

DIRAC experiment (PS 2012)

SPS committee, April 8, 2014.

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I. $K\pi$ atoms.

1. Published a CERN preprint about $K^-\pi^+$ and $K^+\pi^-$ atoms lifetime measurement. The paper is submitted to Ph.L.
2. The new procedure for the tuning of the setup, using Lambda and anti-Lambda decays, has been fulfilled for runs of 2008, 2009 and 2010 (Figure 1 and 2). Using results of this tuning the new experimental ntuples are prepared. Peak in QL distribution is found to be at 0, as it is expected.
3. The new software for preparation of Monte-Carlo simulation is finished. The main improvement in this procedure is the correct multiple scattering description in the thin layers. Also the SFD planes response has been significantly improved. It is ready to be used in the production of the ntuples for Monte - Carlo simulated events (Figure 3 and 4).
4. Is under studying the possibility to process and analyze $K^-\pi^+$ and $K^+\pi^-$ pairs with high background in SFD (about 1/3 of total statistics).
5. The preliminary result on the Pbr values obtained with data with low, medium and high background will be presented in October 2014.

II. Long-lived $\pi^+\pi^-$ atoms.

1. The new software for the tuning of the setup for run of 2012 is finished and the ntuples of experimental events with low and medium background in SFD is going to be finished in a couple of weeks.
2. The experimental distributions of e^+e^- pairs generated on Be target and Pt foil were analyzed and it was evaluated the peaks positions and widths in the Qy distribution (Figures 5,6,7,8,9). The Monte-Carlo generators that describe these peaks are ready.
3. The final simulation for Coulomb, nonCoulomb and atomic pairs is under study. The simulation will be started only after checking the correct description of the small magnet using e^+e^- pairs distribution in Qy.

III. $\pi^+\pi^-$ pairs analysis.

1. The new procedure for the tuning of the setup, using Lambda and anti-Lambda decays, has been fulfilled for runs of 2008, 2009 and 2010. Using results of this tuning the new experimental ntuples are prepared. Peak in QL distribution is found to be at 0, as it is expected (Figure 10).
3. The new software for preparation of Monte-Carlo simulation is finished. The main improvement in this procedure is the correct multiple scattering description in the thin layers. Also the SFD planes response has

been significantly improved. It is ready to be used in the production of the ntuples for Monte - Carlo simulated events.

4. The preliminary result on the Pbr values obtained with data with low, medium and high background will be presented in October 2014.
5. The multiple scattering measurement using dedicated experimental data is in progress, the results will have a precision 0.5%. Preliminary results will be presented in June 2014.

IV. K^+K^- pairs analysis.

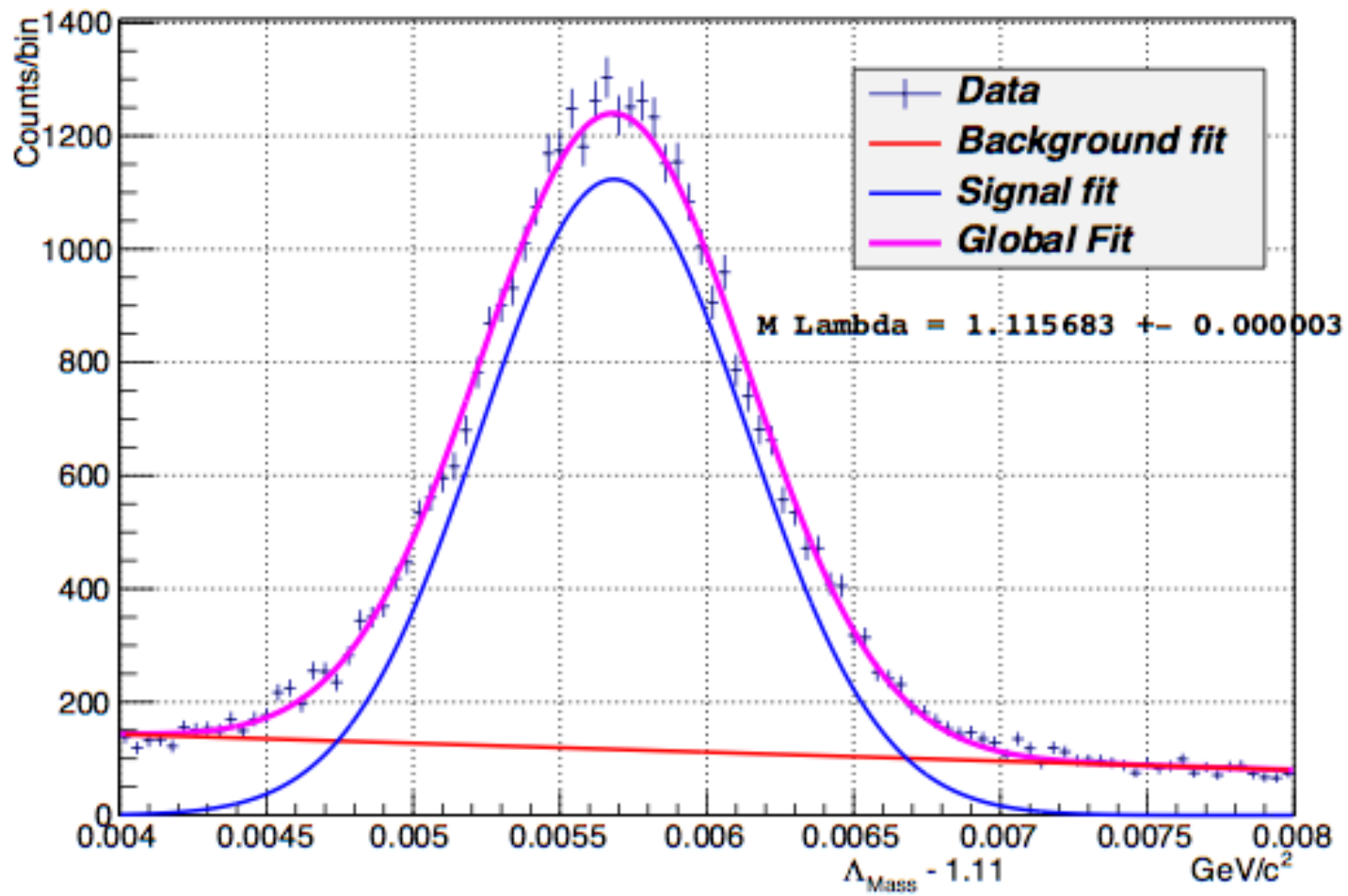
We are analyzing the existing experimental data in order to search for K^+K^- Coulomb pairs signal. These pairs allow us to extract the number of K^+K^- atoms produced simultaneously with Coulomb pairs. At present time for the RUN of 2010 was evaluated the numbers of $\pi^+\pi^-$, K^+K^- , P-antiproton pairs and their ratio (Figures 10,11,12, 13a, 13b,14). In April will begin the search for Coulomb pairs.

V. $\pi^+\mu^-$ and $\pi^-\mu^+$ pairs analysis.

1. We are analyzing the existing experimental data (2010-2012) in order to search for $\pi^+\mu^-$ and $\pi^-\mu^+$ Coulomb pairs signals. These pairs allow us to extract the number of $\pi\mu$ atoms produced simultaneously with Coulomb pairs. At present time for the RUN of 2010 the dedicated event preselection has been performed

VI. Investigation of $K^+\pi^-$, $K^-\pi^+$, $\pi^+\pi^-$, K^+K^- atoms production in P-nucleus interactions at proton momentum 24GeV/c and 450GeV/c.

