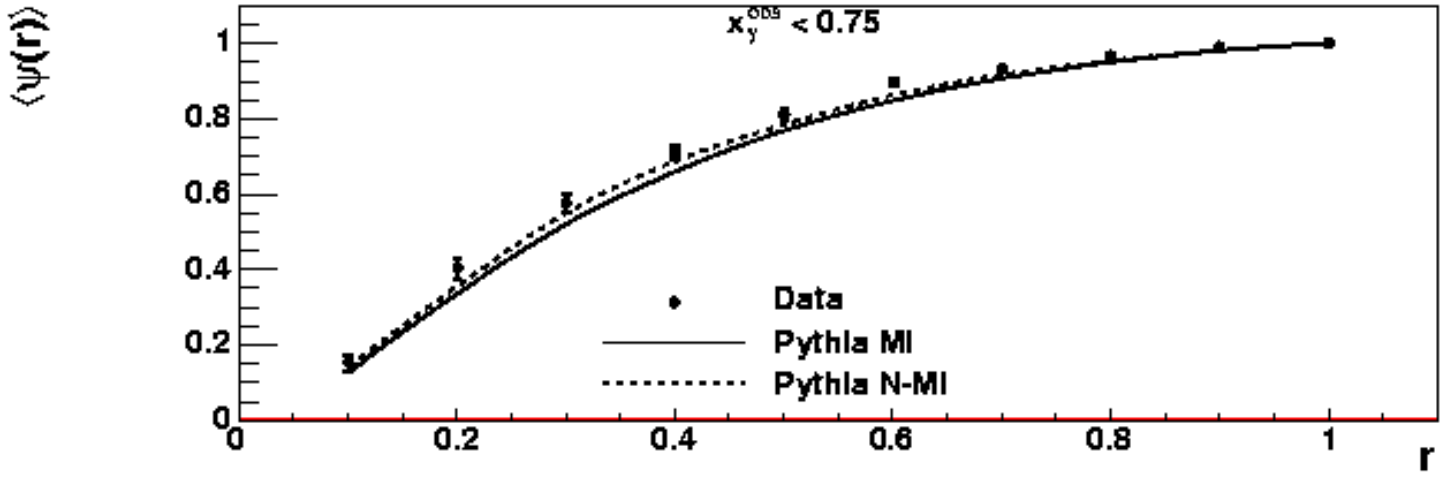
Statistical uncertainties shown

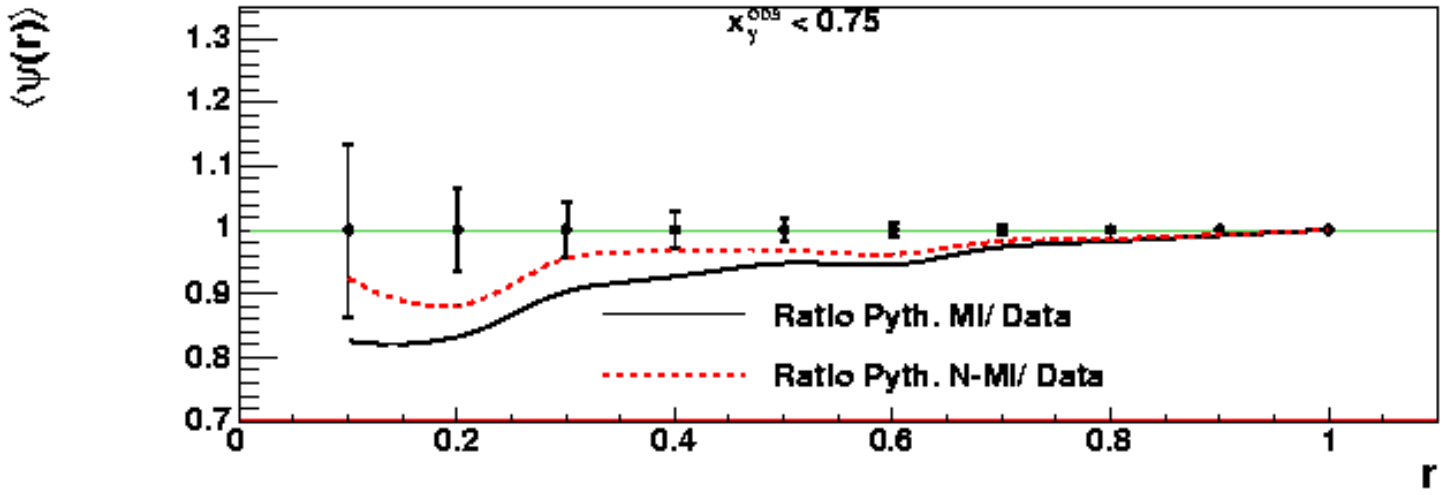
No MI in PYTHIA for high Xγ.

