Status of η_c reconstruction at SPD

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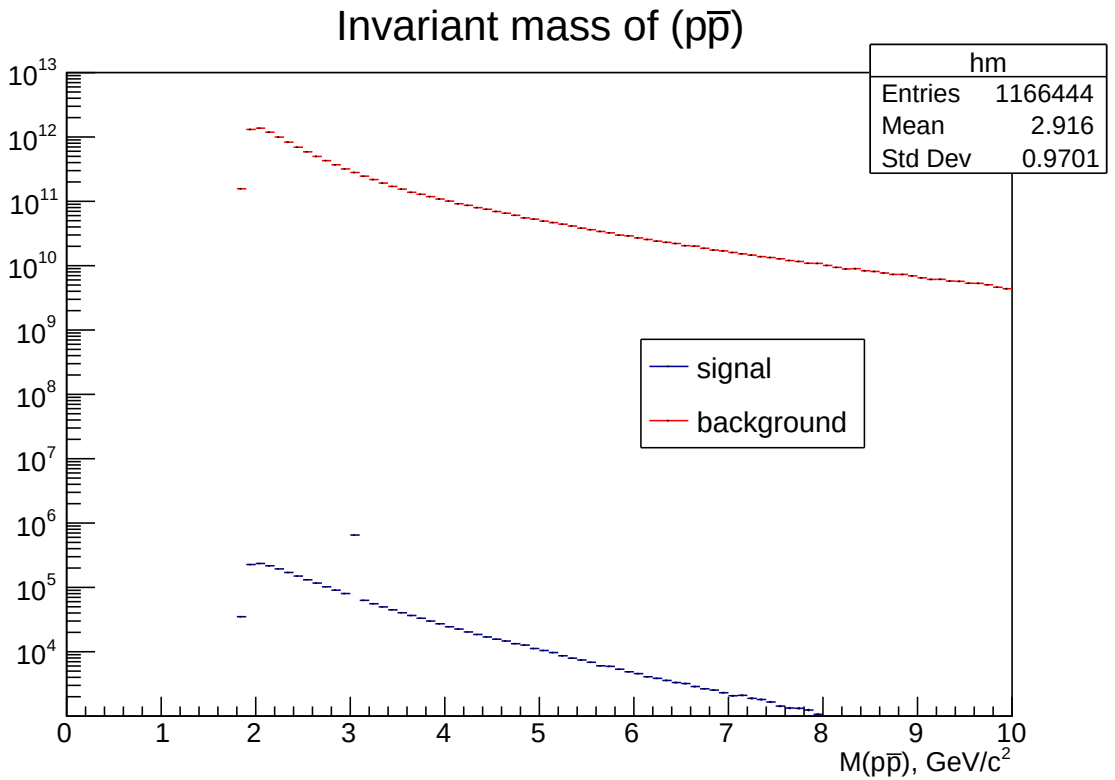
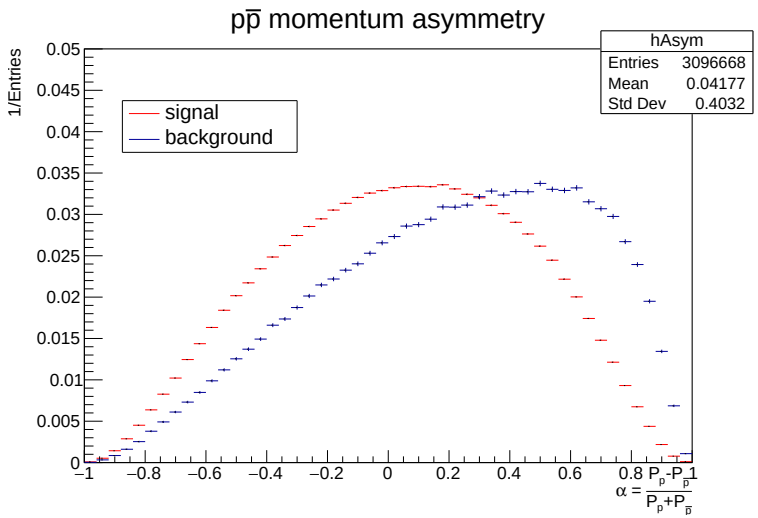
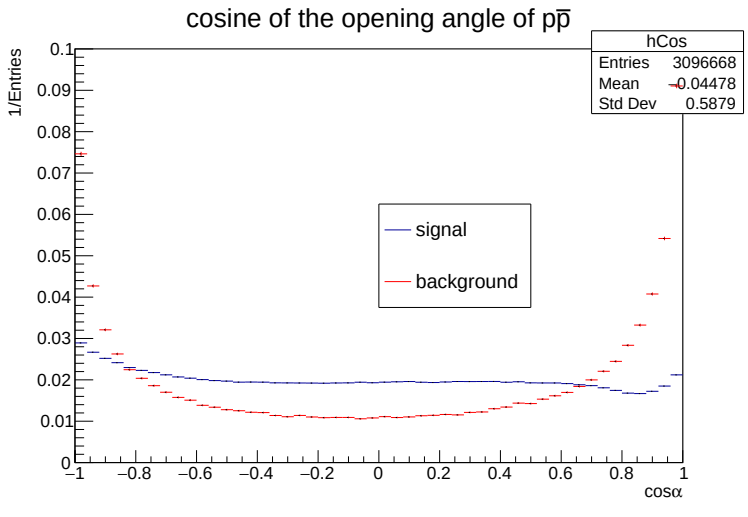
A brief reminder

