Precision Measurement of J/ψ Leptonic Branching Fraction — answers to the referees

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Here are the response to the three referees of the paper titled "Precision Measurement of J/Psi Leptonic Branching Fraction", the comments from Dr. Li Xiaonan and Prof. Zhu Yongsheng were extracted from their e-mail to other referees, the relevant persons and the author, and those from Prof. Walter Toki were a summary of the discussion with the author and also the other two referees had on Nov. 8, 1996.

Yuan Changzheng
Nov. 11, 1996

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>>From: MX%"lixn@bepc5.ihep.ac.cn" 20-SEP-1996 17:18:27.61
>>To: yuancz@bepc5.ihep.ac.cn, guyf@bepc5.ihep.ac.cn, zhuys@bepc5.ihep.ac.cn,
>>   toki@lamar.ColoState.edu, lixn@bepc5.ihep.ac.cn, joe@utdallas.edu,
>>   lijin@bepc5.ihep.ac.cn
>>CC:
>>Subj: reply for jpsi paper
>>
>>Hello,
>>
>>The next opinions are based on the paper, Precision Measurement of J/Psi
>>Leptonic Branching Fraction.
>>
>>The measurement is based on a direct method. It is simple and can get
>>a very precise result. I will mention here about some issues about this
>>measurement.
>>
>>(1). The trigger efficiency. This is efficiency with more than 4 tracks.
>>Maybe it has not effect on the result. But it should be mentioned in the
>>paper.
>>

I estimated the effect of the trigger efficiency according to the data supplied by Trigger Group, and found the trigger efficiency for pi+pi-\ell+\ell- events is 100%, and that for pi+pi- anything events, since there are only two charged tracks when J/psi decays into all neutral, is a bit lower, but the ratio of J/psi decays into allneutral is only a small fraction in J/psi inclusive decay, so the effect on B_ll is far less than 0.2% and is considered to be negligible.
I will try to find a place to add one sentence or two in the paper when revise it.

>>(2). The systematic errors. These includes errors from pion selection(2.2%,
>>1.9%), lepton selection(1.3%, 1.6%), efficiency(0.4%) and fit(0.8%).
>>I argue about error from pion selection. This error should be cancelled in the
>>final result because the measurement is based on a relative measurement.
>>That means different criteria of pion selection only results a different
>>recoil mass sample. process I and II use same sample. The error from pion
>>selection in paper is just a kind of statistical error due to different
>>sample. Therefore, the result should not have this systematic error.
>>

If the data sample is large enough and the distributions of process I and II will be the same, so the systematic error cancelled out in pion selection, since the selection of the pions in the two processes are the same, as stated above, but the fact is the statistics limited us to get a smooth enough distribution, especially in the place we put our cut (we always cut on the tail to remove as less as possible events), so varying cut around the nominal value used for cut vary the Brs too. The paper analyzing the same channels of MK3 states that the effects on varying pion selection criteria cancelled out, I wonder whether it is based on careful study or just take for granted.

>>(3). I heard that the result of paper is based on the 93/94 data. There is
>>a argue that we should include 95 data. My opinion is that it is not
>>necessory. The reason is that the paper has a result with three times
>>precision than Mark III. And the statistical error is much smaller than

>>systematic error. It is not more meaningful to suppress statistical error.
>>
>>The conclusion is that measurement has a more precise result. The paper
>>has a basis to be published openly. but I think (1) (2) problems should
>>be taken into account by author.
>>
>>Li Xiaonan
>>

Thank you very much.

>>From: MX%"zhuys@bepc5.ihep.ac.cn" 30-OCT-1996 18:36:47.15
>>To: lixn@bepc5.ihep.ac.cn, toki@lamar.ColoState.edu,
>> zhuys@bepc5.ihep.ac.cn, guyf@bepc5.ihep.ac.cn, yuancz@bepc5.ihep.ac.cn,
>> FAH@uhhepb.phys.Hawaii.Edu, Jingyun Fan <Jy_Fan@bbs.ustc.edu.cn>
>>CC:
>>Subj: comment for the j/psi-->l+l- memo and paper (draft)
>>
>>(1) For Fred's memo.
>> I looked at the updated version of Fred's memo about j/psi-->i+i- in
>>his home page "http://www.phys.hawaii.edu/~fah/besec".
>>The whole impression is that, it shows some plots, but, the descripsion
>>of the analysis is too brief, based on which it is very hard to judge
>>the correctness of the results and the analysis itself. It seems to me
>>at present, it is better to make no comment or judgement before more
>>detail memo can be issued out by Fred.
>>

