Benchmark Analysis for e+e- -> gamma Z process

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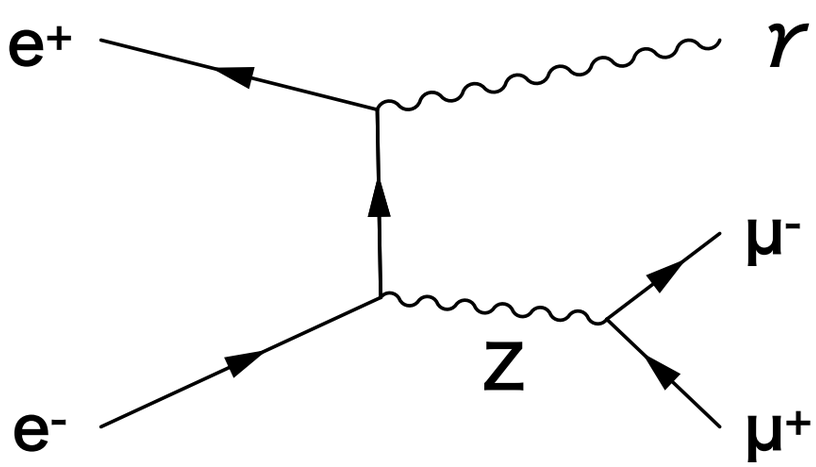
Status report on e^+e^- -> gamma Z analysis

- Using **direction angles of μ^- , μ^+ and γ ,** **photon energy calibration** is being conducted.

- I checked whether constructed energy matched with the MCtrue energy, then photon energy resolution is estimated.

- Plots are very preliminary and rough today.

Determine the energy of photon and muons based on measured direction angle



Direction Angle
θ: azimuthal angle
ϕ: polar angle

4-momentum conservation is considered.
The mass of muon is neglected.

Condition 1:
Using ($\theta_{\mu^-}, \theta_{\mu^+}, \theta_{\gamma}, \phi_{\mu^-}, \phi_{\mu^+}, \phi_{\gamma}$)
-> Determine ($E_{\mu^-}, E_{\mu^+}, E_{\gamma}$)

Condition 2: Add **Beamstrahlung**
Using ($\theta_{\mu^-}, \theta_{\mu^+}, \theta_{\gamma}, \phi_{\mu^-}, \phi_{\mu^+}, \phi_{\gamma}$)
-> Determine ($E_{\mu^-}, E_{\mu^+}, E_{\gamma}, E_{ISR}$)

Condition 3: Add the effect of **Crossing Angle**
Using ($\theta_{\mu^-}, \theta_{\mu^+}, \theta_{\gamma}, \phi_{\mu^-}, \phi_{\mu^+}, \phi_{\gamma}$)
-> Determine ($E_{\mu^-}, E_{\mu^+}, E_{\gamma}, E_{ISR}$)

- Condition 1

$$\begin{cases} E_\mu + E_{\mu^+} + E_\gamma = 500 \\ E_\mu \sin\theta_\mu \cos\varphi_\mu + E_{\mu^+} \sin\theta_{\mu^+} \cos\varphi_{\mu^+} + E_\gamma \sin\theta_\gamma \cos\varphi_\gamma = 0 \\ E_\mu \sin\theta_\mu \sin\varphi_\mu + E_{\mu^+} \sin\theta_{\mu^+} \sin\varphi_{\mu^+} + E_\gamma \sin\theta_\gamma \sin\varphi_\gamma = 0 \\ E_\mu \cos\theta_\mu + E_{\mu^+} \cos\theta_{\mu^+} + E_\gamma \cos\theta_\gamma = 0 \end{cases}$$

