Discussion on BES-II Data Reconstructed on PC/Linux Platform

Can we do BES-II data reconstruction on PC/Linux with code Version of 101 (102) for direct J/ψ physics analysis ? [1]

Gang Rong

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[1] The talk is given at BES Monthly' Meeting at IHEP on January 20, 2000. It was based on many useful discussions with Prof. Z.G. Zhao, Prof. Y.C. Zhu, Prof. Y.N. Guo, K.L. He and S.Q. Zhang.

INTRODUCTION

- Why need data reconstructed on PC/Linux ?
  - BES/BES-II Physics (J/ψ, ψ', Charmed Mesons, τ, Baryons, Hadron production ...) analysis needs more CPU, larger Disk ...
  - PCs/Linux – PC is cheaper and Linux is free software. Easier to get more CPU and Larger Disk.
  - BES D and D_S physics analysis has been performed on PC/Linux with BES V8.6 (Linux version) code based on data reconstructed on HP/UX platform since September 1998.

    BES-II J/ψ physics analysis is planed to perform on PC/Linux platform with data reconstructed on HP/UX. For these reason, we at least need to generate and reconstruct Monte Carlo data at PC/Linux platform.
  - Actually, if we can do BES-II data reconstruction, MC (Monte Carlo) simulation and MC data reconstruction on PC/Linux platform together with physics analysis, we can obtain physics result much faster than that based on the data reconstructed on PH/UX at IHEP.
  - Charmed Mesons physics analysis with BES V8.6 code (Linux version) based on PC/Linux plus CERNLIB with data reconstructed on HP/UX platform was proved OK, and physics results analyzed on PC/Linux are comparable to that analyzed on HP/UX platform.
  - At present, there are some opened questions to be answered before the BES-II data reconstructed on the PC/Linux platform can be directly used for physics analysis on PC/Linux platform. One of the questions is whether the reconstructed BES-II data

obtained on PC/Linux and HP/UX platforms are comparable. Especially for reconstructed charged track 3-momentum vectors.

– Is it possible to switch from HP/UNIX to PC/Linux?
  More and more BES physicists at IHEP side are interested in physics analysis based on PC/Linux and software experts begin to be interested in the off-line data processing performed on PC/Linux.

  To answer the opened questions, we studied the BES-II data off-line reconstruction on PC/Linux, and made a comparison of the reconstructed data on both PC/Linux and HP/UX platforms.

  The comparison result shows that the reconstructed 3-momentum vector values from the PC/Linux and HP/UX platform are identical within 3(4) digital after points for more than 98% (95%) charged tracks.

  If the comparison result of physics analysis based on the data from the two platforms is also OK, it maybe possible to switch the data off-line reconstruction from HP/UNIX to PC/Linux for BES-II experiment. This would save a lot of Money and a lot of time !

BES-II Software (V101) and PC/Linux Platform

The feasibility study of that whether the BES-II data reconstructed on PC/Linux platform can be directly used in J/ψ physics analysis is performed based on the BES-II software of version 101, developed by BES Collaborators (US and China sides), and the PCs/Linux Cluster of D physics group at IHEP.

– BES-II Software of Version 101

  The data off-line reconstruction software of version 101 was copied from BES-II software library on HP Workstation to the main PC server – PIII-500 PC of our distributed PCs system (Cluster) of D physics group. The BES-II software library of version 101 was built on the main PC server.

  K.L He and G. Rong are responsible for the code management on the main PC server of the PCs Cluster at present.

– PC/Linux Platform

  The Red-hat 6.1 Linux was used as operation system for our PCs Cluster. The BES-II software enviroment was set based on BES (or BES-I) software environment which was set up for the PCs/Linux Cluster in September 1998.