>>(2) For C.Z.Yuan's memo and paper draft.
>> I have looked at both the memo and paper (draft) for the
>>"Precision Measurement of j/psi Leptonic Braching Fraction".
>>Following are my comments and suggestions.
>>
>>1. In section IV A (event selection), for the cut 1 (momentum cuts), it is
>> may be helpful to give short description for physics meaning of these cuts.

Figure 1 in the end of this note may help person to understand the
cut more effectively. The lower momentum cut of 0.45 is used to seperate
pion candidate track (p<0.4) from the lepton track, to use such a low
limitation is try to include as more as possible events with final states
radiation to increase the statistics and to eliminate the effect of the
difference between data and Monte Carlo.

>>2. In section V (Acceptance), author describe the characterristics of process
>> I (psi'-->X+J/psi, X-->pi+pi-, J/psi-->l+l-) for the generated events.
>> Three distributions have been given. If the comparison of M.C. and data
>> for these distributions can be shown and resonable good agreement can be
>> reached, it will certainly make the results more convincing.

Walter also mentioned the angular distributions of pions and leptons.
Figure 2 shows the distribution of all tracks of pi+pi-\ell+\ell- events,
instead of giving the distribution in their mother particle's system, I use
the lab system, because this need not modify the program and reprocess the
data. The agreement between these distributions can show the agreement of
the angles mentioned in the paper, although not direct.

>>3. In section VI (error estimation) and section VII (results and discussion),
>> the statistical errors for the Bee and Bmu are intercanged. Author should
>> give the consistent numbers.

I am sorry for making such a stupid mistake.

>>4. In Reference [9], there is such statement:
>> " We estimate J/psi charged-track-multiplicity distribution to be 1.4%,

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>>    35.2%, 38.5%, 22.4% and 2.5% ".  It might be more appropriate to explain
>>    these numbers are the (Omega)k in section V, with k=0,2,4,6,8
>>    respectively.
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I will modify the draft about this later.

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>>5. Because the PDG96 has been issued publicly, so the paper should quote PDG96
>>   values rather then DPG94.  Probably  values quoted in this paper have no
>>   change, then only the reference quoted need be changed.
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The draft was finished in Oct. 1994, when the PDG94 is the latest version. Anyway, it will be changed in revised version of the draft.

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>>6. The whole contents are saticfactory and the information are sufficient
>>   except the items I mensioned above which need be corrected and checked.


>>7. The results given by this memo and paper draft
>>     Bee = 0.0590 +- 0.0007 +- 0.0016
>>     Bmu = 0.0596 +- 0.0008 +- 0.0016
>>   has better accuracy than existing best corresponding values (Mark 3):
>>     Bee = 0.0592 +- 0.0015 +- 0.0020
>>     Bmu = 0.0590 +- 0.0015 +- 0.0019.
>>   In addition, the dominant part of the errors is the systematical one.
>>   Therefore, the limited increasement of data sample will not improve
>>   the accuracy significantly.  And also the corresponding results based on
>>   full psi(2s) data sample are not yet ready, it still needs some time period
>>   to work out.  Therefore there is no point to delay the publication of this
>>   good results. As well known inside the BES Collaboration, this
>>   results and paper draft has been presented for a quite long period.  If
>>   the issues I mentioned above can be corrected and checked, my personal
>>   opining is, the publication of this paper is mature.  Sure enough, english
>>   expression need be polished.
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Thank you very much.

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The summary of the discussion with Prof. Walter Toki on Nov. 8, 1996.
PARTICIPANTS:   Prof. Walter Toki,   Prof.  ZHu Yongsheng
                Prof. Gu Yifan,      Dr.    Li Xiaonan
                Prof. Xue Shengtian, Yuan Changzheng
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(only questions and comments about current draft and analysis memo are listed, some questions about the understanding of the parameters used in the analysis memo are omitted.)

