Resolution studies using $e^+e^- \rightarrow \gamma\gamma$ events

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Kinematics in CM frame

* indicates CM frame

Calculated energy of photon in Lab frame:
\[ E_{\text{calc}} = \gamma(E_{CM}/2)(1 + \beta \cos \theta_1^*) \]

\[ dE/E = (E_{\text{meas}} - E_{\text{calc}})/E_{\text{calc}} \]
Analysis

- Data: taken in January, 2002
- Require to pass L3 $e^+e^- \rightarrow \gamma\gamma$ trigger
- Select 2 highest energy photons
- Cut: Maximum acollinearity = 0.03 rad
- Study energy resolution
  - As function of $\theta_{\text{Lab}}$
  - As function of $\phi$
- Fit using: Crystal Ball function
  - Starting points from gaussian fit around peak
Energy resolution vs. $\theta_{\text{Lab}}$
Energy resolution for low $\theta_{\text{Lab}}$
Example: Best fit, Worst fit

- **Bin 11:** $\theta_\text{Lab} = 0.768367 - 0.810204$
  - $\text{Chi2}/\text{ndf} = 96.83 / 78$
  - $\text{Mean} = 0.01684 \pm 0.0004719$
  - $\text{Width} = 0.01602 \pm 0.0003221$
  - $\text{Norm} = 713.3 \pm 11.79$
  - $\text{CBcutoff} = 0.622 \pm 0.02726$
  - $\text{CBpower} = 4.118 \pm 0.2939$

- **Bin 1:** $\theta_\text{Lab} = 0.350000 - 0.391837$
  - $\text{Chi2}/\text{ndf} = 1760 / 92$
  - $\text{Mean} = 0.02049 \pm 0.000338$
  - $\text{Width} = 0.03048 \pm 0.0002593$
  - $\text{Norm} = 1082 \pm 10.89$
  - $\text{CBcutoff} = 1.064 \pm 0.02604$
  - $\text{CBpower} = 1.987 \pm 0.0899$
\( \chi^2 \) Probability

\( \chi^2/\text{ndf} \) bad in general.

Crystal ball function seems not be the optimal model.
Mean vs. $\theta_{\text{Lab}}$
FWHM/2.354 vs. $\theta_{\text{Lab}}$

Is there a trend or a step?
Mean vs. $\phi$

No obvious $\phi$ dependence.
FWHM/2.354 vs. $\phi$

No obvious $\phi$ dependence.
Summary

- Energy resolution is very poor for the innermost endcap area.
- Crystal Ball function is not optimal parameterization of energy resolution.
- Mean might depend on $\theta_{\text{Lab}}$.
- FWHM/2.354 may depend on types of amplifiers. (high gain, low gain)
- No obvious dependency on $\phi$. 