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ON THE SELECTION OF INCLUSIVE Λ BARYON PRODUCTION

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1. Introduction

To determine the production rate of Λ baryon or its multiplicty is the fundamental step to study the characteristics of Λ, as well as the whole baryon group, such as Ξ^- and Ω^-, et al.

The cut conditions used by different authors [1],[2],[3],[4] have been tested. In order to simplify the cut conditions and further suppress the backgrounds. we have tested around 20 cut conditions, and at last, in this note reduced to following 9 effective cuts, including our some specific considerations.

2. Datasets and Software packages

The data of about 100000 events from 1991 and 90000 events 1993 $q\bar{q}$ (class 16) and 150000 events of Monte Carlo Jetset 7.3 are used.

The YV0V for V^0 searching software package from ALEPHLIB is used.

3. Selection conditions and Some Considerations

Based on the conventional method to select Λ with $\Lambda \rightarrow p\pi^-$ and the characteristics of the detector, three main steps are considered:

- select out all V^0 candidates.
- reject fake V^0.
- reject γ conversion and $K_s^0 \rightarrow \pi^+\pi^-$.

Nine kinds cuts are used in succession and the optimum cut values are determined from the following Monte Carlo analysis by using about 10^4 events. Among those cuts, there are some having been used in common papers, for example, the opening angle between the direction of vector pointing from primary vertex to second vertex and the momentum direction composed from two daughter tracks of Λ; the closest approach of Λ daughter tracks in the transverse (xy) plane (DOCT)as described in Note [1]; the mass window cuts YXM for Λ and YXMK for K_s^0 and the χ^2 of mass fit etc. The following are some our considerations and specific cut conditions:

1) CHI1 and CHI2

CHI1, CHI2 stand for the χ^2 of the two daughter tracks of V^0 constraining themself fit to the primary vertex. From Fig.1a and Fig.1b the chosen values is $\chi^2 > 20$ for both tracks. After this cut the background is reduced down to about 20% (mainly the fake V^0), however the Λ signal remains as 89.6% shown in the sixth column of Table 1. So the ratio of signal to background improves to a factor of ~4.5, but the ratio of Λ to K_s^0 has not been improved as shown in the fourth and last columns in Table 1.

2) W_{11}, W_{22}

Here we use the weights of dE/dX for proton and pion to suppress background, in particular to reduce K_s^0 backround.

$$W_{in} = exp(-x_i^2/2)/\sigma_i$$

where i=1: proton, i=2: pion, n=1:track of larger momentum,n=2:track of smaller momentum,and

$$x_i = [(dE/dX) - (dE/dX)_{i-expected}]/\sigma_i$$

For Λ, shown in Fig.2a and Fig.2b, the proton weight W_{11} is dominant ($W_{11} \sim 1$), but for K_s^0, the proton weight W_{11} is small ($W_{11} \sim 0$). As expected for the remained tracks the π weight W_{22} for both Λ and K_s^0 are dominant as shown in Fig.2b and Fig.2d. At last we choose $W_{11} > 0.1, W_{22} > 0.9$.

From Table 1, one may see that this cut not only suppresses the common background to 33%, but also suppresses the ratio K_s^0/Λ from 3.0 to 1.32 after cut.

3)ANK1

The angular distribution of Λ baryon boosted in K_s^0 coordinate system ANK1, has a clear threshold shown in Fig 3b, however, for K_s^0 this distributiona is rather homogenuous shown in Fig.3c. We make a cut ANK1> 0.75 to reject a large part of K_s^0 and conserve Λ. The ratio K_s^0/Λ reduces from 3.01 down to 0.695 after this cut seen from Table 1 and background is suppressed to 25.5%, which also can be seen from the invariant mass distribution of K_s^0 before and after this cut (Fig.4a,4b), compared with that of Λ(Fig.4c,4d).

4) xma, dz0 and dxy of photo conversion

By using three parameters xma(the invariant mass of tracks at the materialization point), dz0(distance in z between the two tracks at the origin) and dxy(distance in xy plane between the two tracks at the closest approach to the materialization point) in photo-conversion package QPAIRF of ALPHA, the background are further rejected down to 24% and a large part of Λ remains ($\sim$ 86%) after the cuts being able to be seen from Fig.5c, Fig.5d and Table 1. The optimum chosen values are xma> 0.03 and dz0> 0.25 shown in Fig.5a and Fig.5b. The invariant mass spectra of Λ before and after this cut are shown in Fig.5e,5f.

3. Results and discussion

1) After all the above mentioned cuts, the invariant mass distributions of Λ baryon for Monte Carlo as well as for the data of 91 and 93 Aare shown in Fig.6a-6f. One would see that the backgrounds are strongly suppressed and the multiplicty of Λ is 0.37774 ± 0.0128 for 91 data and 0.3699 ± 0.0129 for 93 data. The efficiency is 0.2549 ± 0.0031. The purity of Λ is 91.06%, and 2.5% of reconstructed K_s^0 are ambiguous with Λ.

