Event Analysis on R Value Measurement

R Group

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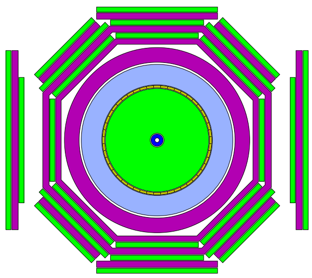

BES Monthly Meeting
Sept. 4, 1997

Outline

- **Strategy of R value measurement**
- **Background rejection**
- **Candidate of hadron events**
- **Future efforts**

Definition of R:

$$R = \frac{\sigma(e^+e^- \to q\bar{q})}{\sigma(e^+e^- \to \mu^+\mu^-)}$$

Experimental expression:

$$R = \frac{\sigma^0_{had}}{\sigma^0_{\mu\mu}} = \frac{N^{obs}_{had}}{\sigma^0_{\mu\mu} \cdot \bar{\varepsilon}_{had} \cdot (1+\delta) \cdot L}$$

L: **integrated luminosity**

$\sigma^0_{\mu\mu}$: **the calculated lowest QED cross section of**

$e^+e^- \to \mu^+\mu^-$

$$\sigma_{\mu\mu}(s)^0 = 4\pi\alpha^2/3s$$

$(1+\delta)$: **radiative correction**

$\bar{\varepsilon}_{had}$: **acceptance**

Interested in hadron events.

However,the following background contamination:

- $e^+e^- \to e^+e^-(\gamma)$
- $e^+e^- \to \mu^+\mu^-(\gamma)$
- $e^+e^- \to \tau^+\tau^-$ **(above τ threshold)**
- **two photon process**
- **cosmic rays**
- **beam gas**
- **junk**

Background events reject:

- $e^+e^-(\gamma)$: dE/dx **and BSC**
- $\mu^+\mu^-(\gamma)$: **TOF,BSC and** μ **counter**
- $\tau^+\tau^-$ **: partly by Ptes**
- **two photon process: E&P balance,Monte Carlo**
- **beam gas: Vertex,E&P balance**
- **cosmic rays: TOF,vertex**
- **junk: good track selection**

Single beam, seperate beam and cosmic rays data are checked:

Candidate of hadron events:

Reject cosmic ray:
1. Time window: At least one track
$t < 0$ **or** $t > 8ns$
2. $|t_1 - t_2| > 4ns$

Good charged tracks selection:
1. track fitting Mfit=2
2. polar angle $|\cos(\theta)| < 0.8$
3. track vertex $V_{xy} < 1.5cm$**,**$|V_z| < 15cm$
4. time window: $2ns < t < 8ns$
5. charge correction $Ichrg * (-1)$
6. B field correction $P * 0.996$

Photon track selection:
1. low limit of energy: $80MeV$
2. angle between charged track and photon: $> 12°$
3. coordination hitting BSC: corrected by event vertex

Candidate of hadron events:

Huge background in two-prong events:
1. reject $e^+e^-(\gamma)$**: using BSC & dEdx**
a. a pair of plus and minus tracks
b. BSC range : $|Z_{sc} < 4cm$ **or** $|Z_{sc}| > 140cm$
c. $P > 1.2GeV/c$ **for at least one track**
d. $E_{sc} > P$ **for at least one track,or**
$(\frac{Esc_{\pm}}{P_+} - 1)^2 + (\frac{Esc_{-}}{P_-} - 1)^2 \leq 0.36$

2. reject $\mu^+\mu^-(\gamma)$ **using Muon Counter& BSC**
a. $|\cos(\theta)| < 0.6$

define distance:

$$d = \sqrt{(x_{proj} - x_{hit})^2 + (y_{proj} - y_{hit})^2}$$

$d < 4cm$ **1st layer hit**
$d < 5cm$ **2nd layer hit**
$d < 6cm$ **3rd layer hit**
b. if $\geq$ **2rd** μ **layer hitted ,or**
both tracks hit 1st layer
& $Esc/p * \sin(\theta) < 0.25$

Candidate of hadron events:

3. reject $\tau^+\tau^-$ contamination: $Ptes$

$$Ptes = \frac{P_T}{E_{miss}^{max}} = \frac{((\bar{P}_1) + (\bar{P}_2))_T}{W - |(\bar{P}_1)| - |(\bar{P}_2)|} < 0.3$$

4. reject γ conversion($\gamma \to e^+e^-$):

a. $\theta(e^+, e^-) < 5°$

b. $m_{(e^+,e^-)} < 50MeV$

5. $\Sigma P_i + \Sigma E_{ni} > 0.5E_b$

6. $P\&E$ **balance:**$B_{xy} < 0.7$**,**$B_z < 0.7$

$$Bxy = \frac{\sqrt{(\Sigma P_i(x) + \Sigma E_{ni}(x))^2 + (\Sigma P_i(y) + \Sigma E_{ni}(y))^2}}{\Sigma |P_i(x,y)| + \Sigma |E_{ni}(x,y)|}$$

$$B_z = \frac{P_i(z) + \Sigma E_{ni}(z)}{\Sigma |P_i| + \Sigma |E_{ni}|}$$

E_{ni} **the deposit energy of the** $i-th$ **neutral cluster at BSC**

$E_{ni}(x)$ **the** x **component of** E_{ni}

These cuts reject effectively the cosmic ray,two-photon processes and beam related background events.

Candidate of hadron events:

P&E balance is also applied to Multi-prong events.

Candidate of hadron events

- **0 prong events**
  - **truly neutral hadron events (such as** $\pi^0\pi^0$**)**
  - **missing all good tracks**

  unfortunately:
  - **Huge contamination from** $e^+e^- \rightarrow \gamma\gamma(\gamma)$
  - **poor energy resolution**
  - **complicated noise**

  Analysis ignored.
  Compensate by simulation.

- **1 prong events: 1(+),1(–)**
  Asymmetry distribution of $\cos(\theta)$**,**Zsc **can't fit to** Vz**.**
  Analysis ignored.
  Compensate by simulation.

Candidate of hadron events

- **2 prong events: 2(++),2(+−),2(−−)**
  $v_{Z1} - VZ2$ **fit.**

- ≥ 3 **prong events: 3(+ + −),3(− − +)**
  Hadron candidates.

Future efforts:

- **more careful on hadron events selection**
- **simulation of efficiency and background subtraction**
- **systematic error analysis**