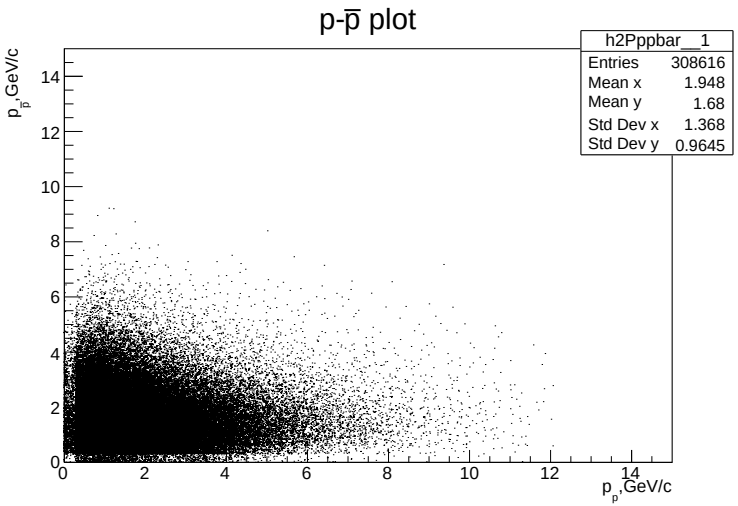


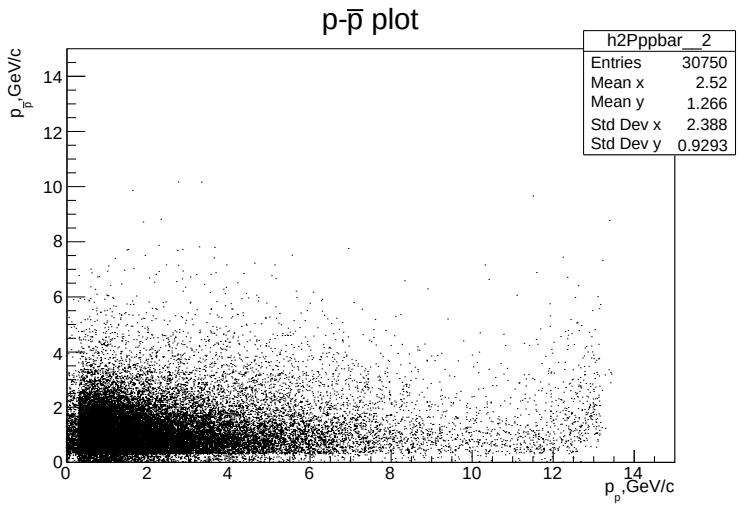
- $p - p$ collision with $\sqrt{s} = 27 GeV$
- $\sigma_{\eta_c} = 400 nb$
- $B_{\eta_c \to p\bar{p}} = 1.45 * 10^{-3}$
- $\sigma_{MB} = 40 mb$
- ≈ 6 orders of magnitude difference
- We have to reduce the background by imposing some cut(s)