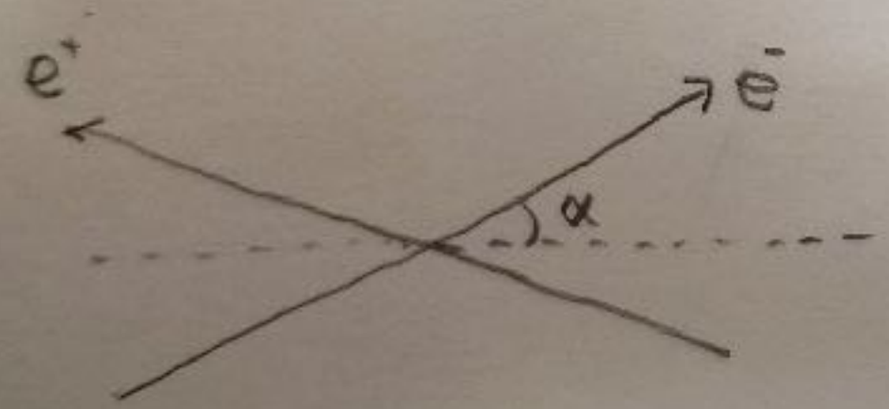
- Condition 2

$$\begin{cases} E_\mu + E_{\mu^+} + E_\gamma + |P_{ISR}| = 500 \\ E_\mu \sin\theta_\mu \cos\varphi_\mu + E_{\mu^+} \sin\theta_{\mu^+} \cos\varphi_{\mu^+} + E_\gamma \sin\theta_\gamma \cos\varphi_\gamma = 0 \\ E_\mu \sin\theta_\mu \sin\varphi_\mu + E_{\mu^+} \sin\theta_{\mu^+} \sin\varphi_{\mu^+} + E_\gamma \sin\theta_\gamma \sin\varphi_\gamma = 0 \\ E_\mu \cos\theta_\mu + E_{\mu^+} \cos\theta_{\mu^+} + E_\gamma \cos\theta_\gamma + P_{ISR} = 0 \end{cases}$$

· Condition 3

$$\begin{cases} E_\mu + E_{\mu'} + E_\gamma + |P_{ISR}| = 500 \\ E_\mu \sin\theta_\mu \cos\varphi_\mu + E_{\mu'} \sin\theta_{\mu'} \cos\varphi_{\mu'} + E_\gamma \sin\theta_\gamma \cos\varphi_\gamma + P_{ISR} \sin\alpha = 500 \sin\alpha \\ E_\mu \sin\theta_\mu \sin\varphi_\mu + E_{\mu'} \sin\theta_{\mu'} \sin\varphi_{\mu'} + E_\gamma \sin\theta_\gamma \cos\varphi_\gamma = 0 \\ E_\mu \cos\theta_\mu + E_{\mu'} \cos\theta_{\mu'} + E_\gamma \cos\theta_\gamma + P_{ISR} \cos\alpha = 0 \end{cases}$$

Crossing angle ($\equiv 2\alpha$)

