MERIT beam parameters

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We have 3 beam 'cameras' -> 3 images for every beam pulse

Camera positions: Camera Camera Camera
414 454 484

1st approach: To fit projections*

Mean = 0.31(7) mm
Sigma = 6.42(12) mm

XY

2nd approach: To fit shadows**

Mean = -4.64(3) mm
Mean = 0.16(4) mm

Mean = -4.71(3) mm
Sigma = 2.21(4) mm
Sigma = 2.22(4) mm
Sigma = 4.82(5) mm

We have 3 beam 'cameras' -> 3 images for every beam pulse

Camera positions: Camera Camera Camera
414 454 484

* Projection for X is \( P(x) = \frac{1}{n_y} \sum_{i=1}^{n_y} z(x, y_i), \)
similarly for Y.

** Shadow for X is \( S(x) = \max[z(x, y_i)], (i = 1, n_y), \)
similarly for Y.
Fitting: Procedure

Simple fitting function: Gaussian + 'background'

Fitting algorithm (how to avoid gaps; how to choose initial value of the 'background' term, etc...) was based on the analysis of the 15-20 randomly selected images (after this, completely 'blind' analysis -> no parameters tuning)

In total: 520 beam pulses* x 3 cameras x 2 projections = 3120 distributions have been fitted

Result: Table - ntuple (part of it shown below)

<table>
<thead>
<tr>
<th>Date (ddmmyyyy)</th>
<th>Time (hhmmss)</th>
<th>Camera 414</th>
<th>Camera 454</th>
<th>Camera 484</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>X&lt;sub&gt;mean&lt;/sub&gt; (mm)</td>
<td>Sigma&lt;sub&gt;x&lt;/sub&gt; (mm)</td>
<td>Y&lt;sub&gt;mean&lt;/sub&gt; (mm)</td>
</tr>
<tr>
<td>11112007</td>
<td>122348</td>
<td>9.204</td>
<td>6.081</td>
<td>5.331</td>
</tr>
<tr>
<td>11112007</td>
<td>123724</td>
<td>9.851</td>
<td>5.720</td>
<td>5.490</td>
</tr>
<tr>
<td>11112007</td>
<td>124959</td>
<td>10.288</td>
<td>5.508</td>
<td>5.880</td>
</tr>
<tr>
<td>11112007</td>
<td>125545</td>
<td>12.105</td>
<td>4.446</td>
<td>5.808</td>
</tr>
<tr>
<td>11112007</td>
<td>125829</td>
<td>13.043</td>
<td>3.803</td>
<td>5.821</td>
</tr>
<tr>
<td>11112007</td>
<td>130436</td>
<td>8.399</td>
<td>6.587</td>
<td>6.164</td>
</tr>
<tr>
<td>11112007</td>
<td>130618</td>
<td>11.813</td>
<td>4.675</td>
<td>5.870</td>
</tr>
</tbody>
</table>

This will be used to reconstruct the Run number and to attach this table to the 'global' table with experimental results.

This will be used to recognize a shot with the 'suspicious' fitting result and to fit it 'manually'.

Results: Shadows

Distributions of the Gaussian means

Illustration only. For more details go to:
http://hepunx.rl.ac.uk/uknf/wp3/shocksims/mermar/
Results: Projections

Distributions of the Gaussian sigmas

Find the corresponding event in the table (Slide 3) and fit it manually (if possible)

Illustration only. For more details go to:
http://hepunx.rl.ac.uk/uknf/wp3/shocksims/mermar/

Suspicious results (empty shots, beam on the edge of the 'visible field', etc…)
Results: Shadows

Distributions of the ratios of the Gaussian sigmas

\[
\left( \frac{\sigma_x^i}{\sigma_x^j}, \frac{\sigma_y^i}{\sigma_y^j} \right)
\]

\[
\frac{\sigma_x^{414}}{\sigma_x^{454}}
\]

\[
\frac{\sigma_y^{414}}{\sigma_y^{454}}
\]

\[
\frac{\sigma_x^{454}}{\sigma_x^{484}}
\]

\[
\frac{\sigma_y^{454}}{\sigma_y^{484}}
\]

Nice agreement with 'Beam Optics' values

BO ~ 1

BO ~ 1.33
Results: Shadows

Distributions of the ratios of the Gaussian sigmas

\[ \left( \frac{\sigma_x^i}{\sigma_y^i} \right) \]

- \( \sigma_x^{414} / \sigma_y^{414} \)
- \( \sigma_x^{454} / \sigma_y^{454} \)
- \( \sigma_x^{484} / \sigma_y^{484} \)

Results:
- 'Beam Optics' value = 1.3
- 'Beam Optics' value = 1.7
Beam size vs beam intensity

The beam-spot datafile (see Slide 3) has been attached to the 'global' MERIT datafile.

This is a first result about beam size dependence on beam intensity (and momentum).
Results of fitting of the shadows

(1) $\sigma_x = 2.93$

(2) $\sigma_x = 3.26$

(3) $\sigma_x = 3.22$

(1) $\sigma_y = 1.90$

(2) $\sigma_y = 2.05$

(3) $\sigma_y = 1.66$

For low beam intensity shots, in around 50% of the cases the situation is similar to (1) and (2). Even when we have a beam shot similar to case (3) the x/y widths ratio is close to 2. The plot above shows the results of the fitting of these 3 distributions.

The interesting fact is that in the case (3) we have the highest value of the beam intensity and the camera response does not reflect this.
Beam position on target

EXP

Taken online (estimated by the eye from the screen data)

FIT

Calculated by using:

1) the fitted beam positions for Camera454 and Camera484 (see Slide 4, for example):

2) the Camera454, Camera484 and target positions

* From 'Beam Spot Information' talk, I. Efthymiopoulos, VRVS Meeting, November 30, 2007
Conclusions (Main results so far)

Distributions of the ratios of the Gaussian sigmas

Mean = 1.07  'Beam optics' ~ 1

Mean = 1.41  'Beam optics' ~ 1.33

Mean = 1.80  'Beam optics' = 1.7

MERIT beam parameters have been obtained (on the basis of the beam monitors data) for each shot during the run; Two approaches: Cross-checked; So far, everything looks as expected; Next; compare with beam optics calculations shot-by-shot.