PYTHIA MI <u>does not</u> describe data for the charm sample!!

Jet shapes for the charm enriched sample

- Average fraction of the total transverse momentum in a given cone of radius r (scalar sum). Only the "other Jet" is shown.

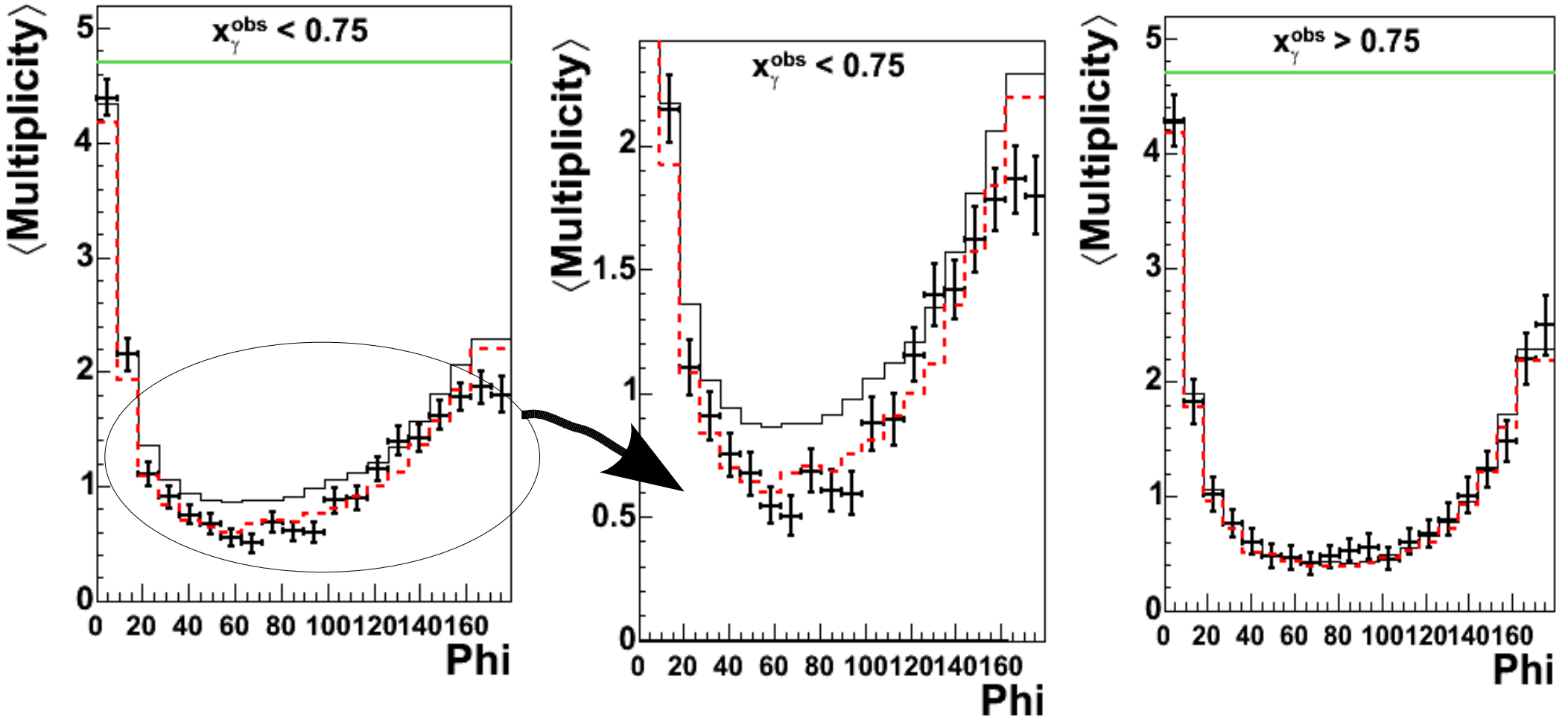




