Comparison of SimBES/Data/Sober

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1 Introduction

What is SimBES ? It is **GEANT3** based simulation program for BES, mainly constructed from scratch by Li Canguo with helps of others.

And Sober ? It is partly **EGS**(Electron Gamma Shower) based simulation program, currently running at BES.

Why SimBES ? See Li Canguo's report at BES'98 meeting:

- Include hadronic processes in the simulation
- Maintainable, more flexible

It should be carefully checked before formal release. Six weeks ago, I were asked to check SimBES with Sober and Data.

2 Sample Selection/Production

Samples of e, μ, hadrons produced for comparison. Only BES-II is concerned here.

For DATA

- e: bhabha events selected at Ecm=2.8GeV
- μ: cosmic μ selected at 2.8GeV
- hadrons: selected at both 2.8GeV and 2.6GeV(v100)

all reconstructed with drunk-v101 except at 2.6GeV with drunk-v100

For MC: Sober(v101) and SimbES

- e: *bhagen* generator used at Ecm=2.8GeV
- μ: *p2mumu* generator used at Ecm=2.8GeV

- hadrons: *lund* generator used at Ecm=2.8GeV

the corresponding realization version is 063. And all reconstructed with drunk-v101.

Machine work on: pony3/PC-Linux

3 Comparison on Subdetectors

Subdetectors of MDC, BTOF, BSC, MUO is studied, BTOF and BSC are concentrated.

MDC: Consistent mostly on momentum, angle, vertex-position distr. for SimBES/Data/Sober, see fig 1, 2
Except

- momentum is a little smaller in SimBES
- Difference on PHMP, $SimBES > Sober > Data$
- Vertex distr. (vx,vy) for bhabha events in Data is quite different from that in MC(Sober/SimBES)