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>> 1.  comparision between data and Monte Carlo about the angular distribution
>>of pi^+, pi^-, e^+, e^-,mu^+ and mu^- of pi+pi-\ell+\ell- events.
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Please see Figure 2.

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>> 2.  Energy distribution plot of electron cut, compare data and Monte Carlo.
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Please see Figure 3.

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>> 3. Same as (2)1. of Prof. Zhu's comments.
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Figure 1 may help.

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>> 4. systematic error, Br varys as function of cut position.
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This shows the difference between Monte Carlo and data, the principal cuts are varied around nominal cut position and the results can be seen in Figure 4,

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>> 5.  Big picture of m_rec of process I and II.
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Please see Figure 5.

>> 6. Add the effct of more than 4 prongs events.

According to the study of Prof. Fred Harris of UH, BES monte Carlo cannot simulate the duplicate fitting of the same physical track very well, so one need to add these kind of events in the data sample. After selection, I found 163 pi+pi-mu+mu- events and 337 pi+pi-e+e- events including those events with tracks splashed back to MDC, which is already included in the draft (34 pi+pi-mu+mu- events and 37 pi+pi-e+e- events). The fractions of these events are in agreement to what got by Fred, which are 4.0% for pi+pi-e+e- and 3.0% for pi+pi-mu+mu-. This effect will increase the Brs to the following results:

B_ee = 6.15%
B_mm = 6.09%

The percentage errors will not change.

The final results in the draft will be corrected later.

