

Update on SMOG LHCb simulation

Patrick Robbe, Frédéric Fleuret, 18 June 2014

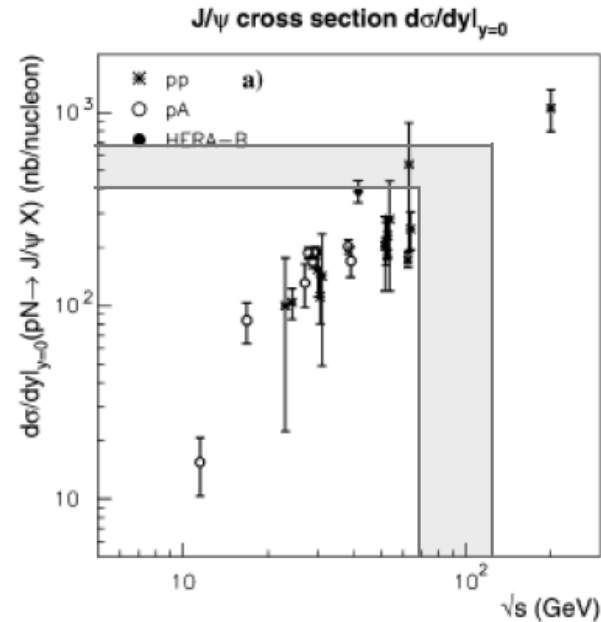
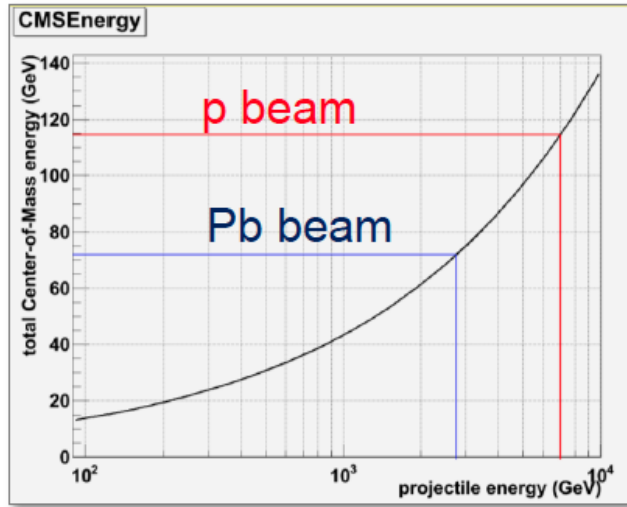
Setup

- Collisions of Pb beam (2.76 TeV) with Argon gas fixed target in LHCb interaction point:
 - Centre of mass energy of 72 GeV
 - In the CM frame, LHCb acceptance is $-1.8 < y_{\text{LHCb}}^* < 0.2$
 - Very roughly, the particle multiplicity in the most central PbAr collisions is ~ 10 times more than pp collisions.

Luminosity

- Target density: $2 \cdot 10^{12} \text{cm}^{-2}$ ($P=10^{-6}$ mbar, $L=80\text{cm}$)
- Beam intensity:
 - p: $3.55 \cdot 10^{18} \text{s}^{-1}$ (2808 bunches of $1.15 \cdot 10^{11}$ p)
 - Pb: $4.56 \cdot 10^{14} \text{s}^{-1}$ (592 bunches of $7 \cdot 10^7$ Pb)
- Instantaneous luminosity (Target density x beam intensity)
 - p: $7 \mu\text{b}^{-1} \text{s}^{-1}$
 - Pb: $0.9 \text{mb}^{-1} \text{s}^{-1}$
- Integrated luminosity (1 month, 30%)
 - p: 5.6pb^{-1}
 - Pb: 0.7nb^{-1}

Cross sections



- $$Br_{\mu^+\mu^-} \times \left. \frac{d\sigma_{J/\Psi}}{dy} \right|_{y=0} (pA \rightarrow J/\Psi + X) \sim 5.9\% \times 400 \text{ nb/nucleon} \sim 24 \text{ nb/nucleon}$$

| | A | $A \times 5.6 \text{ pb}^{-1} \times 24 \text{ nb}$ | $A \times 208 \times 0.7 \text{ nb}^{-1} \times 24 \text{ nb}$ |
|----|-----|---|--|
| Ne | 20 | $2.7 \cdot 10^6$ | $0.7 \cdot 10^5$ |
| Ar | 40 | $5.4 \cdot 10^6$ | $1.4 \cdot 10^5$ |
| Kr | 84 | $11.3 \cdot 10^6$ | $2.9 \cdot 10^5$ |
| Xe | 131 | $17.6 \cdot 10^6$ | $4.6 \cdot 10^5$ |