2) The decay length RLAM cut although is one of the common used cuts, and it can reduce the background to 19.7%, but it is not so effective to reject K_s^0 as shown in the fifth row of Table 1. Especially in case of the necessity to conserve as much as the decay length information for all events, this cut is better to be avoided. From the fourth row of Table 1, one may see the results from combined cuts of W_{11}, W_{22} and ANK1 compared with the result of RLAM. It is very obvious that in particular, K_s^0/Λ reduces from 3.01 down to 0.357, while RLAM only reduces to 2.62. One may get the impression of these two kinds of cuts for Λ from Fig.7a, 7b and for K_s^0 (Fig.7c, 7d) respectively. With W-ANK1 combined cut, K_s^0 (Fig.7c) are rejected obviously more than with decay length cut (RLAM4).

3) The 9 selected conditions are effective and are simplified from about 20 conditions.

REFERENCE

[1] C.Grab, ALEPH Note 90-154.

[2] G.Cowan et al., ALEPH 92-21.

[3] B.Rensch, ALEPH Note 91-48.

[4] P.Hanson, ALEPH Note 93-137

[5] OPAL Collaboration, Phys.Lett.B264(1991)467.

[6] A.De Angelis, CERN PPE 193-35.

TABLE CAPTIONS

Table 1. Number of V^0 for Λ and K_s^0 before and after different cuts

FIGURE CAPTIONS

Fig.1(a) CHI1 CHI2 distribution of MC resconstructed Λ

Fig.1(b) CHI1 CHI2 distribution of MC truth Λ

Fig.1(c) Λ invariant mass before CHI1 CHI2 cut

Fig.1(d) Λ invariant mass after CHI1 CHI2 cut

Fig.2(a) W_{11} distribution of MC truth Λ

Fig.2(b) W_{22} distribution of MC truth Λ

Fig.2(c) W_{11} distribution of MC truth K_s^0

Fig.2(d) W_{22} distribution of MC truth K_s^0

Fig.3(a) ANK1 distribution of MC resconstructed Λ

Fig.3(b) ANK1 distribution of MC truth Λ

Fig.3(c) ANK1 distribution of MC truth K_s^0

Fig.3(d) Λ invariant mass after ANK1 cut

Fig.4(a) K_s^0 invariant mass before ANK1 cut

Fig.4(b) K_s^0 invariant mass after ANK1 cut

Fig.4(c) Λ invariant mass before ANK1 cut

Fig.4(d) Λ invariant mass after ANK1 cut

Fig.5(a) xma distribution of MC resconstructed K_s^0

Fig.5(b) dz0 distribution of MC resconstructed K_s^0

Fig.5(c) xma distribution of MC resconstructed Λ

Fig.5(d) dz0 distribution of MC resconstructed Λ

Fig.5(e) Λ invariant mass before xma dz0 cut

Fig.5(f) Λ invariant mass after xma dz0 cut

Fig.6(a) Λ invariant mass before cut(MC resconstructed)

Fig.6(b) Λ invariant mass after all cuts(MC resconstructed)

Fig.6(c) Λ invariant mass before cut(1991 data)

Fig.6(d) Λ invariant mass after all cuts(1991 data)

Fig.6(e) Λ invariant mass before cut(1993 data)

Fig.6(f) Λ invariant mass after all cuts(1993 data)

Fig.7(a) Λ invariant mass after W and ANK1 cut

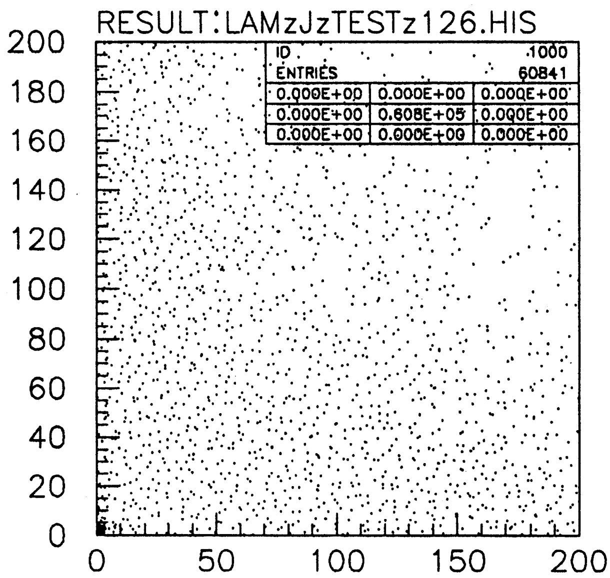
Fig.7(b) Λ invariant mass after RLAM4 cut

Fig.7(c) K_s^0 invariant mass after W and ANK1 cut

Fig.7(d) K_s^0 invariant mass after RLAM4 cut

Table 1:

cut	before cut			after cut		
	Total V^0	Total $\Lambda(K^0)$	K^0/Λ	Total V^0	Total $\Lambda(K^0)$	K^0/Λ
$W_{11} > 0.1$ $W_{22} > 0.9$	84178	1213(3652)	3.01	27760	1041(1374)	1.32
ANK1$>$ 0.73	84178	1213(3652)	3.01	21503	1082(752)	0.695
$W_{11} > 0.1$ $W_{22} > 0.9$ ANK1$>$ 0.73	84178	1213(3652)	3.01	11518	1018(363)	0.357
RLAM$>$ 4	84178	1213(3652)	3.01	16583	1092(2856)	2.62
XMA$>$ 0.03 $DZ_0 > 0.25$	84178	1213(3652)	3.01	20352	1043(3138)	3.01
CHI1$>$ 20 CHI2$>$ 20	84178	1213(3652)	3.01	16869	1087(3473)	3.195