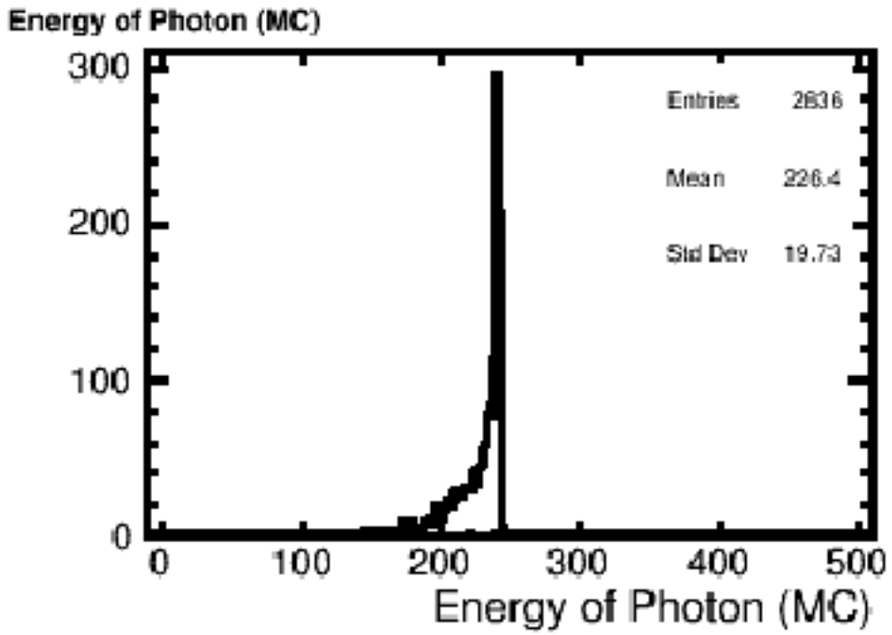


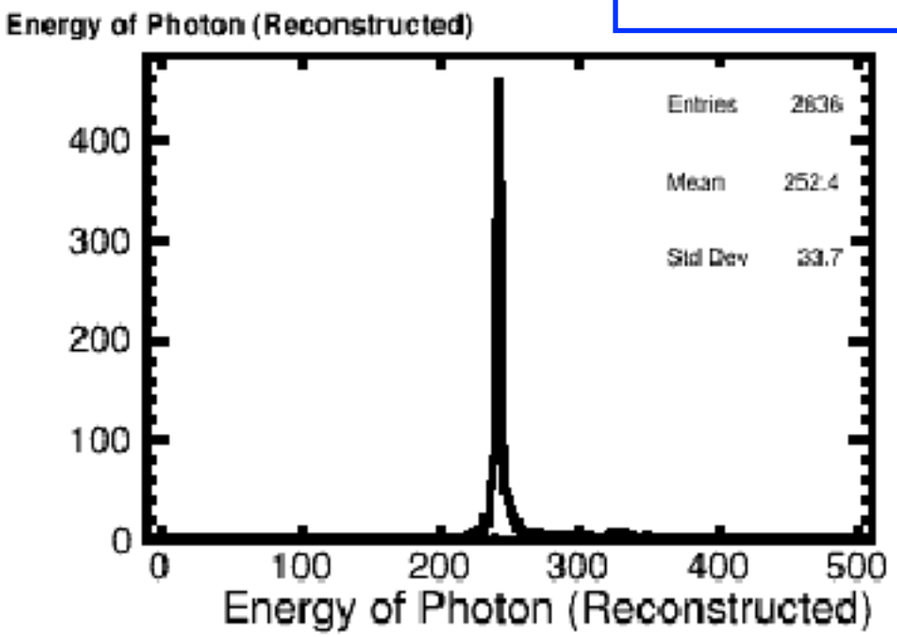
Condition 1:

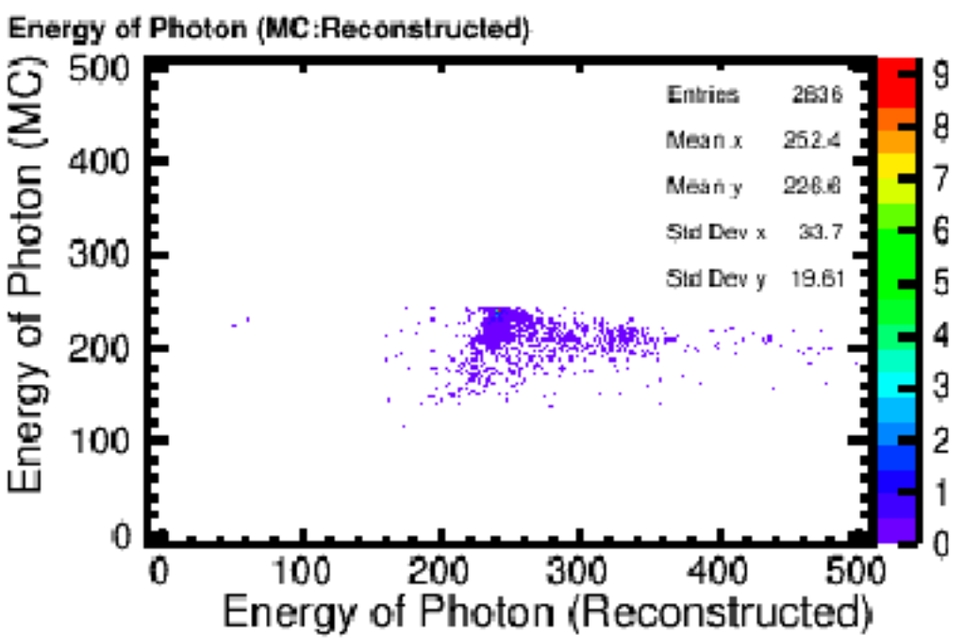
Using ($\theta\,\mu$-, $\theta\,\mu$+, $\theta\,\gamma$, $\phi\,\mu$-, $\phi\,\mu$+, $\phi\,\gamma$)