p

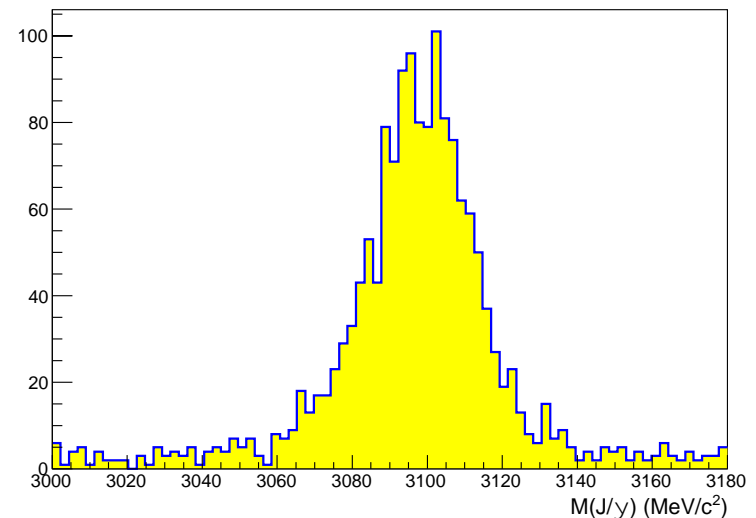
Pb

PbAr full simulation (signal)

- $\chi_c \rightarrow J/\psi (\mu\mu) \gamma$ signal, from EPOS files, through the full LHCb simulation (Geant4)+ reconstruction chain:
 - Minimum Bias = EPOS
 - Signa chi_c = Pythia6

$M(J/\psi)$

Total efficiency $\sim 20\%$



PbAr full simulation (signal)

$\chi_c \rightarrow J/\psi (\mu\mu) \gamma$, adding a Calorimeter photon

gamma_CL>0.75

muplus_PT>700.

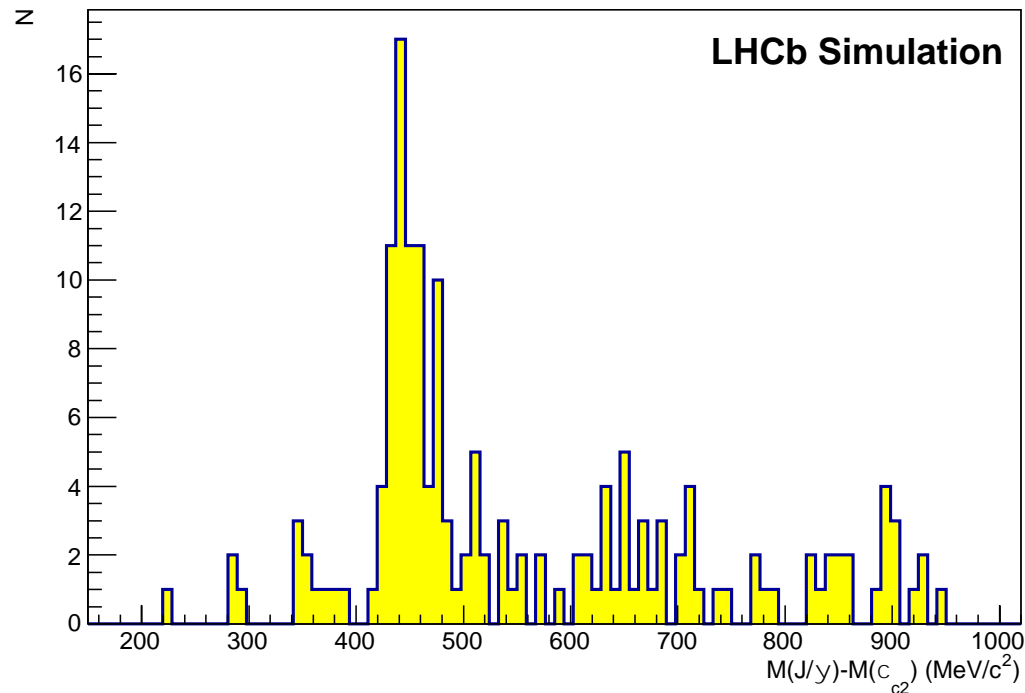
muminus_PT>700.

gamma_P>4000.

gamma_PT>500.