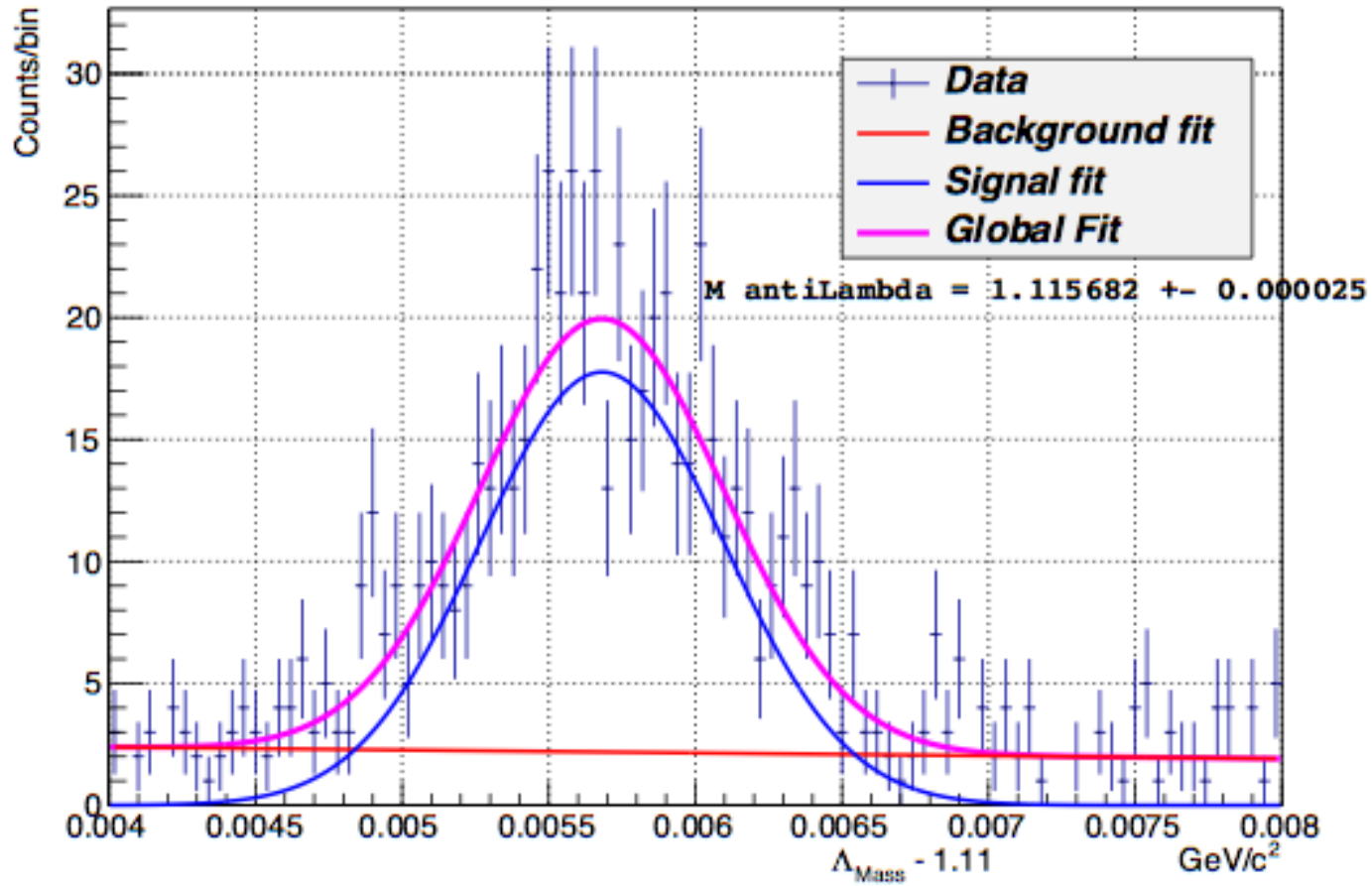
This work is in progress using the FRITIOF generator tuned for the low energy (proton momentum 32GeV/c) inclusive cross sections. This generator also describes the high energy (proton momentum 450GeV/c) inclusive cross sections.



PDG Lambda Mass = 1.115683 ± 0.00006 GeV

Figure 1

Lambdas



PDG Lambda Mass = 1.115683 ± 0.00006 GeV

Figure 2

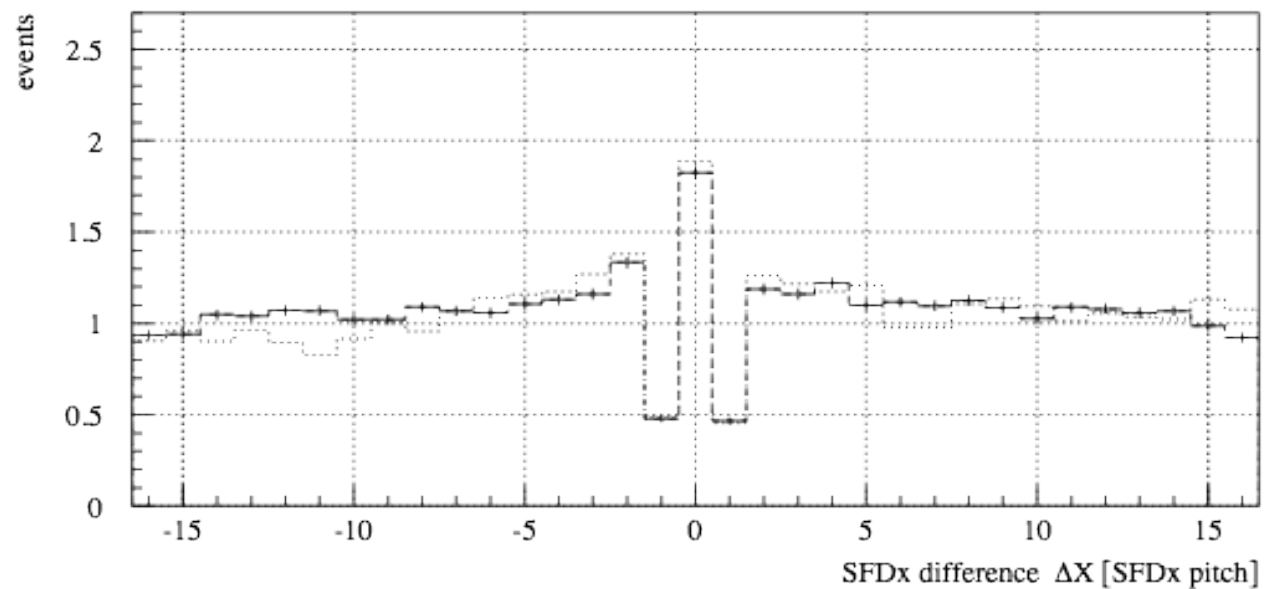
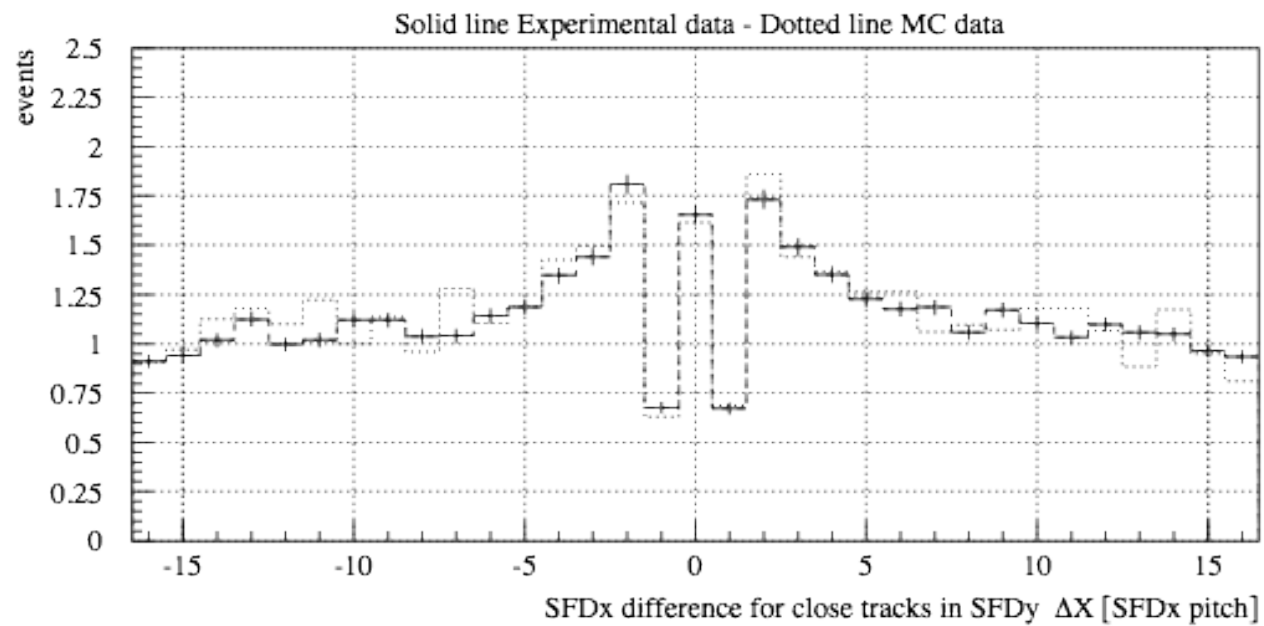


