Measuring simulation $m_b(250)$ in e+e-→bb at 250GeV

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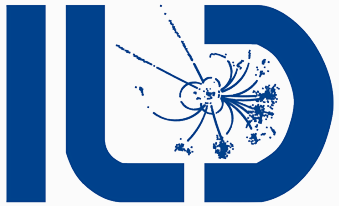

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Introduction

- ✓ Quark mass is input parameters of the Standard model.
- ✓ Because of the effect of renormalization, quark mass has energy dependence.
- ✓ b mass at higher-energy will be a input parameter to the GUT scale physics.

So, **b mass @higher-energy is interesting object**!

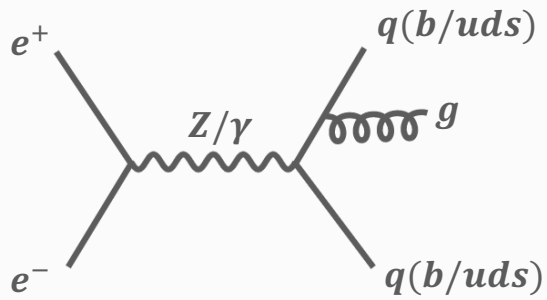
- ✓ So far, b mass at ~90GeV has been measured at LEP collider.

LEP result :

$$m_b(M_Z) = 2.85 \pm 0.18(\mathrm{stat}) \pm 0.13(\mathrm{exp}) \pm 0.19(\mathrm{had}) \pm 0.12(\mathrm{theo})\ \mathrm{GeV}/c^2$$

S/B events

Signal Gluon radiation→3Jet event



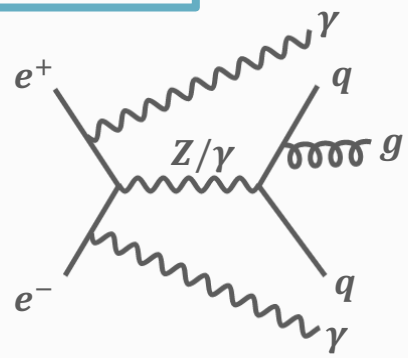
Quark mass sensitivity :

Gluon radiation cross section $\supset$ $-(\text{Quark mass})^2$ $-(\text{Quark mass})^4$

Observable :

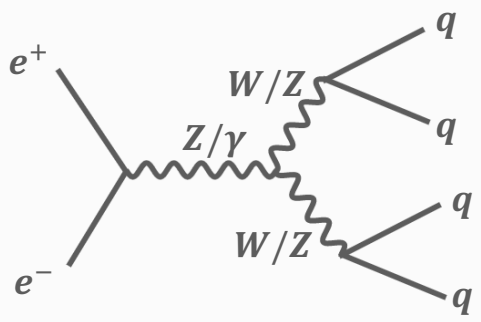
$$R_3^{bl} \equiv \frac{\Gamma_{3b\ jet}/\Gamma_{all\ b\ jet}}{\Gamma_{3uds\ jet}/\Gamma_{all\ uds\ jet}}$$ → Extract b mass@250GeV

Back Ground

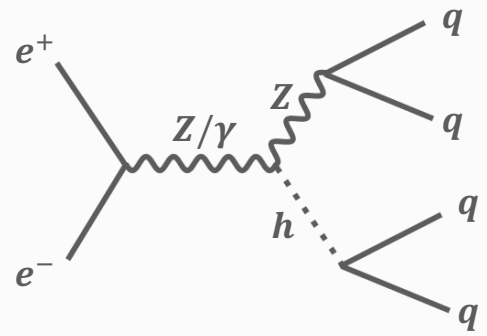


Radiative return(high ISR) event

Energy of quark pair decrease largely
→b mass at 250GeV can't be seen.



WW/ZZ full-hadronic modes



Zh full-hadronic modes

Can be mis-knowledge as 3Jet event

Simulation condition

- ✓ ILC Soft version : v02-00-01
- ✓ DBD ILD detector geometry : ILD_o1_v05
- ✓ Jet-Clustering algorithm : Cambridge algorithm in genkt for ee collider