$M(\chi_c) - M(J/\psi)$

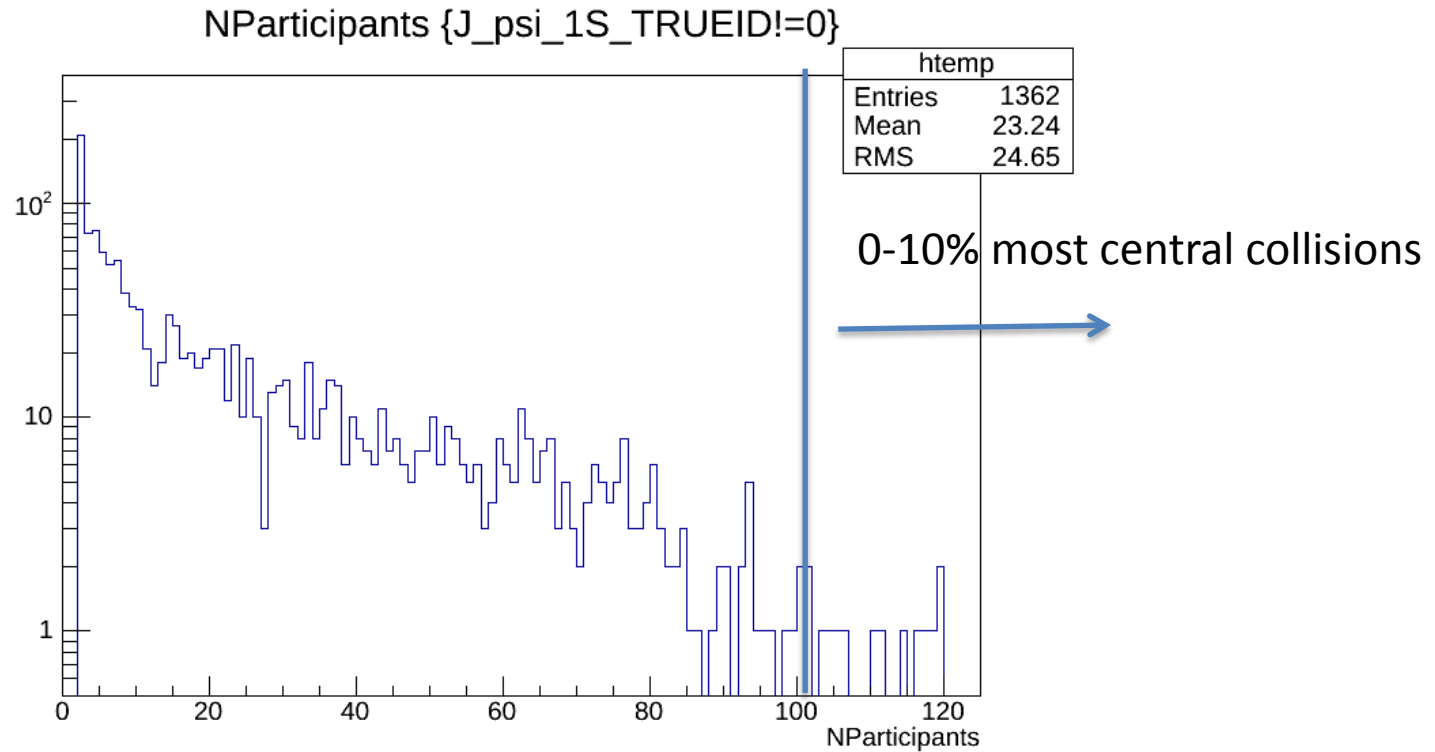
Total efficiency $\sim 1.5\%$



PbAr Minimum Bias

- Simulated 41900 EPOS MB events with the full LHCb simulation:
 - J/ψ :
 - Expect 56000 signal in 1 month,
 - With significance $> 7\sigma$
 - χ_c :
 - Expect 3000 signal in 3 months,
 - With significance $> 3\sigma$
- All numbers limited by MC statistics
- Untuned selection

Centrality



Some J/ψ seen in the most central collisions, with standard reconstruction:
Probably gain with looser tracking Global Event Cuts
Here also limited by MC statistics

Conclusions

- Very preliminary studies to refine further !
- J/ψ reconstruction in PbAr seems « easy », and possible also in most central collisions
- χ_c is more difficult, but does not seem to be impossible
- Next steps:
 - Study effects of tracking GEC
 - Have a look at the PbNe collisions recorded in 2013