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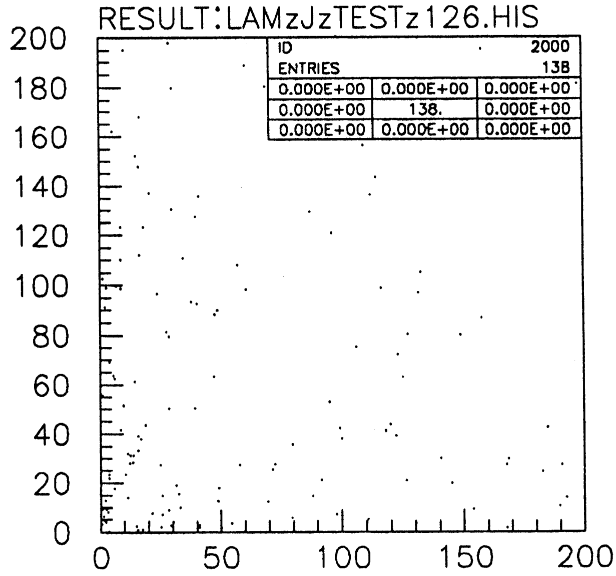

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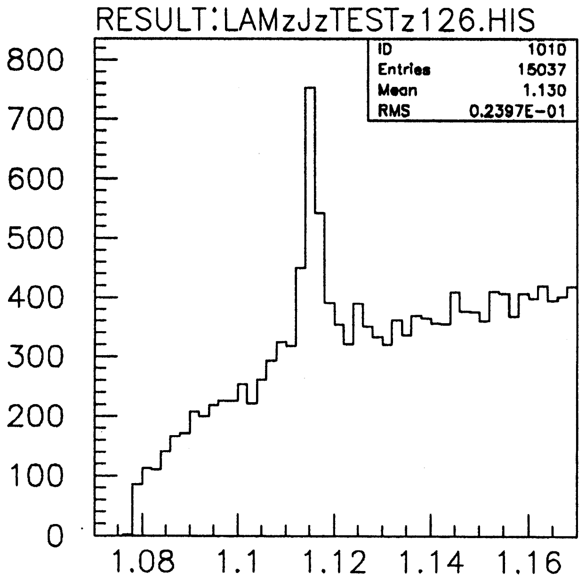

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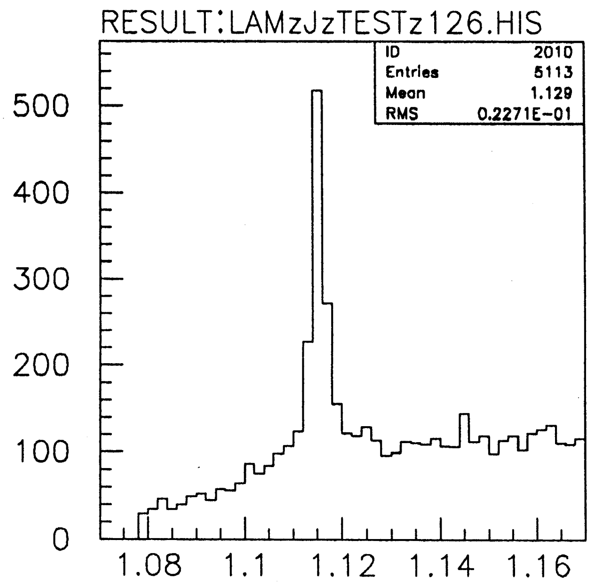

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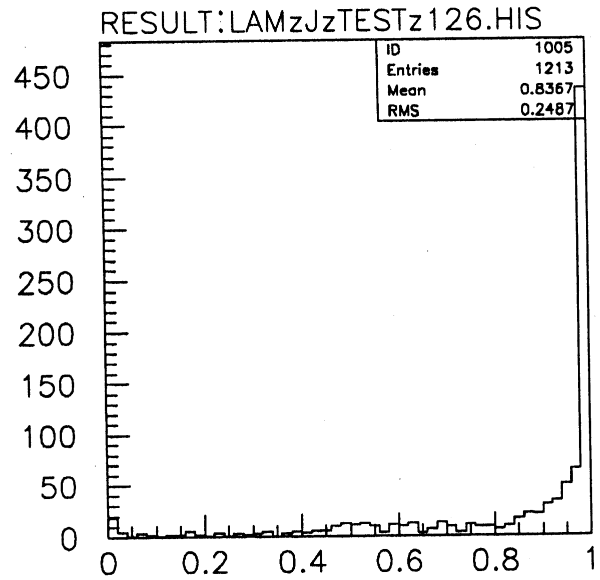

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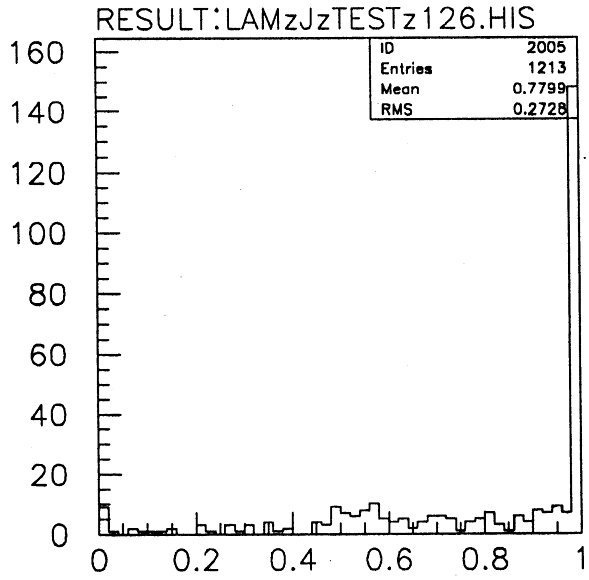