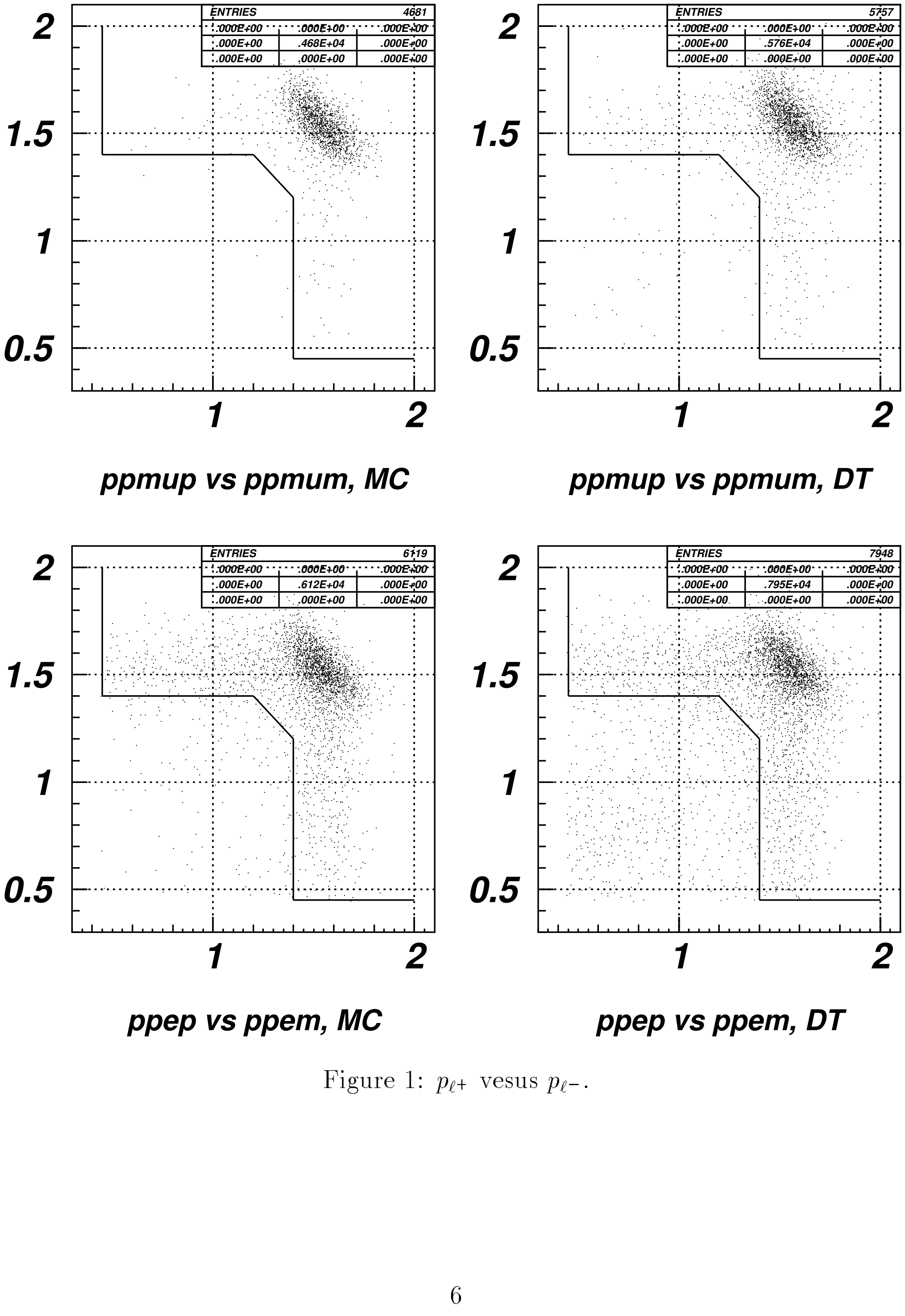

Figure 1: p_{ℓ^+} vesus p_{ℓ^-}.