Figure 3

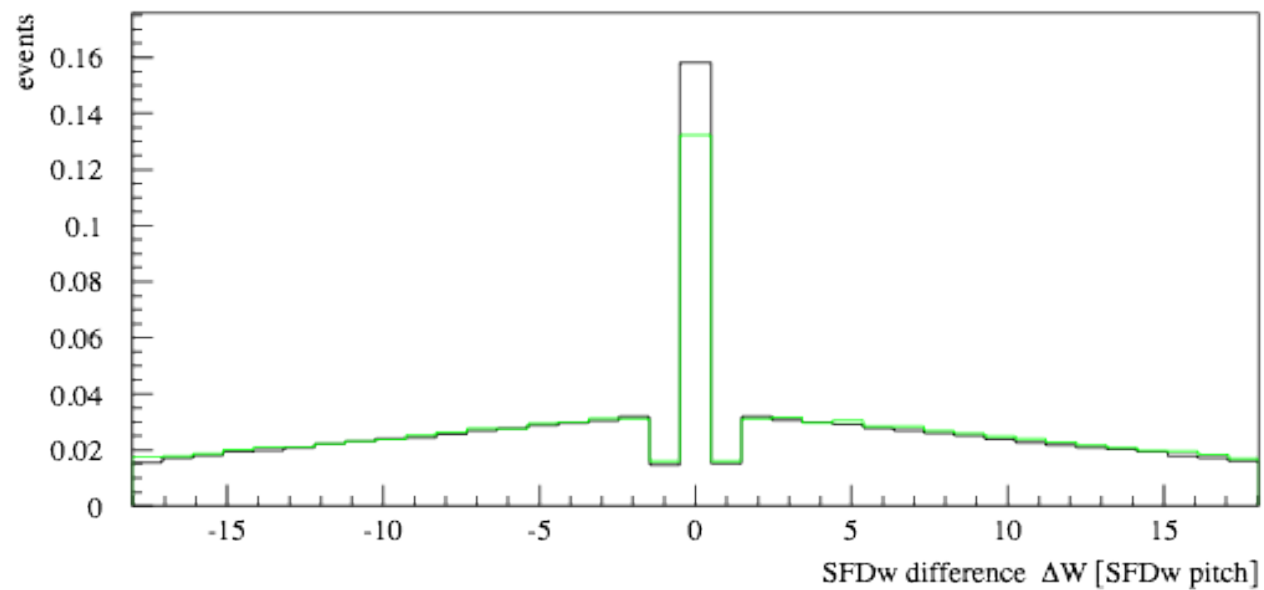
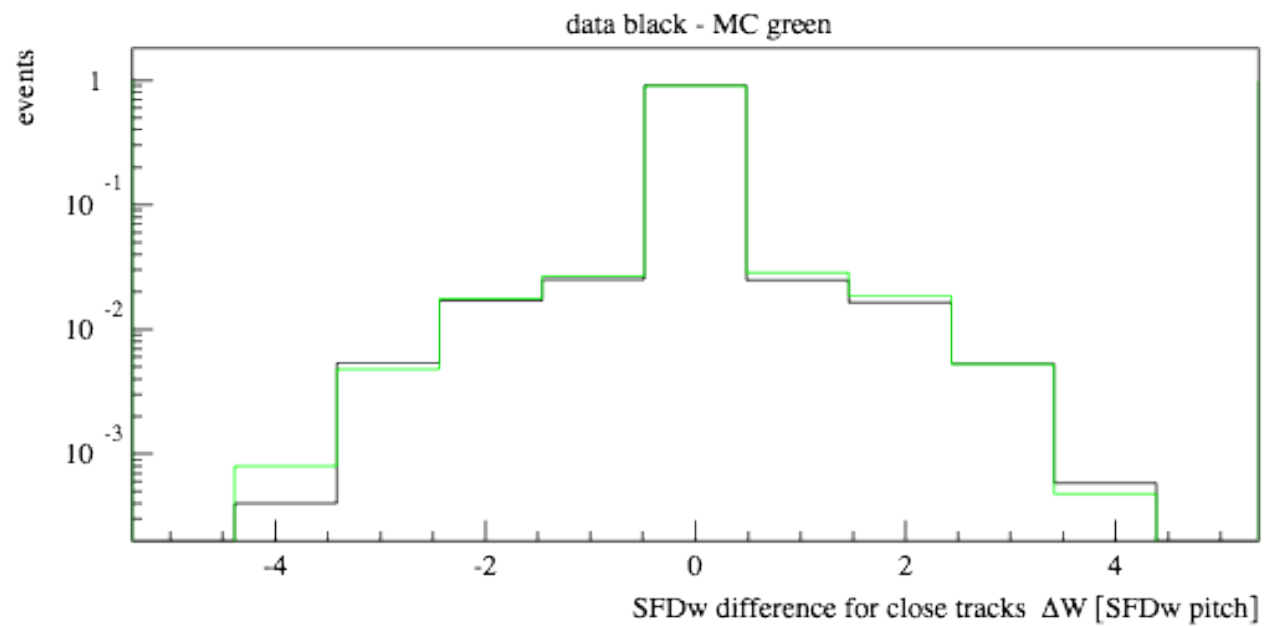


