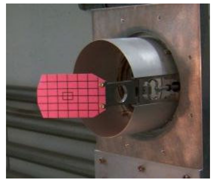
MERIT beam spot size

Goran Skoro

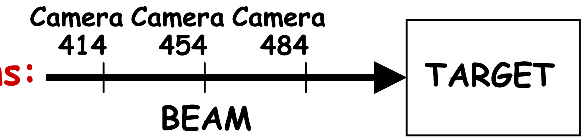
18 June 2008

Goran Skoro
The University Of Sheffield.

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



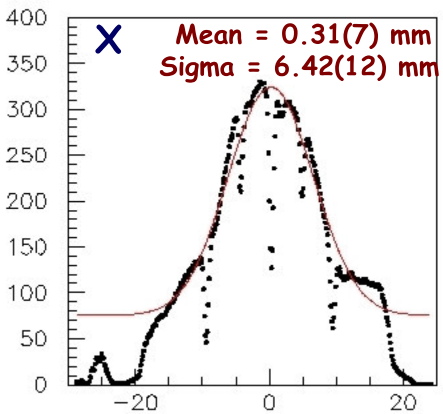
Camera positions:

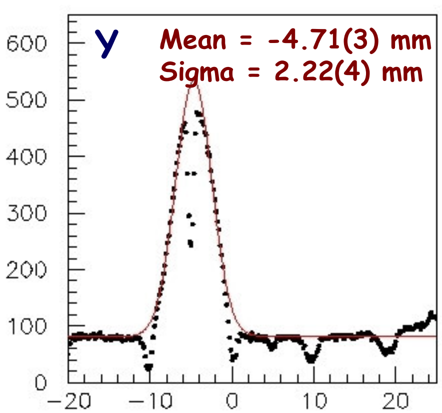


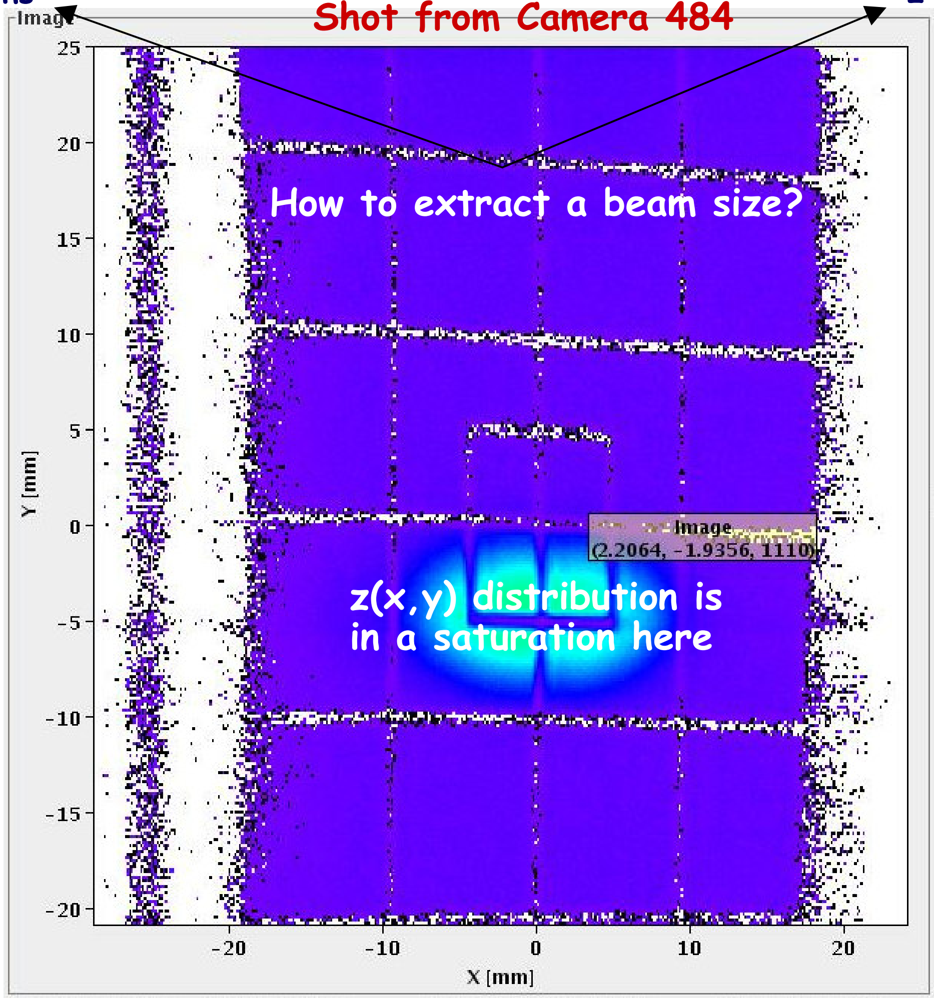
1st approach: To fit projections*

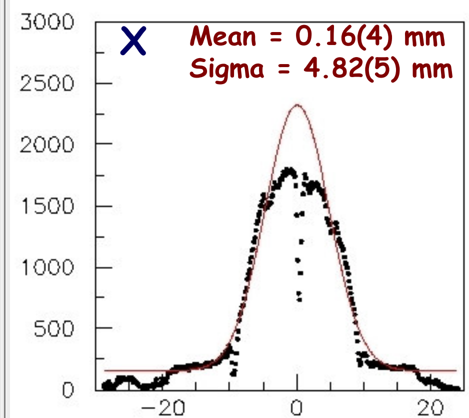
2nd approach: To fit shadows**

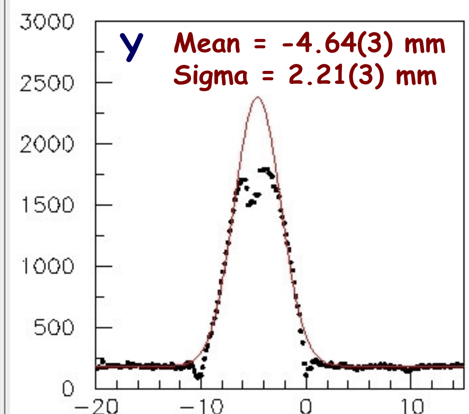
Shot from Camera 484









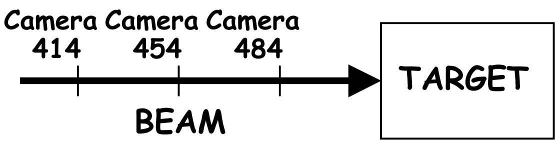


* Projection for X is $P(x) = \frac{1}{n_y}\sum_{i=1}^{n_y} z(x, y_i)$, similarly for Y.

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

Goran Skoro
The University Of Sheffield.

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)

		Camera 414				Camera 454			Camera 484
