Drell-Yan measurements with SPD. Background studies

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Background to Drell-Yan process

- Drell-Yan process: $p + p \rightarrow \mu^+ + \mu^- + X$
  - $\sigma_{\text{tot}}(m_{\mu\mu} > 4\ \text{GeV}) = 0.075\ \text{nb}$ (at $\sqrt{s} = 26\ \text{GeV}$)

- Main source of background – muons from π and K decays.
  - $\sigma_{\text{tot}} = 39.4\ \text{mb}$ (minimum bias events with $\sqrt{s} = 26\ \text{GeV}$)
  - $\sim 10^{-4}$ of these events contribute to BG in range $m_{\mu\mu} > 4\ \text{GeV}$

- To achieve $\frac{BG}{DY} \sim 0.1$, we need to suppress BG in $\mathbf{\sim 10^6}$ times.

Events generation

- Pythia 6
- Two proton beams with $\sqrt{s} = 26\ \mathrm{GeV}$.
- Decays of $\pi^{\pm}, K^{\pm}, K^{0}$ turned on.
- Only muons produced within volume of SPD dimensions are taken into account.

Minimum bias events

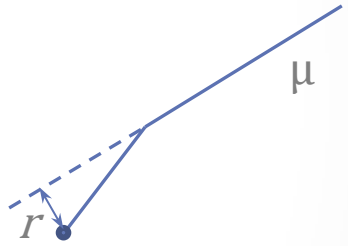
- MSEL=2
- 10^{11} events

Drell-Yan events

- Only process $q\bar{q} \to \gamma^{*} \to \mu^{+}\mu^{-}$ enabled.
- $m_{\mu\mu} > 4\ \mathrm{GeV}$
- 10^{6} events