Check on BES-II Data Reconstructed on PC/Linux Platform

– Data Reconstructed on PC/Linux with version of 101 code

Using BES-II data off-line calibration constants obtained on HP/UX (copied them from "/bes/bes/share/const2/v102" on HP Workstation), two run data (run13570 and run13572) are reconstructed on both PC/Linux and HP/UX with v101 code.

Figure 1(a) and 1(b) show the scatter plots of reconstructed dE/dx vs reconstructed momentum of charged particles, and 1(c) and 1(d) show the scatter plots of reconstructed relativistic velocity of charged particles vs their momentum.

Figure 2(a) and 2(b) show the scatter plots of reconstructed dE/dx vs reconstructed momentum of charged particles, and 1(c) and 1(d) show the scatter plots of reconstructed relativistic velocity of charged particles vs their momentum.

– Comparison of the reconstructed data on PC/Linux and HP/UX platforms with version of 101 code

In physics analysis, one needs reconstructed charged particle 3 momentum vector (energy and position of gamma), the mass of charged particle to compute the invariant mass of a few particle system. we need to pay much more attention on the reconstructed momentum vector, energy of gamma and information of charged particle identification.

Figure 3(a), 3(b) and 3(c) show the deviations of the reconstructed momentum vector of reconstructed data from both PC/Linux