Statistical uncertainties shown

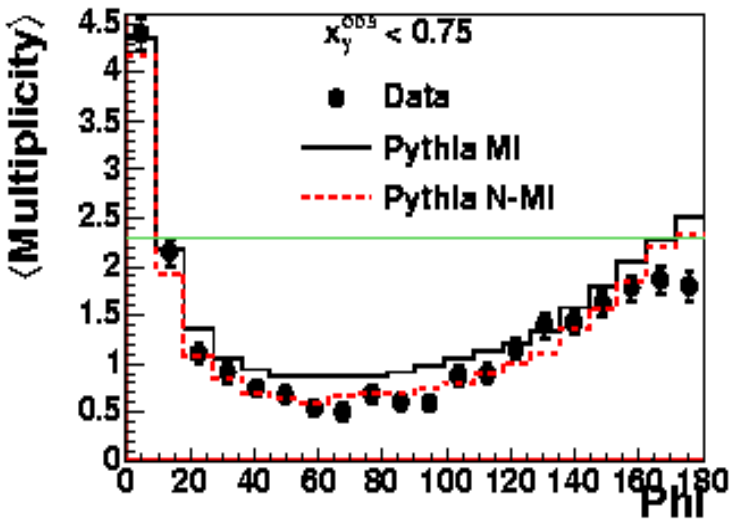
Charm sample multiplicity

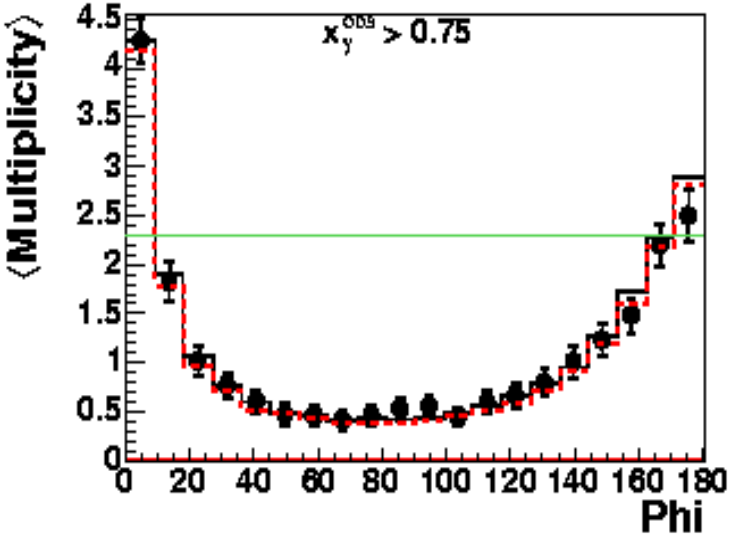
Statistical uncertainties shown



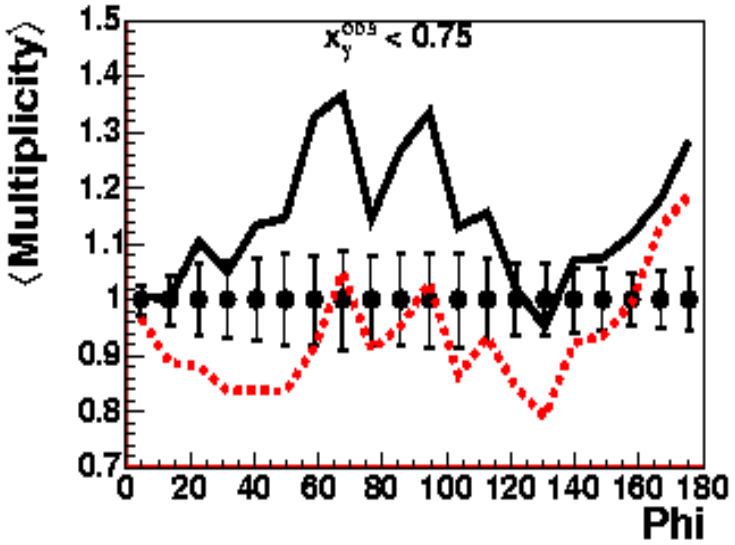
PYTHIA MI <u>does not</u> describe data in the low X_γ region !!