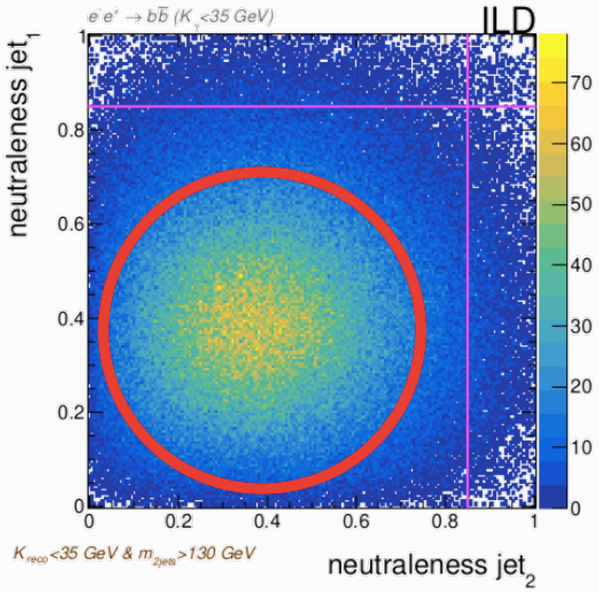
Pre-Selection

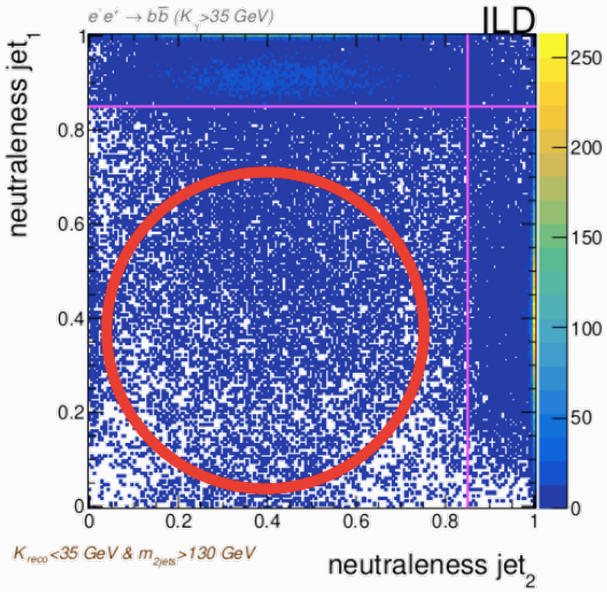
✓ (For the moment,) the following conditions are using.

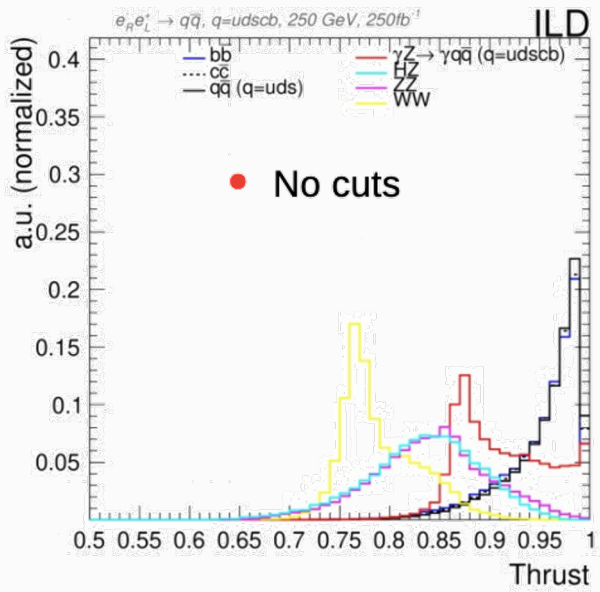
- Radiative return cuts : $\mathrm{K_{reco}} < 50\mathrm{GeV}$ & $\mathrm{m_{2jets}} > 130\mathrm{GeV}$
- Photon veto cuts :
  1. The neutraleness of both jets has to be smaller than 0.85
  2. Both jets should contain more than 5 neutral PFOs
  3. None of the jets should contain a neutral PFO with $\mathrm{E} > 50\mathrm{GeV}$ in the very forward region ($|\cos\theta| > 0.98$)
- Radius on neutraleness plane < 0.35 (inside of red circle)

$\mathrm{Neutraleness} \equiv (\mathrm{Neutral\ PFO}\ E)/(\mathrm{All\ PFO}\ E)$

- Thrust > 0.85







Tagging Selection

✓ In our analysis, b/uds flavor identification is one of the important part.

$$R_3^{bl} \equiv \frac{\Gamma_{3b\ jet}/\Gamma_{all\ b\ jet}}{\Gamma_{3uds\ jet}/\Gamma_{all\ uds\ jet}}$$

←b-jet information

←uds-jet information

✓ The following cuts are using for b/uds extraction.

- For b extraction : b-likelihood>0.8
- For uds extraction : b-likelihood<0.4 && c-likelihood<0.25

	DELPHI hep-ex/0603046		ILD (this study)	
	Purity	Efficiency	Purity	Efficiency
light quark	82%	51%	95%	57%
b quark	86%	47%	96%	80%

Observable R_3^{bl} measurement

✓ Analysis framework for observable measurement has been made, results has been obtained(right plot).