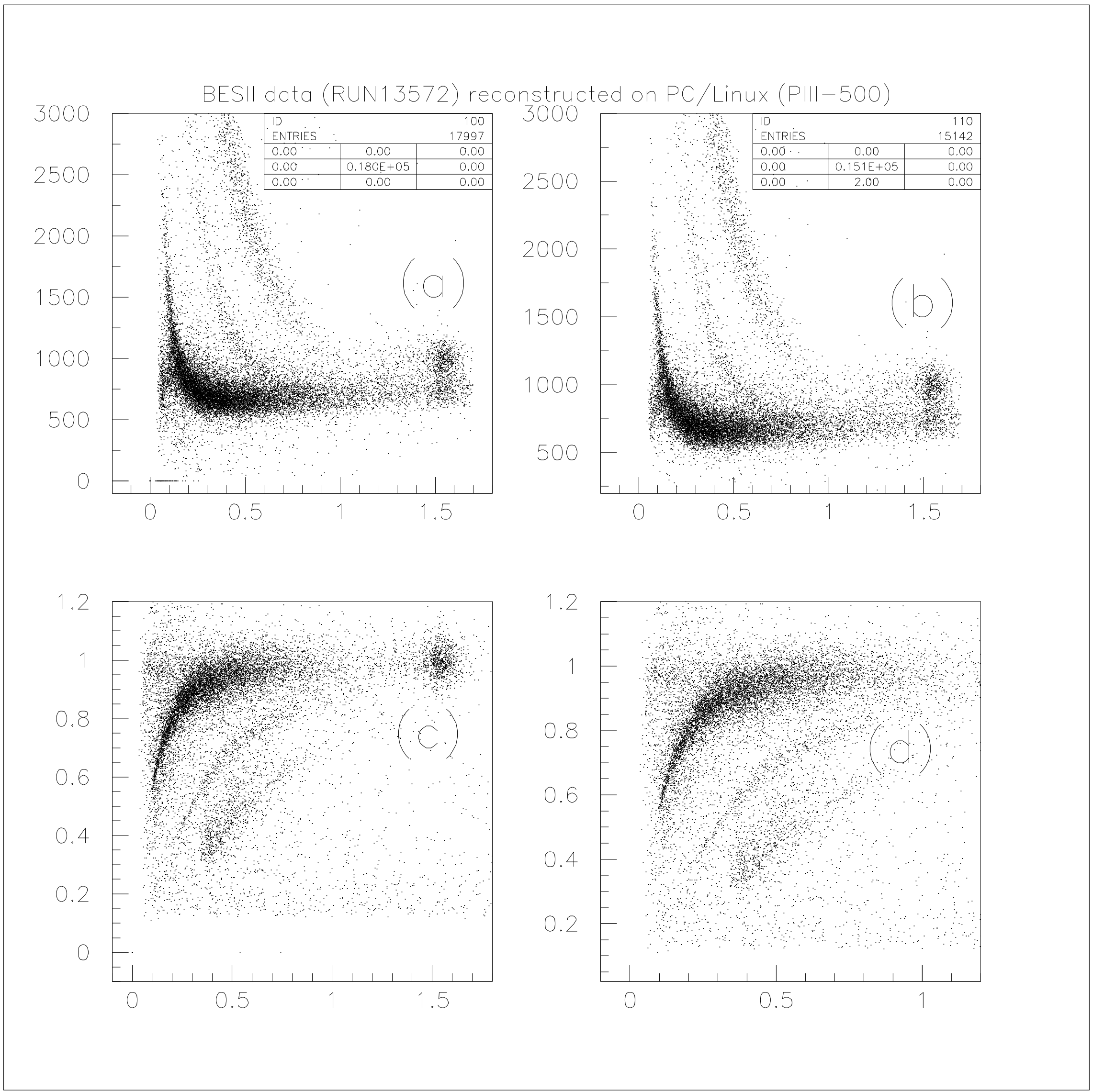

BESII data (RUN13572) reconstructed on PC/Linux (PIII−500)
ID 100
ENTRIES 17997
0.00 0.00 0.00
0.00 0.180E+05 0.00
0.00 0.00 0.00
(a)
ID 110
ENTRIES 15142
0.00 0.00 0.00
0.00 0.151E+05 0.00
0.00 2.00 0.00
(b)
(c)
(d)

Figure 1:

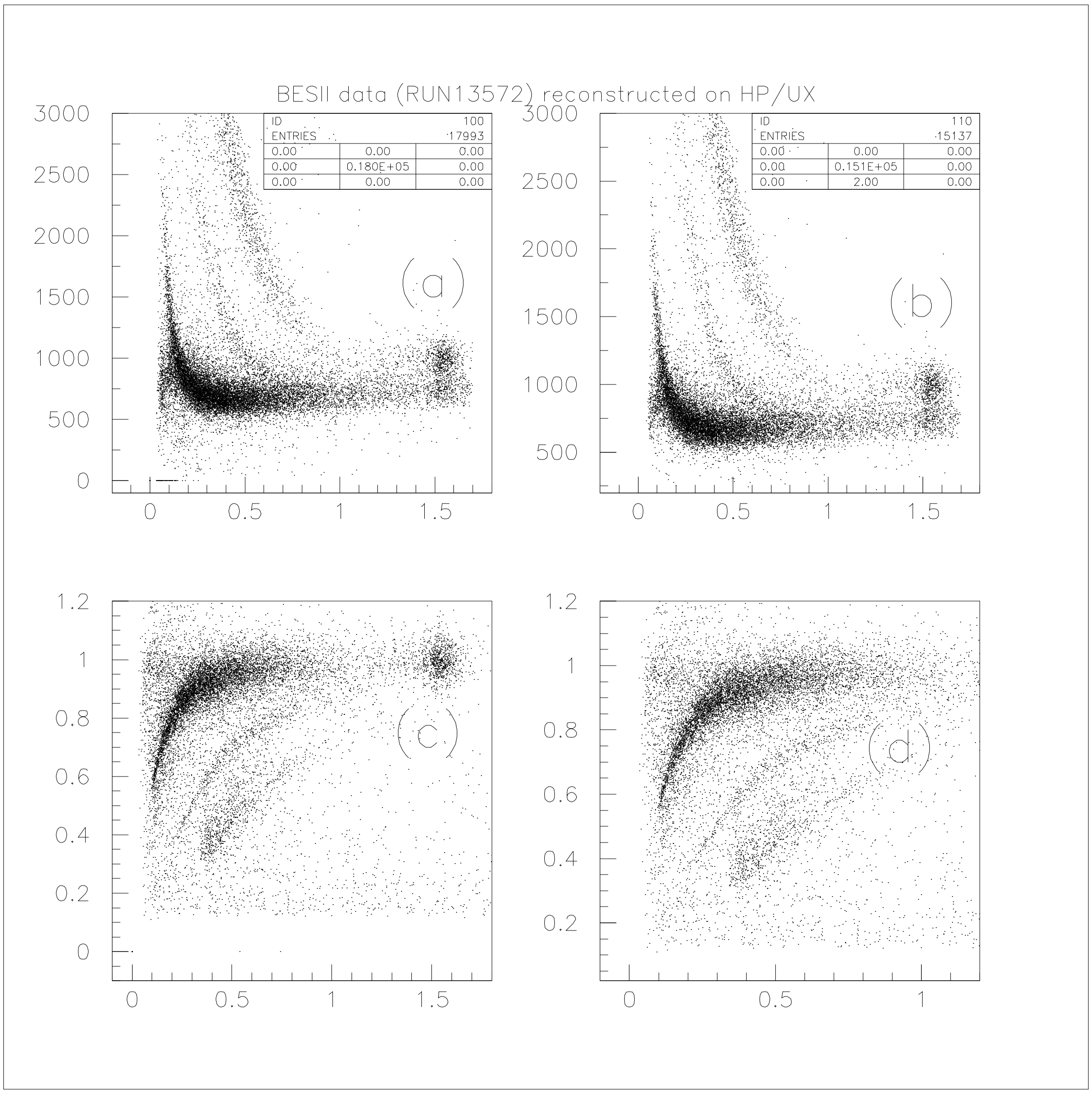