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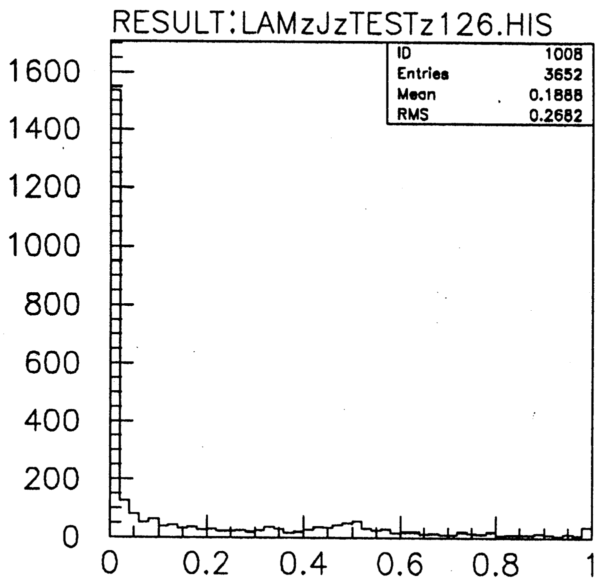

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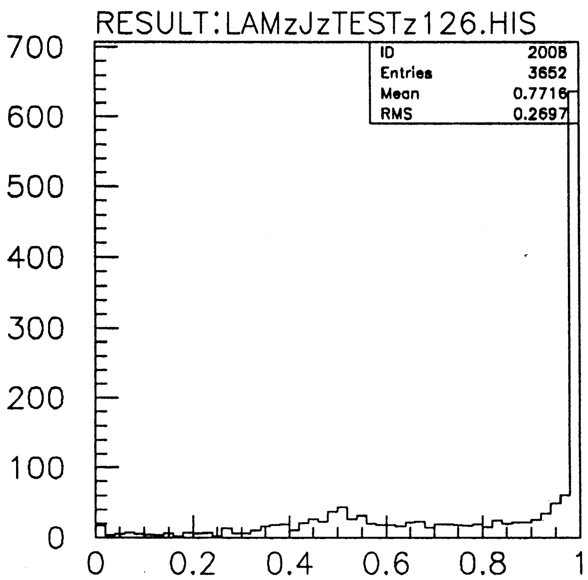

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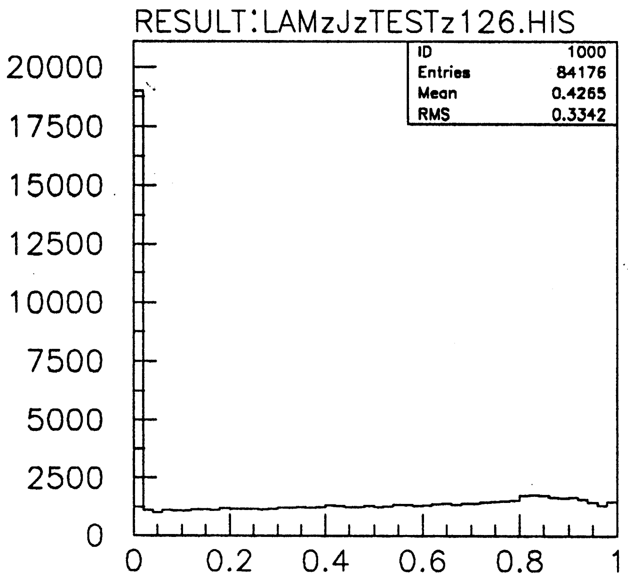

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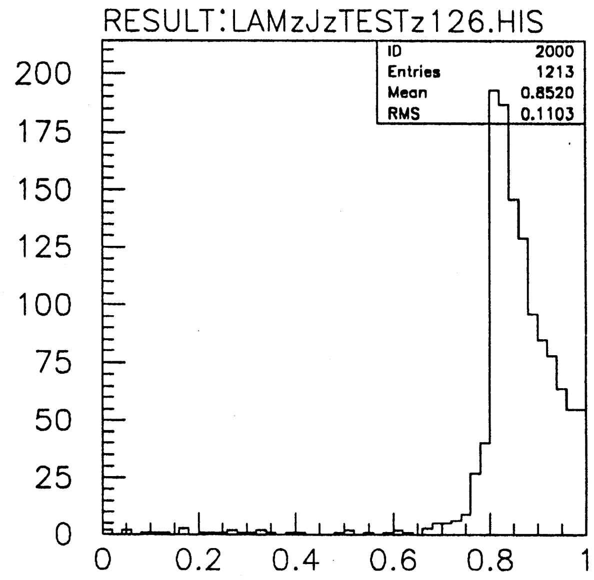