A brief reminder





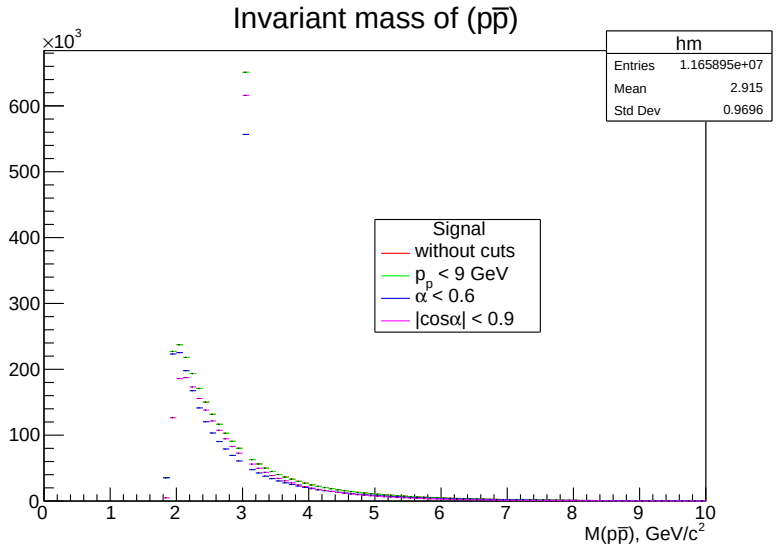


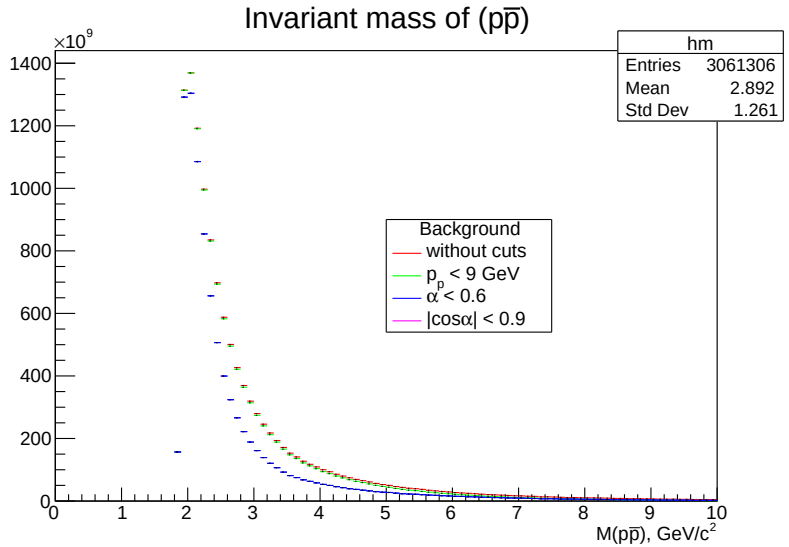


signal

background

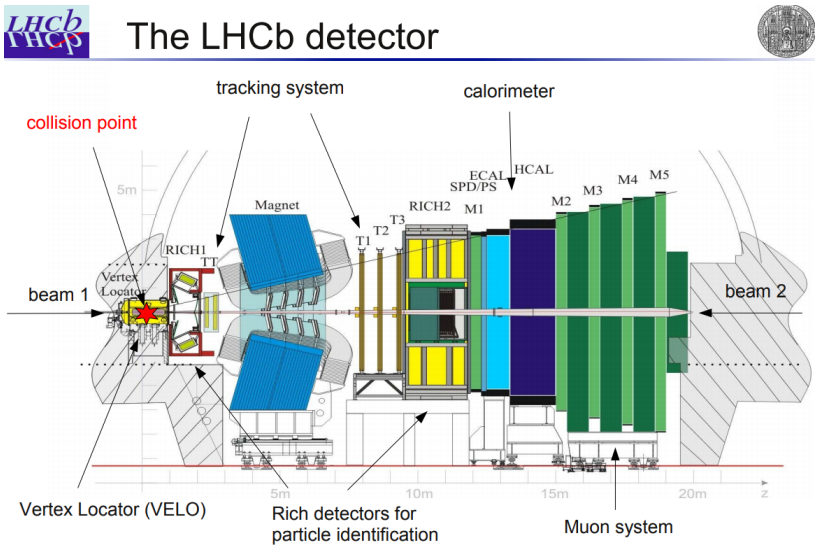
However it didn't work





- I forgot to take into account a cut on the polar angle of the outgoing particle (will be discussed a little later)
- How did The LHCb conduct their analysis?