Date (ddmmyyyy)	Time (hhmmss)	X_{mean} (mm)	$Sigma_x$ (mm)	Y_{mean} (mm)	$Sigma_y$ (mm)	X_{mean} (mm)	$Sigma_x$ (mm)	Y_{mean} (mm)	
11112007	115919	9.164	6.153	6.468	5.999	-1.205	6.541	-10.317	....
11112007	122348	9.204	6.081	5.331	5.723	-1.234	6.671	-10.043	....
11112007	123724	9.851	5.720	5.490	4.750	-0.695	5.703	-10.521	....
11112007	124959	10.288	5.508	5.880	3.615	0.270	4.599	-10.108	....
11112007	125201	7.971	6.342	6.038	3.678	3.236	3.448	-10.015	....
11112007	125545	12.105	4.446	5.808	3.516	-1.036	5.781	-10.194	....
11112007	125829	13.043	3.803	5.821	3.545	-1.424	5.613	-10.246	....
11112007	130436	8.399	6.587	6.164	3.939	1.542	4.026	-10.022	....
11112007	130618	11.813	4.675	5.870	3.730	-1.200	5.505	-10.205	....
11112007	131023	13.622	3.459	5.709	3.493	-2.083	5.311	-10.238	....
11112007	131549	14.397	2.934	5.613	3.350	-3.255	5.101	-10.263	....