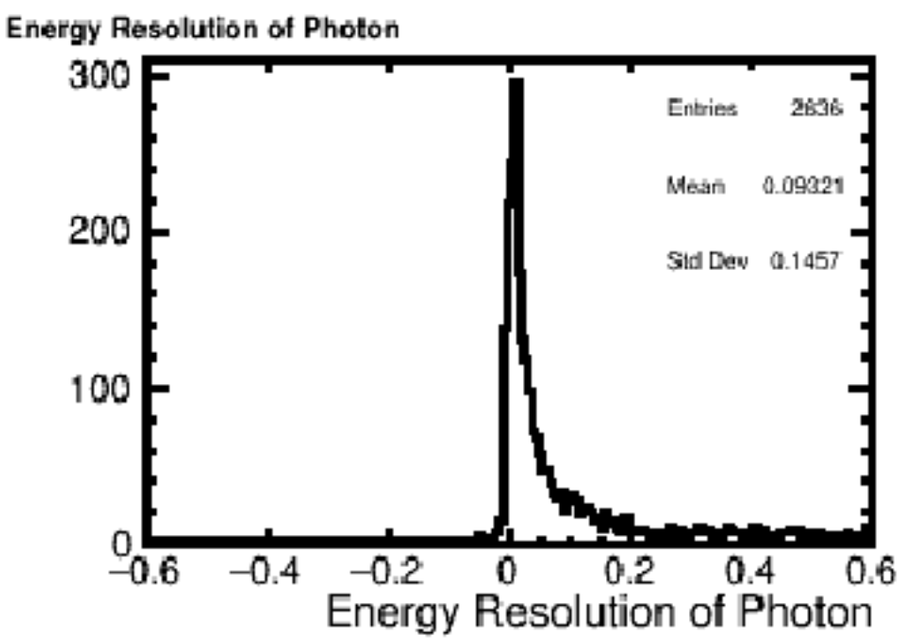
-> Determine (Eμ-, Eμ+, Eγ)

