EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

DIRAC Note 2009-10
September 4, 2009

The alignment of DIRAC setup for year 2008 using the properties of Lambda peak and $\Delta\bar{X}$ coordinate at the target distributions.

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2009

1 Preface

In this work we make the alignment of the setup of year 2008 using the analysis of lambda peaks for real data and the analysis of $\Delta\bar{X}$ coordinates distributions at the target like it was done in ([1]-[6]).

The main aim of this job was to find the optimal values of the magnetic field position along Z-axis(Z_{membr}) and the correction for the each arm angle α_x in the horizontal plane(for both arms this angle(its initial value is 19^o) was increased or decreased simultaneously).

2 Results

On the Fig.1 and 2 the results on $\bar{X}$ are shown.

For both tracks of $\pi^+\pi^-$ correlated pairs the distributions of the values of X-coordinates at the level of the target were obtained. It was done for set of two-dimensional parameters - Z_{membr} versus α_x. For each of these distributions the fitting by Gaussian was done and the parameter,mean value $\bar{X}$, was plotted(Fig.1) for left and right arms.

We see that the mean value of X-coordinate depends both on the values of Z_{membr} and α_x and for the arms this dependence has the opposite signs(green color bins correspond to $\bar{X} < 0$ and red ones - to $\bar{X} > 0$). On these two plots the region we are interested is the points with $\bar{X}_{left} = \bar{X}_{right}$ and this is shown by pink line and this line does not coincide with the green-red bins boundary. But this line indeed is very close to this boundary as its value at angle=0 is about 0.2mm(Fig.2). The parameters of this line: $Z_{membr} = 143.24 \pm 0.01 + (636.32 \pm 0.05) * \alpha_x$.

To find the optimal values of Z_{membr} and α_x the analysis of Lambda peaks was applied.

There were selected the proton-pion pairs with total momentum from 4.75 to 10.5 GeV/c. The invariant mass distributions of π^-p were fitted by the function which is the sum of Gaussian and polynomial of the second degree. The last one describes the background.

We can use the distribution of mean value of Lambda peak for different values of Z_{membr} and α_x (Fig.3) to determine these two parameters optimal values. This can be done if we demand that the mean value of Lambda peak must be equal to the table value(the pink line). The parameters of this line are $Z_{membr} = 148.8 \pm 0.3 + (3.796 \cdot 10^4 \pm 50) * \alpha_x$.

The intersection point gives the optimal values of both parameters:$Z_{membr} = 143.34 \pm 0.01$ cm and $\alpha_x = 0.000144 \pm 7 \cdot 10^{-6}$rad. The both lines are drawn also on the 2-dimensional plot where the distribution of the Lambda peak width are shown(Fig.4). We can see(Fig.5) that this point does not coincide with the minimum of this distribution. To find the minimum of this distribution the fit of it was done by two-dimentional polynomial of forth degree: the obtained minimum is shown by red star and its coordinates are: angle = 7e-6rad and z-position = 143.86cm. This point is shown on Fig.1 as star too and the value of $\bar{X}$ in this point are equal to $\bar{X}_{left} = 0.05cm$,$\bar{X}_{right} = -0.11cm$ and it means that the $\Delta\bar{X} = 1.6mm$ and it is too much to accept this point.

For the cross point and for Lambda peak width minimum coordinates the distributions of invariant mass of π^{-}p are plotted on Fig.6, upper and down pictures correspondingly. For the second point the lambda mass differs($1.115608GeV/c^2$) from the table value but its Lambda peak width is a bit smaller($469KeV/c^2$ against 471).