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

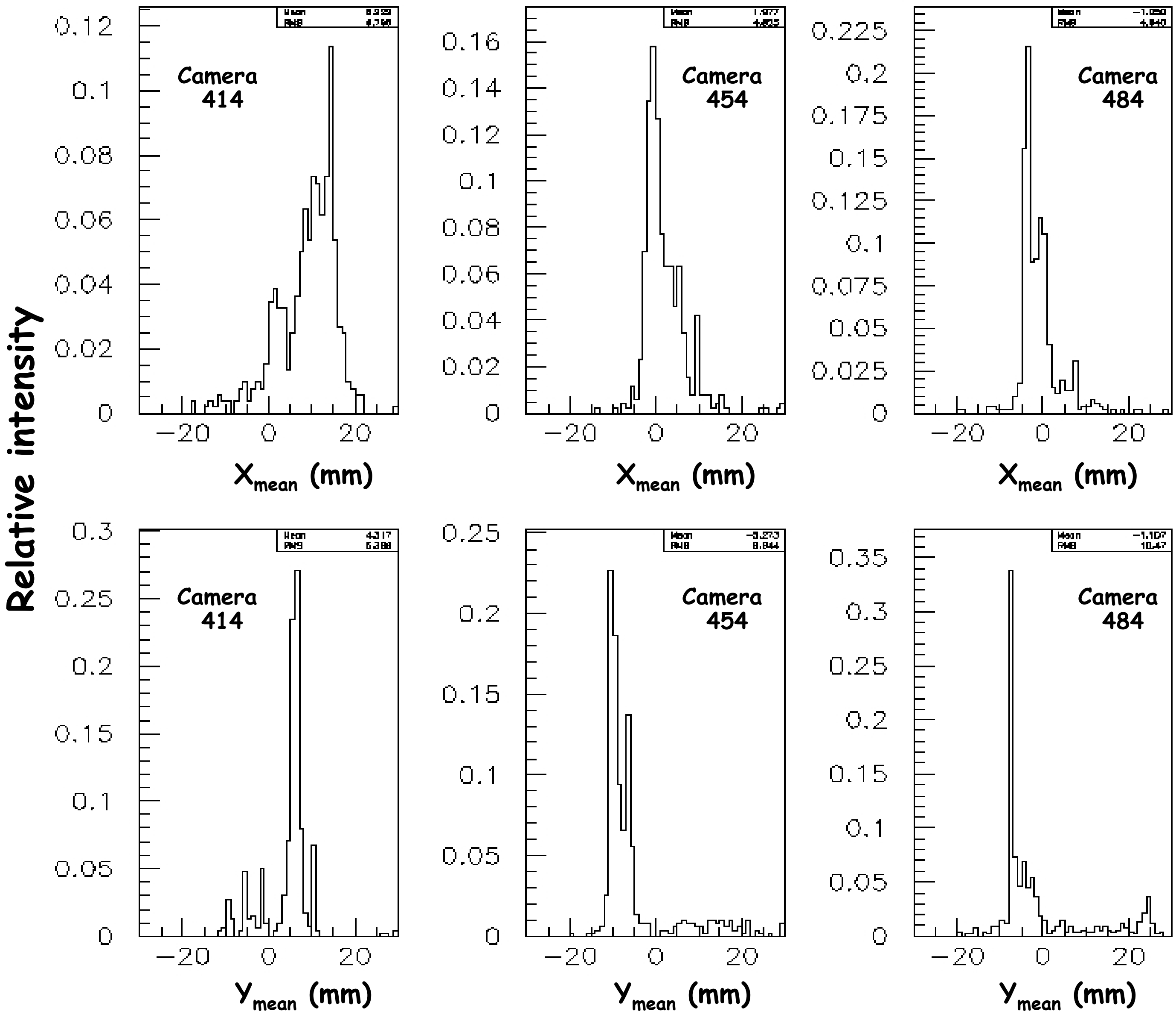
This will be used to recognize a shot with the 'suspicious' fitting result and to fit it 'manually'.

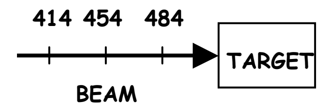
* Period: 23 Oct 2007 – 11 Nov 2007

Goran Skoro
The University Of Sheffield.