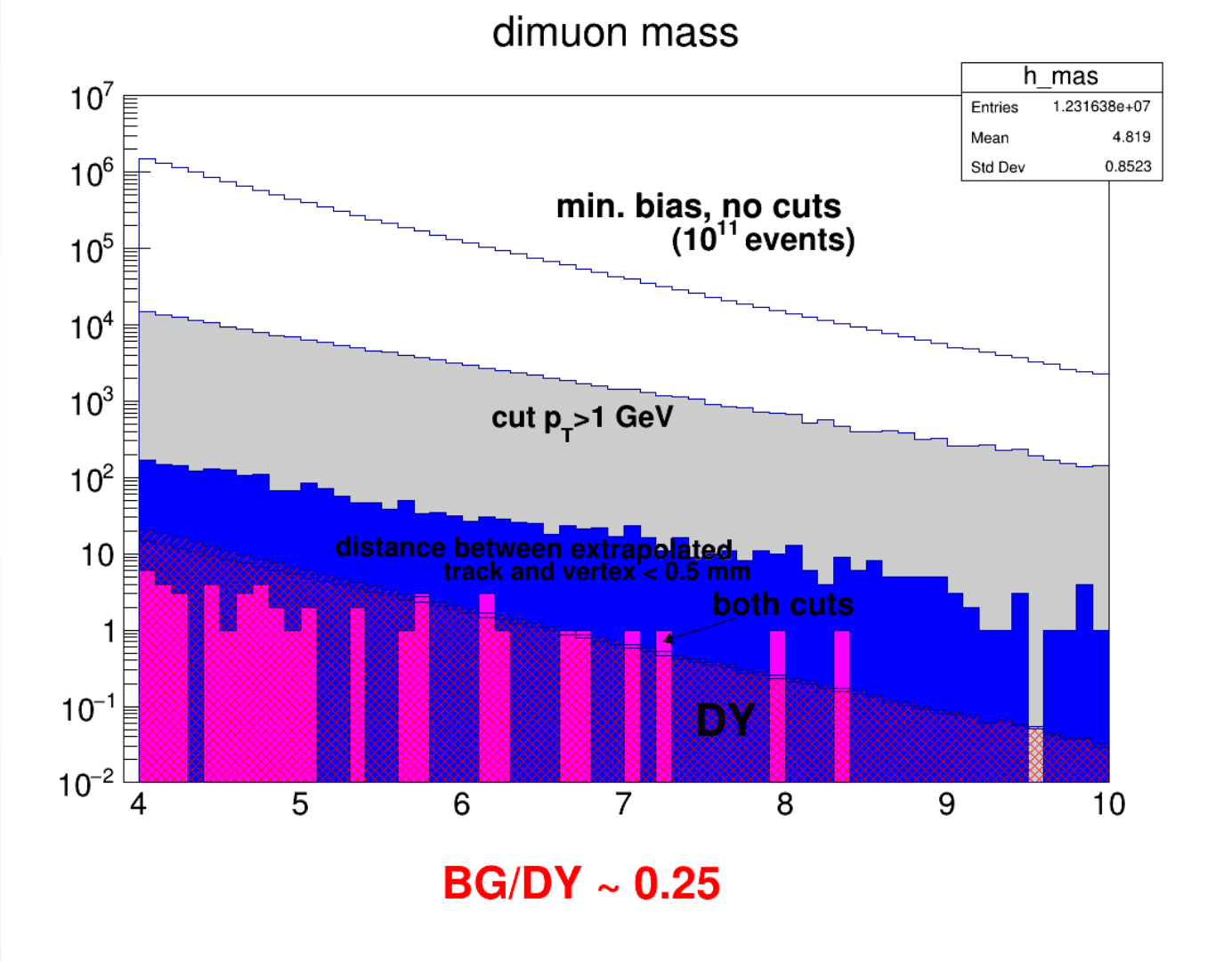
Cuts

- Kinematical cuts
  - $p_T > p_{T,min}$ for each muon in the $\mu^+\mu^-$ pair
- "Geometrical" cuts
  - distance between muon track prolongation and primary vertex $r < r_{max}$



- Combination

Dimuon mass distribution



BG/DY ~ 0.25

Background/signal ratio

