

# Simulation $\bar{p}p \rightarrow e^+e^-\pi^0$ à la Lansberg

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# Outline



- 1 PID Suppression factors
- 2 Simulation cuts
- 3 Simulation Problem



# Simulation characteristics



## ● Signal<sup>1</sup>:

- $W^2=5 \text{ GeV}^2$  and  $10 \text{ GeV}^2$  ( $W^2=s$ )
- $\pi^0$  Forward and Backward  
→ 4 simulations
- Approximation valid for  $\Delta_{T_{\pi^0}} < 0.5 \text{ GeV}$

$Q_{min}(Q_{min}^2)$	$Q_{max}(Q_{max}^2)$	$Q_{max_{possible}}(Q_{max_{possible}}^2)$	$Q_{crit}(Q_{crit}^2)$	$W^2$	fw/bw	$p(\bar{p})$	$W=\sqrt{s}$
1.9 (3.61)	2.3 (5.29)	2.10 (4.41)	2.07 (4.28)	5	1	1.45	2.23
1.9 (3.61)	2.3 (5.29)	2.10 (4.41)	2.07 (4.28)	5	0	1.45	2.23
2.4 (5.76)	3.2 (10.24)	3.03 (9.18)	2.93 (8.58)	10	1	4.29	3.16
2.4 (5.76)	3.2 (10.24)	3.03 (9.18)	2.93 (4.28)	10	0	4.29	3.16

## ● Background:

- $\pi^+ \pi^- \pi^0$  in phasespace
- Limited  $q^2$ :
  - $q_{min}=1.9$  and  $q_{max}=2.3$  for  $W^2=5 \text{ GeV}$
  - $q_{min}=2.4$  and  $q_{max}=3.2$  for  $W^2=10 \text{ GeV}$
- Limited  $\Delta_{T_{\pi^0}}$ : Transverse momentum  $< 0.5 \text{ GeV}$  for both cases

<sup>1</sup>Based on J.P. Lansberg Phys Rev D 76, 111502(R) (2007)



## Software characteristics



- Release: 0.19.7
- At Mainz cluster: blaster.kph.uni-mainz.de
- Updated version of EpEmUser package for analysis
- Created a kinematical filter (Not submitted to the cvs):
  - ProDecayFiles/filter\_pi+pi-pi0\_range.tcl for  $W^2=5 \text{ GeV}^2$
  - ProDecayFiles/filter\_pi+pi-pi0\_range\_W2-10GeV.tcl for  $W^2=10 \text{ GeV}^2$
- ProDecayFiles V00-03-10
- Event Generator for signal:
  - ProDecayFiles/ppbar\_e+e-pi0\_fw\_Qsq5.tcl
  - ProDecayFiles/ppbar\_e+e-pi0\_bw\_Qsq5.tcl
  - ProDecayFiles/ppbar\_e+e-pi0\_fw\_Qsq10.tcl
  - ProDecayFiles/ppbar\_e+e-pi0\_bw\_Qsq10.tcl
- Event Generator for background:  
Is it possible to use the same Event Generator as for the signal but changing the electron mass by the pion mass? How?

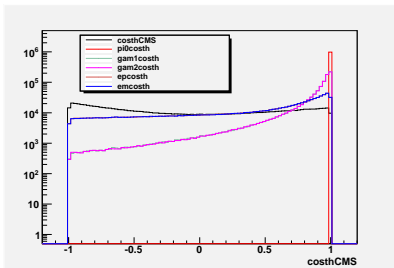


# Signal at $W^2=5 \text{ GeV}^2$

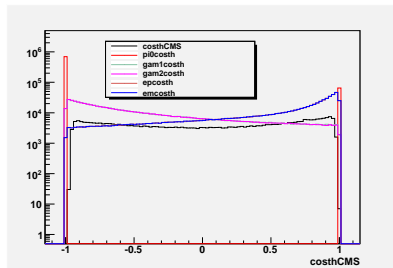


True variables:

$\pi^0$  Forward



$\pi^0$  Backward

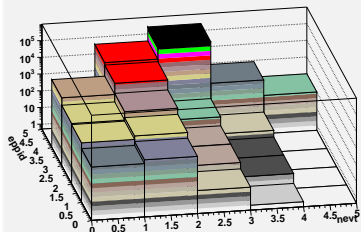
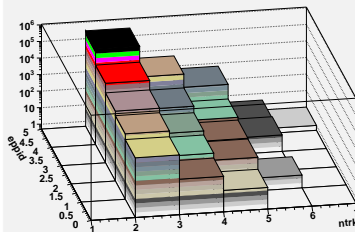


- After the boost some  $\pi^0$  go to forward angles ( $0^\circ$ ) in lab system

