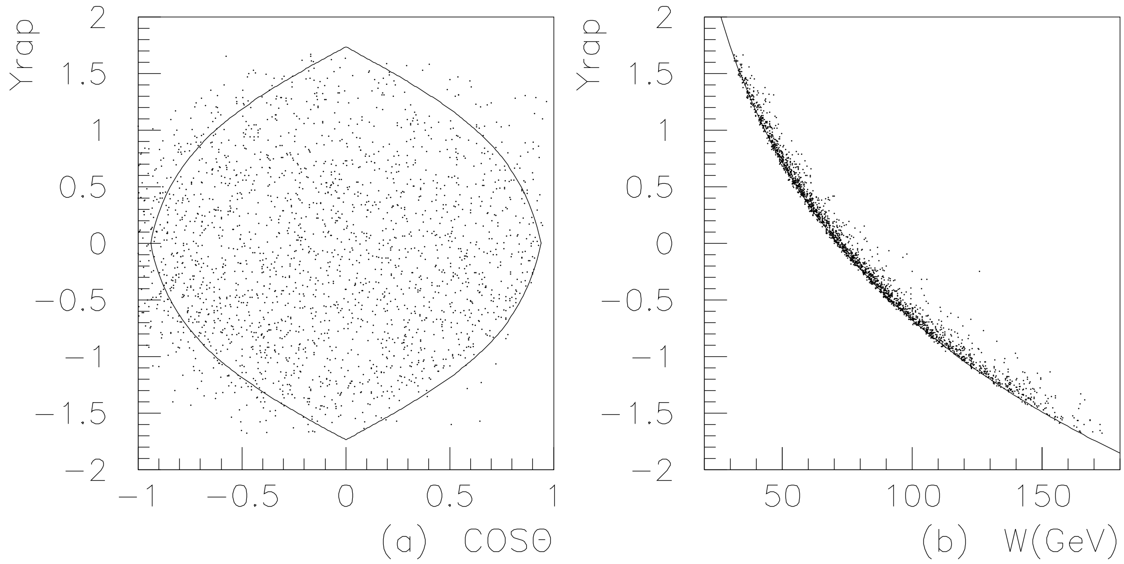

Figure 8: (a) The vertical axis is the true rapidity of J/ψ. The horizontal axis is $\cos\theta$ of l^+ in J/ψ rest frame with respect to the proton beam axis. Area enclosed by the four curves(calculated with the assumption that J/ψ momentum vector is parallel to the ep beam axis) are covered by the tracking chamber, from 20° to 160° in the detector. Scattered spots are generated within 20° to 160° by a Monte Carlo J/ψ event generator. As a result of nonzero transverse momentum of J/ψ, some events lie outside of the theoretical boundaries. (b) Scatter plot of true rapidity of J/ψ vs W by the same Monte Carlo generator. The solid line is the analytical relation for $p_{t,J/\psi} = 0$ case. Most of the generated events lie closely to the solid curve, reflecting p_t is small in most of J/ψ events. W-$y_{\rm rap}$ relation depends on E_p and $m_{J/\psi}$.

2.7 Estimation on number of signal events

The number of observed events depends on several quantities.

$$N = \mathcal{L}_{ep} F_{\gamma/e} \sigma_{\gamma p} B \epsilon \tag{32}$$

N	estimated number of observed events
$\mathcal{L}_{ep}$	estimated integrated ep luminosity in 1993 $\sim 500\text{nb}^{-1}$
$F_{\gamma/e}$	fraction of $\mathcal{L}_{ep}$ that becomes photon flux, ~ 0.16 within the geometrical coverage($W = 30 - 170\text{GeV}$).
$\sigma_{\gamma p}$	J/ψ photoproduction cross section, estimated to be 20-100nb.
B	branching ratio, 6.0% for $J/\psi \to e^+e^-$, 6.0% for $J/\psi \to \mu^+\mu^-$
ϵ	detector efficiency, use geometrical acceptance ~ 0.5

The estimated number of observed e^+e^- events is then $N \sim$ 50-250 for 1993 runs. Cross section measurement was feasible.

2.8 On J/ψ polarization measurement

As explained in Section 2.4, the decay angular distribution is

$$f_0(x;\alpha) = \frac{1+\alpha x^2}{\int_{-1}^{1}(1+\alpha x^2)\,dx} \tag{33}$$

where x stands for $\cos\theta_{\text{decay}}$, and α is an undetermined parameter. The observed angular distribution $f(x, y; \alpha)$ in a detector with acceptance function $\epsilon(x, y)$, where y stands for a complete set of kinematical variables describing J/ψ production, is

$$\begin{aligned} f(x,y;\alpha) &= \frac{(1+\alpha x^2)\,\epsilon(x,y)}{\int(1+\alpha x^2)\,\epsilon(x,y)\,d\sigma_{(x,y)}} \\ &= \frac{1+\alpha x^2}{1+\alpha\langle x^2\rangle}\frac{\epsilon(x,y)}{\int\epsilon(x,y)\,d\sigma_{(x,y)}} \end{aligned} \tag{34}$$

where

$$\langle x^2\rangle = \frac{\int x^2\epsilon(x,y)\,d\sigma_{(x,y)}}{\int\epsilon(x,y)\,d\sigma_{(x,y)}} \tag{35}$$

How many events do we need to determine α with uncertainty $\Delta\alpha$? This can be studied by the maximum likelihood(ML) method.[14]