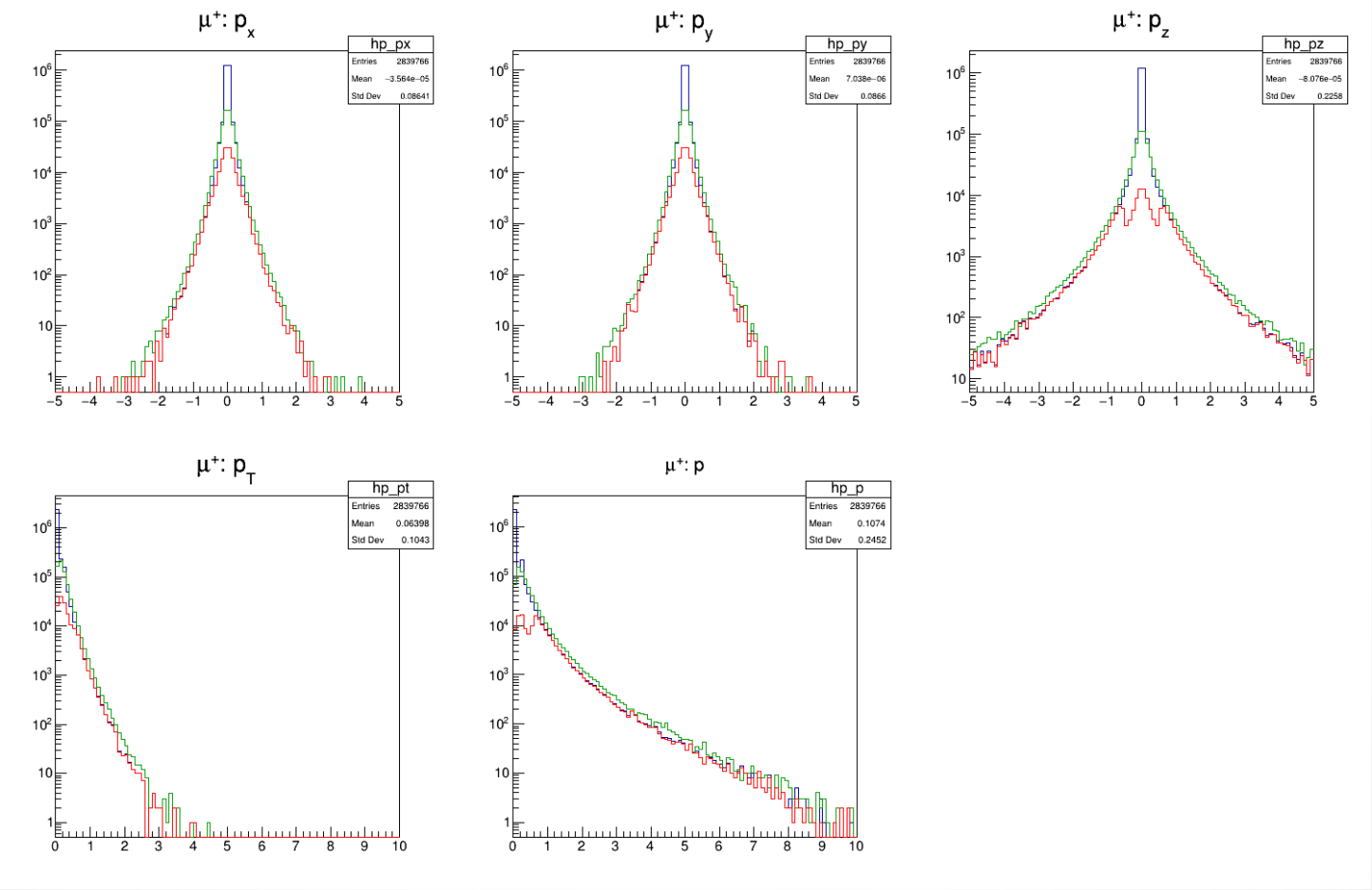
μ track to prim. vertex distance	$p_T > 0.5$ GeV	$p_T > 1.0$ GeV	$p_T > 1.2$ GeV	$p_T > 1.5$ GeV
< 0.2 mm	0.57	0.05	0.02	< 0.01
< 0.3 mm	0.93	0.11	0.07	0.03
< 0.5 mm	1.97	0.25	0.14	0.07
< 1.0 mm	6	0.78	0.45	0.14
DY signal (after p_T cut)	0.95	0.78	0.68	0.51