Figure 4

Production and observation of long-lived $A_{2\pi}$ atoms with break-up Pt foil

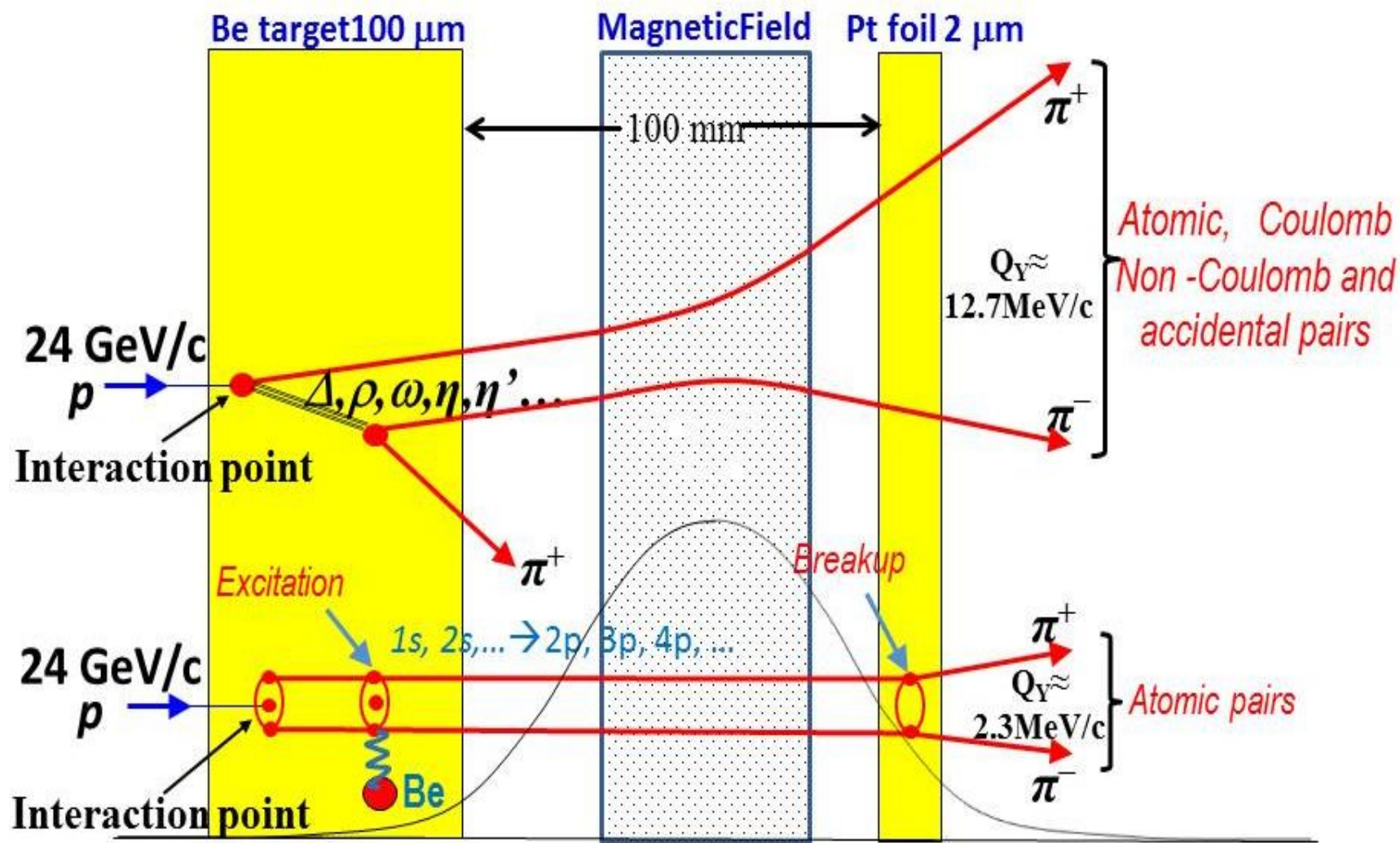


Figure 5

Check for the symmetry of the $Q_x e^+e^-$ distribution

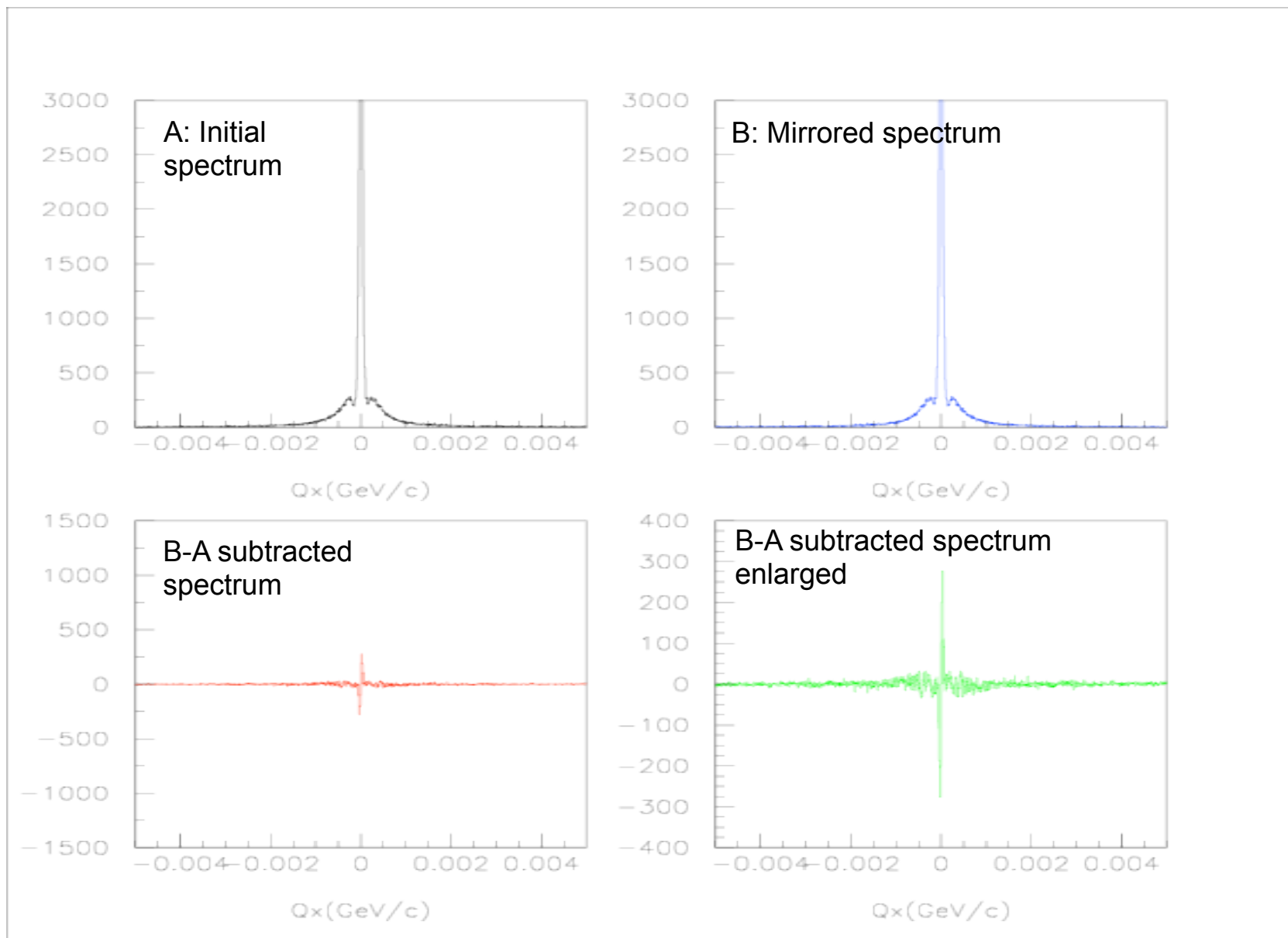


Figure 6

Check for the existence of the 2.3 MeV/c peak as an asymmetry in $e^+e^- Q_y$ distribution