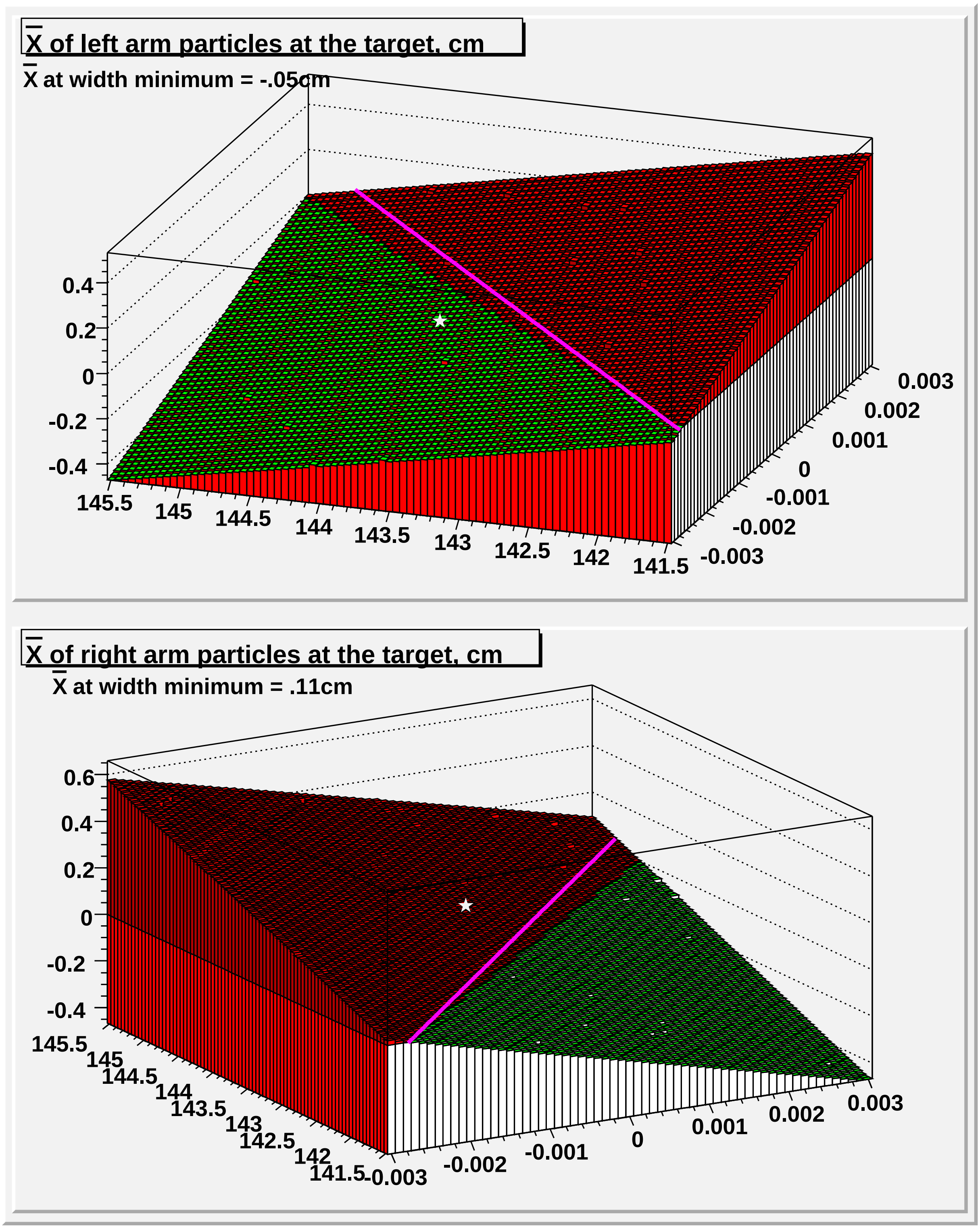

Figure 1: *The distributions of mean value of X-coordinate at the level of target for left arm tracks(top) and for right arm(bottom) on dependence of arm angle and magnetic field position along Z-axis. The red color bins are for* $\bar{X} > 0$ *and green color bins are for* $\bar{X} < 0$*. The pink line is the intersection of these two distributions. The white stars correspond to the point where the width of Lambda peak is minimal(at this point the* $\bar{X}_{left} = 0.05cm$*,*$\bar{X}_{right} = -0.11cm$ *and it means that their difference is equal to 0.15cm).*