Samples:
|cos(μ)| < 0.75
|M(μ⁺μ⁻)-91.2| < 10 GeV
Large ILD model







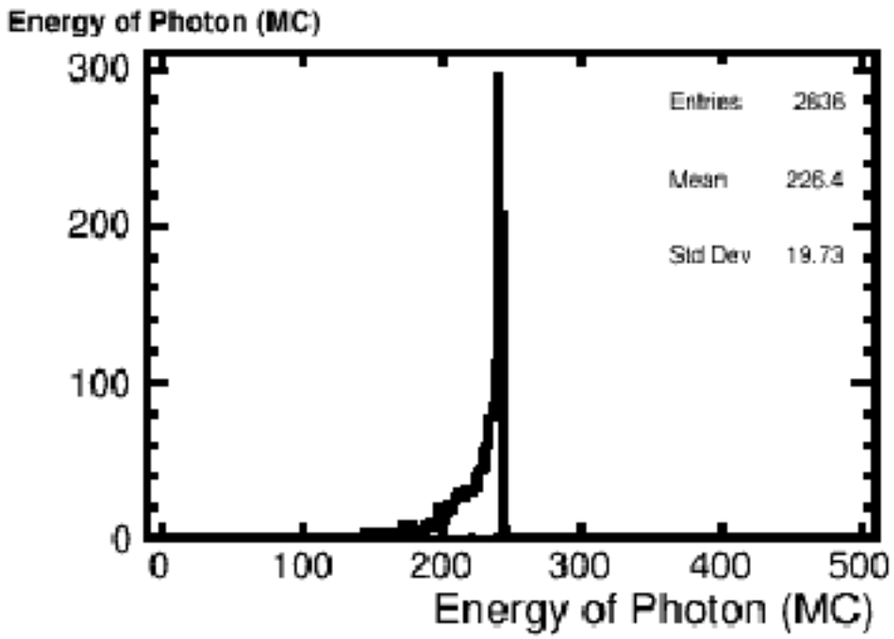


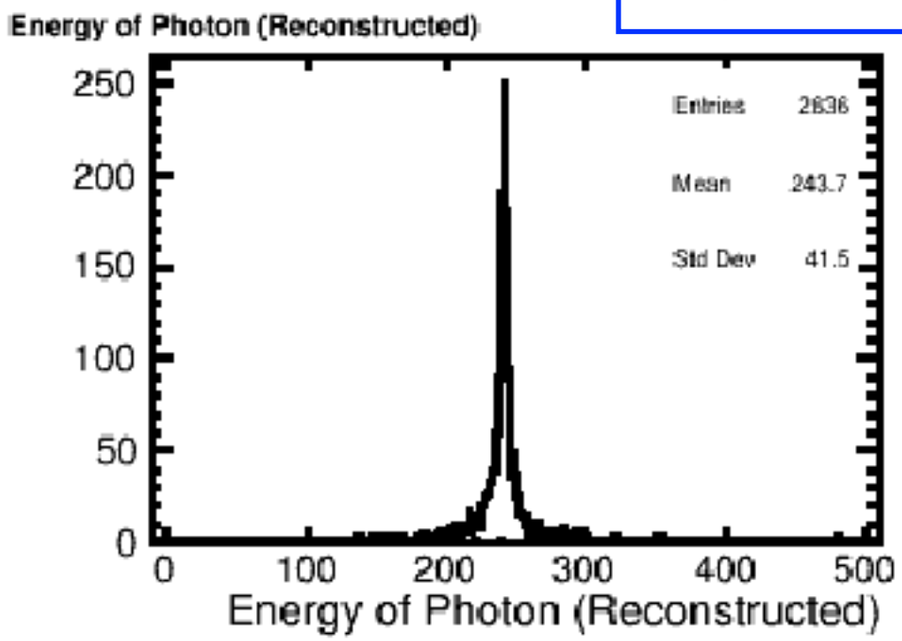
Condition 2: Add Beamstrahlung

