EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

DIRAC Note 2007-12
June 3, 2007

On the comparison of Lambda peak width for Monte-Carlo and real data in the DIRAC setup.

O.Gorchakov

GENEVA
2007

1 Preface

The aim of this work was to compare the width of Λ peak for Monte-Carlo and real data in the DIRAC setup. The first study of this problem using only SFD and DC was done three years ago in [1]. The next study was done in [2] and had already some differences in the versions of GEANT-DIRAC and ARIANE. At least they were:

1. Correction of the setup magnetic field was done[3].
2. Correction of horizontal angular misalignment of arms was done[3].
3. Improvement of multiple scattering procedure was done [4].
4. Description of aluminum membrane was done to be close to the real one.
5. Correction of proton ionization losses in the forward detectors was done.

The current work includes some another improvements:

1. The MC statistics was increased in four times.
2. The precision of drift chambers was chosen like the sum of two Gaussians instead of one Gaussian as it was found by Kruglov's V. and L..
3. In the previous report [2] the used detector.dat file had some small bug.

In the case of Monte-Carlo the generator of Λ particles emitted in the solid angle of our setup was used. The creation point of Λ was in the target and the Λ decay point was simulated by GEANT itself. The real data files and the GEANT-DIRAC output files were analyzed by ARIANE.

The real and MC data of Ni2001 were used.

2 Results

There were selected the proton-pion pairs with total momentum from 5.2 to 8.7 GeV/c. As the momentum distribution for MC and real data pairs are a bit different then the MC events were weighted to get the same momentum distribution as for real data. Also this momentum range was divided into three subintervals(5.2-6.9-7.5-8.7GeV/c). For all of these subintervals and for whole interval the distributions of invariant mass(minus of

$1.11 GeV/c^2$) of proton and pion are shown on Fig. 1, for MC and real data. The real data distributions were fitted by the function which is the sum of Gaussian and polynomial of the third degree. The last one describes the background.

The used fitting procedure was the standard one - MINUIT. In the principle it is the problem for all the fitting procedures to obtain the most correct values of errors of parameters. As in our case the real data distributions have some background whereas the MC ones don't have it(it means that MC distributions have the tails which fall up to zero) and , in principle, this fact could influence on the result for fitting of MC distributions then the MC distributions were slightly modified to make the fitting conditions equal for both types of data: the proportional constant "background" was added to each MC distribution(the ration of peak/background must be the same for MC and real data). The MC data distributions were fitted therefore by the function which is the sum of Gaussian and a constant. The main results are presented in this table.

	Real data , MeV/c		MC , MeV/c	
Momentum interval, GeV/c	$\sigma(M_\lambda)$	$\delta(\sigma(M_\lambda))$	$\sigma(M_\lambda)$	$\delta(\sigma(M_\lambda))$
5.2-8.7	0.5338	0.0075	0.5080	0.0028
5.2-6.9	0.5074	0.0130	0.4637	0.0043
6.9-7.5	0.5486	0.0124	0.5182	0.0054
7.5-8.7	0.5611	0.0132	0.5529	0.0044

For Λ momentum greater 7.5GeV/c the values of σ are very close.

For the total momentum range we have the following values of sigmas for real data and MC one, respectively:

0.534 ± 0.008 and $0.508 \pm 0.003 MeV/c^2$. The are enough close. Also we can say that the small statistics of Λ in the real data makes practically impossible the further work with aim to make these two values more close.

The normalized distributions for Λ for MC and real data are shown on Fig. 2. The shown value(t) is the difference between the invariant mass of p and $\pi(M_{p\pi})$ and the table mass value of $\Lambda(M_{\Lambda table})$, divided by σ of $M_{p\pi}$: $t = (M_{p\pi} - M_{\Lambda table})/\sigma_{M_{p\pi}}$. For MC case, like for invariant mass distributions, the proportional "background" was added also.

The main results are presented in this table.

	Real data		MC	
Momentum interval, GeV/c	$\sigma(t)$	$\delta(\sigma(t))$	$\sigma(t)$	$\delta(\sigma(t))$
5.2-8.7	0.9878	0.0134	0.9470	0.0052
5.2-6.9	1.0062	0.0256	0.9491	0.0096
6.9-7.5	0.9894	0.0217	0.9527	0.0100
7.5-8.7	0.9656	0.0213	0.9442	0.0073

We see that the value of σ of t for MC case is less than for real data. The difference is about of 0.04. The explanation of this fact: for real data the errors which are due to multiple-scattering effects were taken more close to the real values of them. It also means that in the MC case some effects are not taken into account.