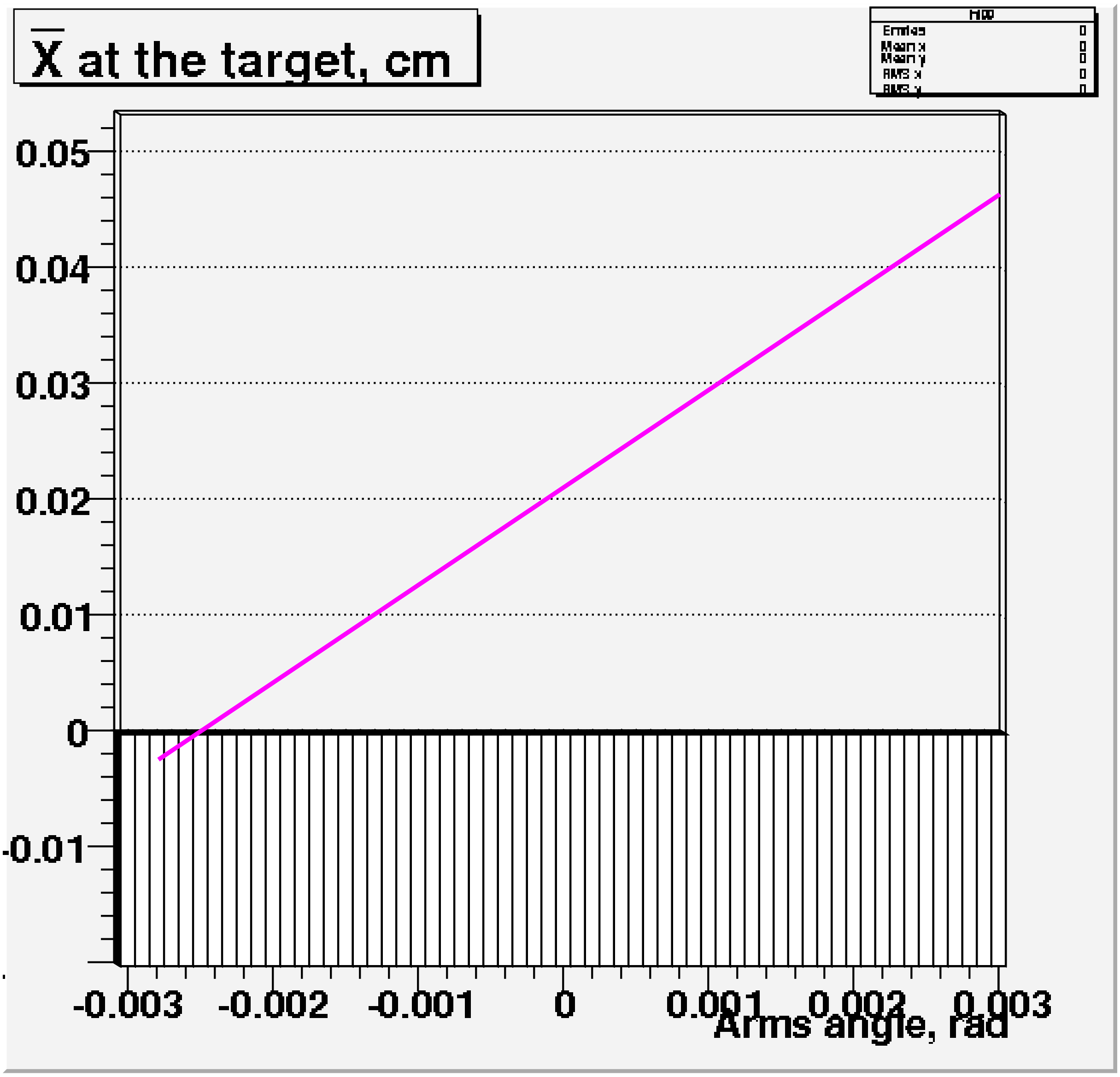

Figure 2: *This pink line is the projection on the plane $\bar{X}$-Angle of the intersection of the distributions of mean value of X-coordinate for the left and right arm.*