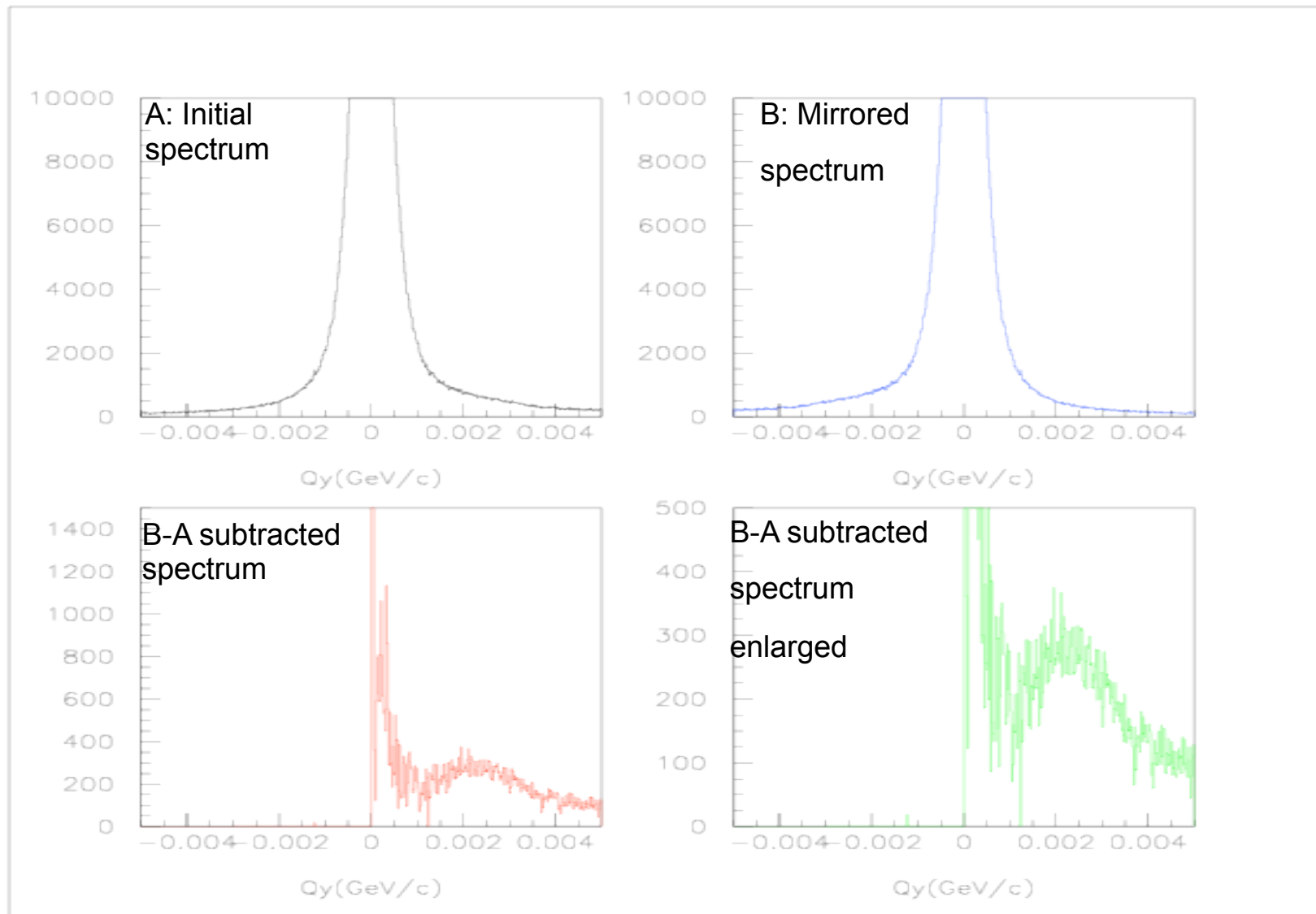


Figure 7

Q_y e^+e^- peak structure

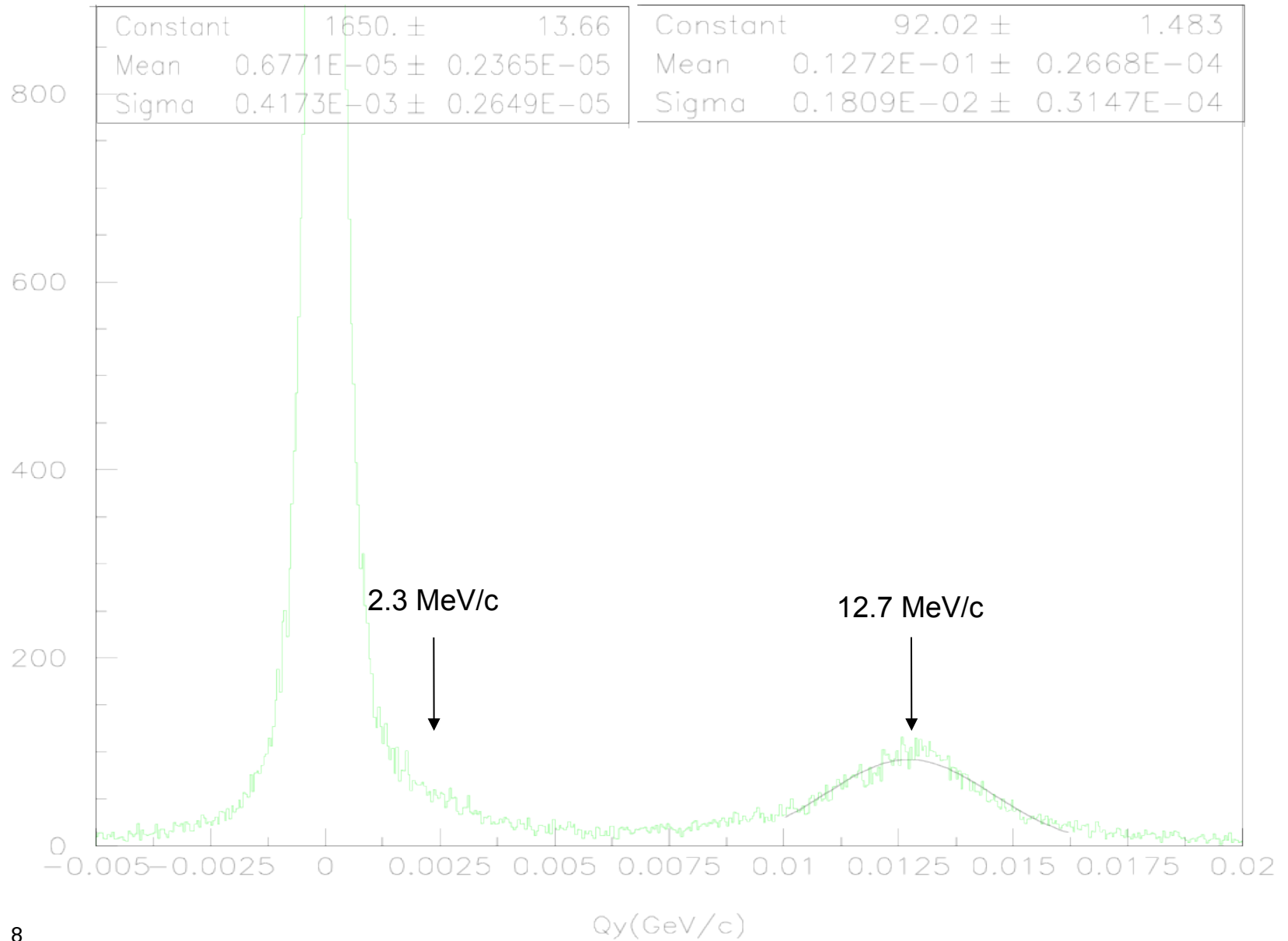


Figure 8

The Q_y 2.3 MeV/c and 12.7 MeV/c peak structure in e^+e^- distribution

TABLE 1.

Peak	μ (MeV/c)	σ (MeV/c)	Relative separation [$\mu(12.7) - \mu(2.3)$] > $3\sigma(12.7)$
0 MeV/c	0.007 ± 0.002	0.417 ± 0.003	
2.3 MeV/c	2.293 ± 0.001	1.210 ± 0.001	
12.7 MeV/c	12.720 ± 0.027	1.809 ± 0.031	10.427 MeV/c > 5.43 MeV/c

Conclusion: the 12.7 MeV/c peak tail contribution to the background of 2.3 MeV/c peak is negligible