SPDRoot simulations

green – "pure" Pythia; 10^6 min. bias events

blue – SpdRoot (Hybrid geometry), all muons;

red – SpdRoot (Hybrid geometry), muons reached RS



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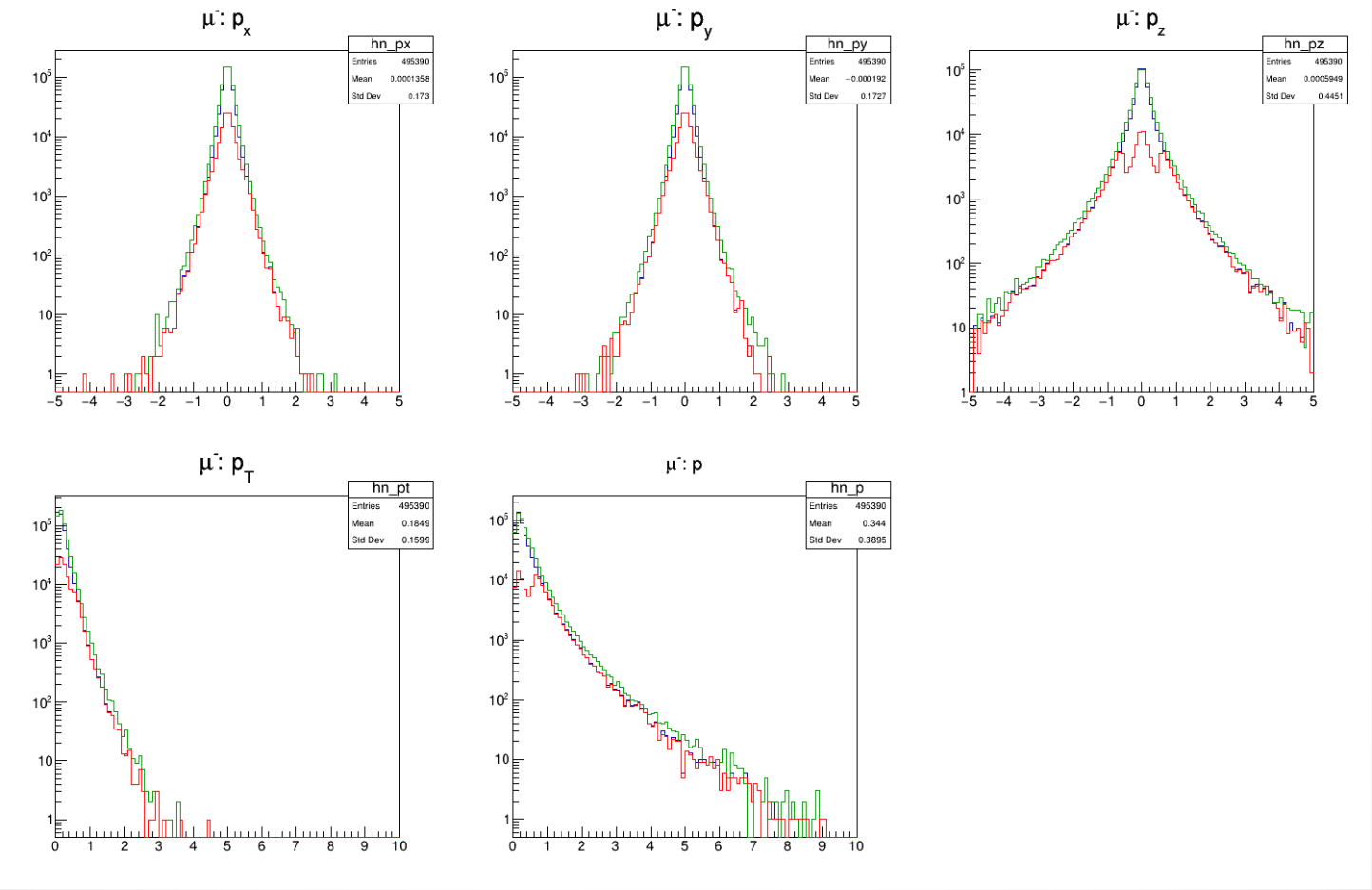