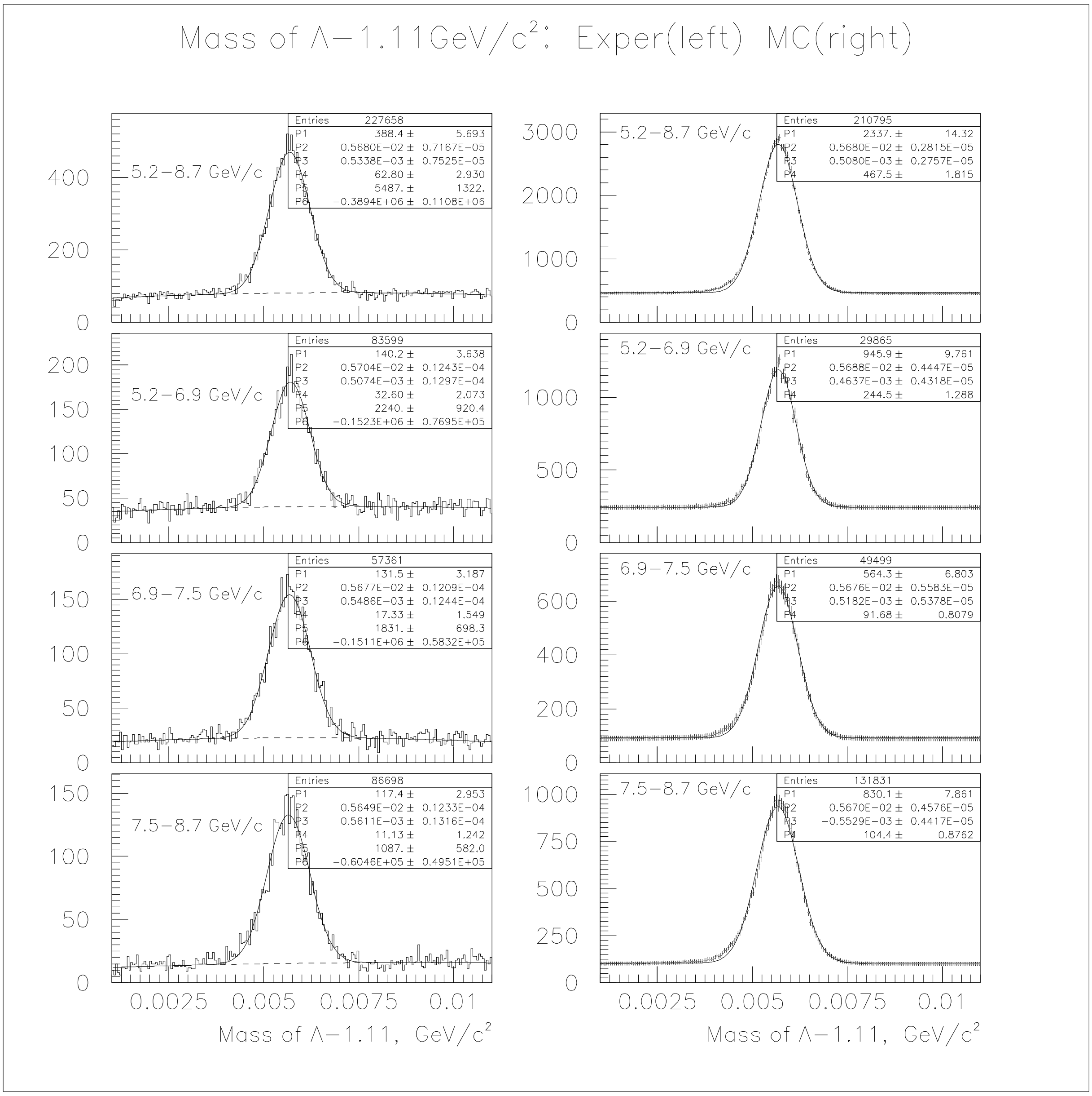

Figure 1: *MC and real data. The distributions of invariant mass of proton and pion for different intervals of lambda momentum. P2 - the center of Lambda peak, P3 - its Gaussian width.*