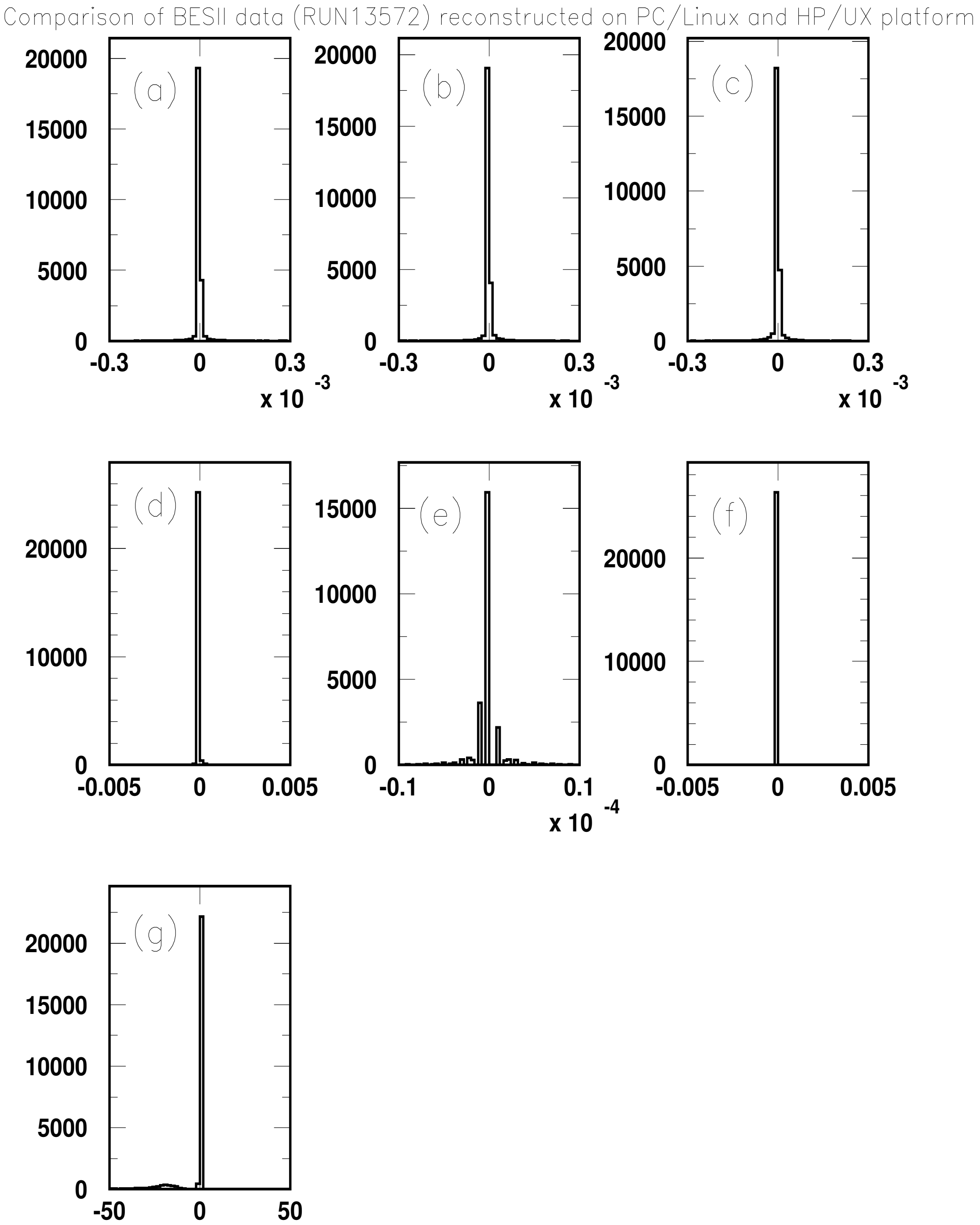