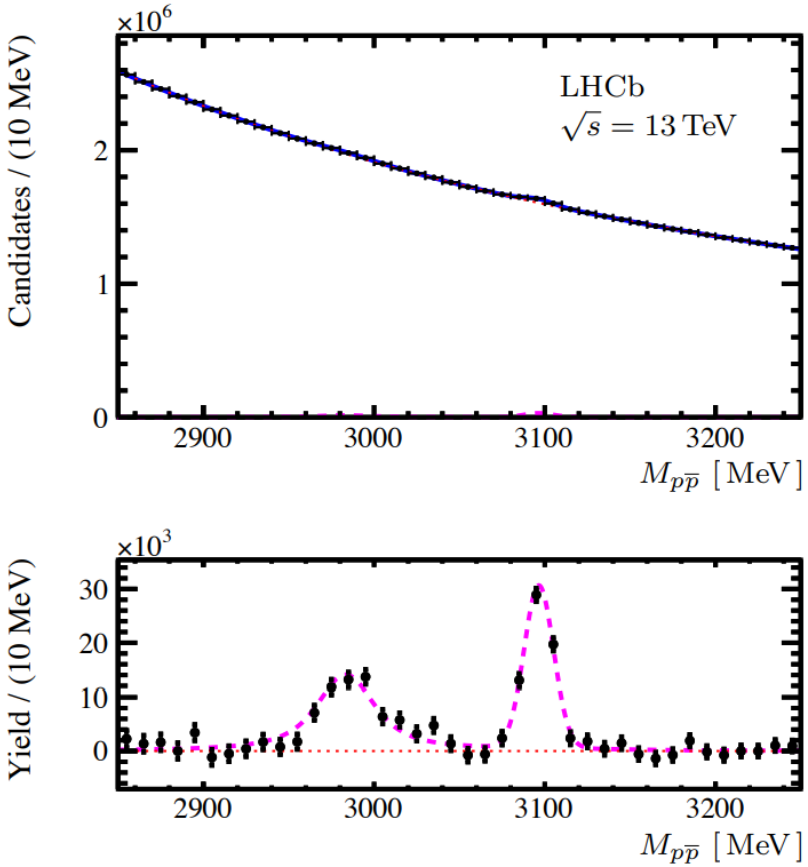
The LHCb Detector at the LHC



- $p - p$ collisions with $\sqrt{s} = 13\,TeV$
- $L = 2 fb^{-1}$
- $\sigma_{MB} = 100 mb$
- $B_{J/\psi \to p\bar{p}} = (2.120 \pm 0.029) * 10^{-3}$

- $(\sigma^{prompt}_{J/\psi})^{6.5<p_T<14.0 GeV, 2.0<y<4.5}_{13\,TeV} = 0.749 \pm 0.005 \pm 0.028 \pm 0.037 \mu b$
- $2.0 < y < 4.5$
- $6.5 < p_T < 14 GeV/c$ for $p - \bar{p}$ pair
- $p_T > 2 GeV/c$ for each particle
- Maximum E_T in HCal & $n_{SPD} < 450$ – L0 trigger
- $10 < \theta < 400 mrad$ for charged particles

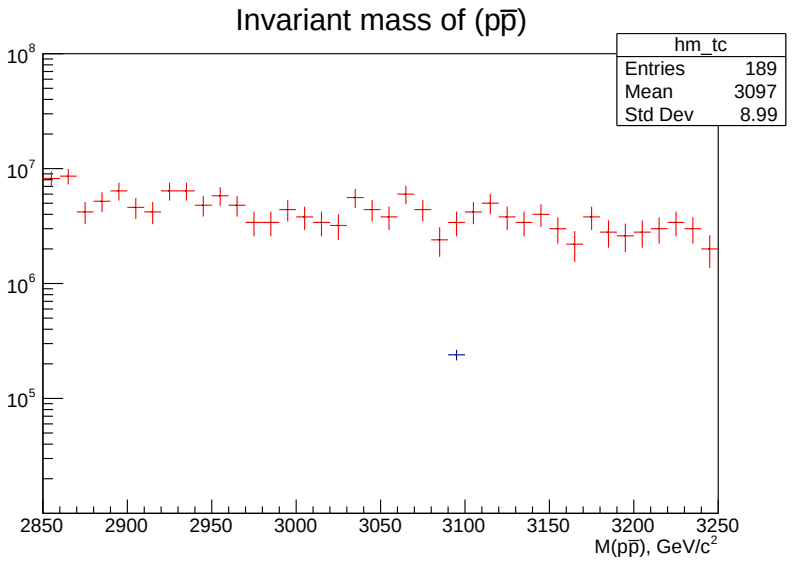
The LHCb outcomes



p_T range [GeV]	$N^{prompt}_{J/\psi}$	$N^{b}_{J/\psi}$	$\frac{N^{prompt}_{\eta_c}}{N^{prompt}_{J/\psi}}$	$\frac{N^{b}_{\eta_c}}{N^{b}_{J/\psi}}$
6.5 – 8.0	21600 ± 1800	5080 ± 140	0.98 ± 0.22	0.26 ± 0.04
8.0 – 10.0	26500 ± 1700	7930 ± 170	1.12 ± 0.18	0.40 ± 0.03
10.0 – 12.0	15100 ± 1100	5240 ± 130	1.24 ± 0.19	0.30 ± 0.04
12.0 – 14.0	5700 ± 700	2830 ± 100	2.24 ± 0.44	0.35 ± 0.05
6.5 – 14.0	69000 ± 2800	21040 ± 270	1.18 ± 0.10	0.33 ± 0.02

arXiv:1911.03326v2 [hep-ex] 5 Mar 2020

My attempt..