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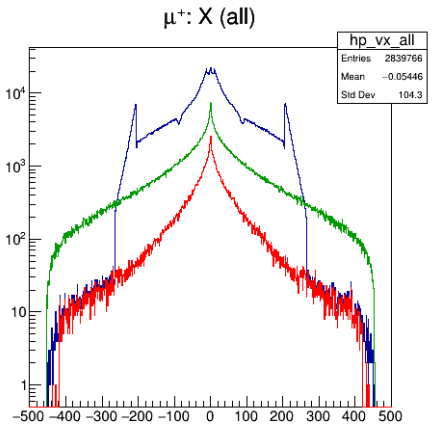

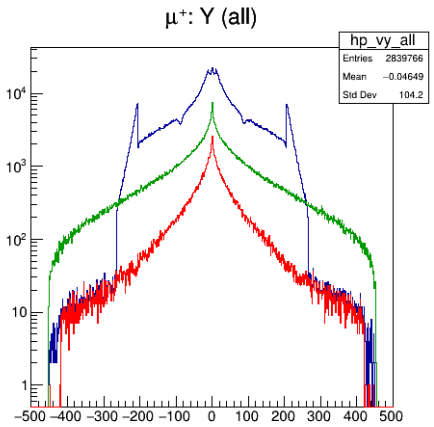

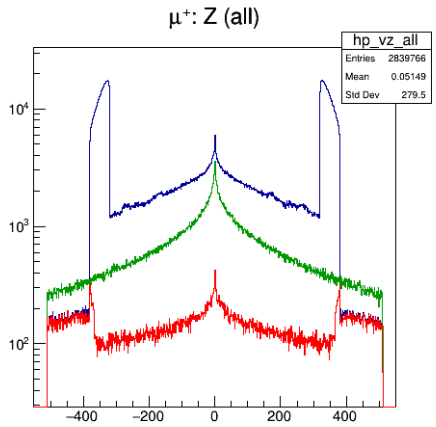

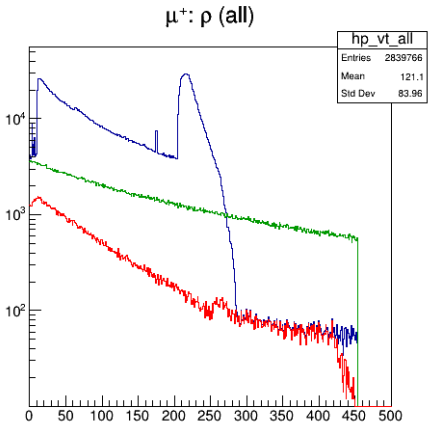

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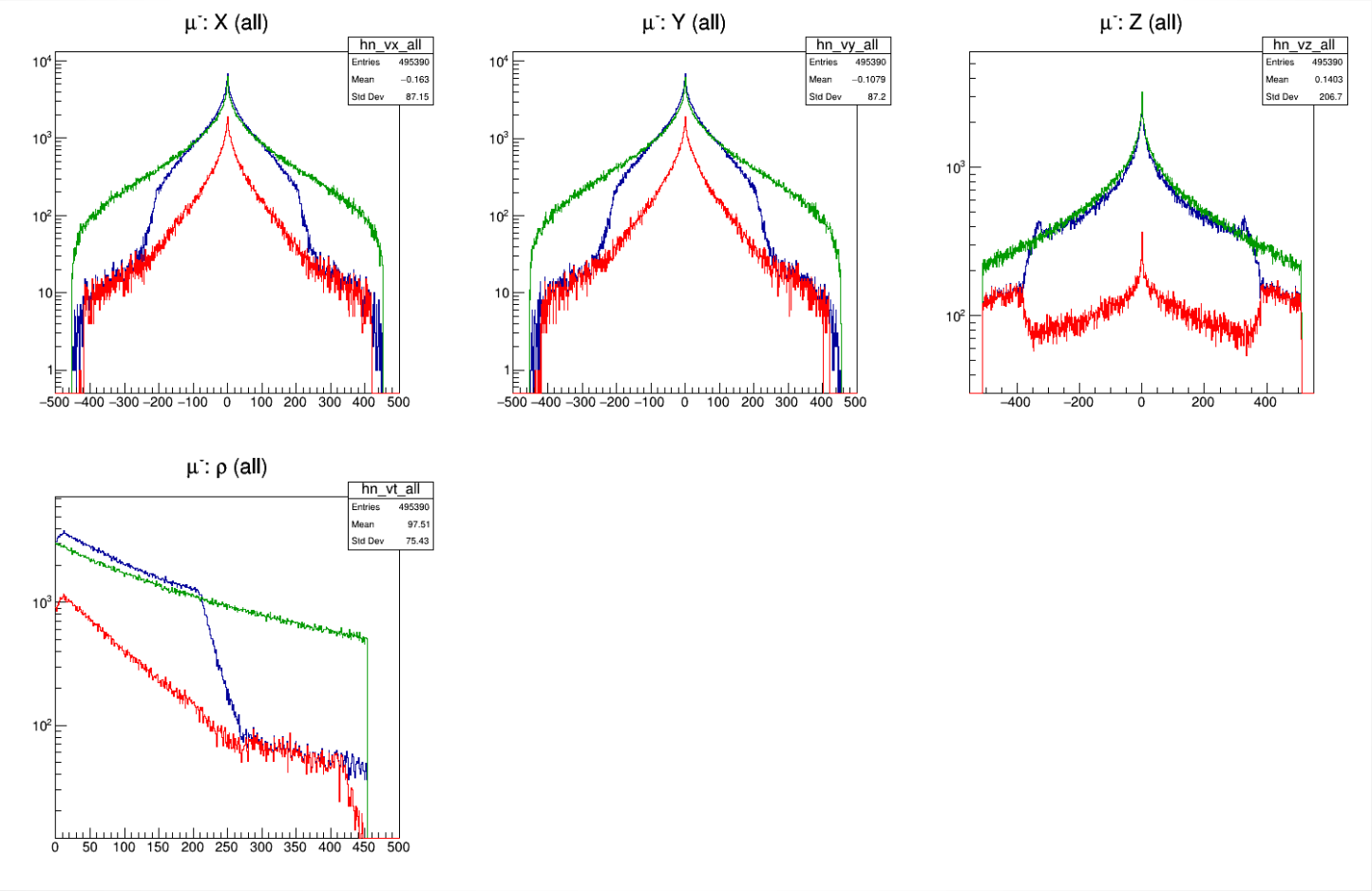