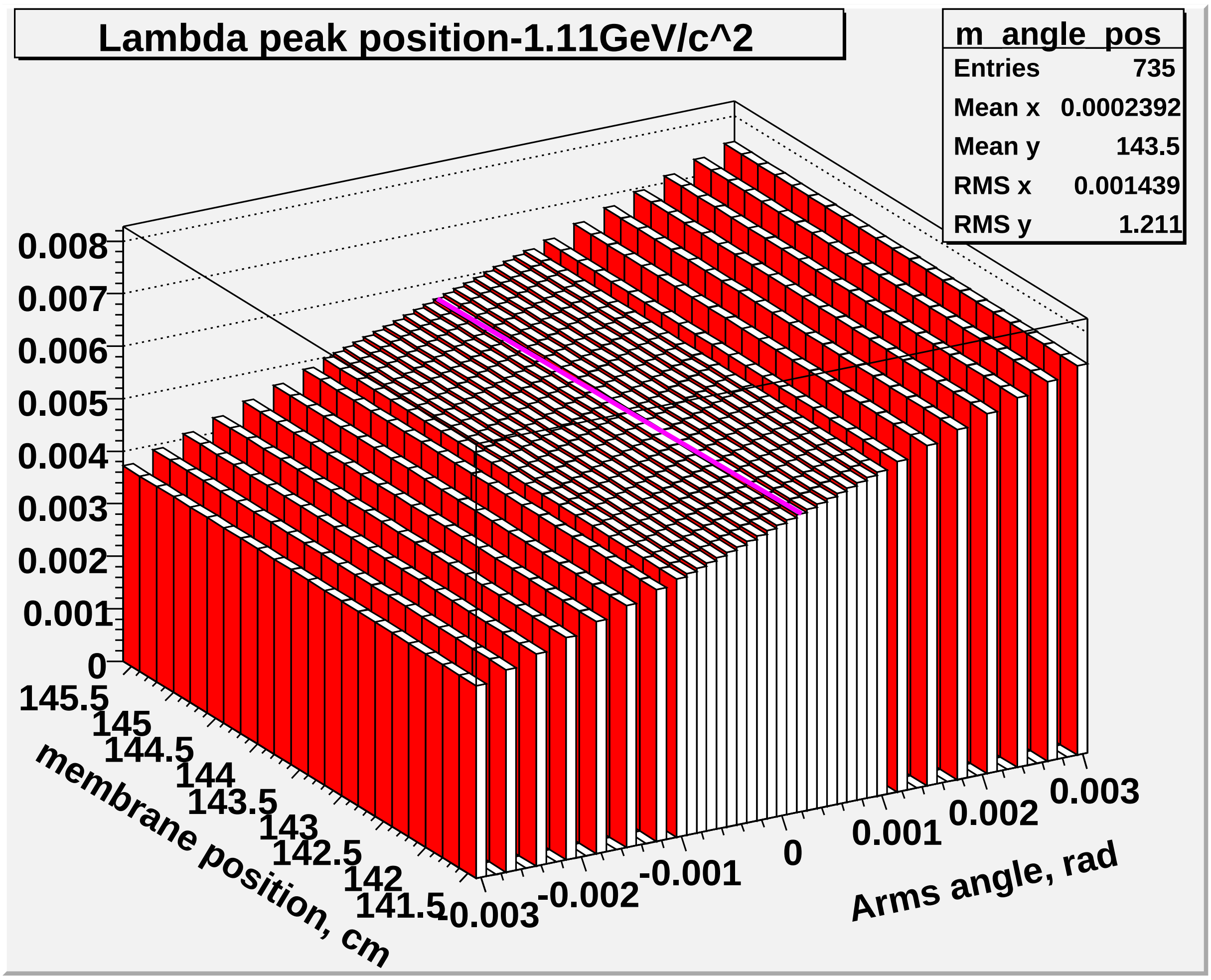

Figure 3: *The distribution of the Lambda peak position for real data on dependence of arm angle and magnetic field position along Z-axis. The red line corresponds to the table value of Lambda mass.*

