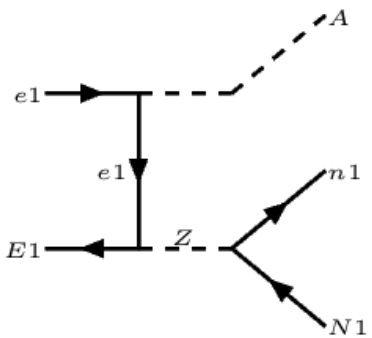
Mono-photon distribution At CEPC

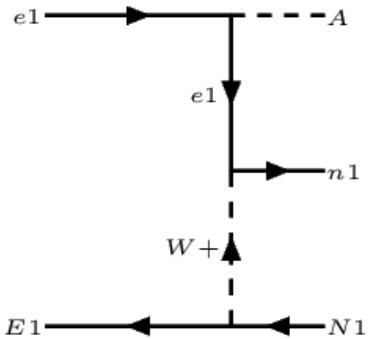
Hao, Yongfeng

Main Process



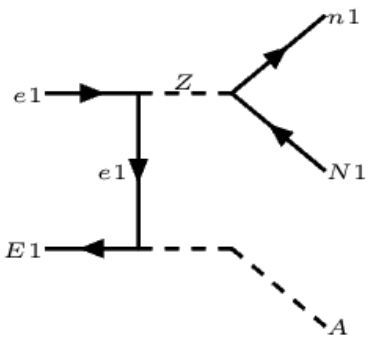
diagr.1

vv(s chan.) + ISR



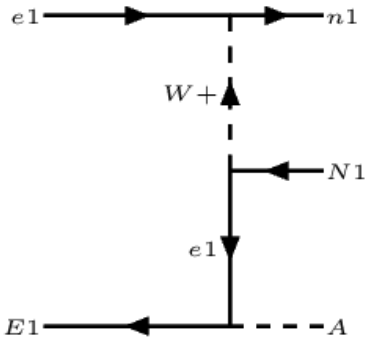
diagr.2

vv(t chan.) + ISR



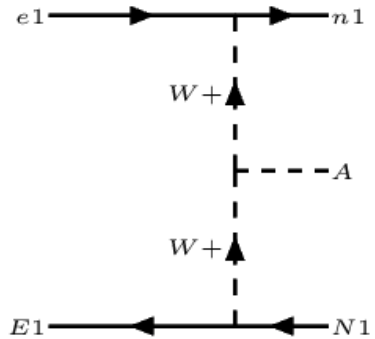
diagr.3

vv(s chan.) + ISR



diagr.4

vv(t chan.) + ISR



diagr.5

WW fusion

e1: electron
E1: positron
A: photon
n1: electron-neutrino
N1:anti-electron-neutrino