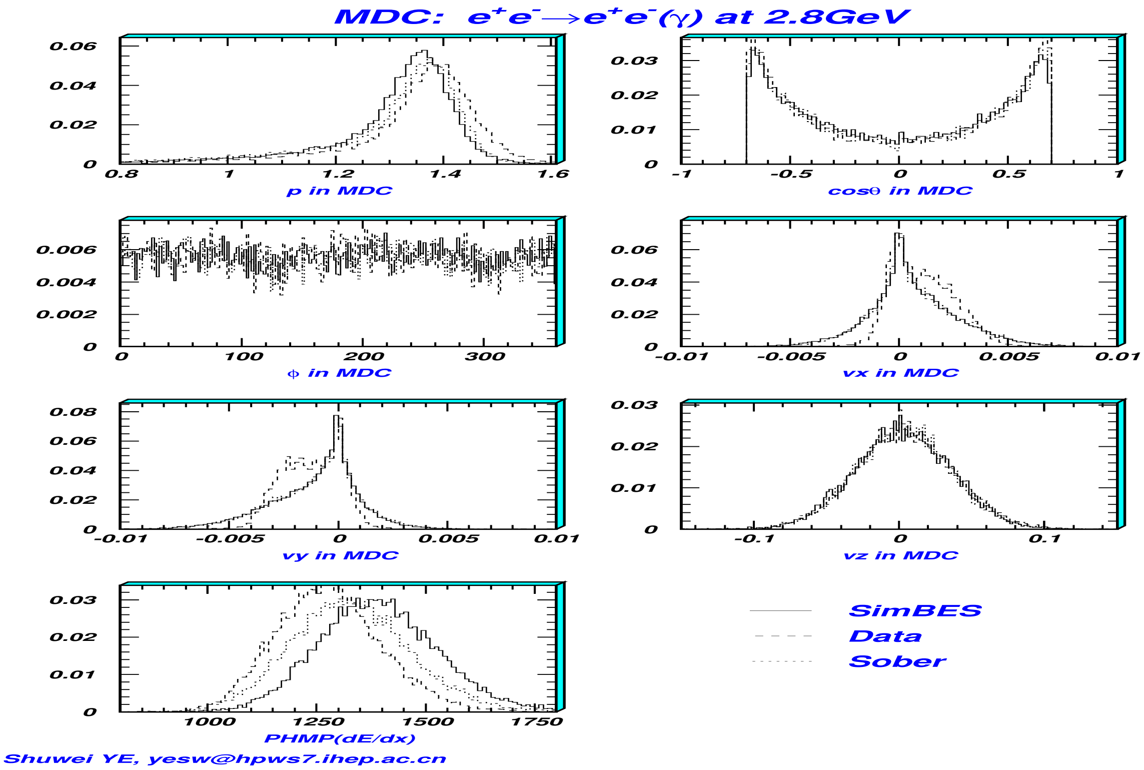


Figure 1: distr. of bhabha in MDC

BTOF

- μ: consistent between SimBES/Sober, no large dimu Data sample, see fig 3

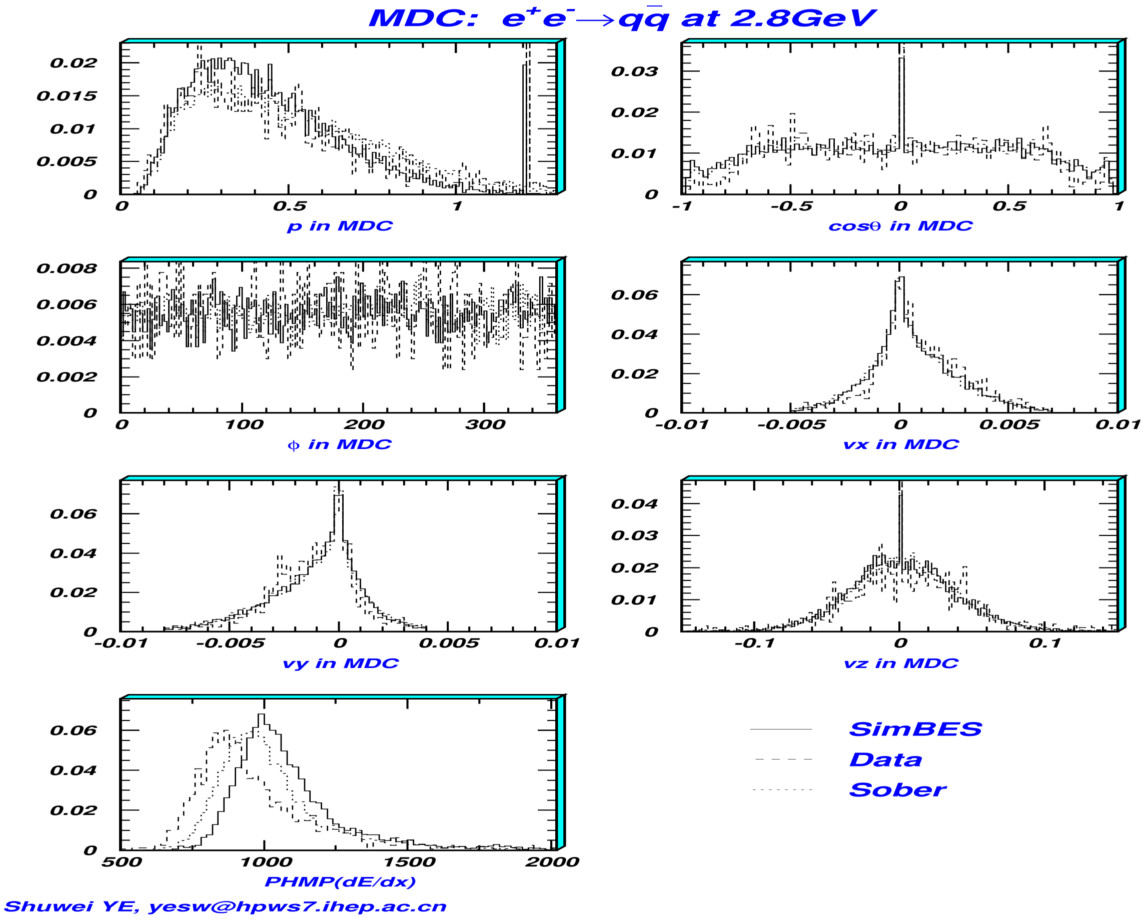
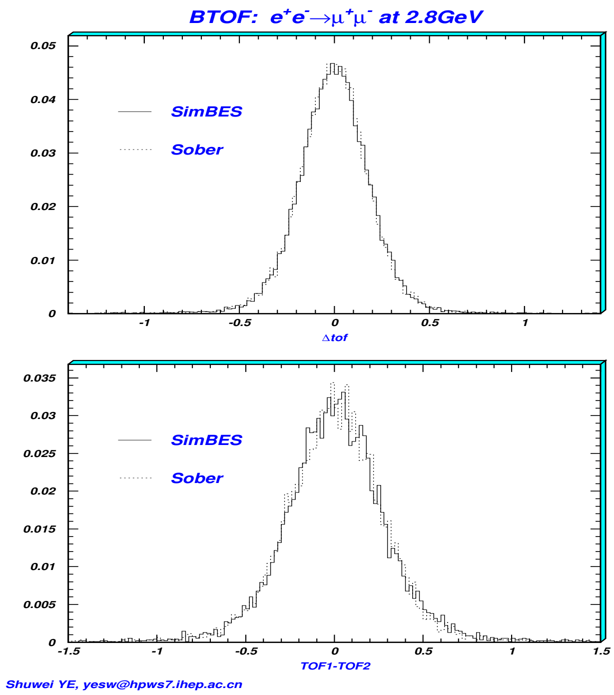


Figure 2: distr. of hadrons in MDC

Figure 3: distr. of μ in BTOF



- e: **consistent** between SimBES/Data/Sober, **except**(see fig 4)