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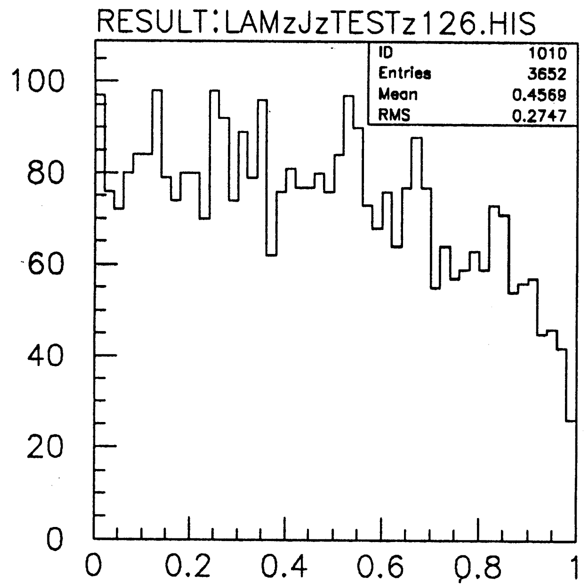

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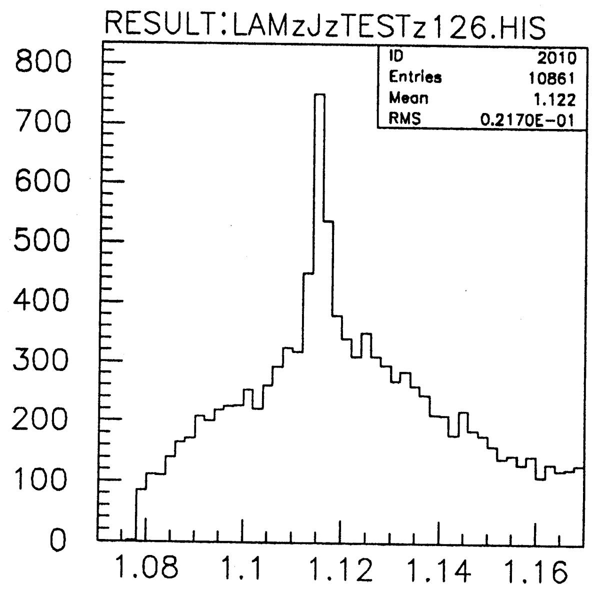

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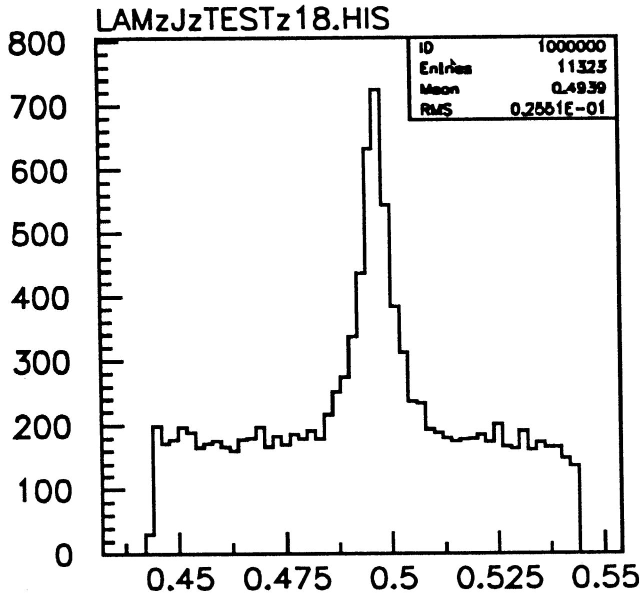

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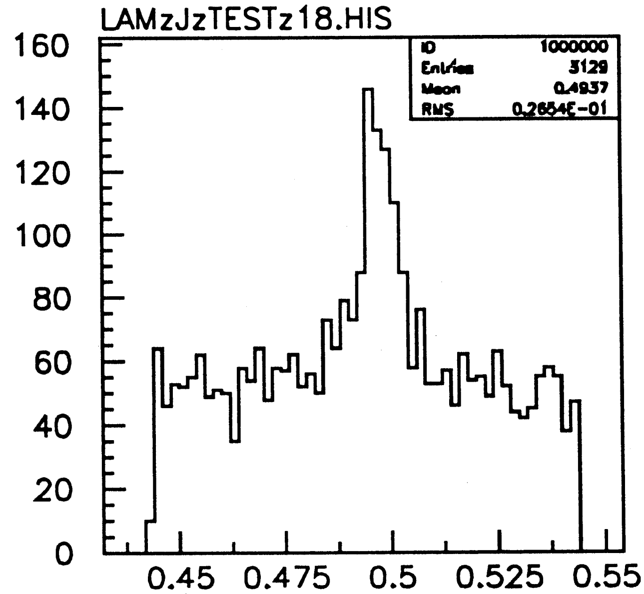

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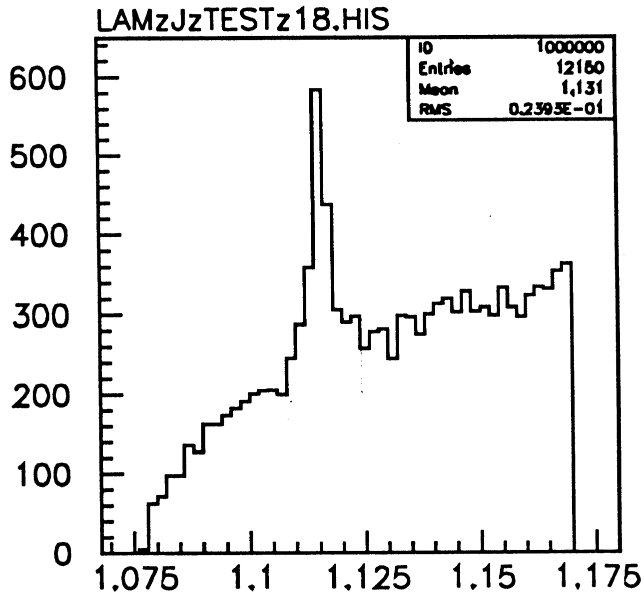