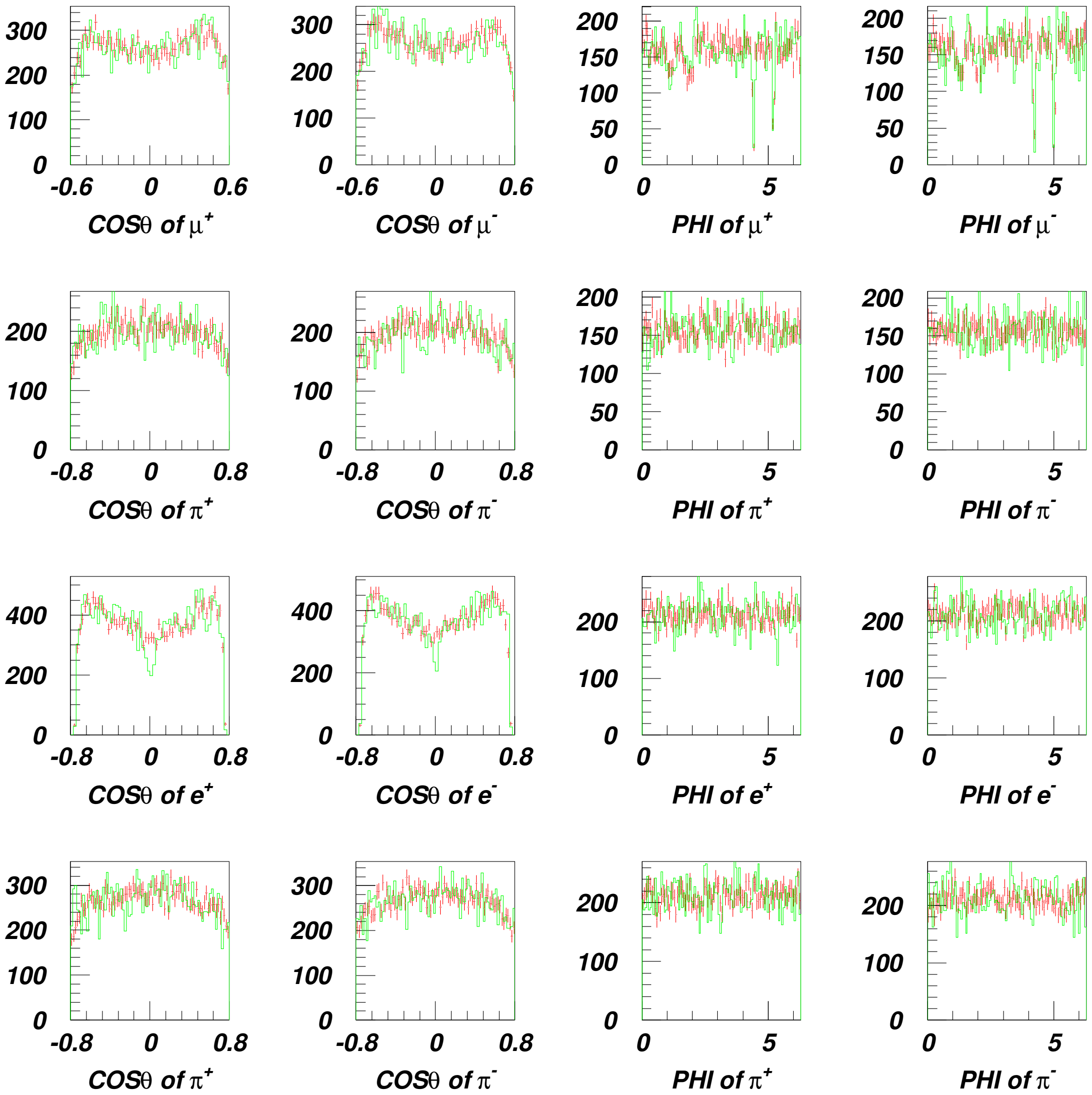

Figure 2: angular distributions of $\pi^+\pi^-\ell^+\ell^-$, histogram for Monte Carlo and error bars for data.