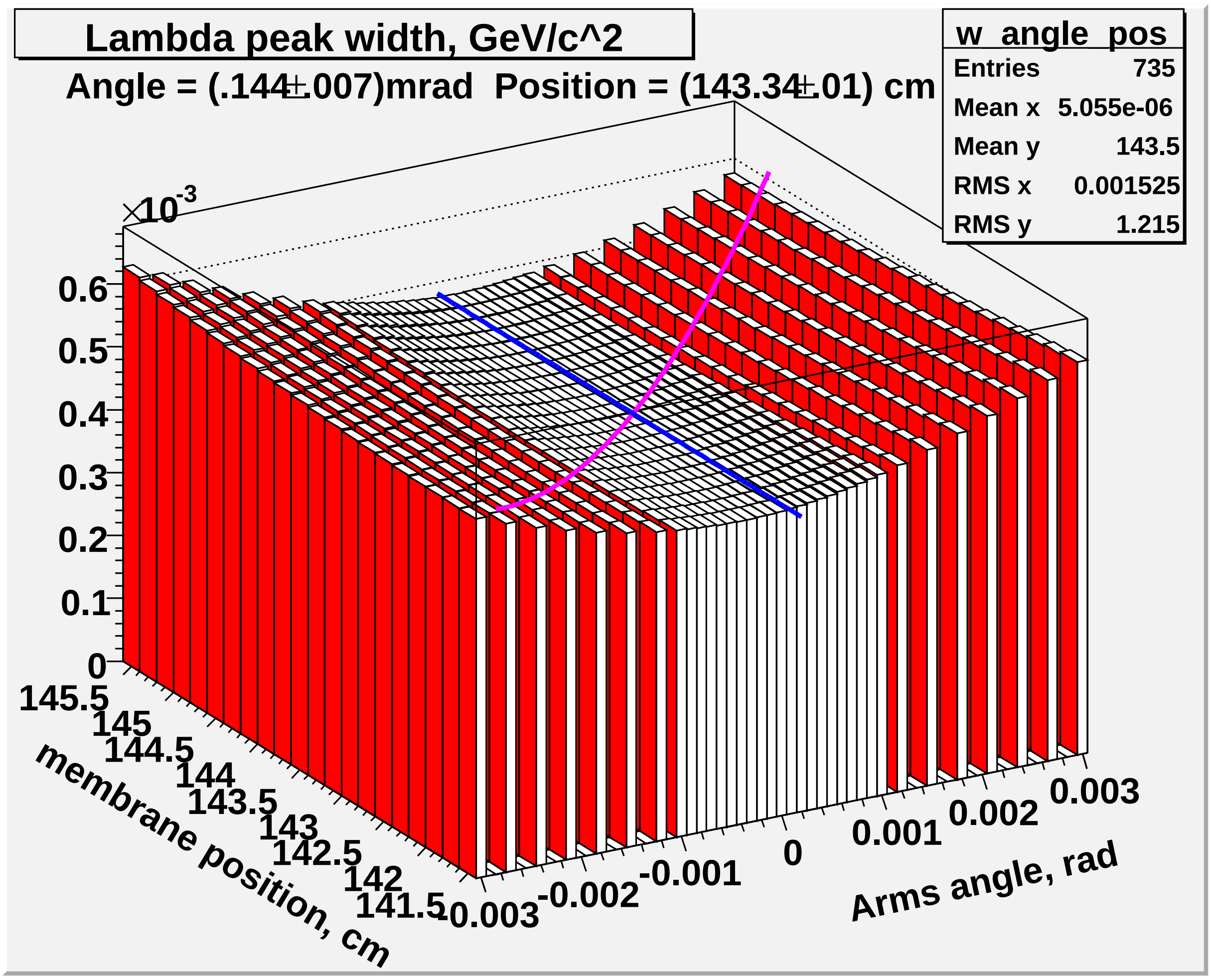

Figure 4: *The distribution of the Lambda peak width for real data on dependence of arm angle and magnetic field position along Z-axis. The pink line corresponds to the* $\bar{X}_{left}$ *and* $\bar{X}_{right}$ *intersection and the blue one - to the table Lambda mass value. The cross point coordinates are angle* $=0.144 \pm 0.007$*mrad and z-position* $= 143.34 \pm 0.01$*cm.*