Secondary ISR

1. Comparable at the region far away from the peak
2. Secondary ISR is significant at lower size of the peak

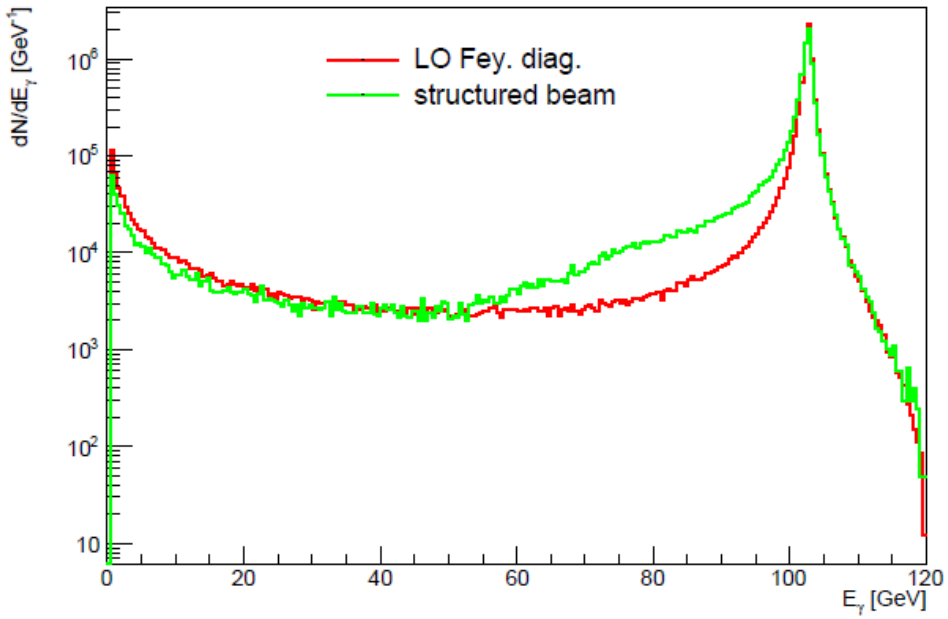
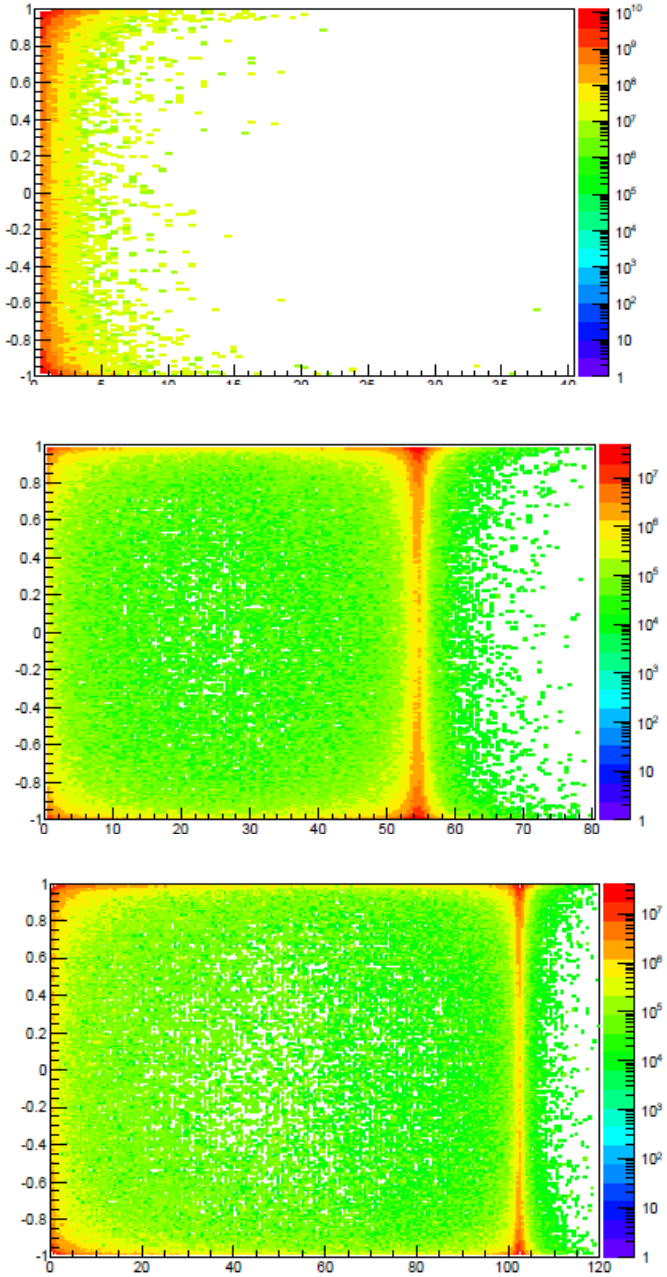


Figure 2: The Events distribution of the leading photon in process $Z(\nu_e\nu_e)$ + ISR at center of mass energy of 240GeV. A cut $|\cos(\theta_\gamma)| < 0.99$ is applied to let the comparison to be meaninglful.

Inclusive ISR as mono-photon

- Center of mass energy: 91.2GeV, 161GeV, 240GeV
- Return Z at 0GeV, 55GeV, 110GeV



Parameterization of Inclusive ISR as mono-photon

$$\frac{dN}{dE_\gamma} = \frac{\alpha_{\mathrm{EM}}}{\pi} \cdot \frac{1+(1-x)^2}{x} \cdot \boxed{2\mathrm{arctanh}(\cos(\theta_c))} \cdot (\sigma_1 + \sigma_2)$$

$$\sigma_1 = c_0 + c_1 x + c_2 x^2 + c_3 x^3$$

$$\sigma_2 = \frac{k(\Gamma_Z M_Z)^2}{(M^2_{\gamma\mathrm{recoil}} - M_Z^2)^2 + (\Gamma_Z M_Z)^2}$$