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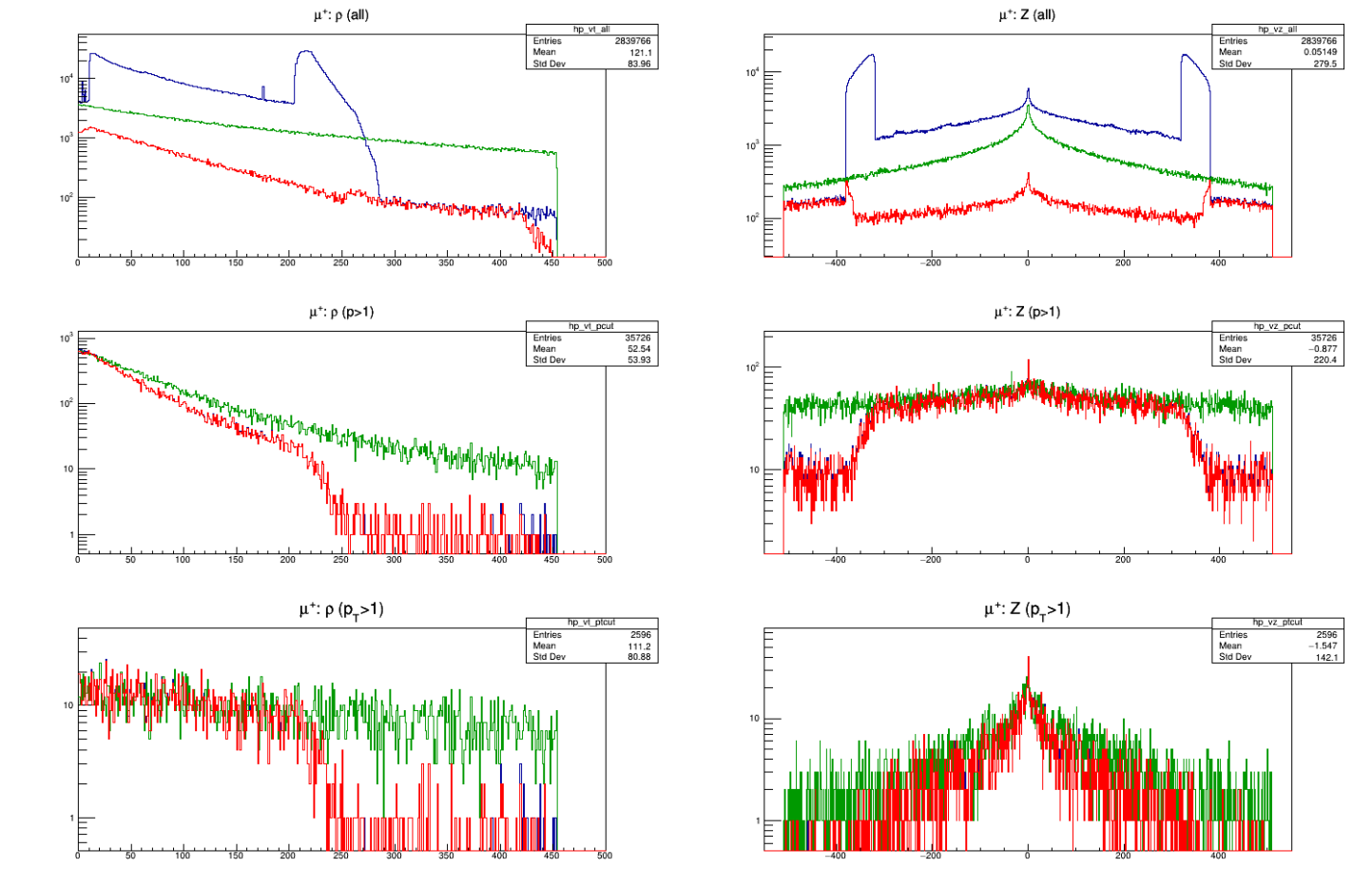