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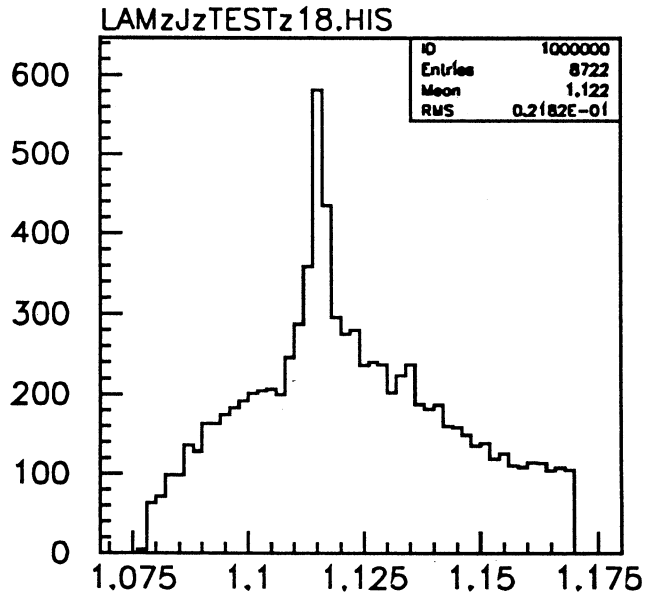

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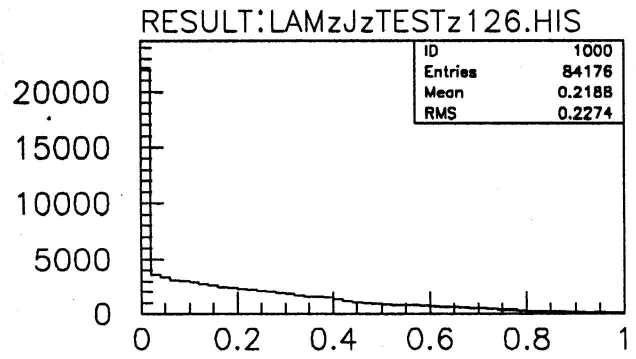

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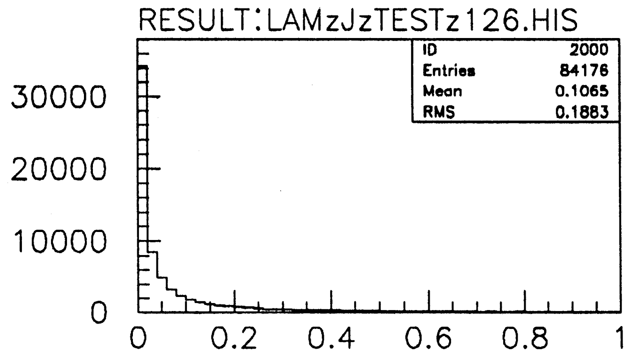

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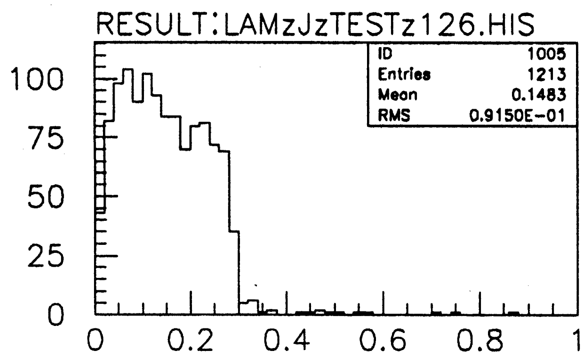

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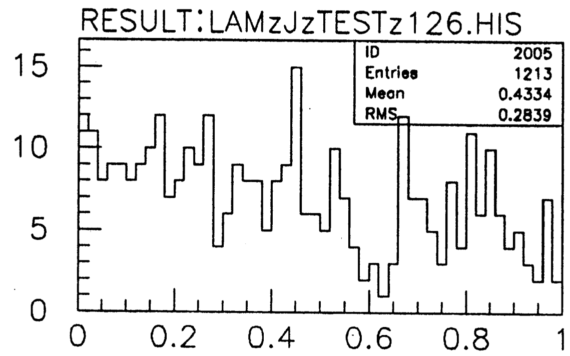

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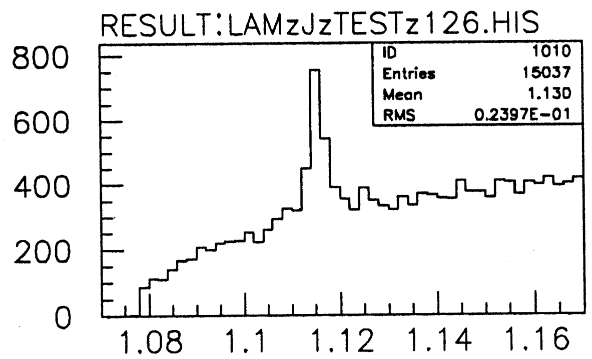