  - average right shifted about 100ps in Sober
  - long tail at high end in SimBES
  - $\sigma(TOF_1 - TOF_2) < \sqrt{2} \times \sigma(TOF)$, see fig 16

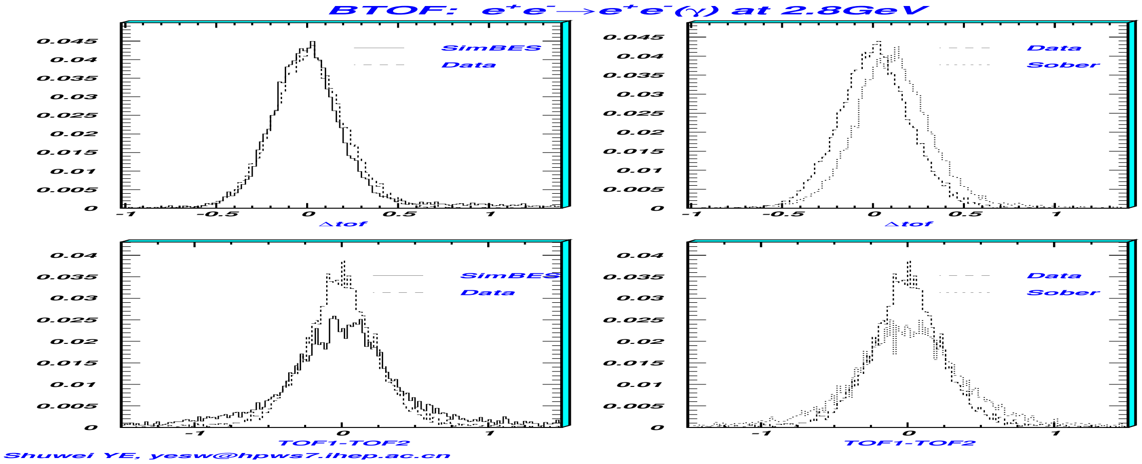


Figure 4: distr. of bhabha in BTOF

- Hadrons: **comparable**, a little worse particle separation in SimBES than in Data