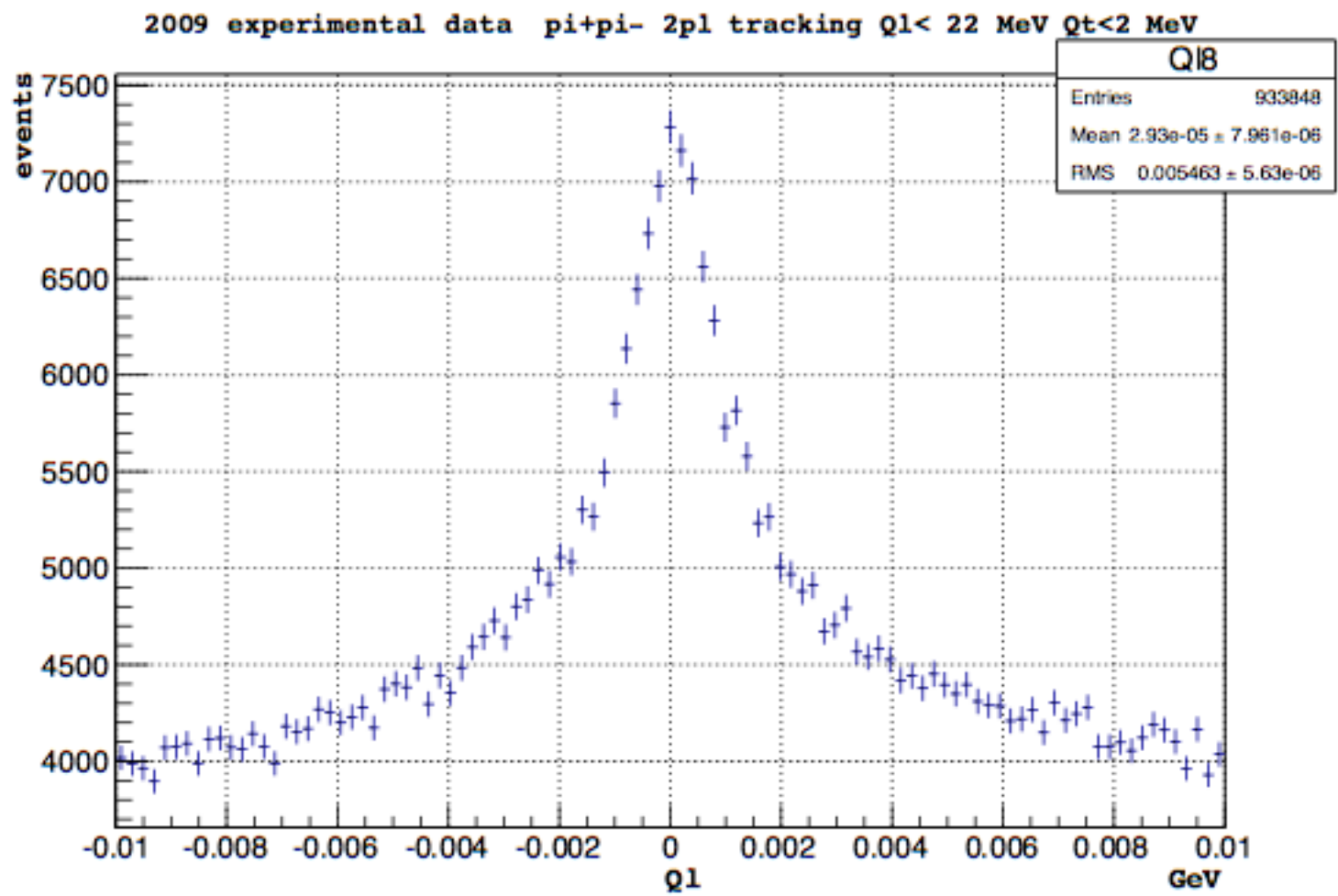
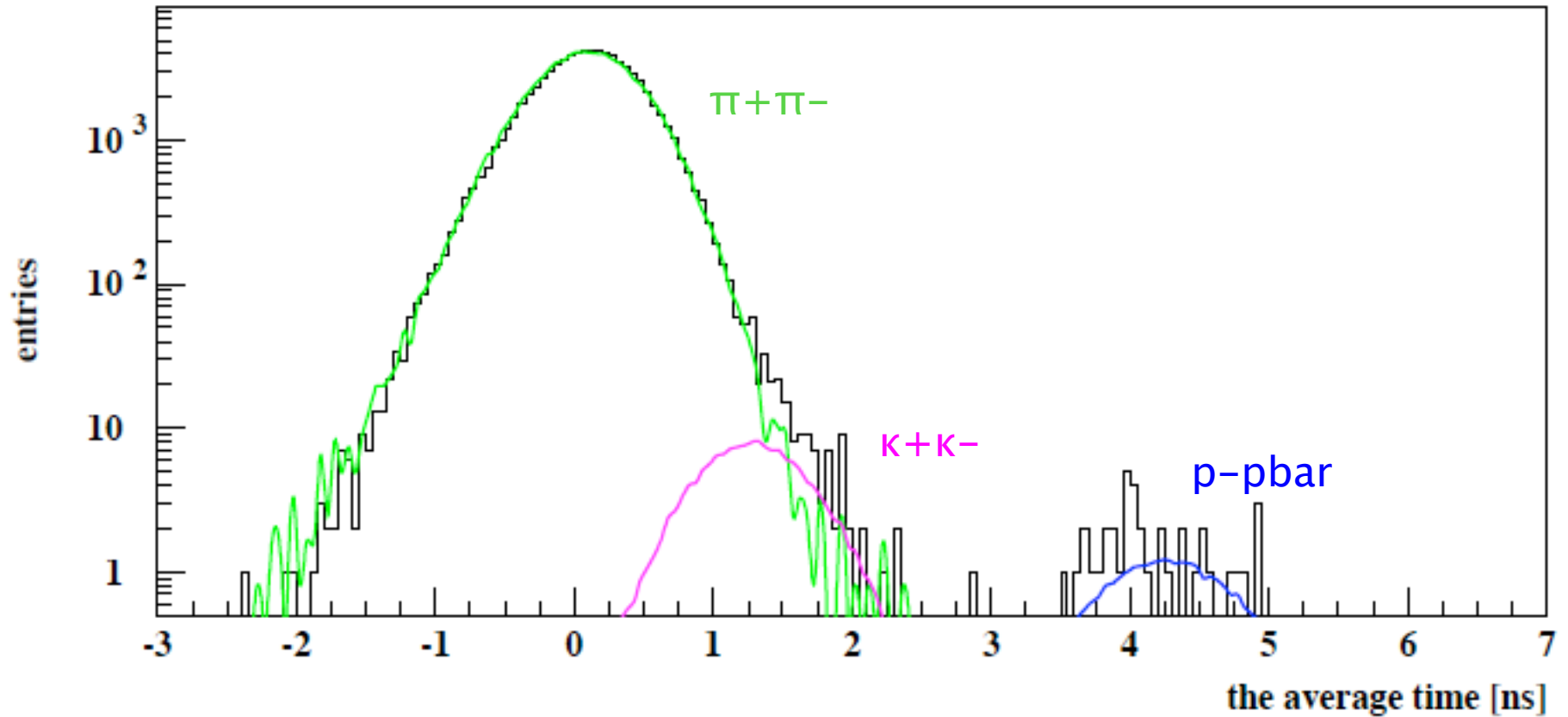
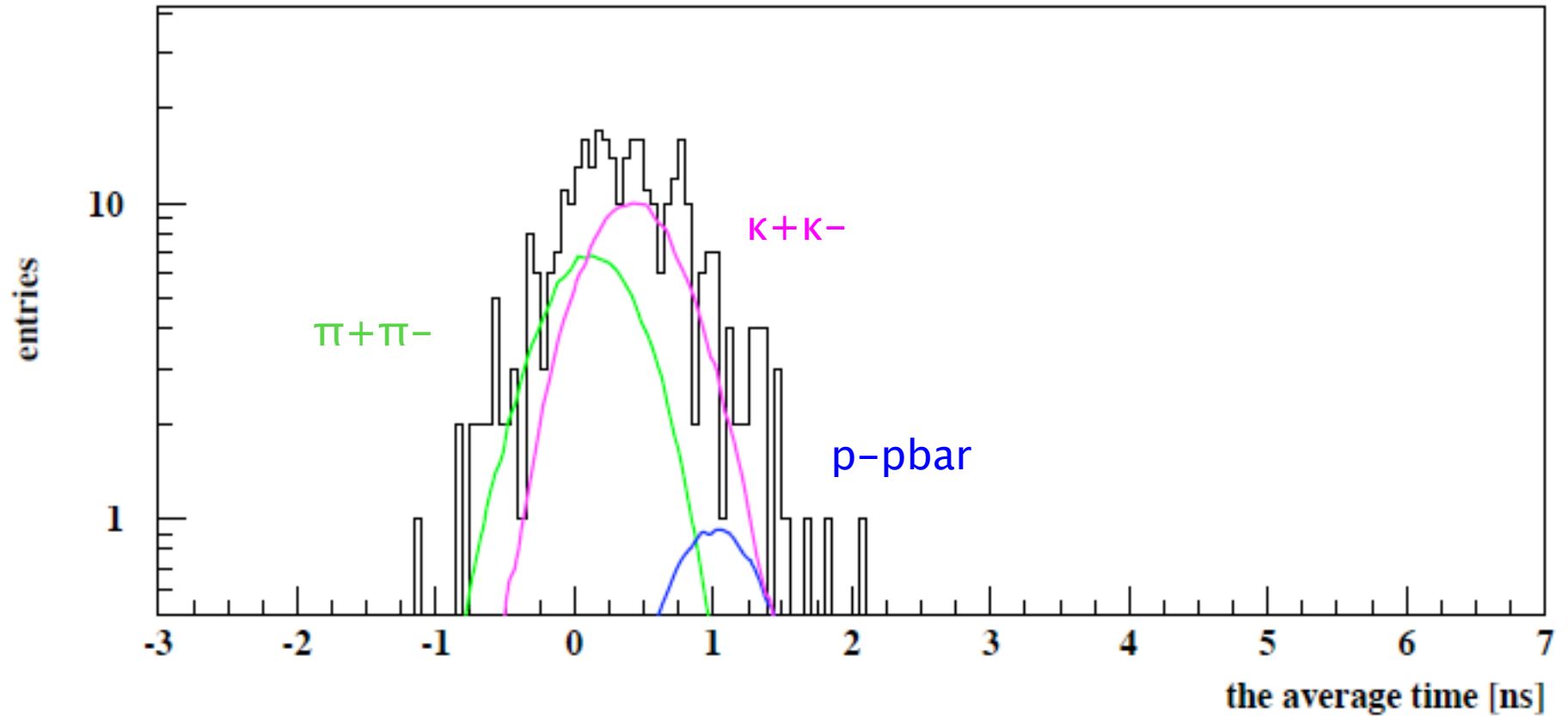


Figure 10