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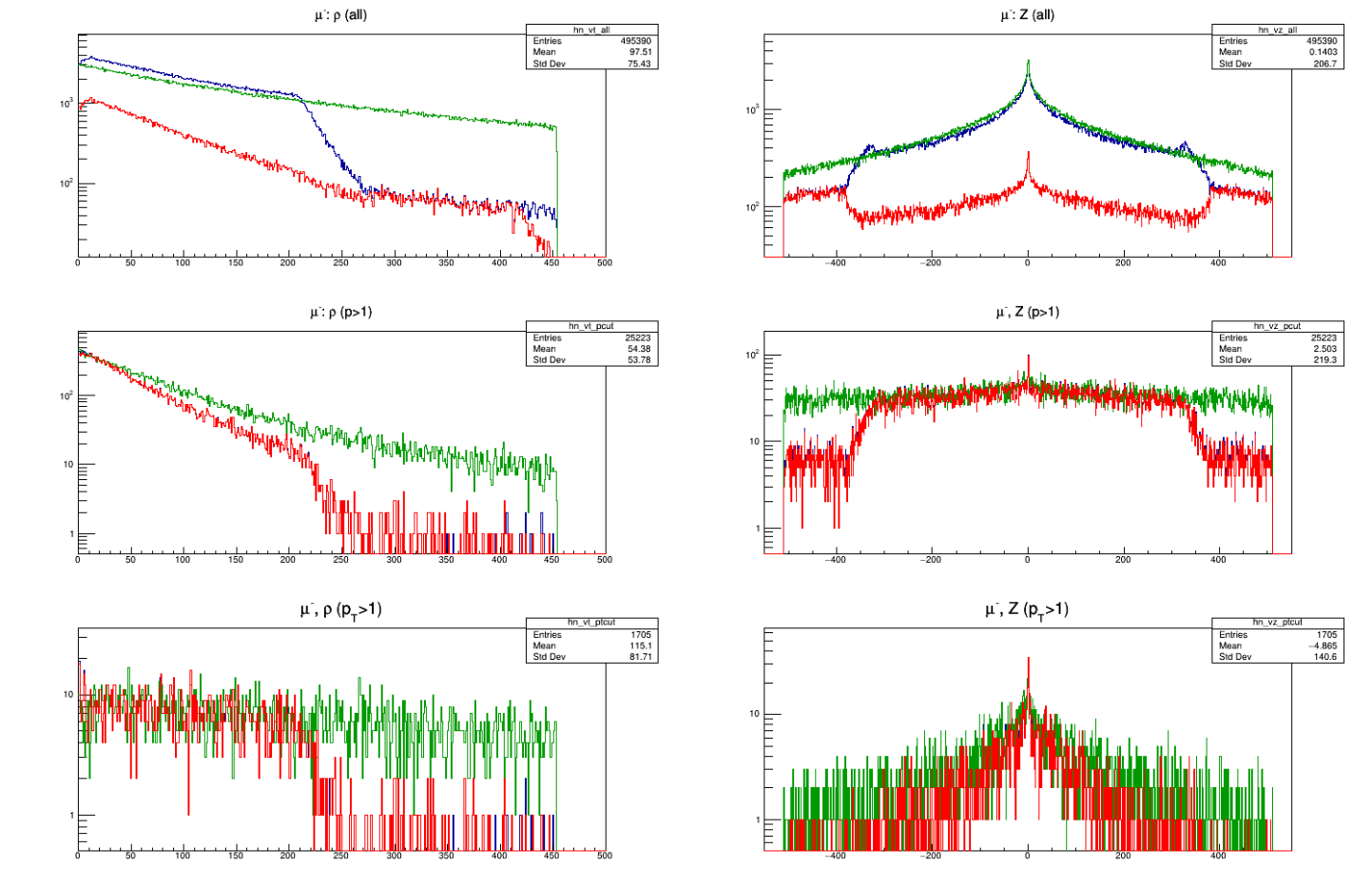

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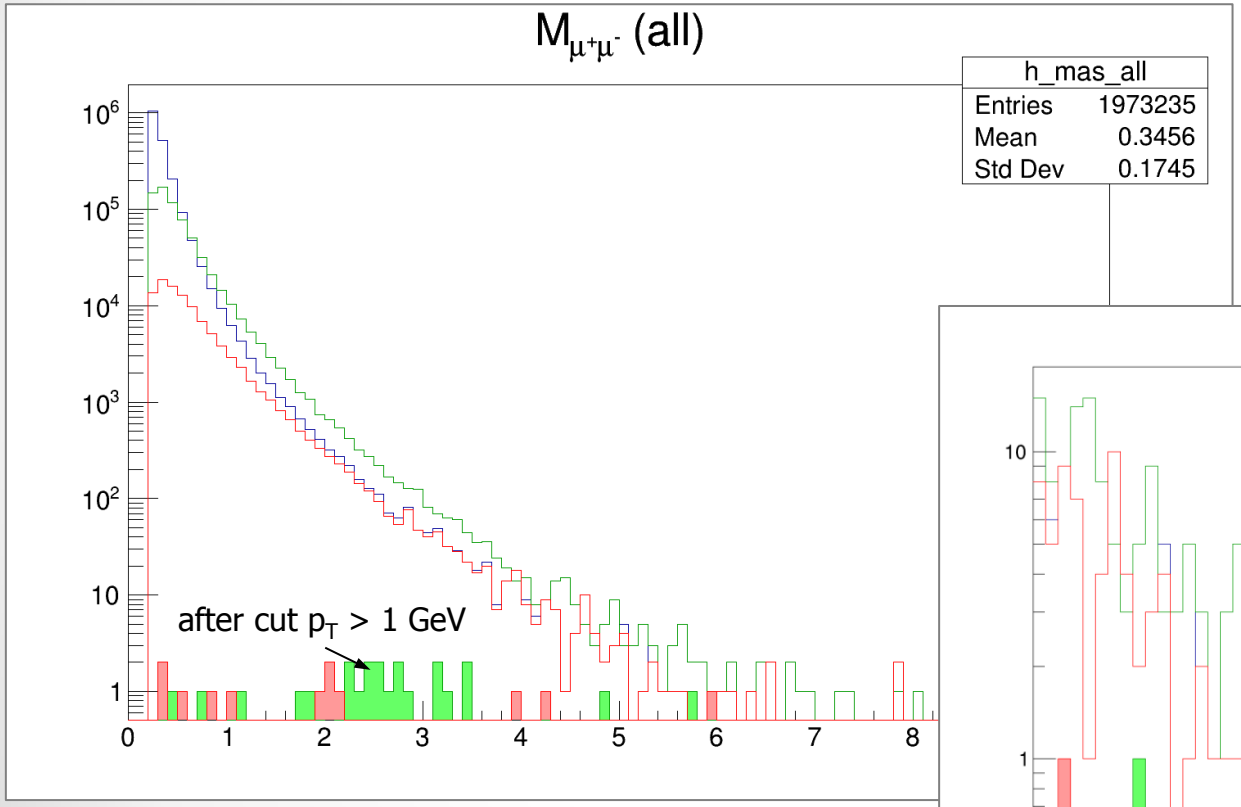