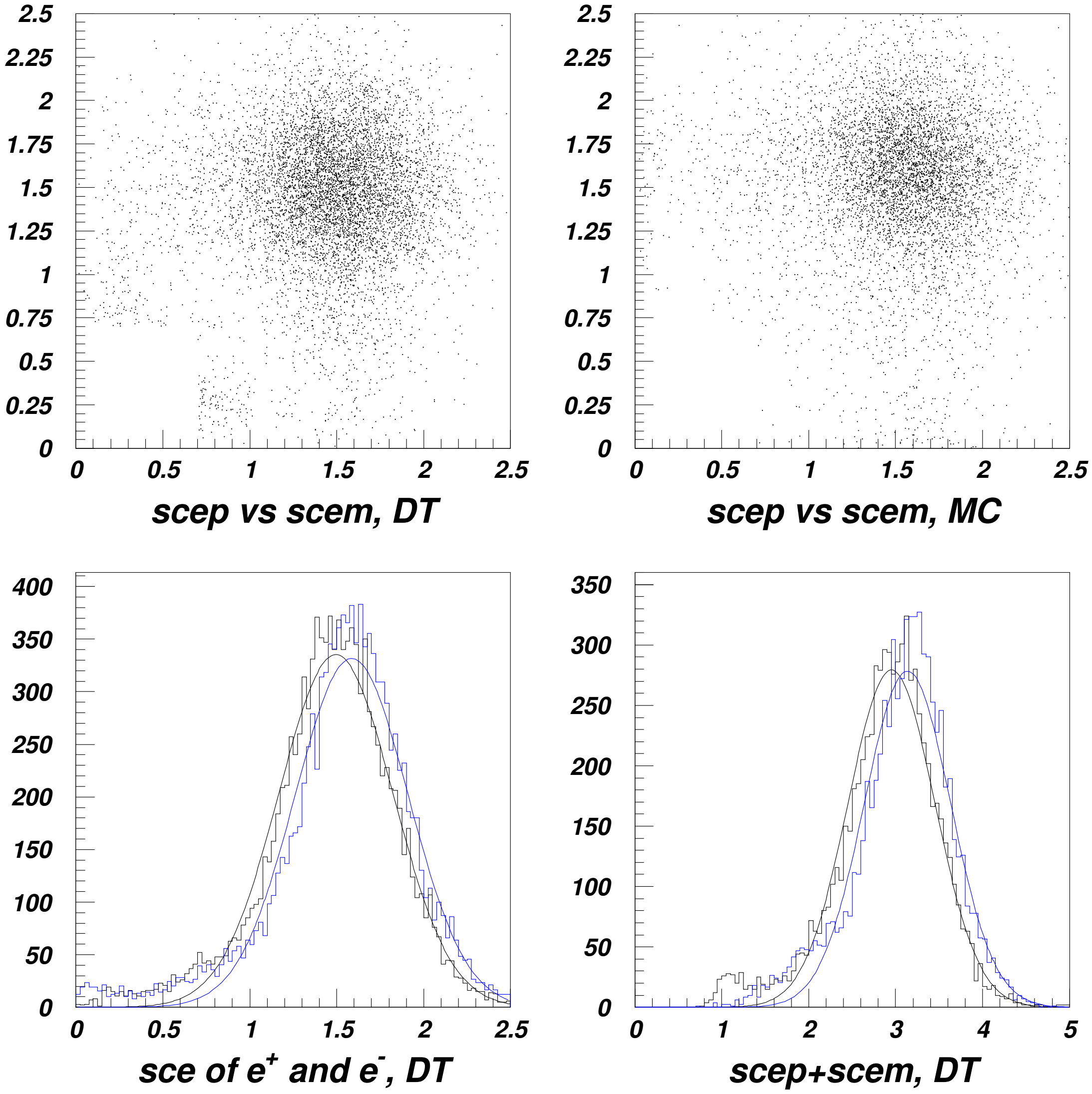

Figure 3: SC energy of electrons, comparison between data and Monte Carlo, black line for data and blue line for Monte Carlo.

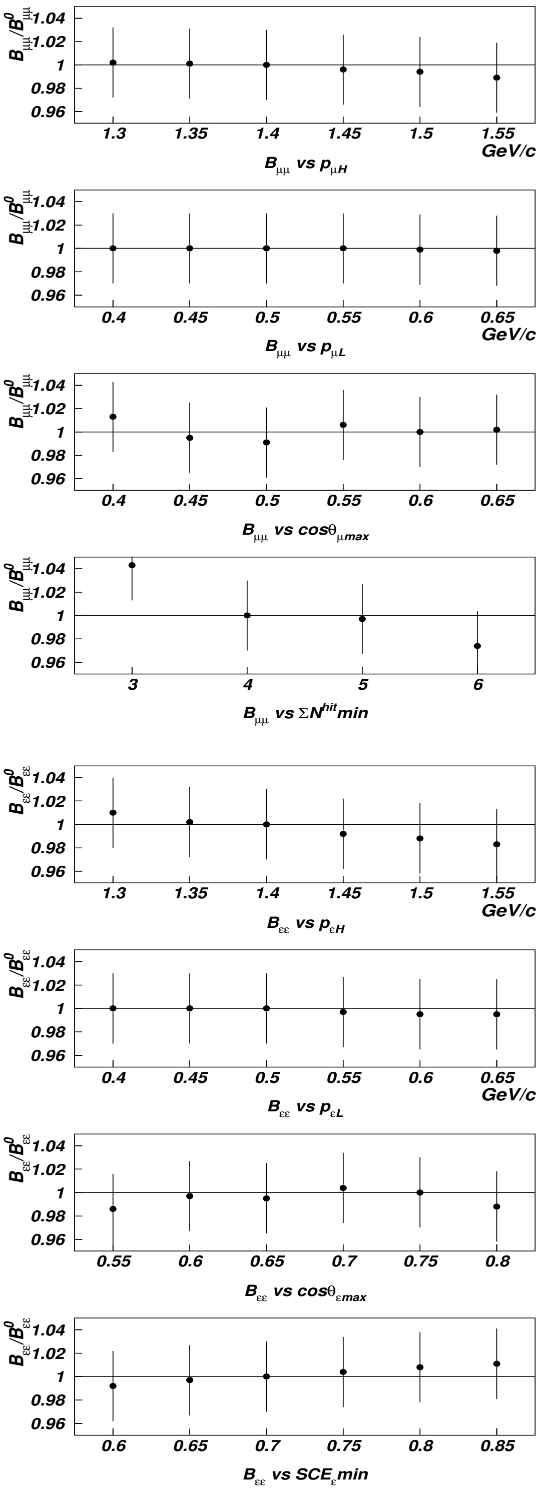

Figure 4: Branching fractions vary when cuts changed.