$$x = \frac{E_\gamma}{\sqrt{s}/2}$$

$$M_{\gamma\mathrm{recoil}} = \sqrt{(\sqrt{s} - E_\gamma)^2 - p_\gamma^2}$$

$\sqrt{s}$ [GeV]	Ran.[GeV]	L [ab^{-1}]	c0,c1,c2,c3,k [GeV^{-1}]
91.2	1 - 20	10	-2.265e+04, 1.764e+05, -5.325e+05, 5.453e+05, 3.799e+10
161	1 - 50	2.6	9.8046e+02, 8.0219e+03, -4.7194e+04, 9.591e+04, 3.590e+10
240	1 - 91	5.6	7.3489E+02,3.2390e+03,-1.1570e+04, 1.372e+04, 4.0536e+10

Table 1: The fit parameters.

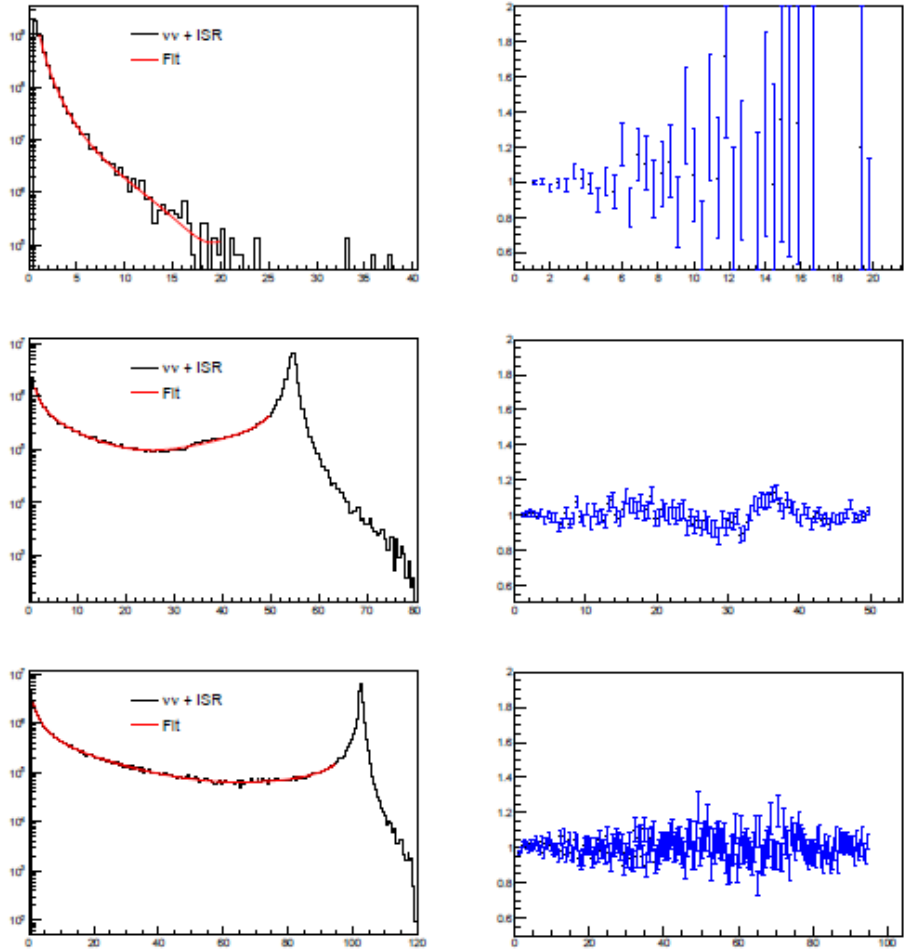


Figure 6: The number of events distribution of the leading photon at center of mass energy of 91.2GeV, 161GeV, and 240GeV(from top to bottom respectively). The integral luminosities are corresponding to 10ab^{-1}, 2.6^{-1} and 5.6 $^{-1}$ respectively. A cut $|\cos(\theta_\gamma)| < 0.99$ is applied.