Results: Projections

Distributions of the Gaussian means





These distributions could be used for projections vs shadows cross-checking

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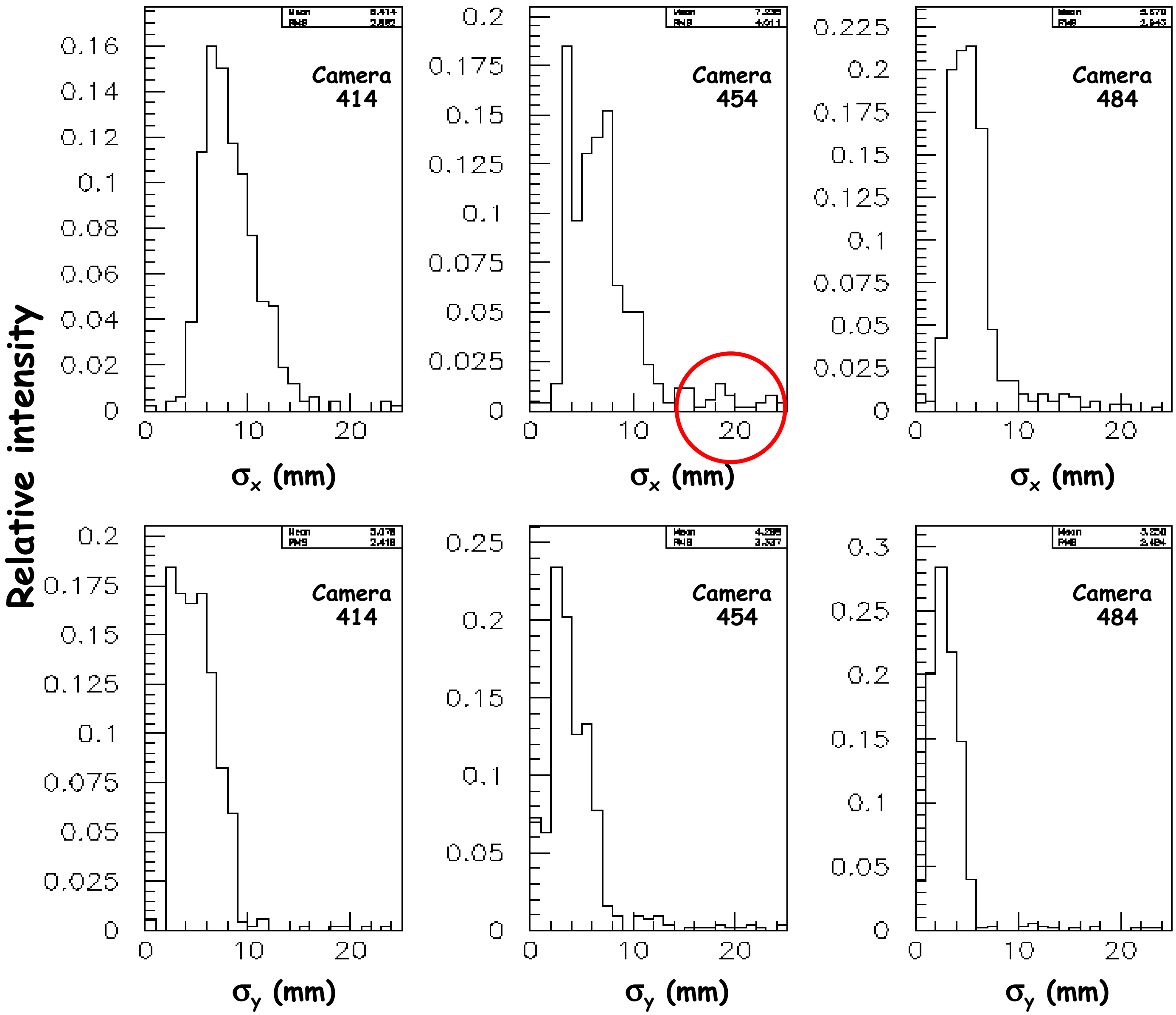
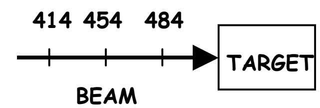
The University Of Sheffield.