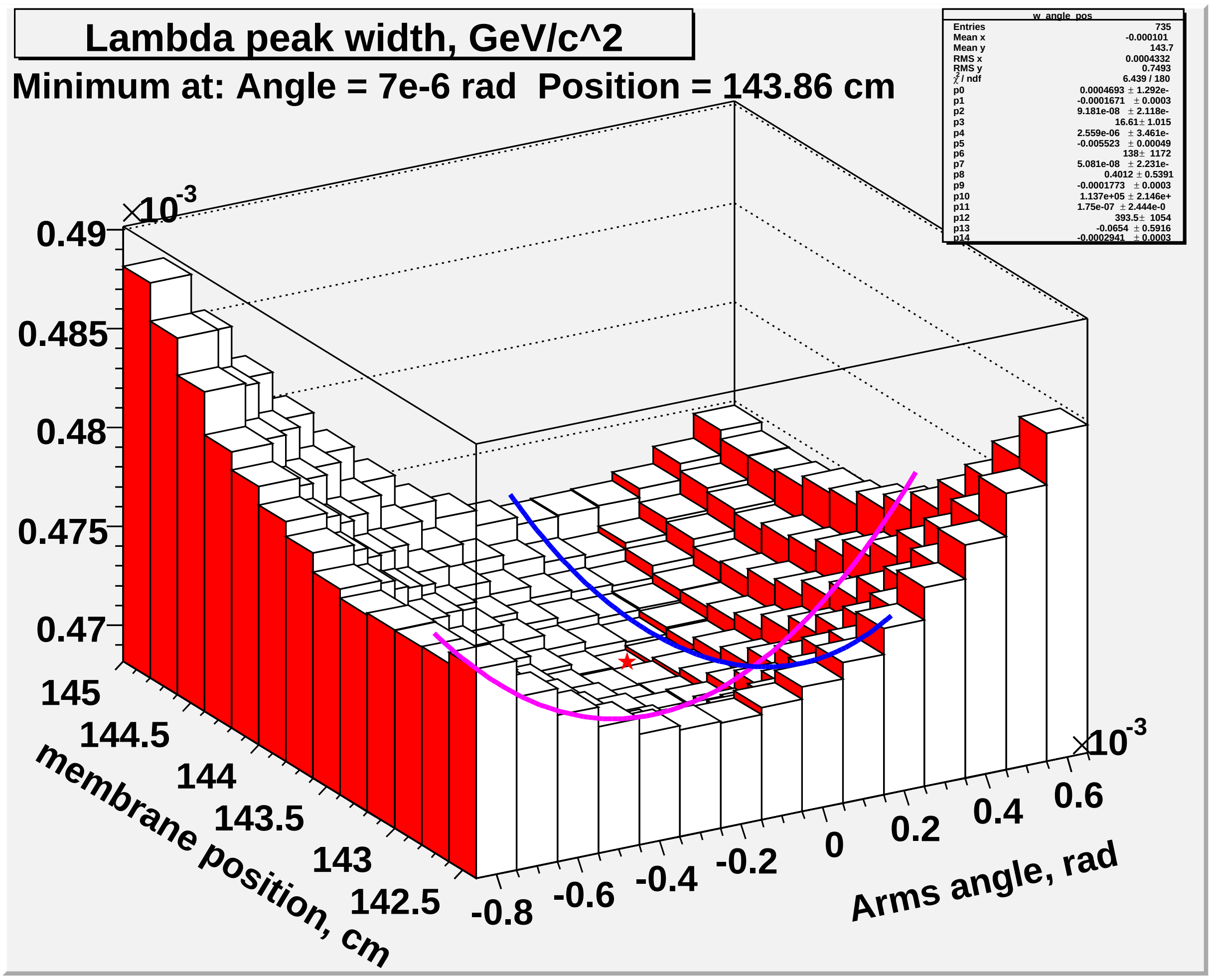

Figure 5: *The zoomed distribution of the Lambda peak width for real data on dependence of arm angle and magnetic field position along Z-axis. The pink line corresponds to the* $\bar{X}_{left}$ *and* $\bar{X}_{right}$ *intersection and the blue one - to the table Lambda mass value. The star point coordinates correspond to the minimum value of Lambda peak width. They are angle = 7e-6 rad and z-position = 143.86 cm.*