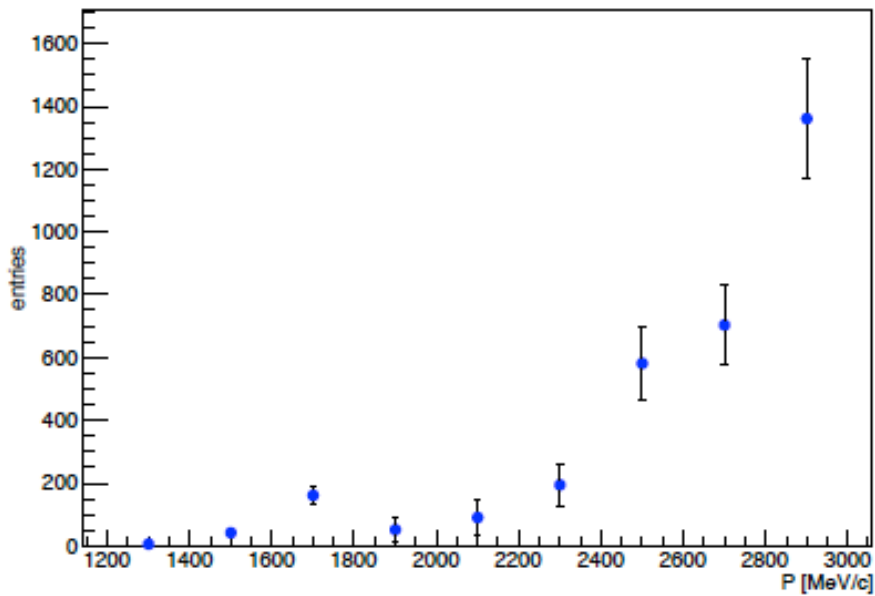
Distribution over time of flight for hadrons with average particle momenta from 1.6 up to 1.8 GeV/c