Results: Projections

Distributions of the Gaussian sigmas





○ -Suspicious results (empty shots, beam on the edge of the 'visible field', etc…)

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

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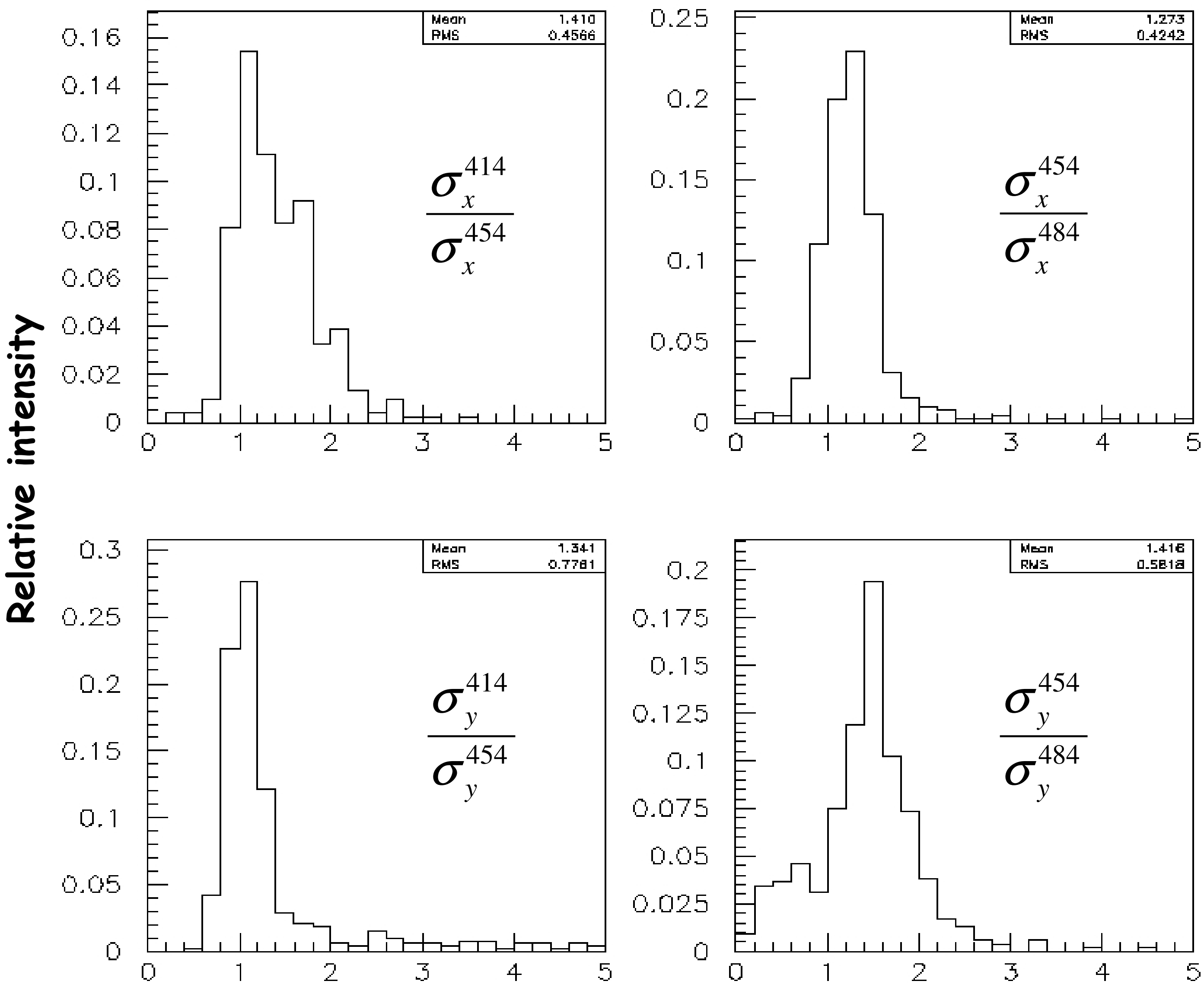
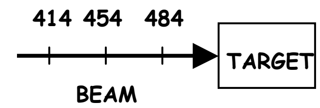
Results: Projections

Distributions of the ratios of the Gaussian sigmas

$$\left(\sigma_x^i / \sigma_x^j\right), \left(\sigma_y^i / \sigma_y^j\right)$$





Looks reasonable

Shows collimation of the beam when travelling from Camera_414 position towards the target