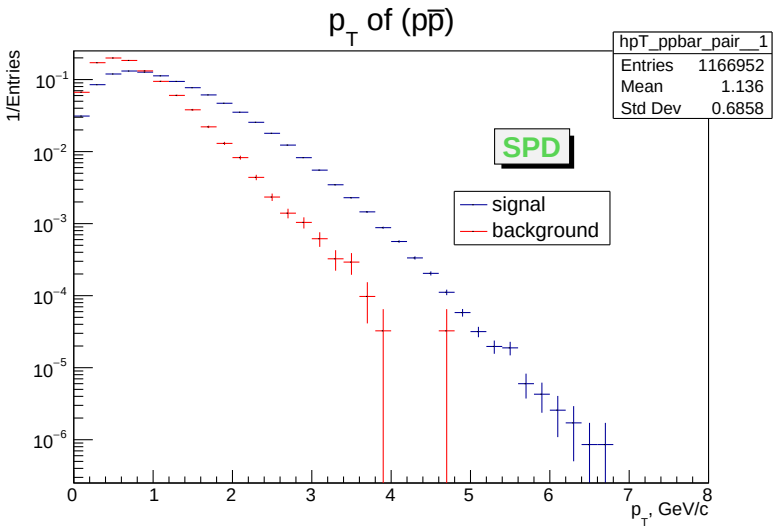
all cuts

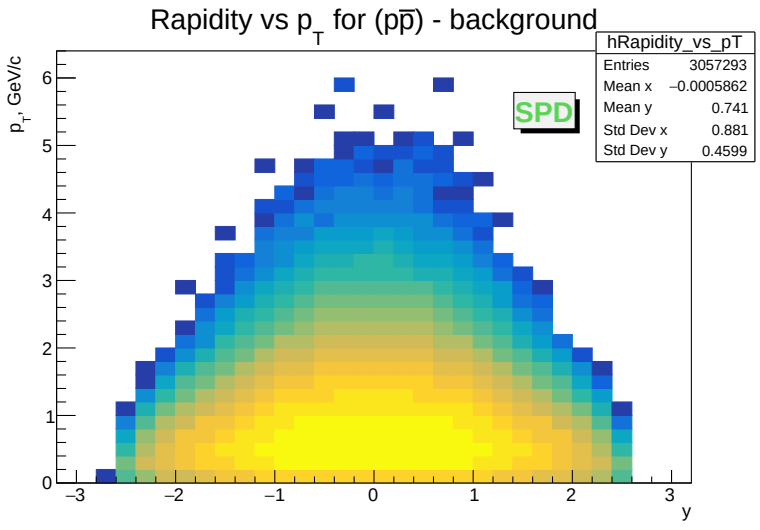
1. The simulated signal and background as well as the signal and background extracted from the LHCb data, respectively

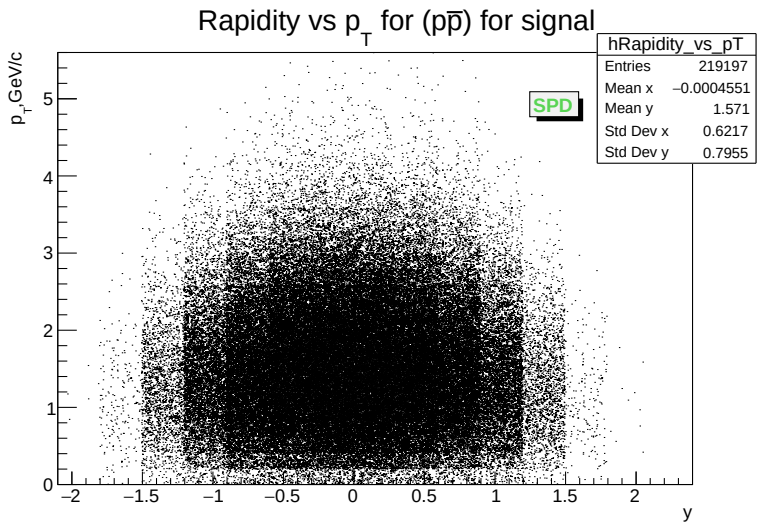
$$\frac{N_{sig}^{MC}}{N_{sig}^{LHCb}} = \frac{239579}{69000} \approx 3.5 \qquad \frac{N_{back}^{MC}}{N_{back}^{LHCb}} = \frac{5.7*10^6}{1.7*10^6} \approx 3.4$$

2. As a consequence, it can be concluded that the signal-to-background ratio is consistent with the LHCb result
3. And what about SPD?