Figure 11



Distribution over time of flight for hardons with average particle momenta from 3.8 up to 4. GeV/c

Figure 12



Number of K^+K^- pairs with statistic error for low momenta. P is an average momentum of particles in pairs.

Figure 13a

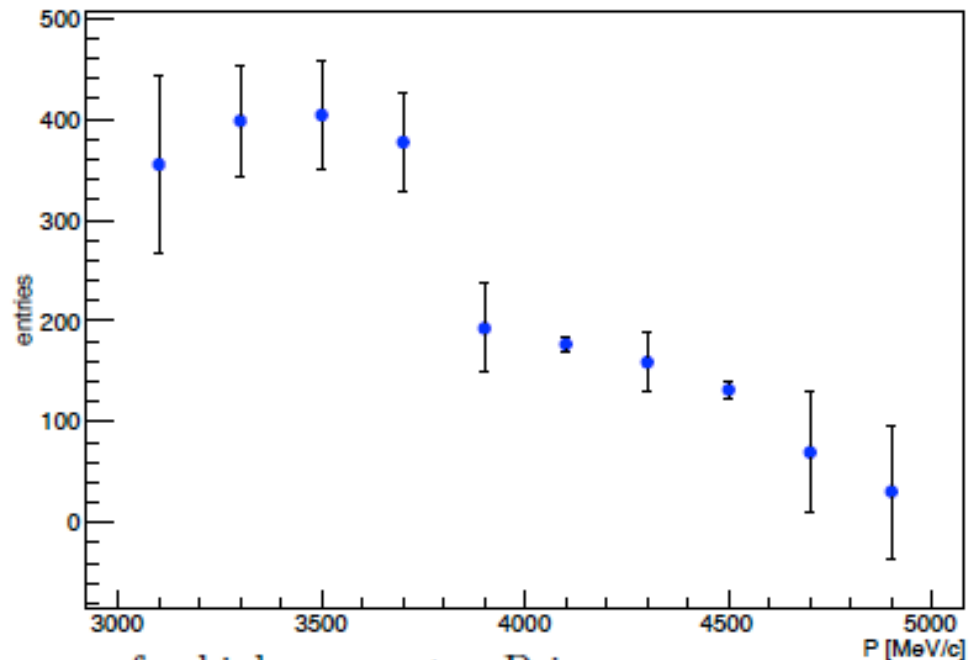
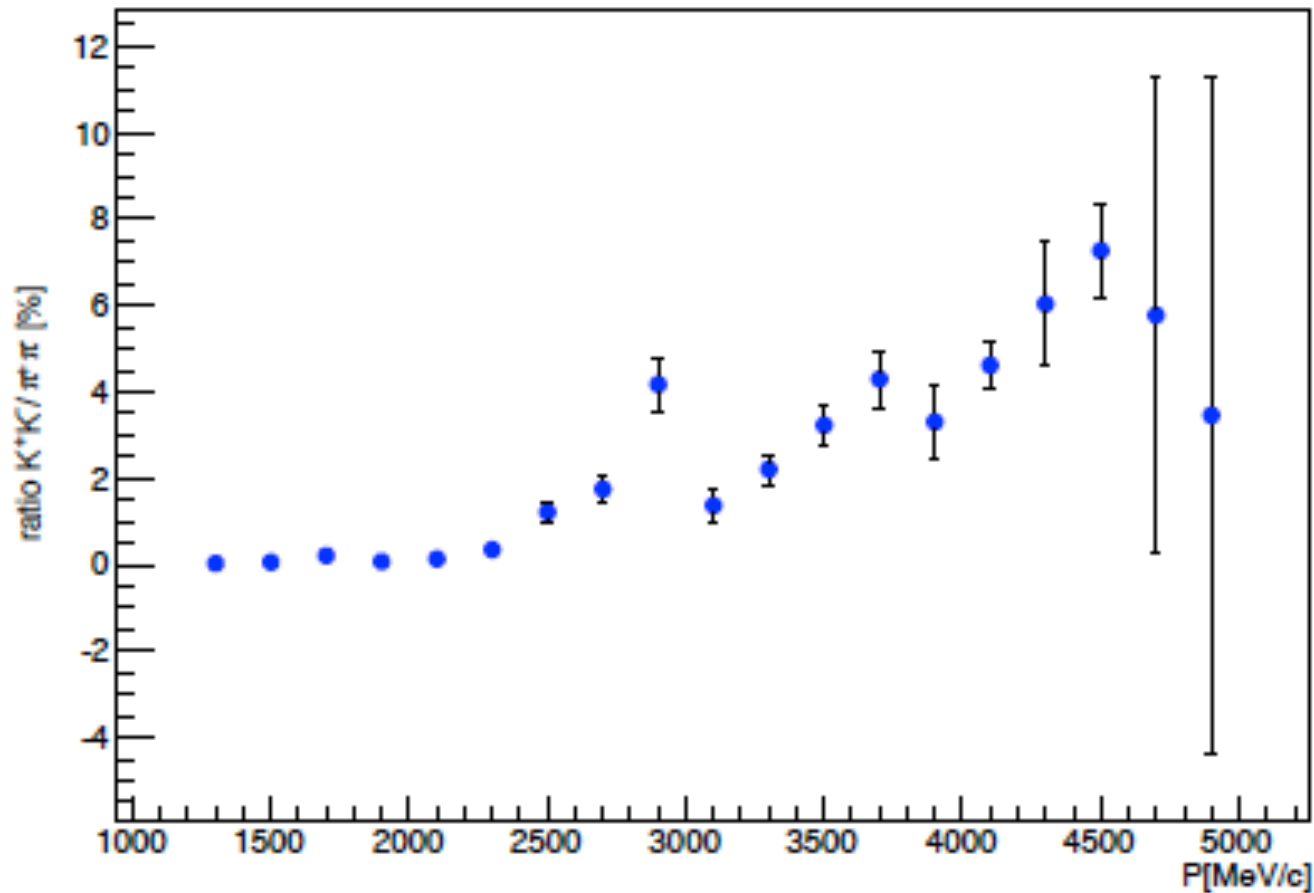


Figure 13b

Number of K^+K^- pairs with statistic error for high momenta. P is an average momentum of particles in pairs.



Ratio between K^+K^- and $\pi^+\pi^-$ pairs with statistic error for whole momentum range. P is an average momentum of particles in pairs.