BSC: Energy scale wrong in SimBES

- μ: uses cosmic μ for Data, see fig 5, 6, 7
  - Deposited E is quite different between Sober/SimBES and Data
  - E distribution among layers, Sober is more consistent with Data than SimBES
  - For hits and hit distribution, SimBES closer to Data
- e: see fig 8, 9, 10
  - On E distribution, SimBES closer to Data
  - While on hits and hit distribution, Sober better than SimBES
- Hadrons: Very good for SimBES, see fig 11, 12, 13
  - On E, Sober–Data–SimBES
  - On hits, Sober–SimBES–Data
  - On E/hit distribution, SimBES/Data quite consistent, while Sober very different

MUO: Haven't checked it carefully, found that SimBES, unlike Sober, tracks electron into MUO which is the case in practice.

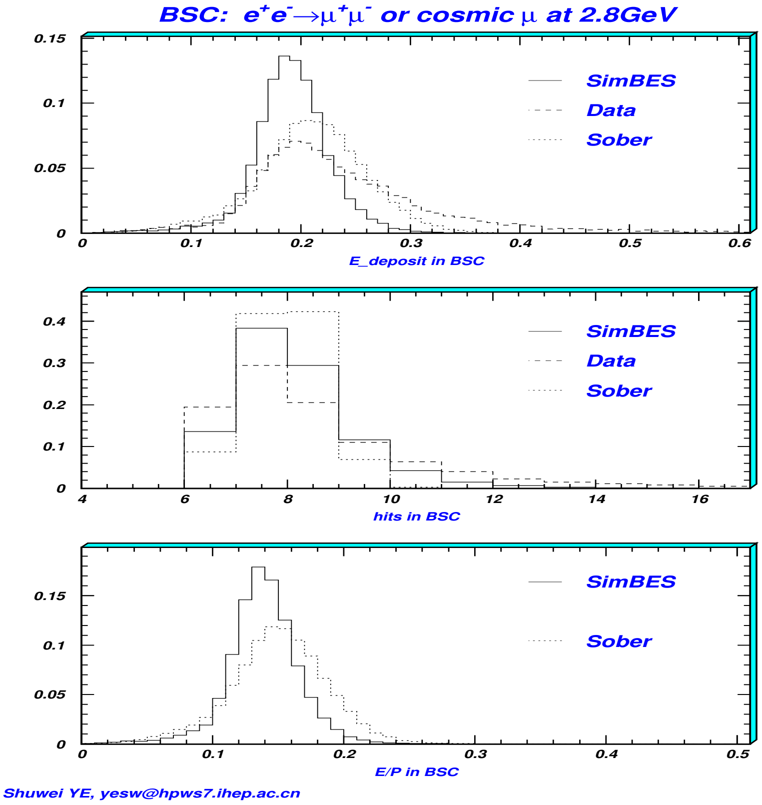


Figure 5: distr. of μ in BSC

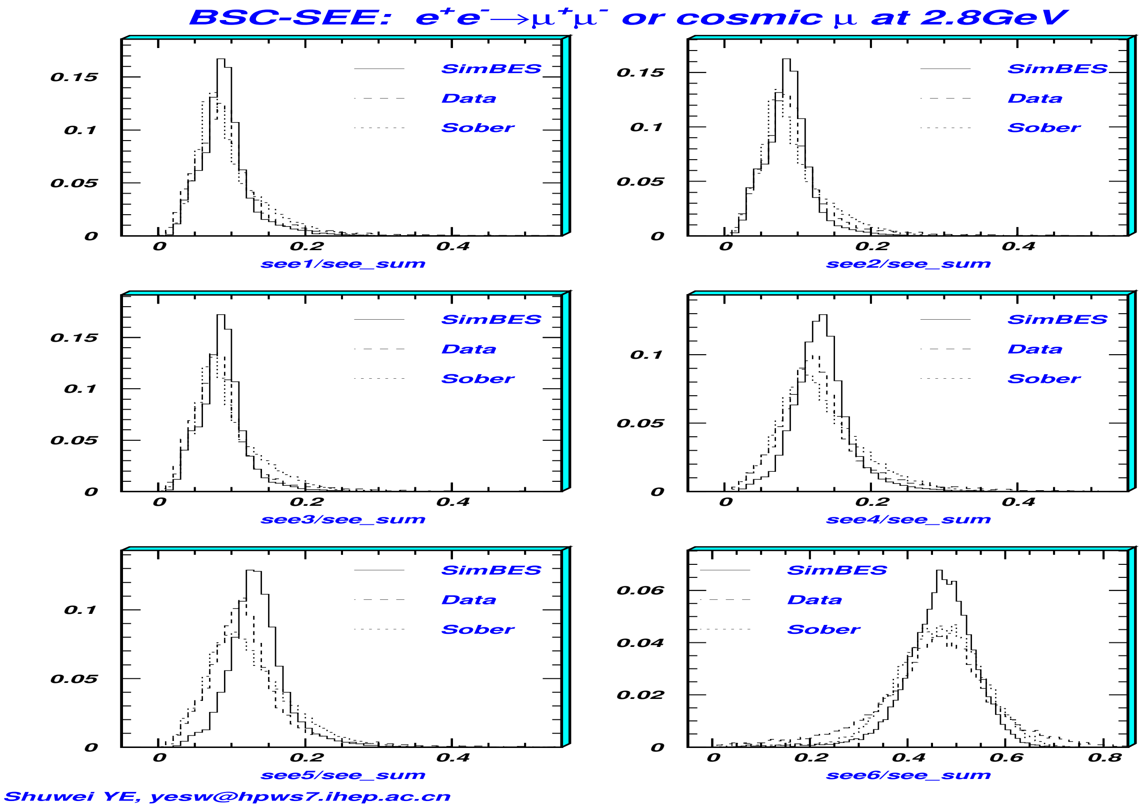