Returning to the SPD case

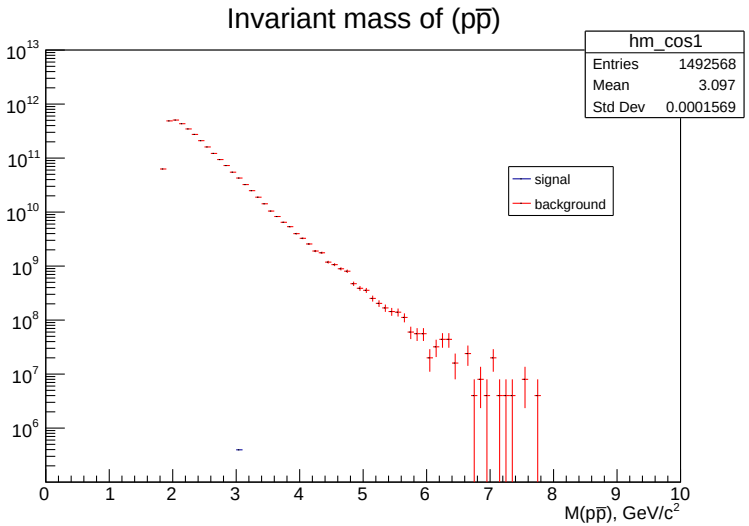




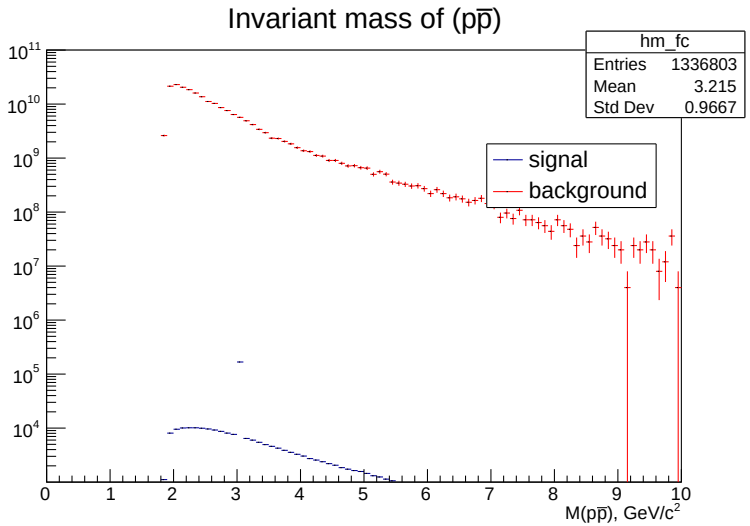


1. $\Rightarrow p_T(p\bar{p}) > 2\ GeV/c$ or $p_T(p\bar{p}) > 3\ GeV/c$
2. As well as $|cos\theta| < 0.9$