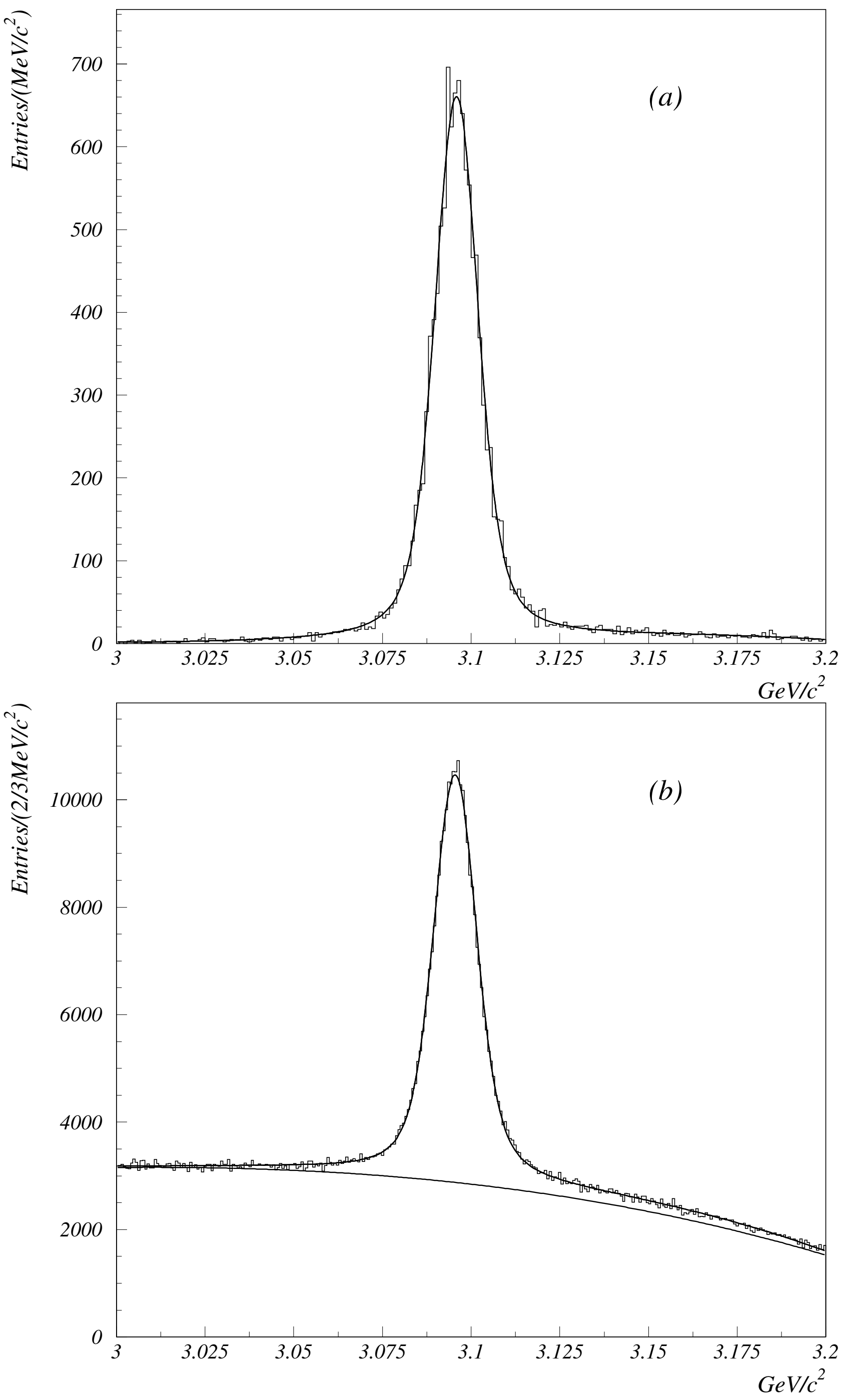

Figure 5: recoil mass distribution of process I and process II, (a) process I; (b) process II.