Figure 6: energy fraction among layers in BSC for μ

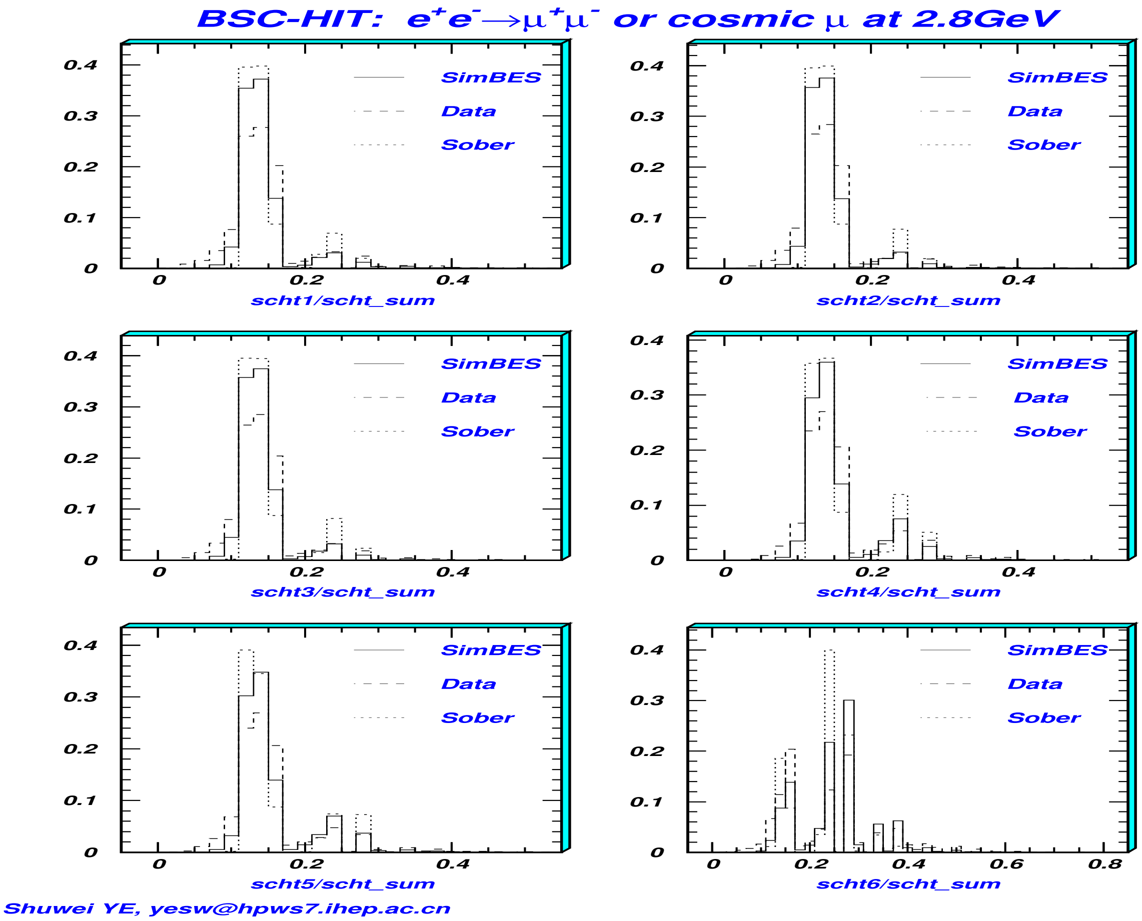


Figure 7: hit fraction among layers in BSC for μ

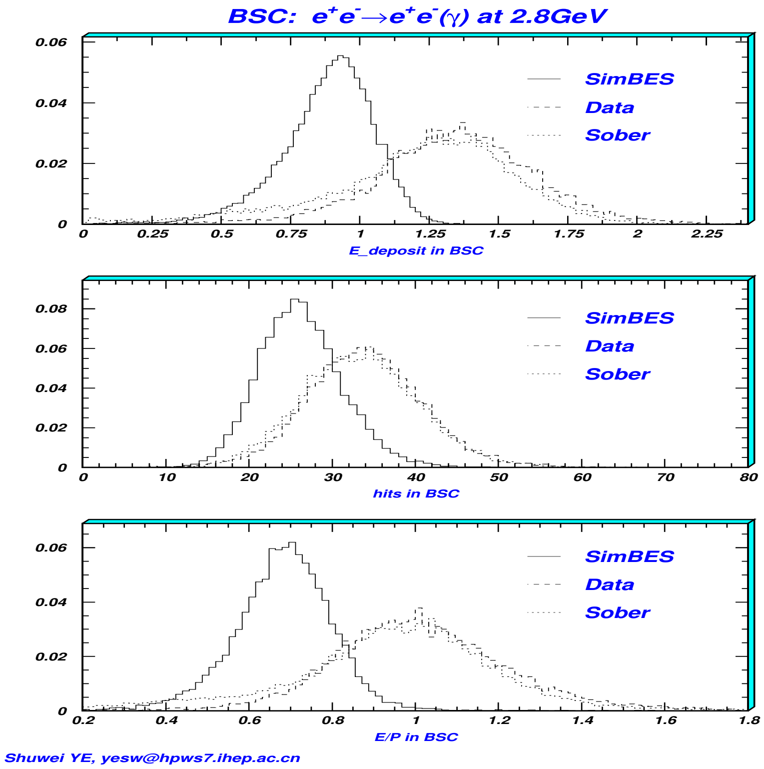


Figure 8: distr. of bhabha in BSC

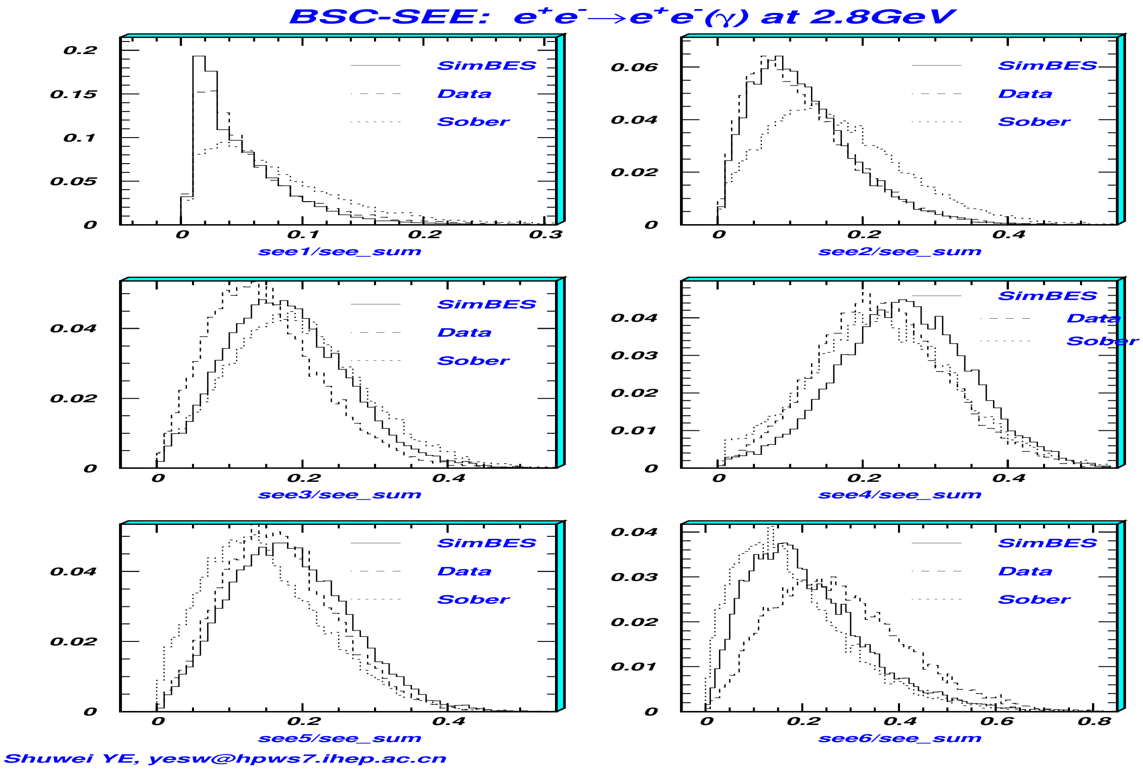


Figure 9: energy fraction among layers in BSC for bhabha

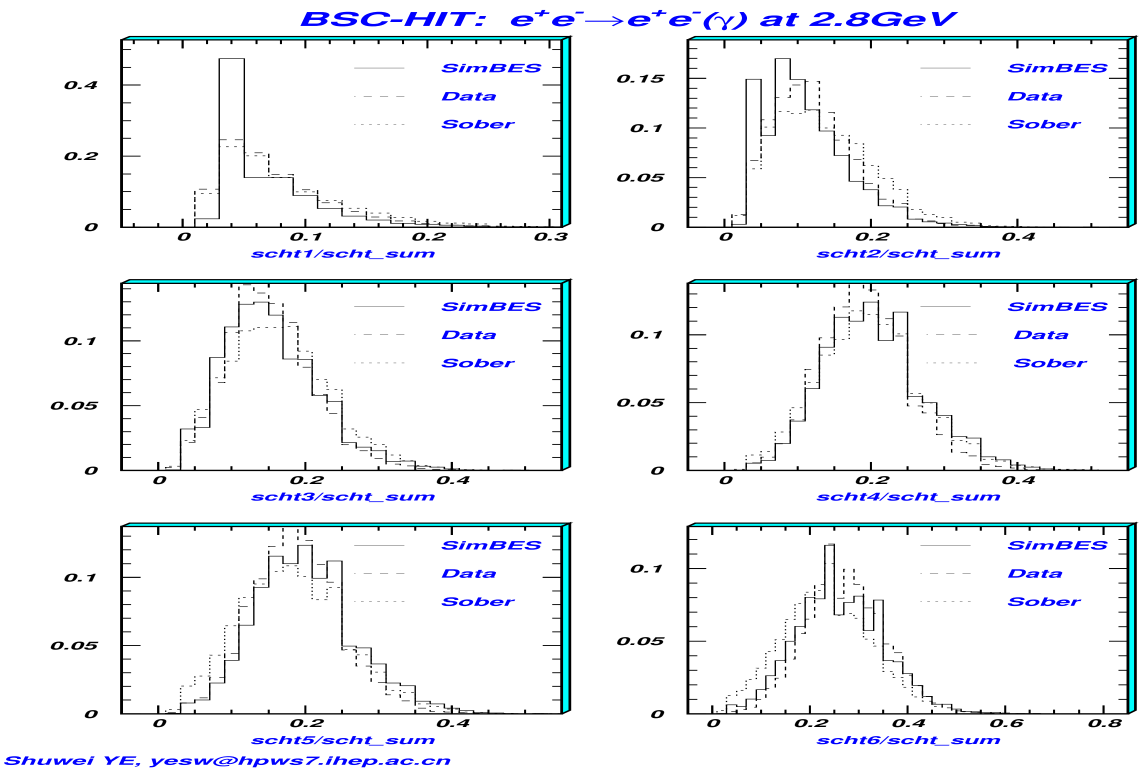
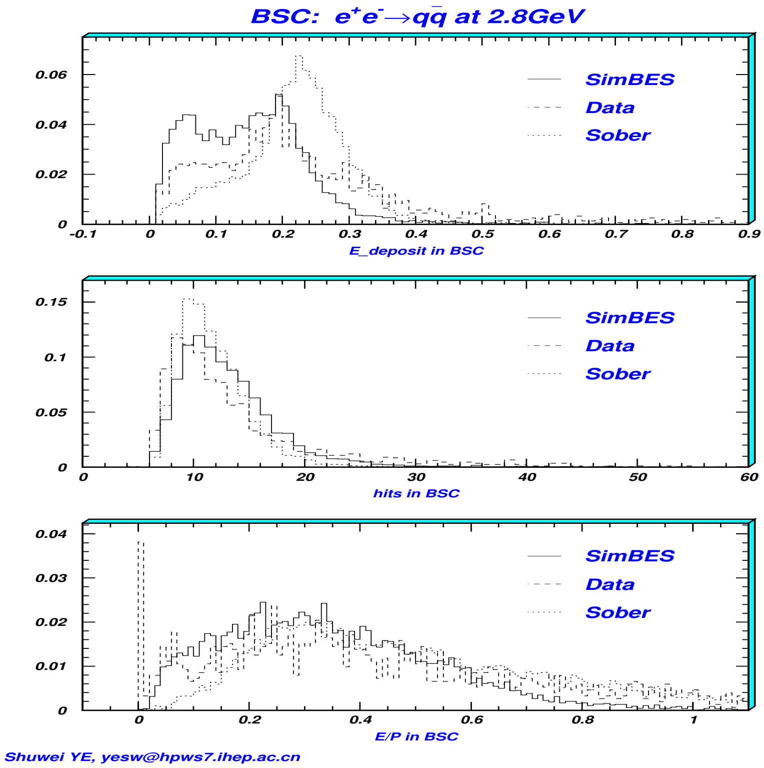