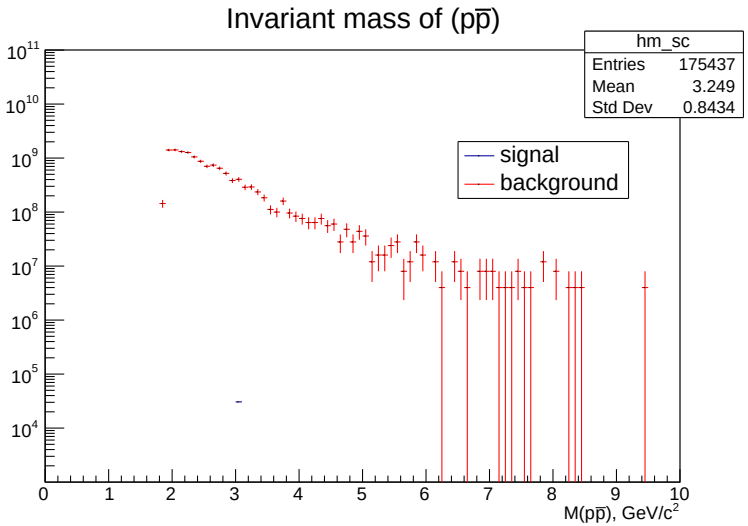
Imposing these cuts



$|cos\,\theta| < 0.9$

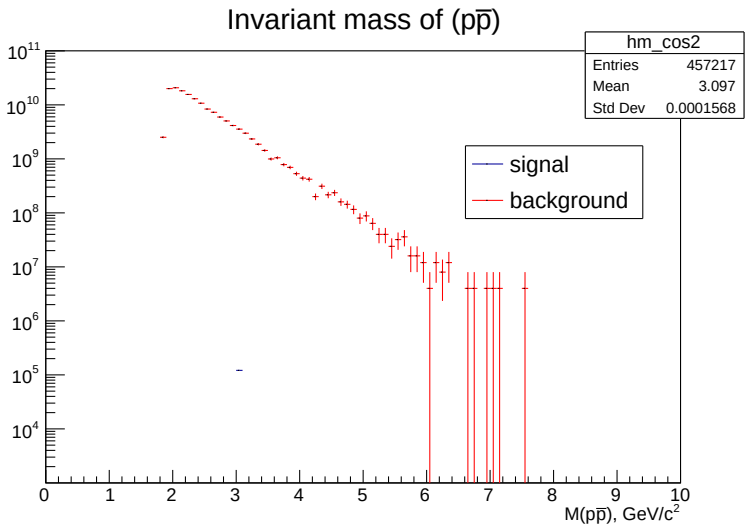


$p_T(p\bar{p}) > 2\ GeV/c$

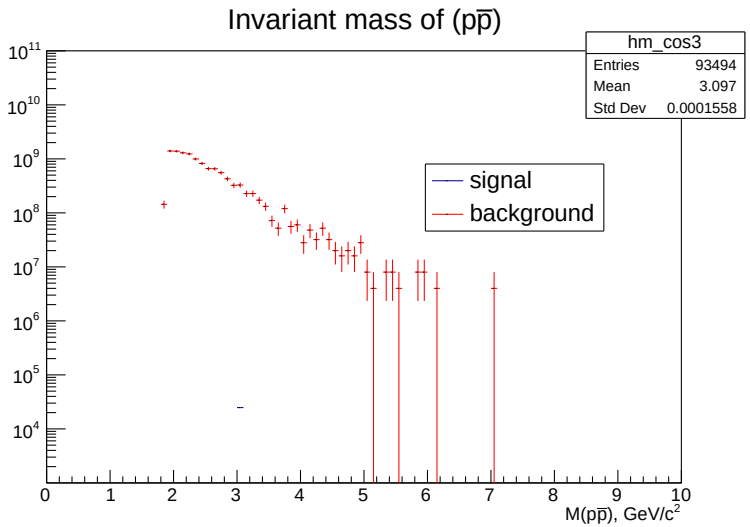


$p_T(p\bar{p}) > 3\ GeV/c$

As a result



$p_T(p\bar{p}) > 2\ GeV/c$ & $|cos\,\theta| < 0.9$



$p_T(p\bar{p}) > 3\ GeV/c$ & $|cos\,\theta| < 0.9$

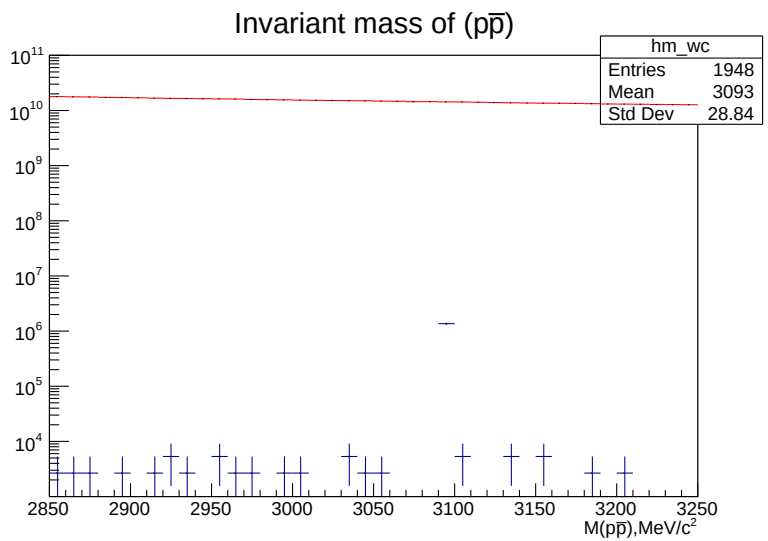
	N_{back}/N_{sig}
$p_T > 2\ GeV/c$	$5.7 * 10^4$
$p_T > 3\ GeV/c$	$1.32 * 10^4$
$\|cos\,\theta\| < 0.9$	$1.1 * 10^5$
$p_T > 2\ GeV/c$ & $\|cos\,\theta\| < 0.9$	$2.9 * 10^4$
$p_T > 3\ GeV/c$ & $\|cos\,\theta\| < 0.9$	$8.8 * 10^3$

Nevertheless the background is still high
Any ideas?