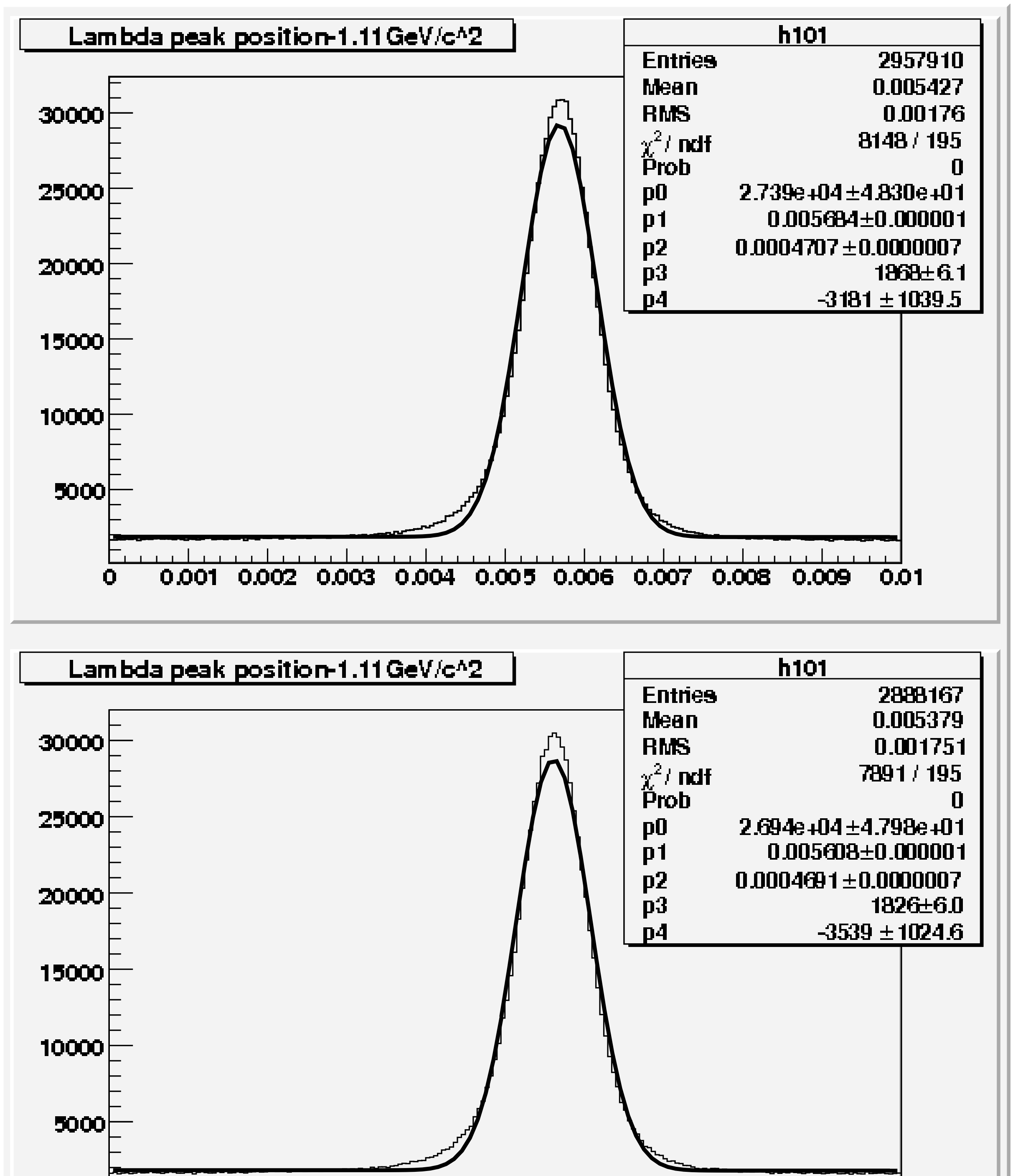

Figure 6: *The distribution of invariant mass of $\pi^- p$ for real data for these parameter values: angle=0.144mrad and z-position=143.34cm(top) and angle=7e-6rad and z-position=143.86 cm(bottom).*

References

[1] O.Gorchakov [JINR], DIRAC Note 2009-08.

[2] O.Gorchakov [JINR], DIRAC Note 2009-02.

[3] O.Gorchakov [JINR], DIRAC Note 2008-11.

[4] O.Gorchakov [JINR], DIRAC Note 2007-17.

[5] O.Gorchakov [JINR], DIRAC Note 2007-12.

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