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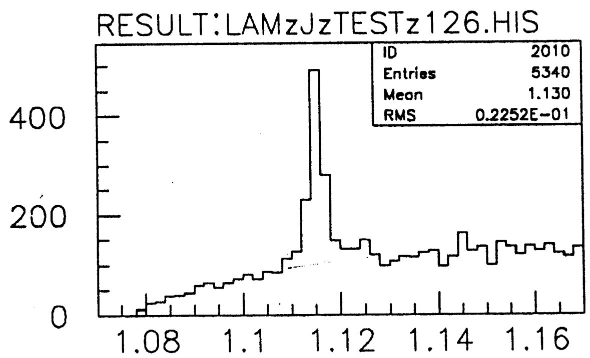

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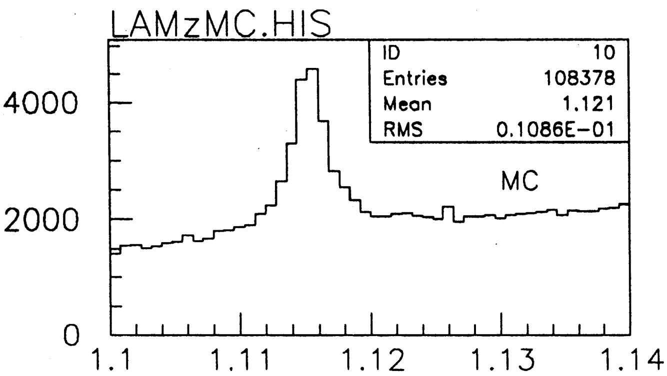

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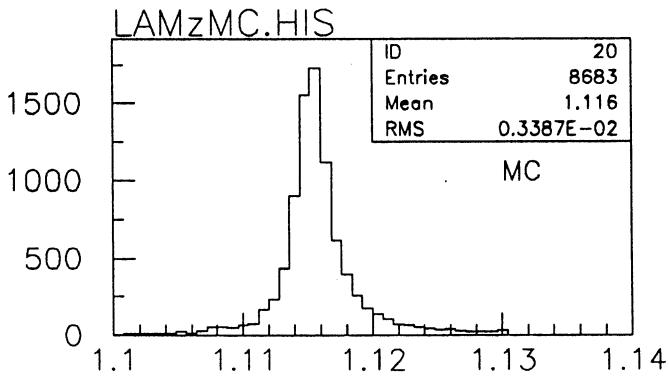

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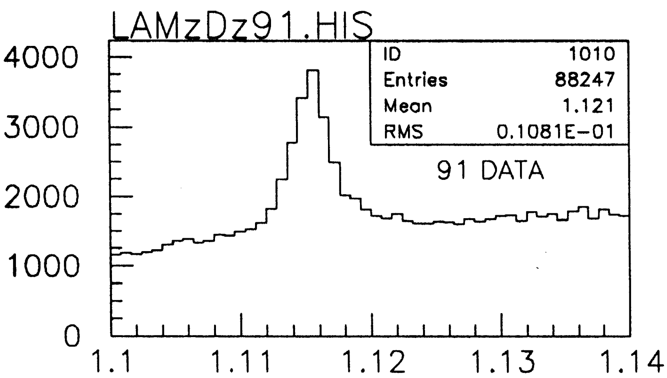

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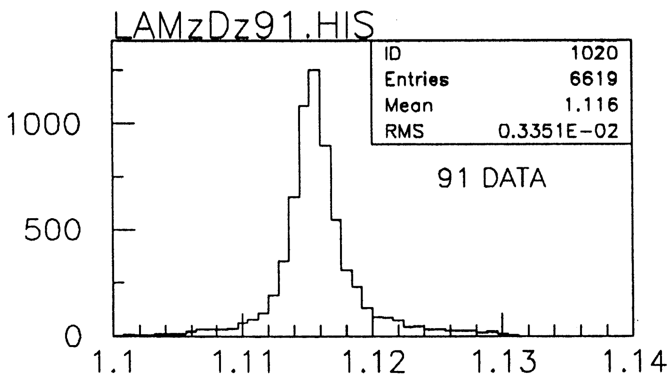

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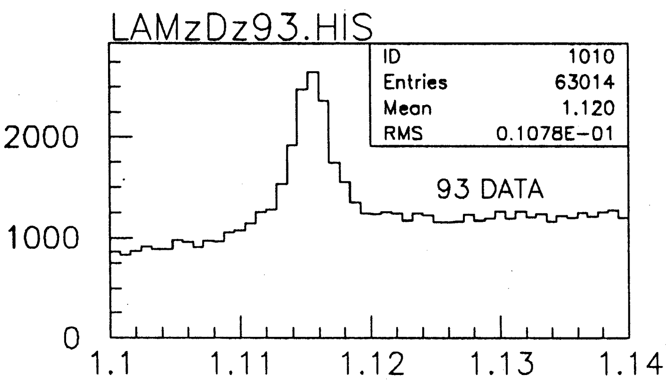