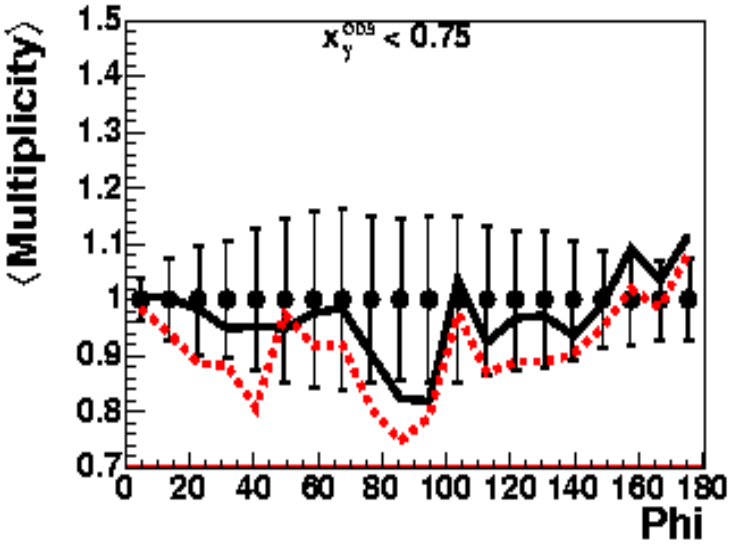
Charm sample multiplicity





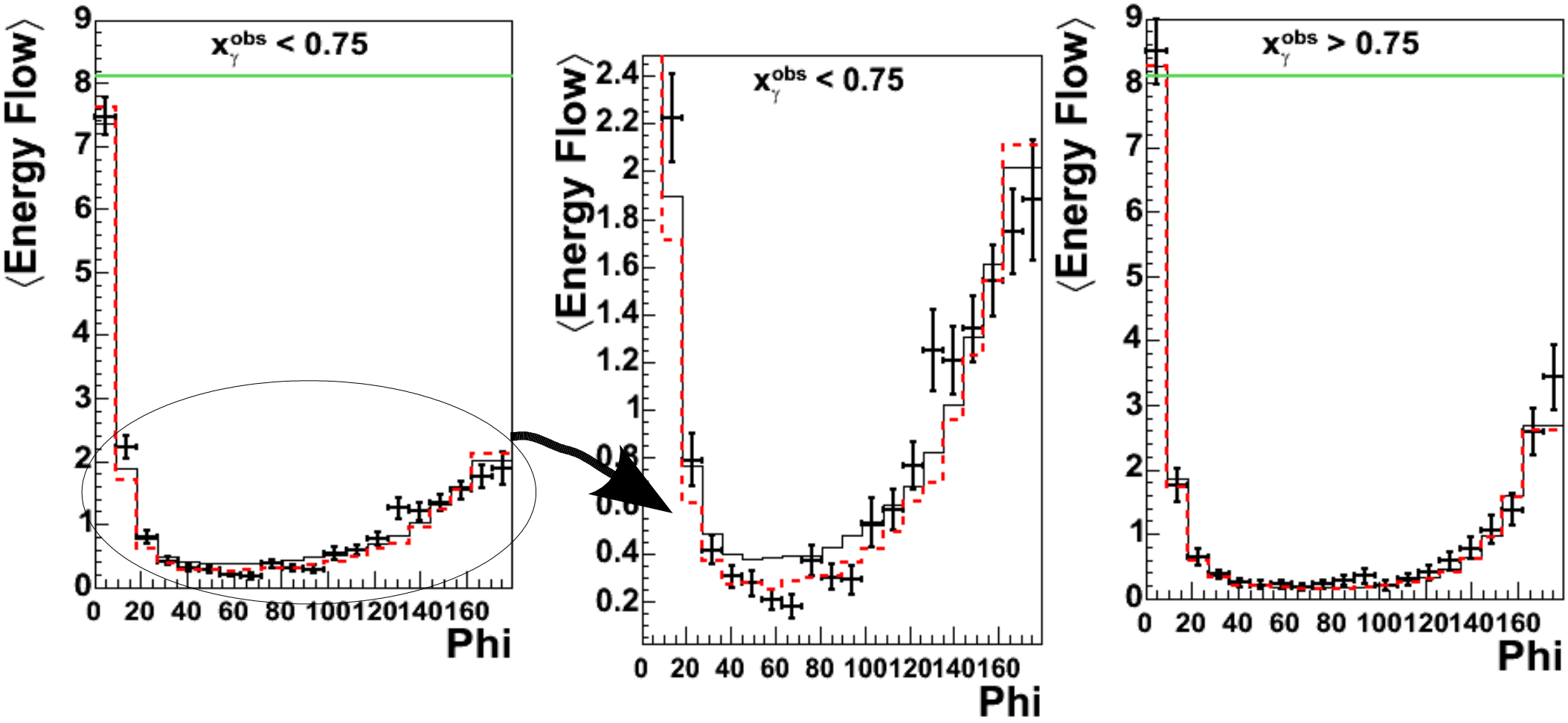
Statistical + systematics uncertainties (some) shown





Charm sample energy flow

Statistical uncertainties shown



It's hard to see something. Can we improve it? → to do!