Figure 10: hit fraction among layers in BSC for bhabha

Figure 11: distr. of hadrons in BSC



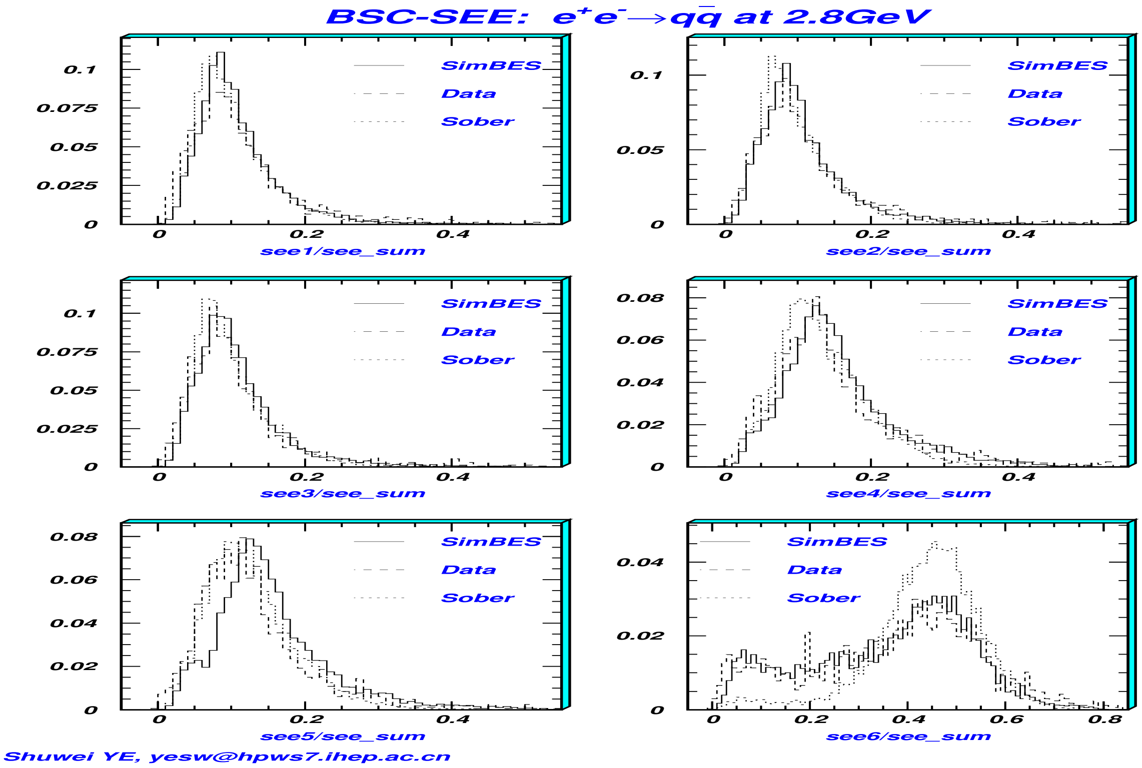


Figure 12: energy fraction among layers in BSC for hadrons

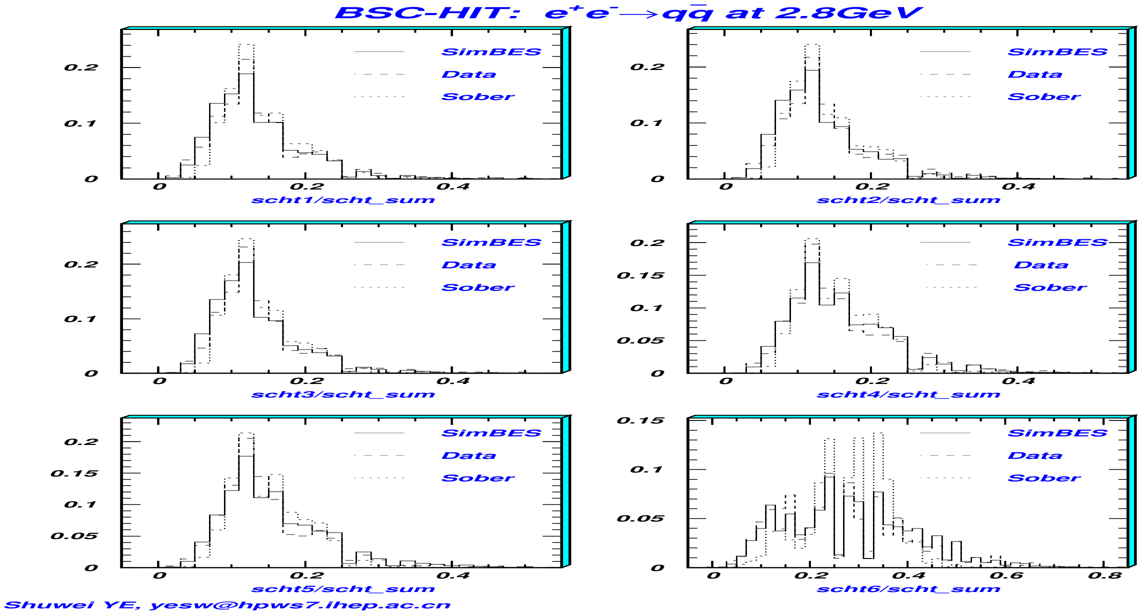


Figure 13: hit fraction among layers in BSC for hadrons

4 Problems in SimBES for BTOF

Two bugs found in SimBES related to BTOF simulation

- Radius discrepancy found between Sober/SimBES. In Sober, $R_{inner} = 115.7cm$, $R_{outer} = 120.7cm$, while in SimBES, $R_{inner} = 116.6cm$, $R_{outer} = 123.5cm$
- Hit information overriding between among