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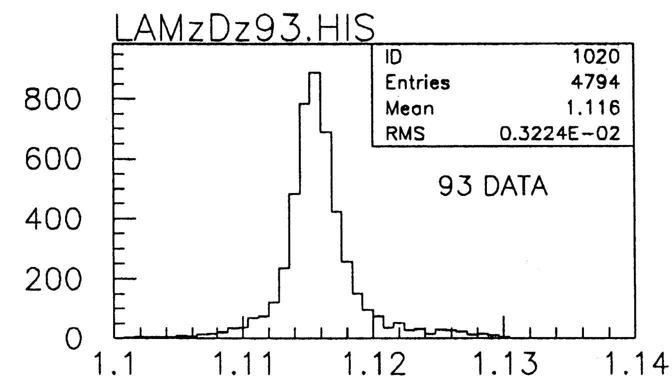

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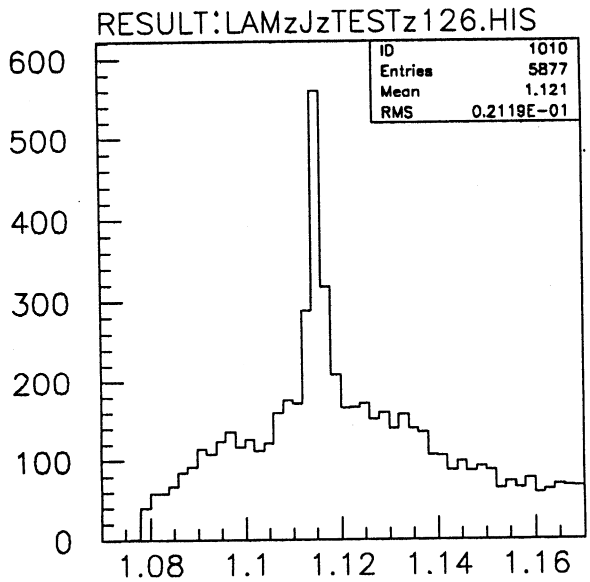

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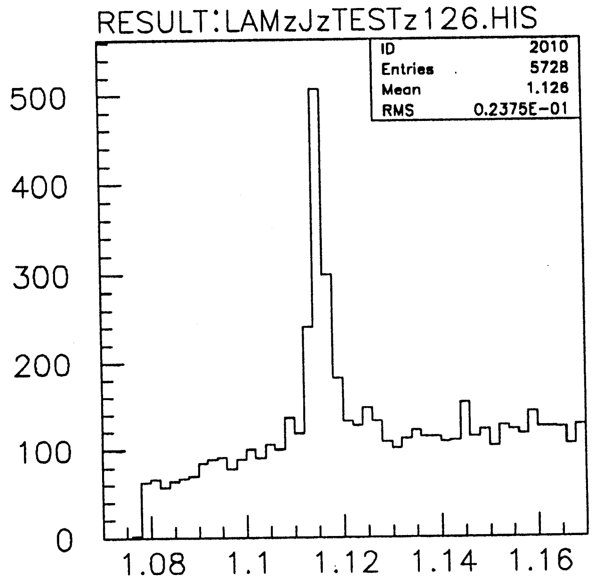

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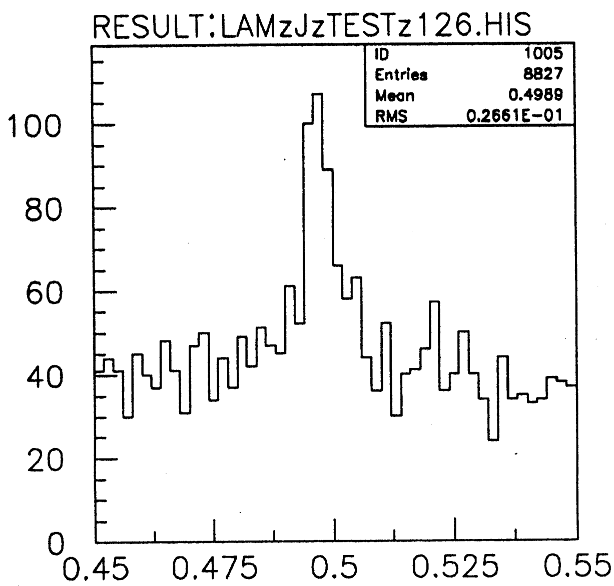

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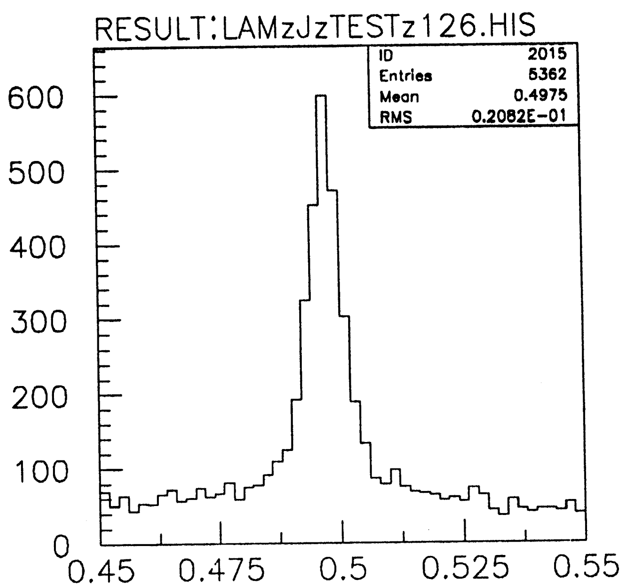

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