Summary

<u>For the light flavour sample...</u>

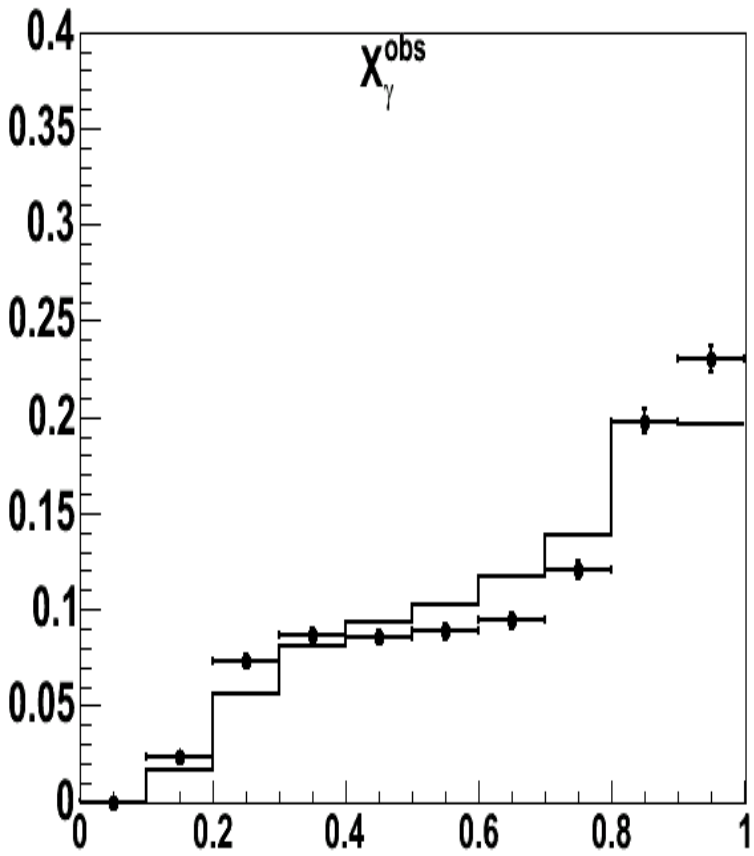
- ✔ PYTHIA MI describes jet shapes in both Xγ regions.
- ✔ PYTHIA MI describes multiplicity and energy flow, also in the transverse region.