These distributions could be used for projections vs shadows cross-checking

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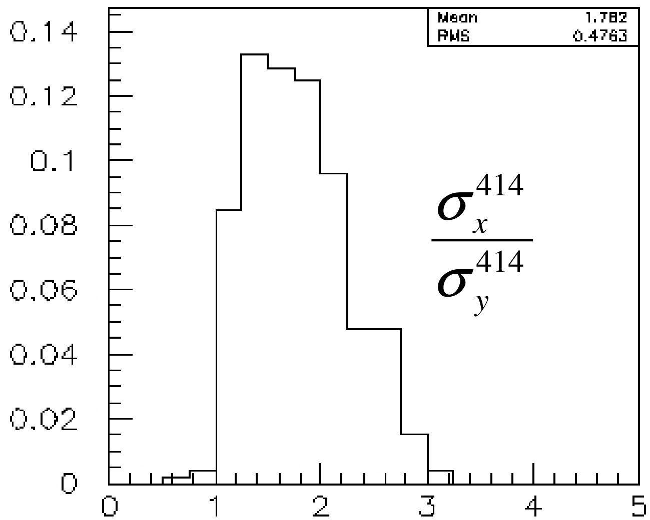
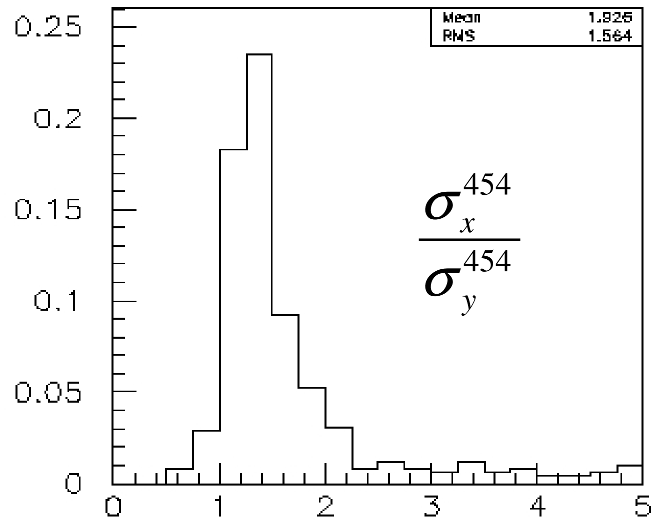
Results: Projections

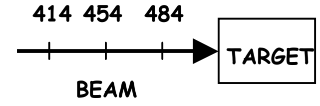
Distributions of the ratios of the Gaussian sigmas

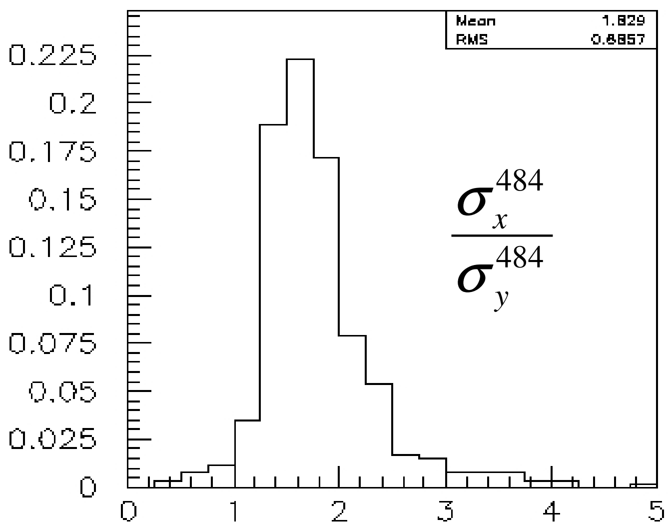
$$\left(\sigma_x^i \middle/ \sigma_y^i \right)$$

Relative intensity









When discussed possible results of this analysis a month ago at Oxford, the conclusion was that it will be a very good progress if we are able to obtain the ratios shown here.

But, maybe the fitting of the 'shadows' will give us a better estimate of the beam size. So the next steps are:

- repeat procedure for the 'shadows';
- compare two sets of the results;
- discuss the results at one of the following MERIT meetings and decide which approach should be used;
- attach the corresponding beam-spot datafile to the 'global' MERIT datafile and start analysis using integrated data.