NOTE: ALL THE VARIABLES EXCEPT  $\cosh_{\text{CMS}}$  ARE PLOTTED IN LABORATORY SYSTEM



# PID information

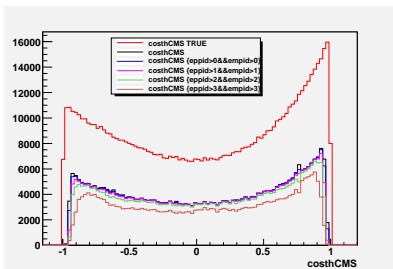

**eppid:nevt**

**eppid:ntrk**




# Signal PID cuts $W^2=5 \text{ GeV}^2$

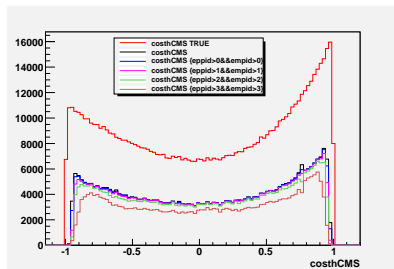


## $\pi^0$ Forward



Cut	events	%
True	980000	100 %
Reco	565254	57.7 %
VL	559134	57.1 %
L	544216	55.5 %
T	522748	53.3 %
VT	429713	43.8 %

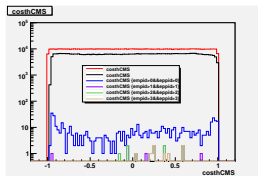
## $\pi^0$ Backward



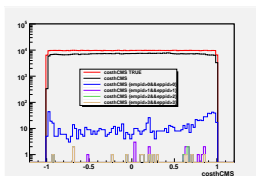
Cut	events	%
True	760000	100 %
Reco	349587	46.0 %
VL	345425	45.5 %
L	336774	44.3 %
T	320752	42.2 %
VT	262883	34.6 %



# Background PID cuts

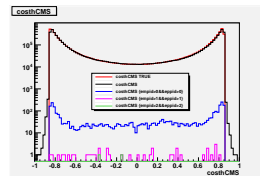

 $W^2=5 \text{ GeV}^2:$ 


Cut	events	%
True	822000	100 %
Reco	515972	62.8%
VL	568	0.069%
L	16	$1.9 \cdot 10^{-3}\%$
T	13	$1.5 \cdot 10^{-3}\%$
VT	9	$1.09 \cdot 10^{-3}\%$

 $W^2=10 \text{ GeV}^2:$ 


Cut	events	%
True	807000	100 %
Reco	591712	73.3%
VL	986	0.12%
L	25	$3.1 \cdot 10^{-3}\%$
T	16	$2.0 \cdot 10^{-3}\%$
VT	13	$1.6 \cdot 10^{-3}\%$

Old Analysis:



Cut	events	%
True	6420000	100 %
Reco	6179221	96%
VL	3433	0.05%
L	38	$5.9 \cdot 10^{-4}\%$
T	2	$3.1 \cdot 10^{-5}\%$
VT	0	$< 10^{-5}\%$

The suppression factor with the new simulation is worse than the suppression factor for the simulation only with  $\pi^+\pi^-$

There is a reason for that? Can I check it in some way?





# Filter background at $W^2=5 \text{ GeV}^2$ : ProdDecayFiles/filter\_pi+pi-pi0\_range.tcl



```
FwkCfgVar minQ2 1.9
FwkCfgVar maxQ2 2.3

mod talk GefSelectFilter
  BooObjects GefKinematic lump Mypip = pi+
  BooObjects GefKinematic lump Mypim = pi-

  BooObjects GefKinematic define Mypip = Mypip
  BooObjects GefKinematic define Mypim = Mypim

  BooObjects GefKinematic combine Mypippim = Mypip Mypim $minQ2 $maxQ2
  BooObjects GefKinematic require Mypippim

  afterFilter set GefKinematic

  BooObjects GefKinematic info

exit
```

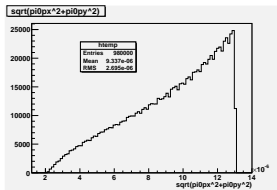


Signal  $\Delta_{T_{\pi^0}} W^2 = 5 \text{ GeV}^2$

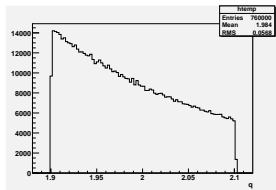
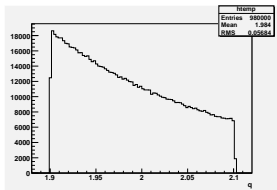
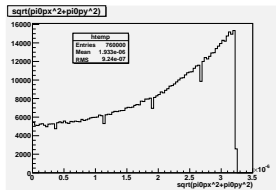


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$\pi^0$  Forward



$\pi^0$  Backward



The particles are not strictly generated at  $0^\circ$  and  $180^\circ$ . Is that normal?