BESII data (RUN13572) reconstructed on HP/UX
ID 100
ENTRIES 17993
0.00 0.00 0.00
0.00 0.180E+05 0.00
0.00 0.00 0.00
(a)
ID 110
ENTRIES 15137
0.00 0.00 0.00
0.00 0.151E+05 0.00
0.00 2.00 0.00
(b)
(c)
(d)

Figure 2:

and HP/UX platforms for x, y and z components, respectively.

The reconstructed charged particle 3-momentum vectors are **identical within 3(4) digits after points** for 98% (95%) charged tracks.

Figure 3(d), 3(e), 3(f) and 3(g) show the deviations of the reconstructed length of charged particle flight from the origin to barrel TOF counters, particle velocities, energy deposited in barrel shower counter and dE/dx pulse heights in MDC reconstructed on both PC/Linux and HP/UX platforms. More detail check on these variables are still in progress.



Comparison of BESII data (RUN13572) reconstructed on PC/Linux and HP/UX platform
(a)
(b)
(c)
(d)
(e)
(f)
(g)
20000
15000
10000
5000
0
-0.3
0
0.3
x 10 -3
-0.005
0.005
-0.1
0.1
x 10 -4
-50
50

Figure 3:

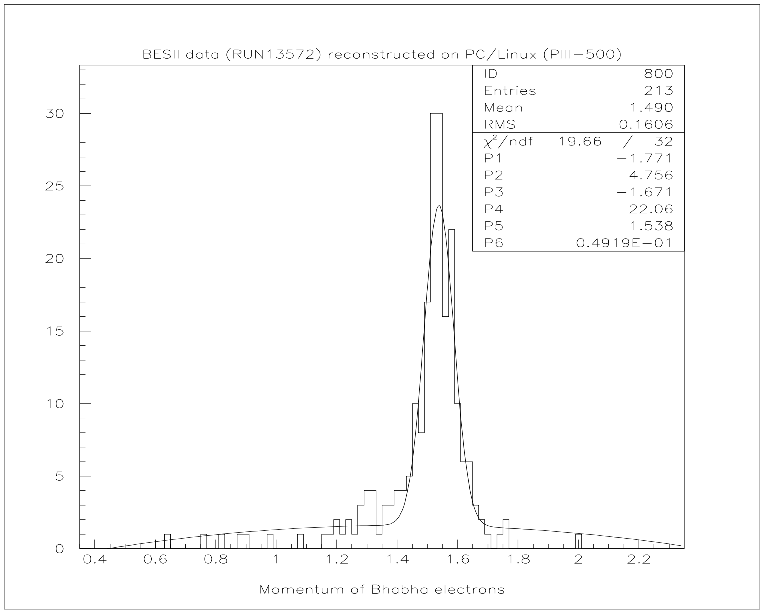


Figure 4:

– Momentum resolution of Bhabha electron reconstructed on PC/Linux and HP/UX platforms
  Figure 4 and 5 show the momentum distributions of the Bhabha electrons reconstructed on both PC/Linux and HP/UX platforms, respectively. Using a Gaussian function and a 3 order polynomial to fit the momentum distributions, we obtain the momentum resolution of

$$\sigma_P/P = \begin{cases} 1.74\% \times\sqrt{1+P^2} & \text{for PC/Linux} \\ 1.74\% \times\sqrt{1+P^2} & \text{for HP/UX} \end{cases}$$

where P is charged particle momentum in GeV/c unit.

– dE/dx resolution of Bhabha electron reconstructed on PC/Linux and HP/UX platforms
  Figure 6 and 7 show the dE/dx pulse height distributions of the Bhabha electrons reconstructed on both PC/Linux and HP/UX platforms,

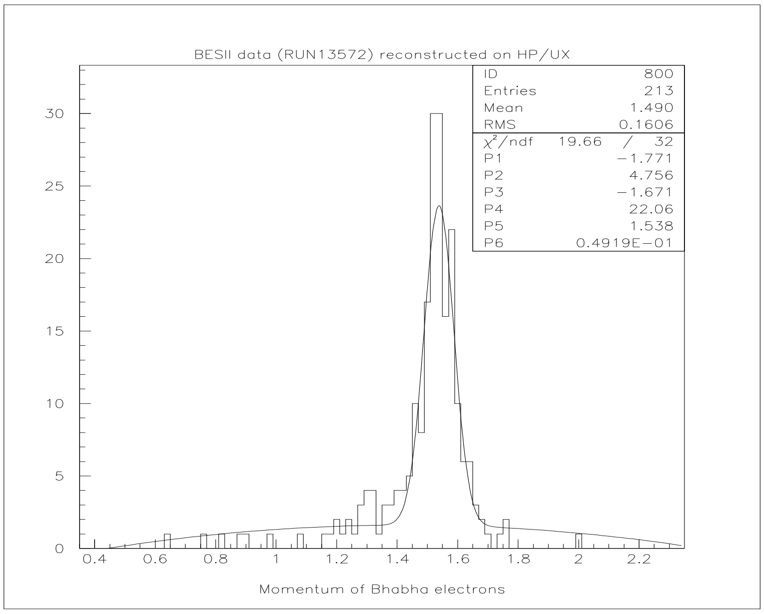


Figure 5:

respectively. Using a Gaussian function to fit the dE/dx pulse height distributions, we obtain the dE/dx resolution of

$$\frac{\sigma_{\mathrm{dE/dx}}}{\mathrm{dE/dx}} = \begin{cases} (8.2\pm0.4)\% & \text{for PC/Linux} \\ (7.9\pm0.3)\% & \text{for HP/UX} \end{cases}$$