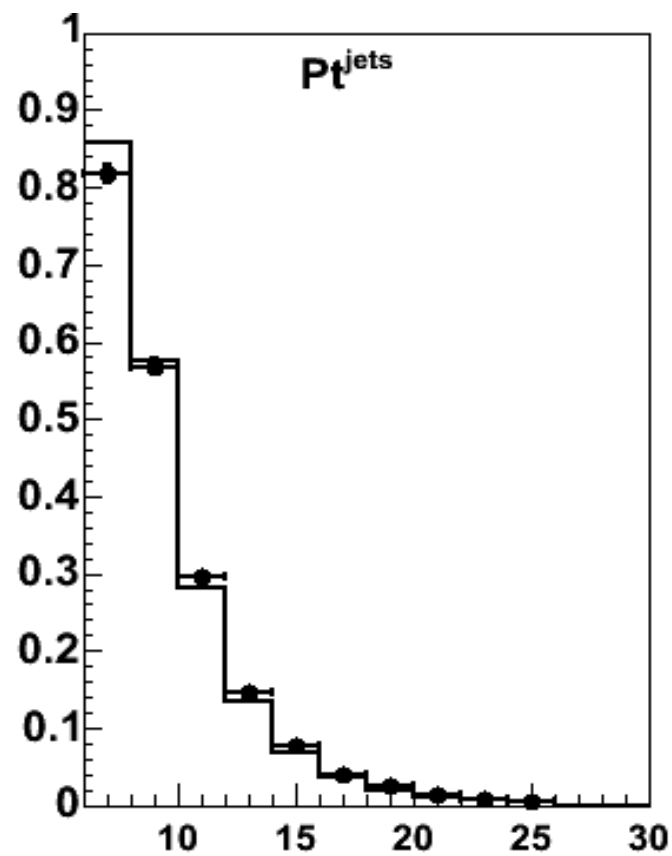
<u>For the charm sample...</u>

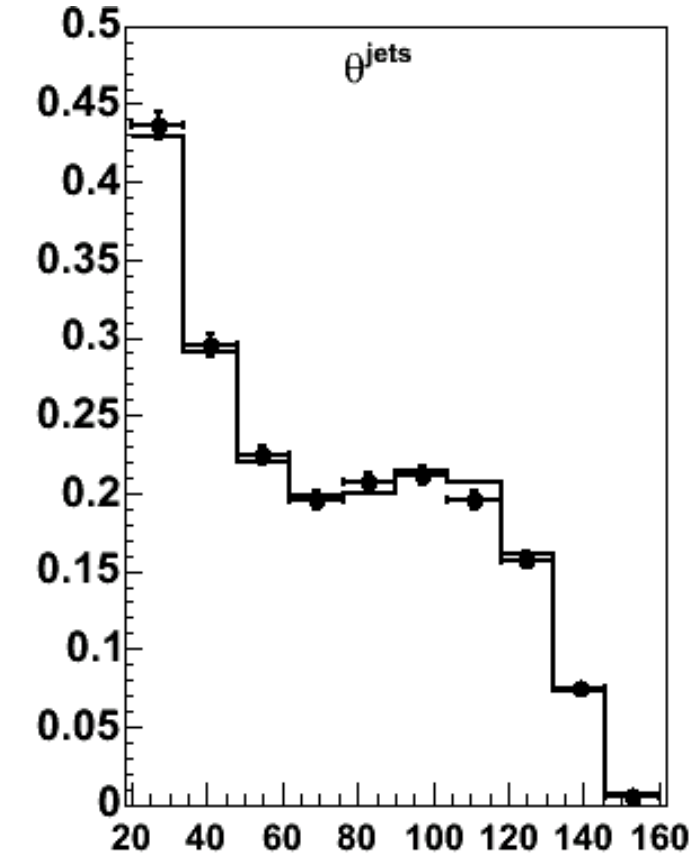
- ✗ Here is PYTHIA without MI that describes jet shapes
- ✗ PYHTIA does not describe multiplicity and energy flow in the low Xγ region.

.... it looks like charm *"is different"*...