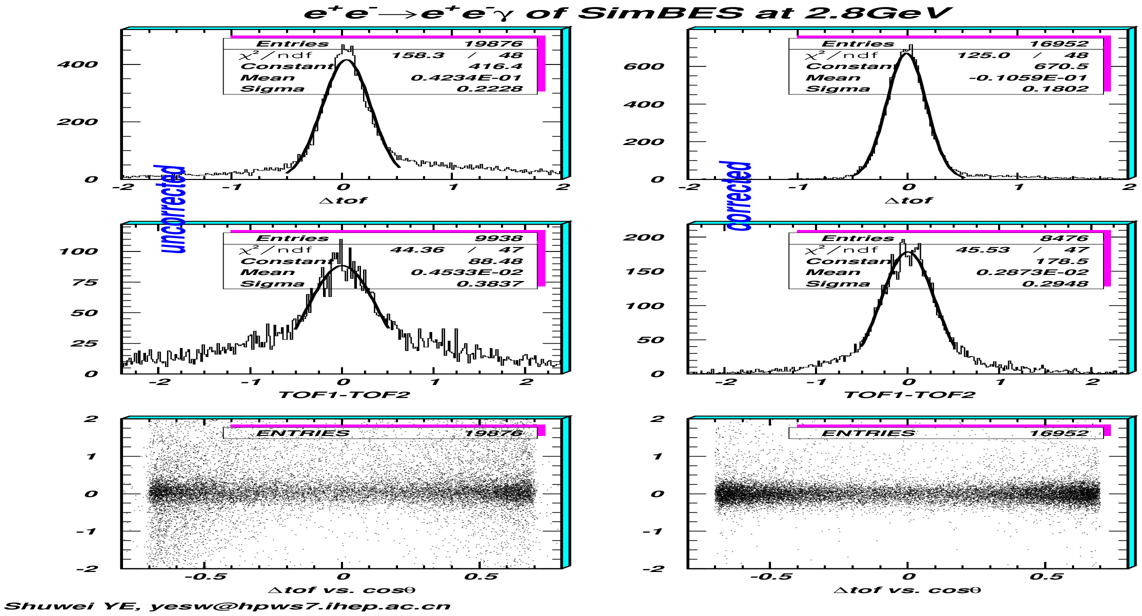


Figure 14: corrected TOF against uncorrected one for bhabha

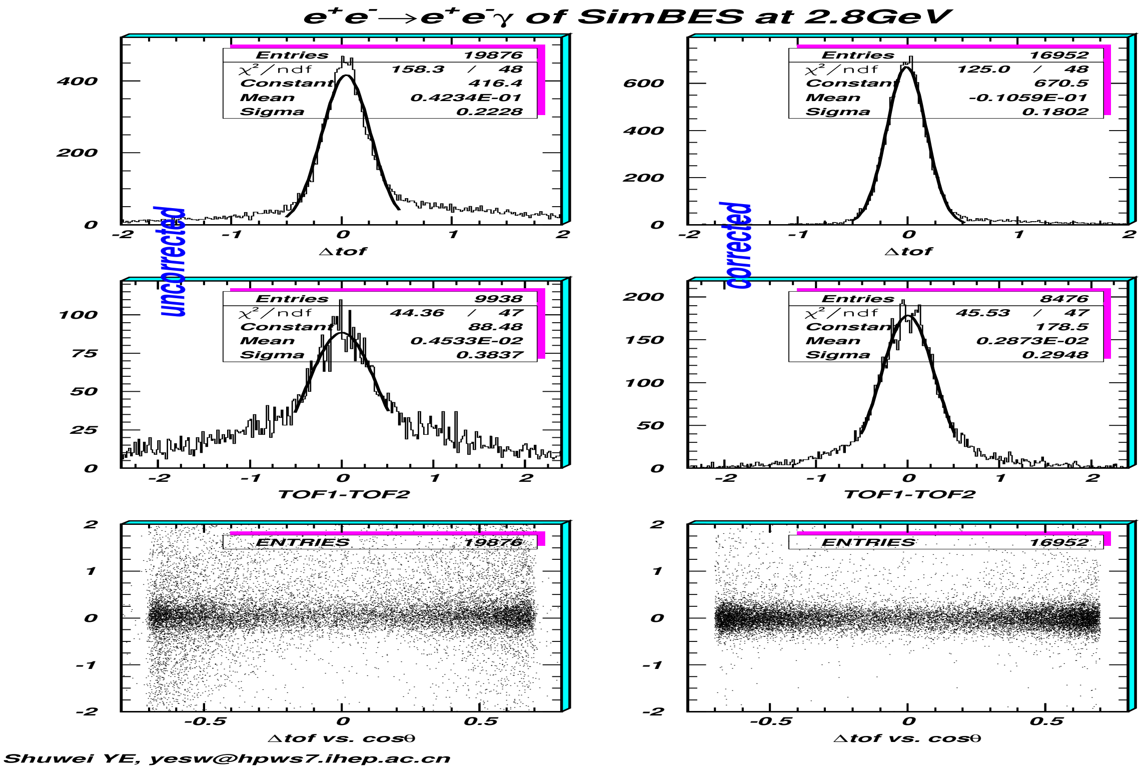


Figure 15: corrected TOF against uncorrected one for dimu

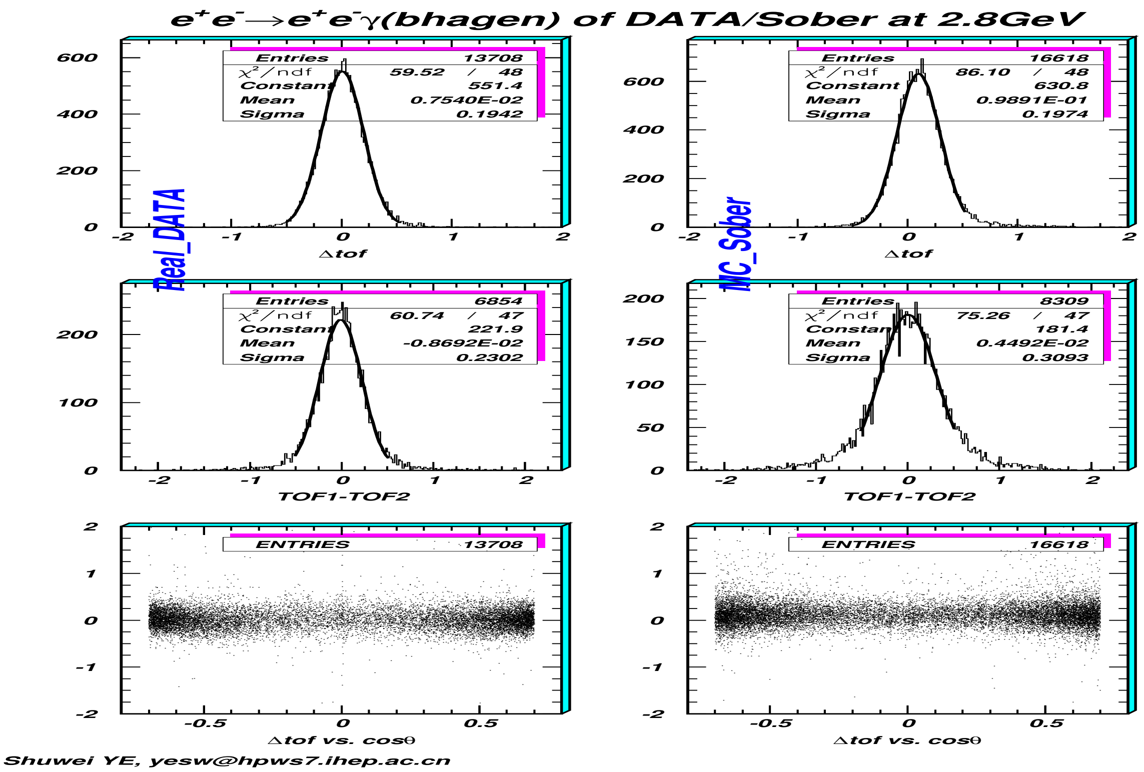


Figure 16: DATA against Sober in BTOF for bhabha

The first bug leads to the TOF time central position shifted. The second spoils the TOF resolution, see fig 14, 15

Still discrepancy between SimBES and Data/Sober, see fig 14, 16 The long tail of ΔTOF in SimBES is believed to occur due to multiple scattering. So, **material description before BTOF wrong ?**

5 Conclusion

For subdetector, SimBES is
MDC: Quite good, except for bhabha vertex. It looks Sober does not produce secondary

track like SimBES dE/dx calibration need be corrected for both Sober/SimBES

BTOF: Good, but need further investigation on ΔTOF long tail of bhabha in SimBES, and understand why $\sigma_{TOF_1-TOF_2}(230ps) < \sqrt{2} \times \sigma_{\Delta TOF}(\sqrt{2} \times 194ps = 274ps)$, see fig 16, which indicates sth dependent/sharing in the time smearing for Data. If true, should be taken into account MC simulation.

BSC: Excellent, esp. on hadrons, but energy scale must be corrected for SimBES. Fine adjust required to improve SimBES simulation.

MUO: Better than sober.

SimBES is quite close to practical application, but further careful check in low level is still necessary.

6 Suggestions

First, bring strong "firepower"(experts) to "bomb" for a short time, do 4 levels of expert check:

- careful check on geometry and material description
- infomation check before digitalization
- infomation check after digitalization
- check after reconstruction, such as χ^2, momentum, etc.

After that, release a test version to comprehensive users for further check.