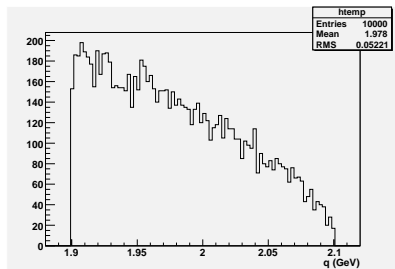
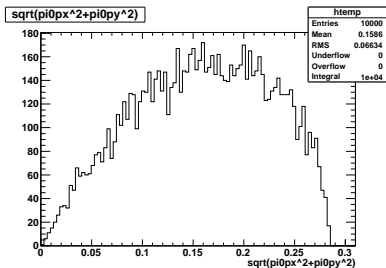
q range is right.



# Background $\Delta_{T_{\pi^0}}$ at $W^2=5 \text{ GeV}^2$



True events:



I don't need to implement a filter for the transverse momentum in this case.

q range is right.



# Filter background at $W^2=10 \text{ GeV}^2$ : ProdDecayFiles/filter\_pi+pi-pi0\_range\_W2-10GeV.tcl



```

FwkCfgVar minQ2 2.4
FwkCfgVar maxQ2 3.2

FwkCfgVar minPt 0.
FwkCfgVar maxPt 0.5

mod talk GefSelectFilter

  BooObjects GefKinematic lump   Mypip = pi+
  BooObjects GefKinematic lump   Mypim = pi-

  BooObjects GefKinematic define Mypip = Mypip
  BooObjects GefKinematic define Mypim = Mypim

  BooObjects GefKinematic combine Mypippim = Mypip Mypim $minQ2 $maxQ2
  BooObjects GefKinematic require Mypippim

  BooObjects GefKinematic define Mypi0 = pi0 0. 100. $minPt $maxPt -1. 1.
  BooObjects GefKinematic require Mypi0

afterFilter set GefKinematic

  BooObjects GefKinematic info

exit

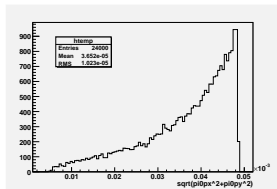
```



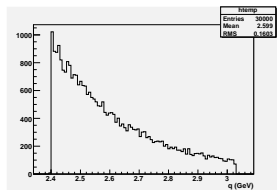
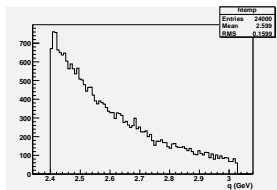
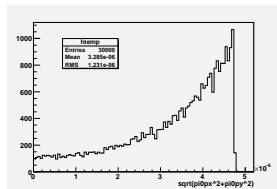
Signal  $\Delta T_{\pi^0} W^2 = 10 \text{ GeV}^2$



$\pi^0$  Forward



$\pi^0$  Backward



The particles are not strictly generated at  $0^\circ$  and  $180^\circ$ . Is that normal? How can I apply the right cuts?

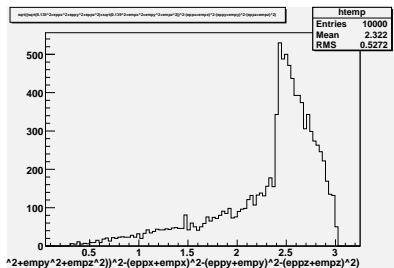
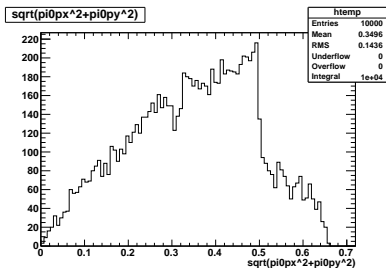
q range is right.



# Background $\Delta_{T_{\pi^0}}$ at $W^2=10 \text{ GeV}^2$



True events (only 10 000 events for testing):



The filter for the transverse momentum is not working.  $q$  range is also wrong. Which could be the reason?



## Problems with signal simulation at $W^2=10 \text{ GeV}^2$



- Many jobs crash in the simulation at  $W^2=10 \text{ GeV}^2$ .
- This problem was already reported (e-mails from 19/07/2010 with topic: Crash in simulation) and in pricipal solved, but now it comes again.

```
KanEventOutput::GTrackK.cc(199):Problem packing |p|: ROUND UP |p| 0
EvtCounter: processing event # 292
Hstep is 0
```

```
*** G4Exception : Requested Integration Step is zero or negative: it must be positive
    issued by : G4MagInt_Driver::AccurateAdvance()
Requested-Step-not-Positive.
*** Fatal Exception *** core dump ***
```

```
*** G4Exception: Aborting execution ***
/var/spool/torque/mom_priv/jobs/684562.blaster.farm.kph.SC: line 2: 28521 Aborted
Monolisa ./epempi0MonoW2-10GeVfw-1.tcl
```

Could you have a look to it?