Components distribution

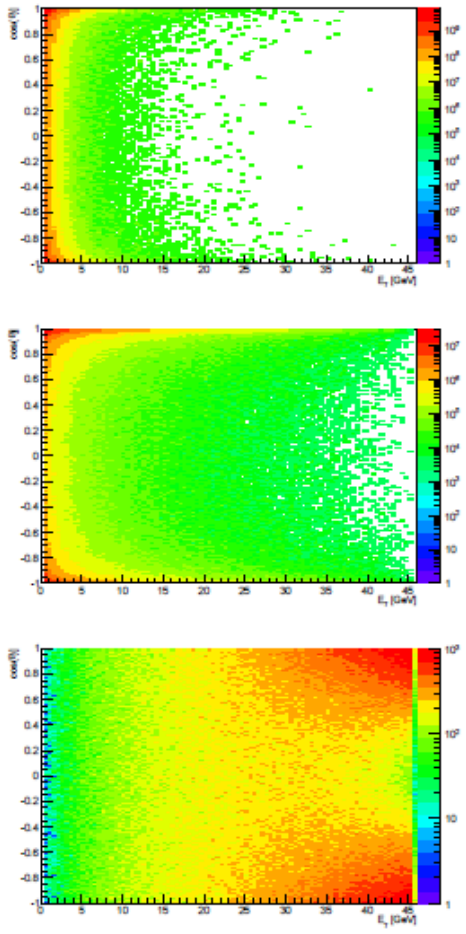


Figure 7: Events distribution for center of mass energy of 91.2GeV. From top to bottom, they are $\nu_e\nu_e$(s channel) + ISR, $\nu_e\nu_e$ (t channel) + ISR, and WW fusion. The integral luminosity is the same in Fig. 4.

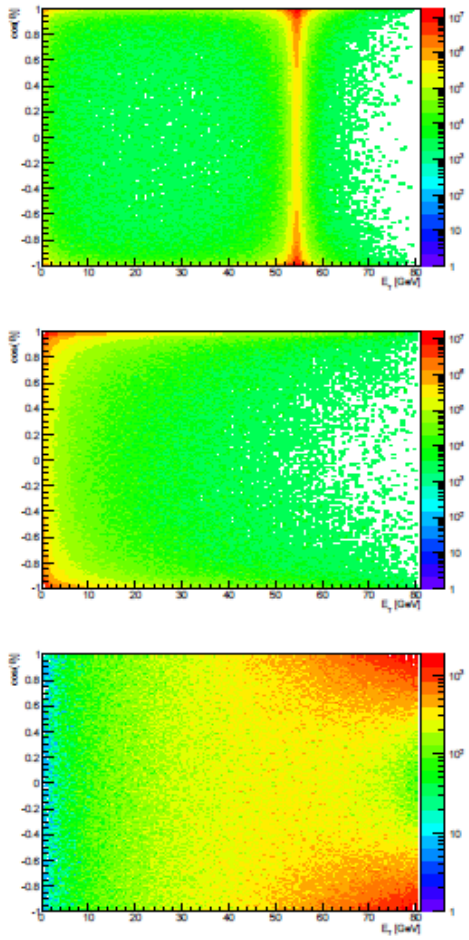


Figure 8: Same as Fig. 5, but for center of mass energy of 161GeV.

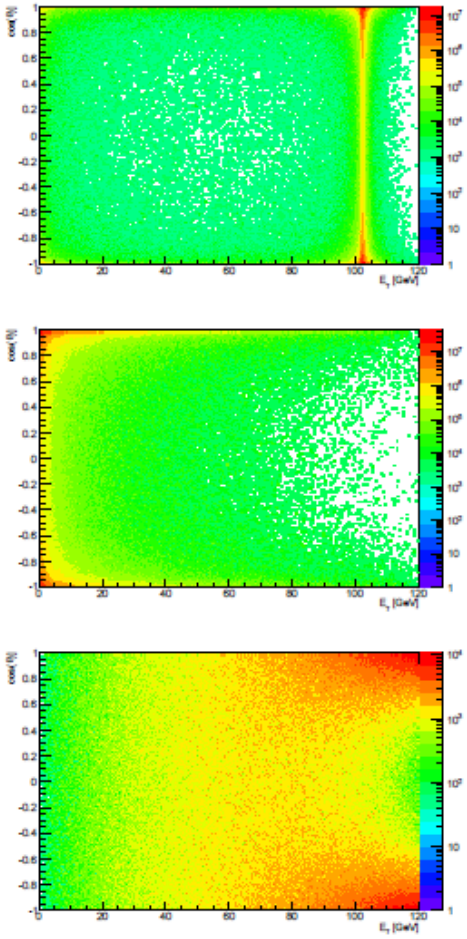


Figure 9: Same as Fig. 5, but for center of mass energy of 240GeV.