Light flavours: Control plots

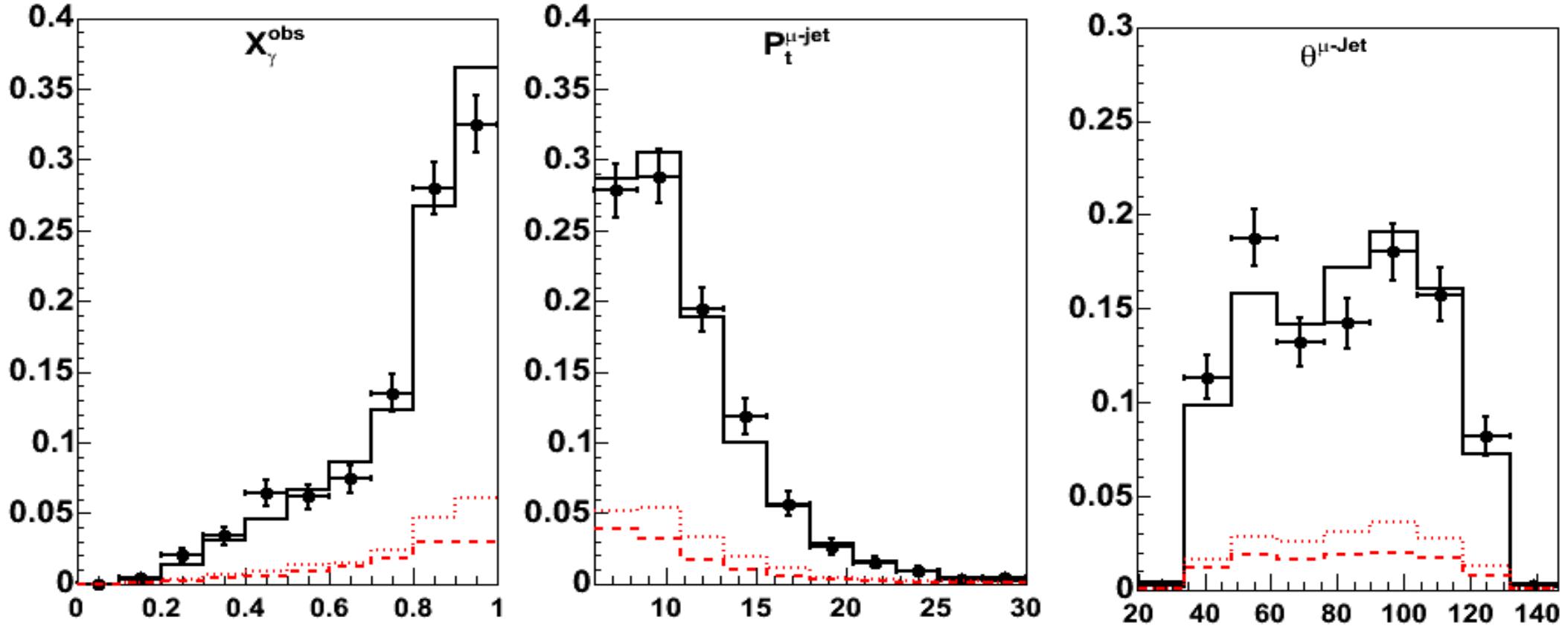






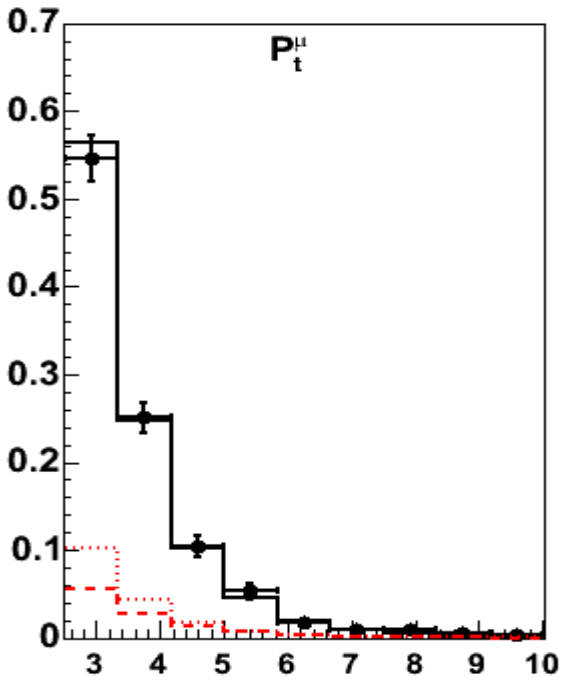
PYTHIA describes data reasonably well.