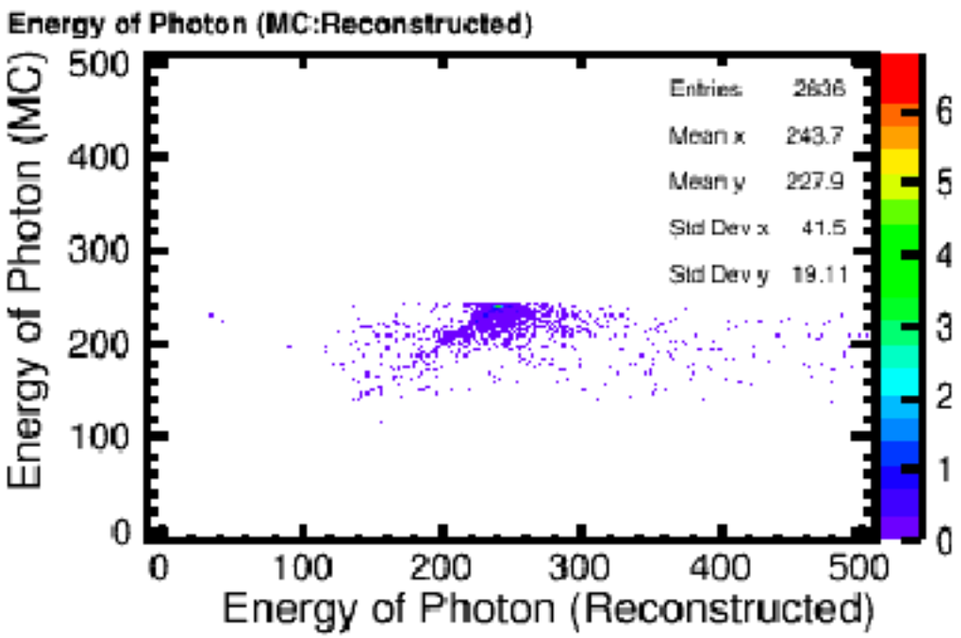
Using (θ_{μ^-}, θ_{μ^+}, θ_{γ}, ϕ_{μ^-}, ϕ_{μ^+}, ϕ_{γ})

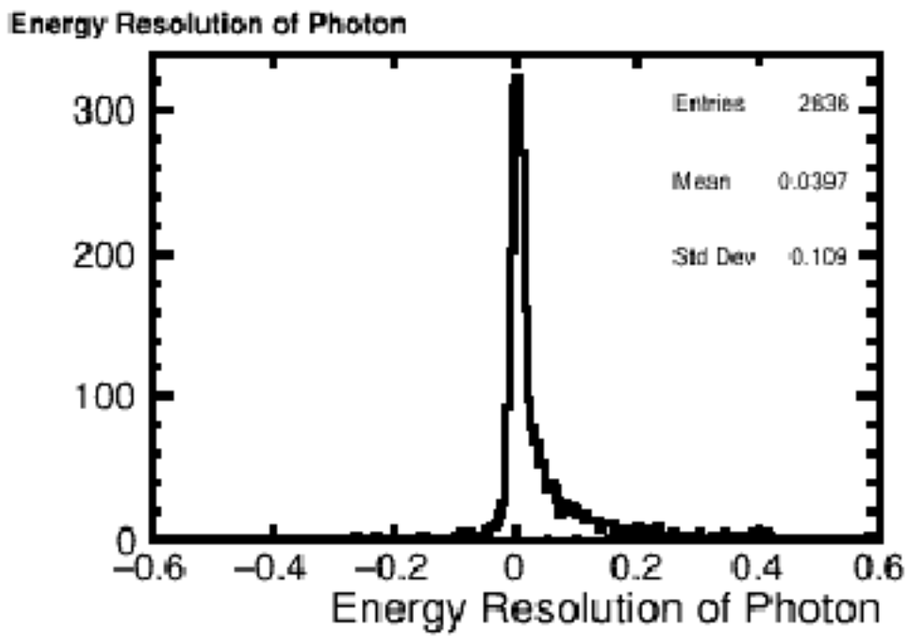
-> Determine (E_{μ^-}, E_{μ^+}, E_{γ}, E_{ISR})