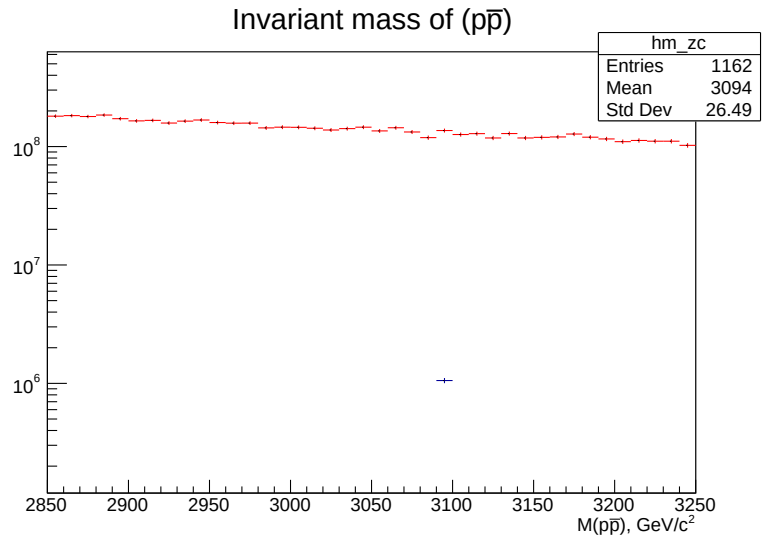
Summary

1. Better, but the background is still large
2. Perhaps, we should impose some 2D-cuts on p_T of p and $\bar{p}$
3. Anyway, the analysis should be continued

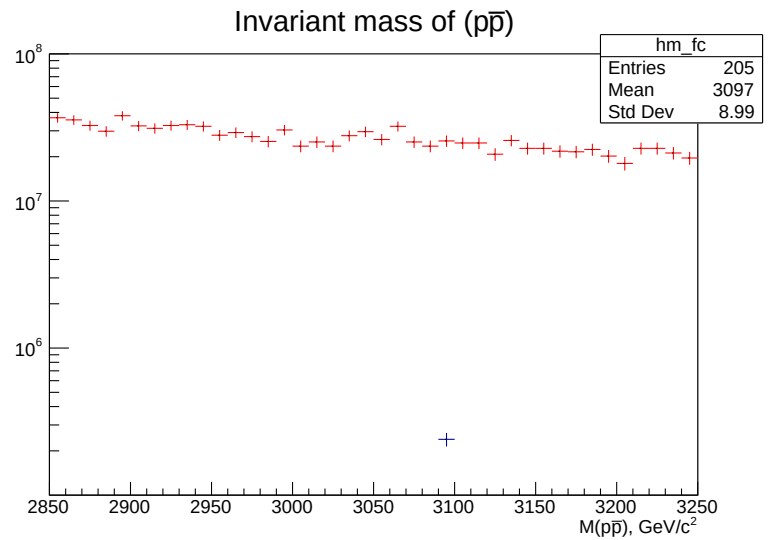
Backup



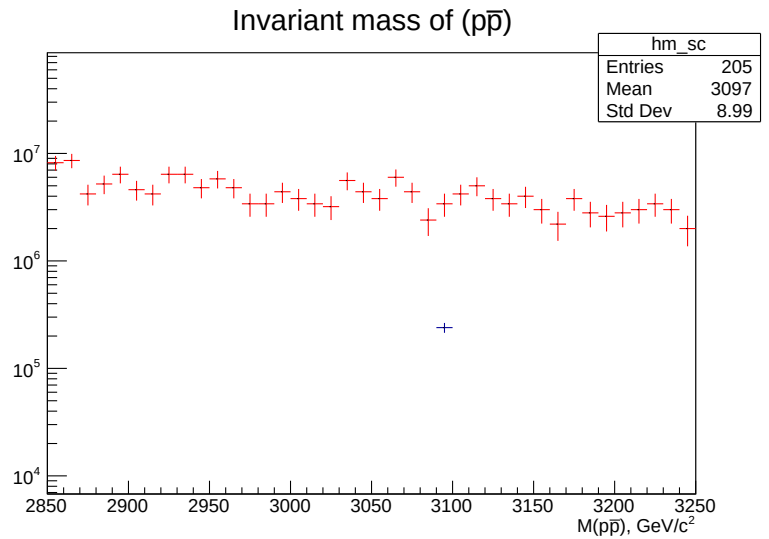
No cuts



$6.5 < p_T^{(p\bar{p})} < 14\ Gev/c$



$6.5 < p_T^{(p\bar{p})} < 14\ Gev/c\ \&\ 2.0 < y < 4.5$



$6.5 < p_T^{(p\bar{p})} < 14\ Gev/c\ \&\ 2.0 < y < 4.5$
$\&\ p_T^{p\ or\ \bar{p}} > 2 GeV/c$