Strategy map

Theory — Compare — **Experiment**

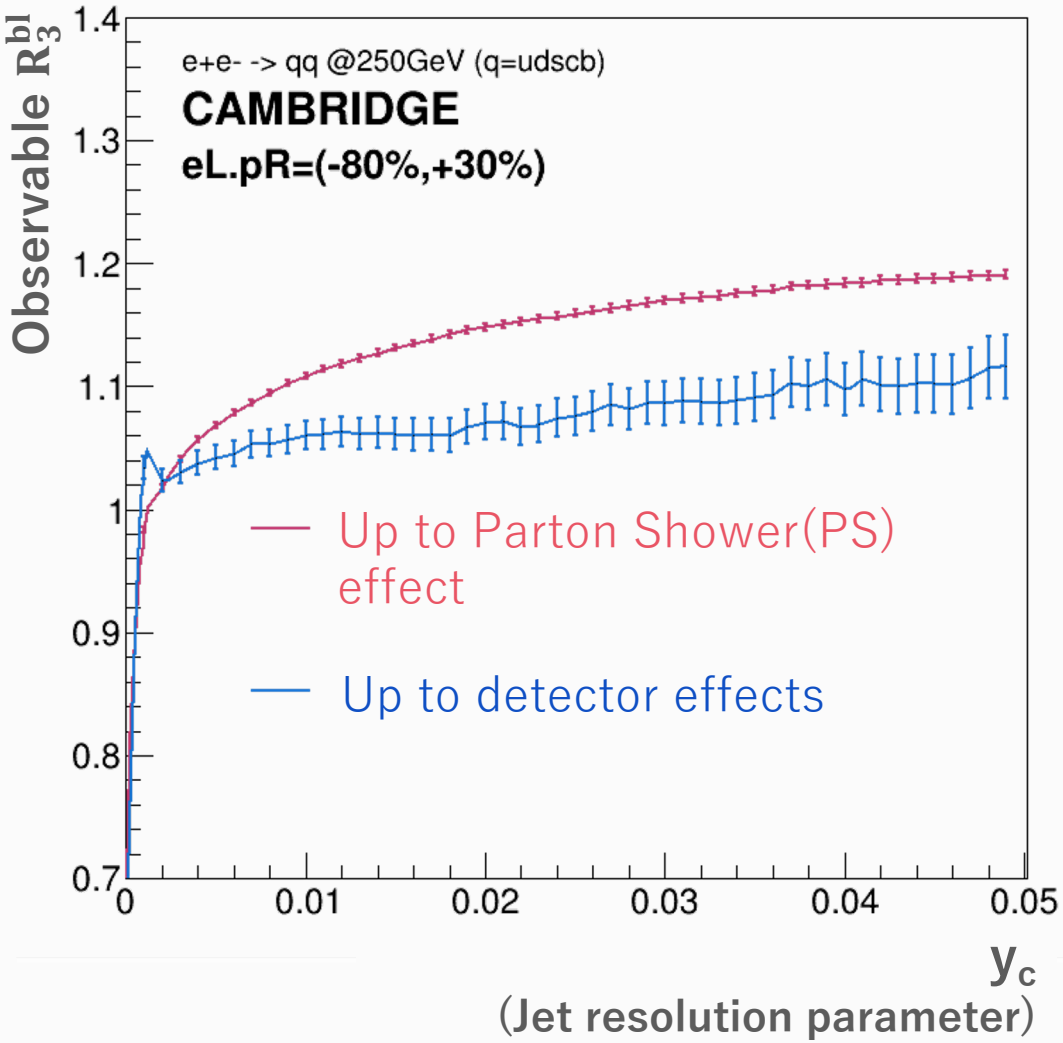
QCD ⟷ $R_3^{bl\ PS} = (Central\ Value) \pm (Stat.error) \pm (Syst.errors)$ **: Unknown yet**

∋ Generator uncertainties
Detector uncertainties
(Selection/BKG rejection)

✓ Estimate systematic errors by propagating detector effects from detector stage result(blue one) through Correction factor.

$$R_3^{bl\ PS} = C^{had} \cdot C^{det} R_3^{bl\ det}$$

Syst. errors ← Propagate — **Detector effects**



Current status

- ✓ We're working for estimation of systematic errors .
- ✓ Correction factors have been obtained and we're looking the impact of BKG contaminations to observable or correction factors.
- ✓ Pre-Selection conditions are also optimizing.
- ✓ After estimation of systematic error of observable, it allow us to estimate the systematic errors of b mass itself by the following relation :

$$\frac{\Delta m}{m}[\%] \sim -100\frac{\Delta R_3^{bl}}{R_3^{bl}}[\%]$$

Back up

b/c likelihood distributions

- For b extraction : b-likelihood>0.8
- For uds extraction : b-likelihood<0.4 && c-likelihood<0.25