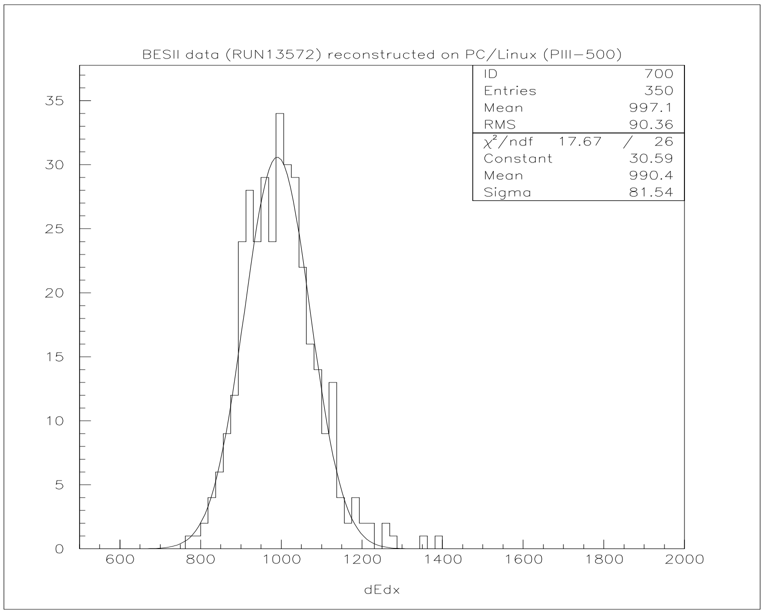


Figure 6:

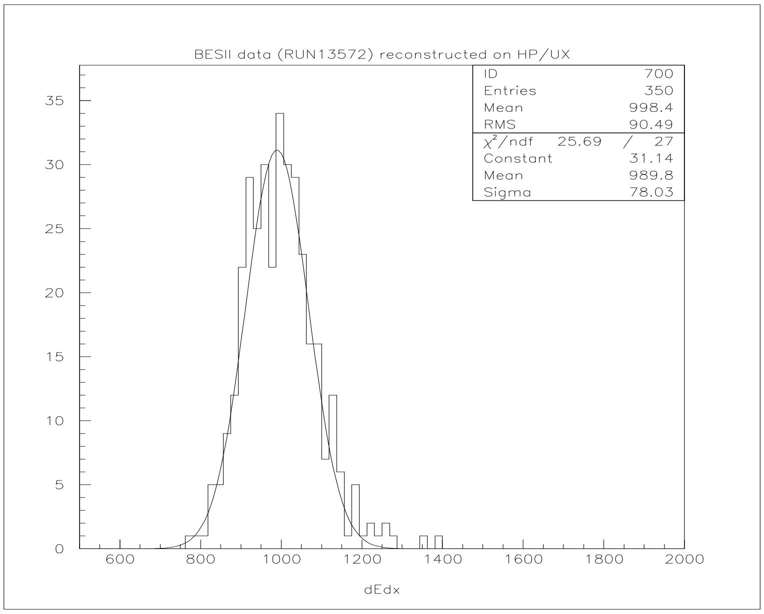


Figure 7:

CPU power of PC/Linux and HP/UX

- Data Reconstructed by Using (735/125)/UNIX

  It caused 0.36 seconds to fully reconstruct one event.

- Data Reconstructed by Using HP(J2240)/UNIX

  It caused 0.069 seconds to fully reconstruct one event for the case of using two CPUs.

- Data Reconstructed by Using PC(PIII-500)/Linux

  It caused 0.06 seconds to fully reconstruct one event.

Summary

Using one run BES-II data reconstructed on both PC/Linux and HP/UX, we studied the possibility to reconstruct BES-II data on PC/Linux for physics analysis. From the comparison of the reconstructed data on both PC/Linux and HP/UX, we find that

- The reconstructed 3-momentum vector values from the PC/Linux and HP/UX platform are identical within 3(4) digital after points for more than 98% (95%) charged tracks.
- Physics results based on data reconstructed on both HP/UX and PC/Linux would be the same. This needs to be checked with physics analysis on the two platforms.
- The PIII-500 PC's CPU speed is the same as that as HPJ2240 Workstation for BES-II data off-line reconstruction.

Some detail work on comparison of data reconstruction and physics analysis on the two platforms are still in progress.