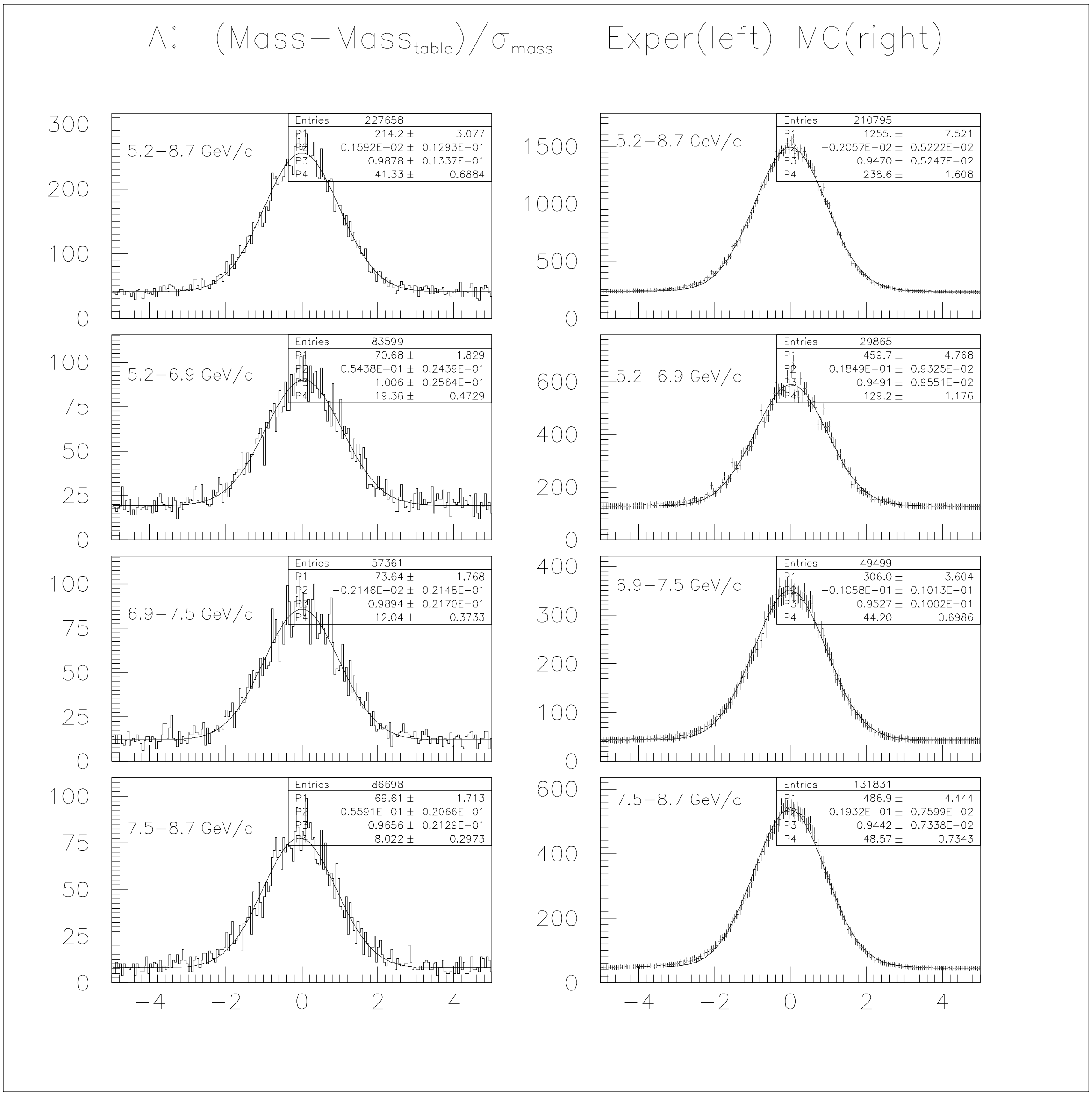

Figure 2: *MC and real data. The difference between the invariant mass of* p *and* $\pi(M_{p\pi})$ *and the table mass value of* $\Lambda(M_{\Lambda table})$*, divided by* σ *of* $M_{p\pi}$*:* $(M_{p\pi} - M_{\Lambda table})/\sigma_{M_{p\pi}}$*.*

References

[1] P.Kokkas [Un.Ioannina], DIRAC Note 2004-04.

[2] O.Gorchakov [JINR], DIRAC Note 2007-06.

[3] O.Gorchakov [JINR], DIRAC Note 2005-21.

[4] O.Gorchakov [JINR], DIRAC Note 2007-05.