Samples:
$|\cos(\mu)| < 0.75$
$|M(\mu^+\mu^-)-91.2| < 10$ GeV
Large ILD model







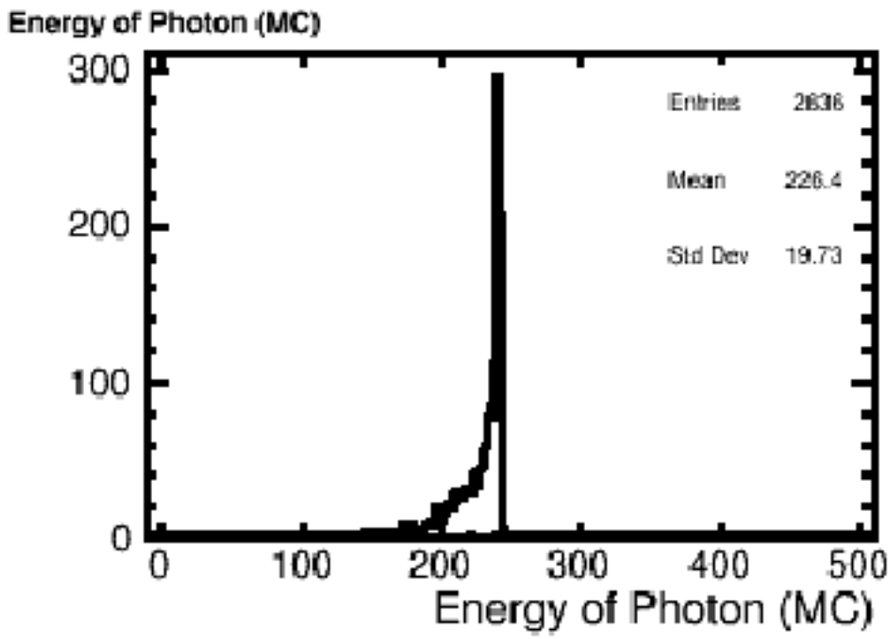


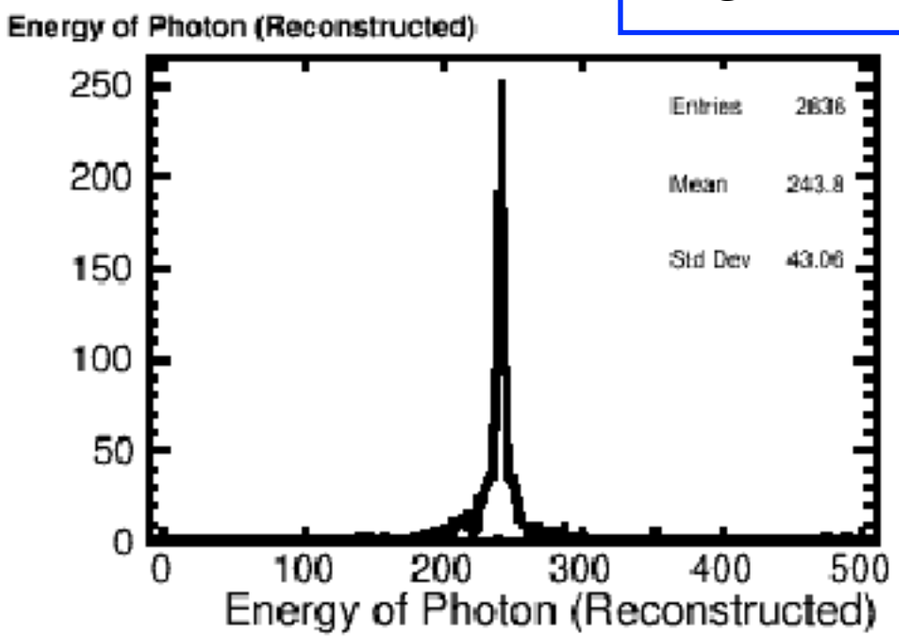
Condition 3: Add the effect of Crossing Angle