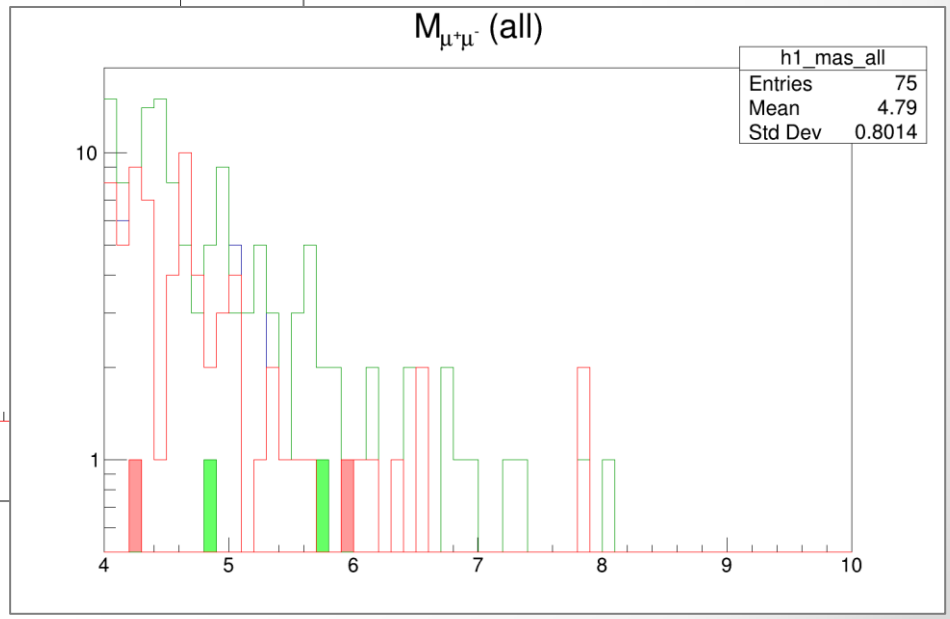

Conclusion

- Background studies for Drell-Yan process are in progress.
- High precision reconstruction of primary and secondary vertices are needed.
- Other methods of background suppression (without absorber) are to be considered.
- Further sources of background are to be estimated.

Thank you for your attention!

Backup slides

Minimum bias events generation

- Pythia 6
- MSEL = 2
- Two proton beams with $\sqrt{s} = 26\ \mathrm{GeV}$.
- Decays of $\pi^{\pm}, K^{\pm}, K^{0}$ turned on.
- 10^{11} events.
- Only muons produced within volume of SPD dimensions are taken into account.

$\sigma_{\mathrm{tot}} = 39.4\ \mathrm{mb}$

Drell-Yan events generation

- Pythia 6
- Only process $q\bar{q} \rightarrow \gamma^* \rightarrow \mu^+\mu^-$ enabled.
- $m_{\mu\mu} > 4\ \mathrm{GeV}$
- Two proton beams with $\sqrt{s} = 24\ \mathrm{GeV}$.
- Decays of $\pi^{\pm}, K^{\pm}, K^0$ turned on.
- 10^6 events.
- Only muons produced within volume of SPD dimensions are taken into account.

$$\sigma_{\mathrm{tot}}(m_{\mu\mu} > 4\ \mathrm{GeV}) = 0.075\ \mathrm{nb}$$