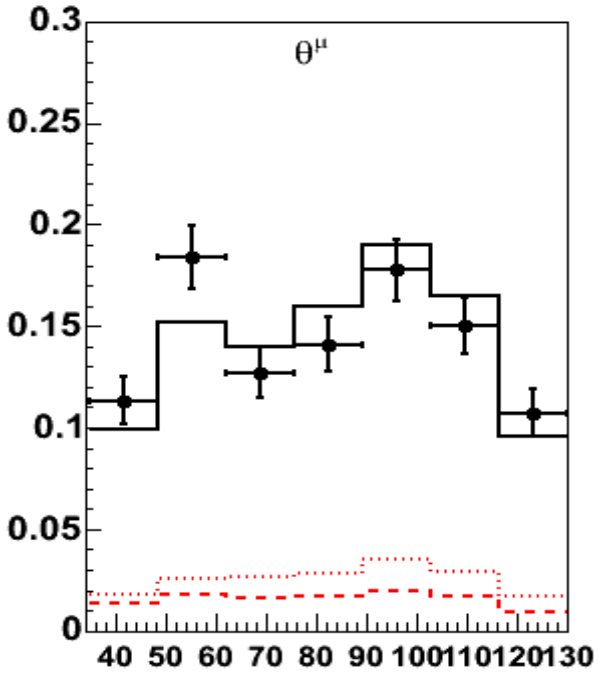
Charm enriched sample Control plots

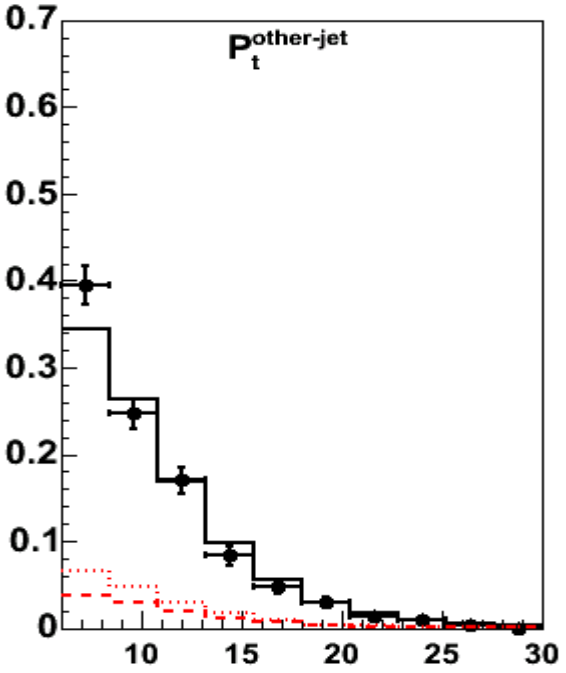


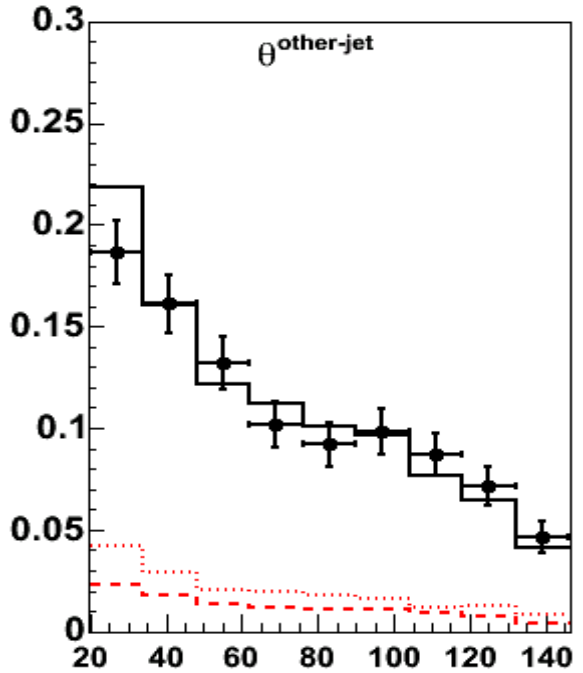
PYTHIA describes reasonably well data.

Charm enriched sample (more) Control plots

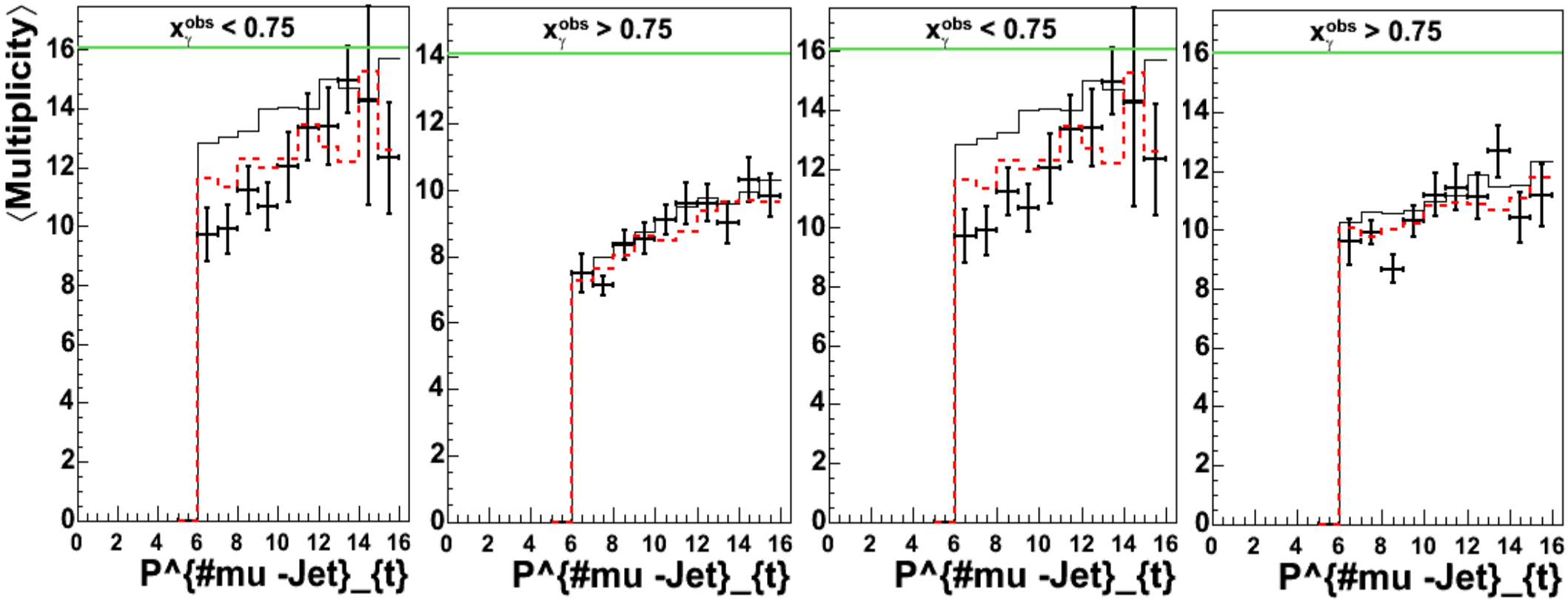








Charm sample multiplicity



PYTHIA MI <u>does not</u> describe data in the low X_γ region !!