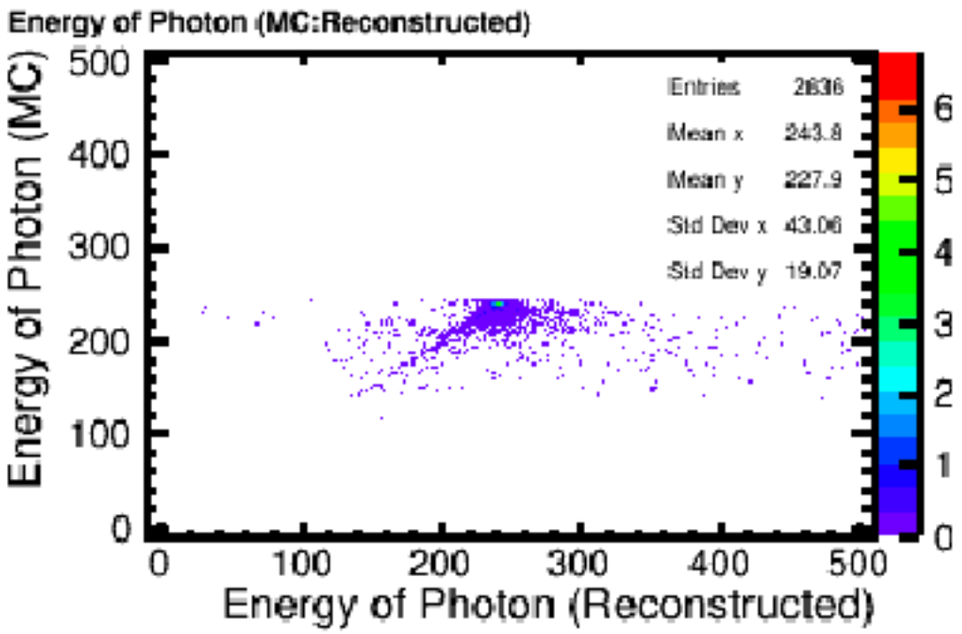
Using (θ_{μ^-}, θ_{μ^+}, θ_{γ}, ϕ_{μ^-}, ϕ_{μ^+}, ϕ_{γ})

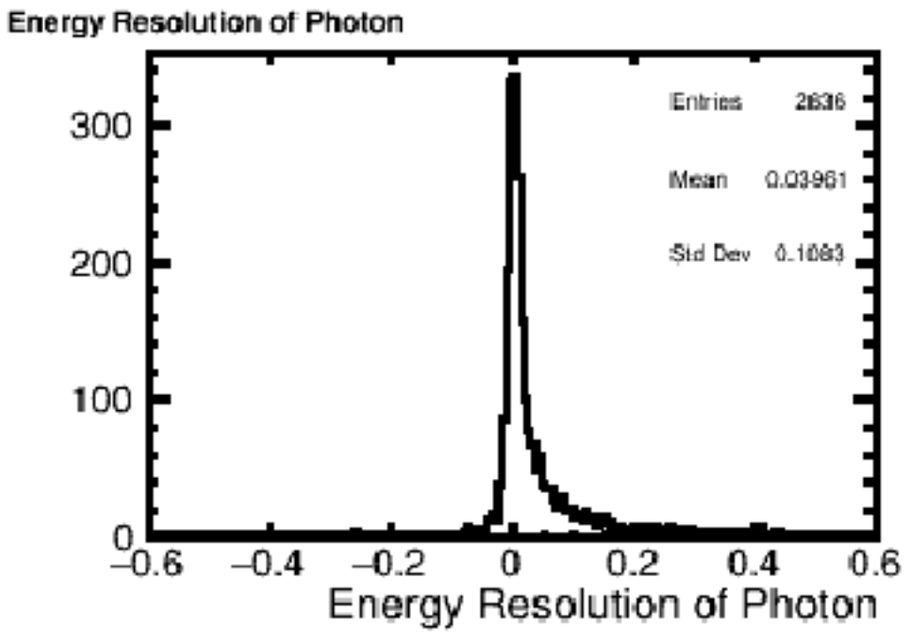
-> Determine (E_{μ^-}, E_{μ^+}, E_{γ}, E_{ISR})

Samples:
|cos(μ)| < 0.75
|M(μ⁺μ⁻)-91.2| < 10 GeV
Large ILD model









Next Step

- I will try below

Condition 4: With ISR and the effect of Crossing Angle
Using (θ_{μ^-}, θ_{μ^+}, θ_{γ}, ϕ_{μ^-}, ϕ_{μ^+}, ϕ_{γ}, E_{μ^-}, E_{μ^+})
-> Determine (E_{γ}, E_{ISR})

and compare the energy resolution.