A Brief Look at Muons in the EMC

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Recap

- Using \( \mu\mu\gamma \) sample used for ISR analysis (Runs 1-4).
- My cuts:
  - Two ‘good’ measured tracks
  - One ‘good’ measured photon
  - One of the charged particles identified as a muon (using \textit{loose PidMuonMicroSelector})
  - Convergent kinematic fit
  - \( \chi^2 \) probability > 0.05
- Cuts leave around 700,000 events from data.
- However, there were also pre-selection cuts applied (see BAD 558 and 831).
Heidelberg Plot

As seen in Frederick Grüll’s talk on 6th October, 2004
Plot Generation

• I did not have crystal numbers…
• …and so divided angular range into 56 equal bins in theta (therefore only approximate crystals).
  – Code to convert from theta to crystal ring number would be helpful, as well as more accurate.
• Crystal lengths as taken from *BaBar Physics Book*
• Used $\theta_{EMC}$ and $E_{EMC}$
• Used different means:
  – Straightforward mean from ROOT
  – Mean from a Gaussian fit
  – Mean from a ‘running Gaussian’ fit
    - (Need to give more thought to this one!)
• ISR group place a cut on angles

‘Running Gaussian’ fit

\[
f(x) = Ce^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}
\]

$\sigma = \sigma_0$ for $x > \mu$
$\sigma = \sigma_0 - r(x-\mu)$ for $x < \mu$
Energy Deposited / Crystal Length
(Means without a fit)

Run 1
Run 4

Ecal mu/length plot

<table>
<thead>
<tr>
<th>Ecal_mu_means_len</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entries 0</td>
</tr>
<tr>
<td>Mean 26.11</td>
</tr>
<tr>
<td>RMS 14.98</td>
</tr>
</tbody>
</table>
Energy Deposited / Crystal Length (Means from Gaussian fit)

Run 1
Run 4

Ecalmu/length plot (gauss fit)

<table>
<thead>
<tr>
<th>Entries</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>26.3</td>
</tr>
<tr>
<td>RMS</td>
<td>14.75</td>
</tr>
</tbody>
</table>
Energy Deposited / Crystal Length (Means from ‘running Gaussian’ fit)

Run 1
Run 2
Run 3
Run 4

Ecalmu/length plot (rg fit)

<table>
<thead>
<tr>
<th>Ecal_mu_rgmeans_len</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entries</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>RMS</td>
</tr>
</tbody>
</table>
Energy Deposited (Means without a fit)

Run 1
Run 2
Run 3
Run 4
Energy Deposited (Means from Gaussian fit)

Ecal mu plot (gauss fit)

Run 1
Run 2
Run 3
Run 4

Ecal_mu_gmeans
Entries 0
Mean 26.02
RMS 15.28
Energy Deposited (Means from 'running Gaussian' fit)

Run 1
Run 2
Run 3
Run 4
Some individual ‘crystals’

Run 1 only

Energy deposited in ECAL by muons (GeV)

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Conclusions

• Looks like there is some forwards to backwards angular variation

• My plots do not look identical to Heidelberg plots…
  – Energy deposited over ‘crystal’ length varies over a larger range in my plots
    - Consequence of my imperfect binning?

• I could look at photons relatively quickly, and could try to use a better fit.