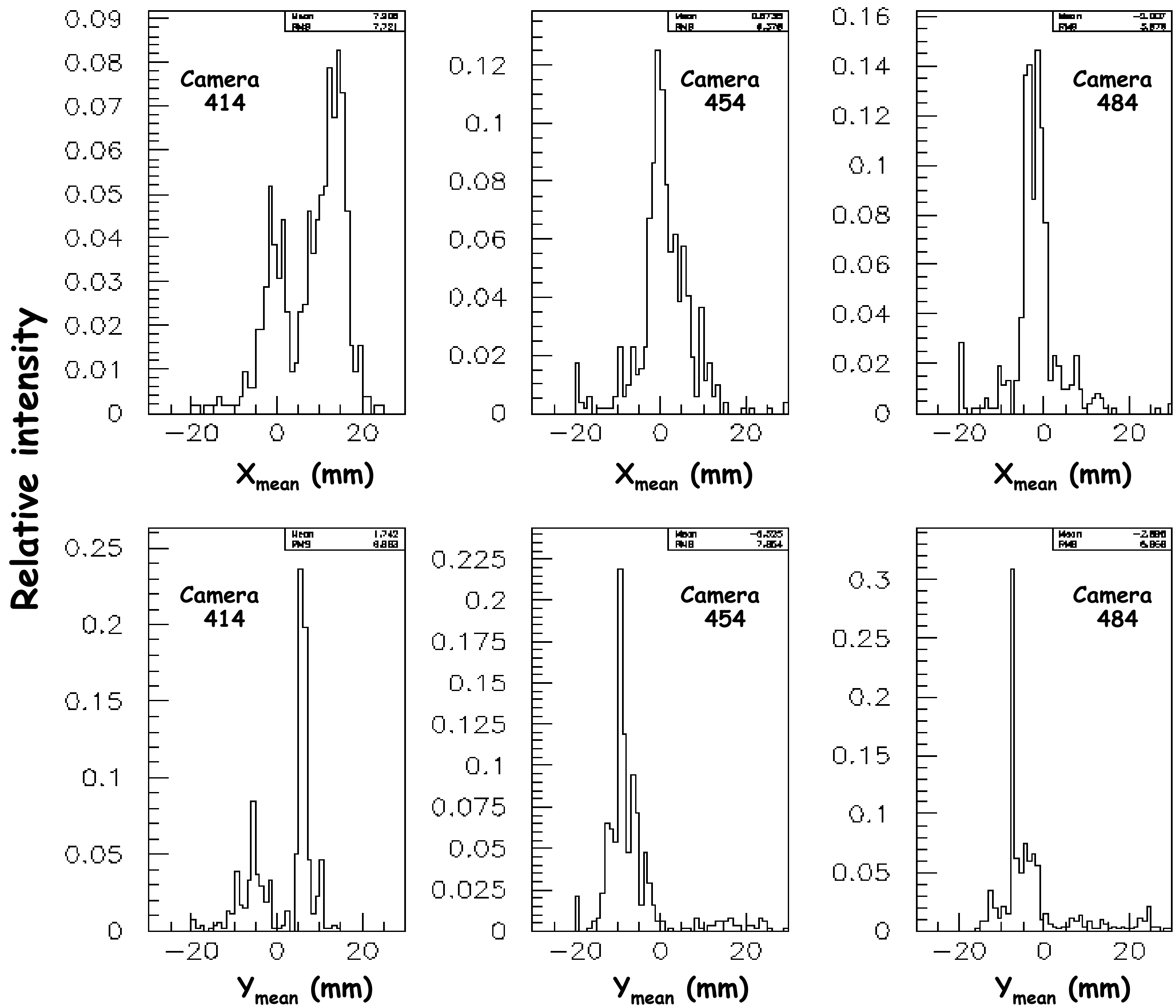
4 June 2008

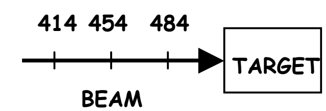
Results: see following slides

Goran Skoro
The University Of Sheffield

Results: Shadows

Distributions of the Gaussian means





Comparison with projections's results is shown on Slide 12

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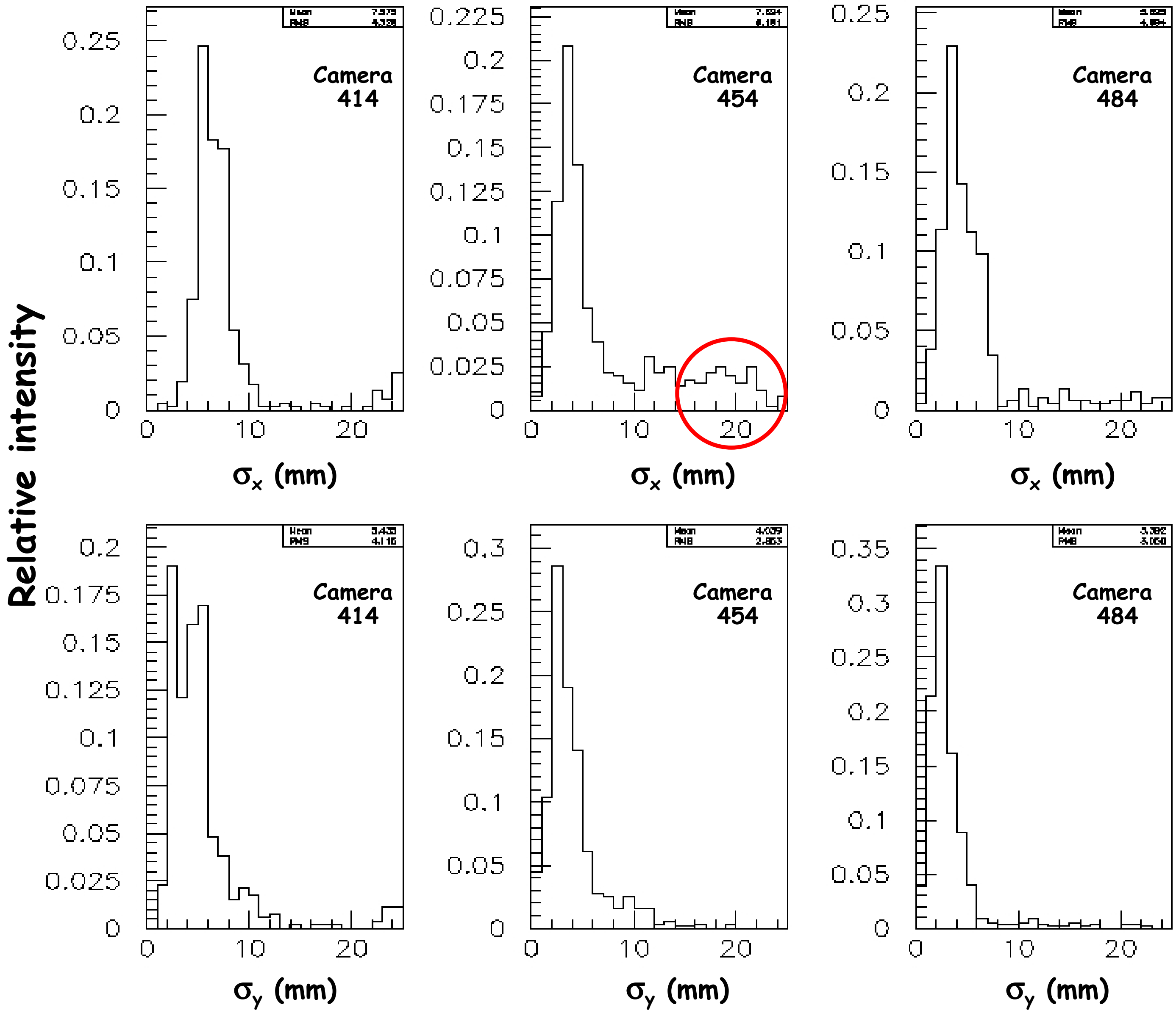
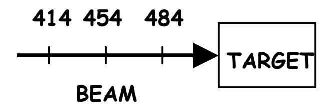
Results: Shadows

Distributions of the Gaussian sigmas





○ -Suspicious results (empty shots, beam on the edge of the 'visible field', etc…)

Comparison with projections's results is shown on Slide 13

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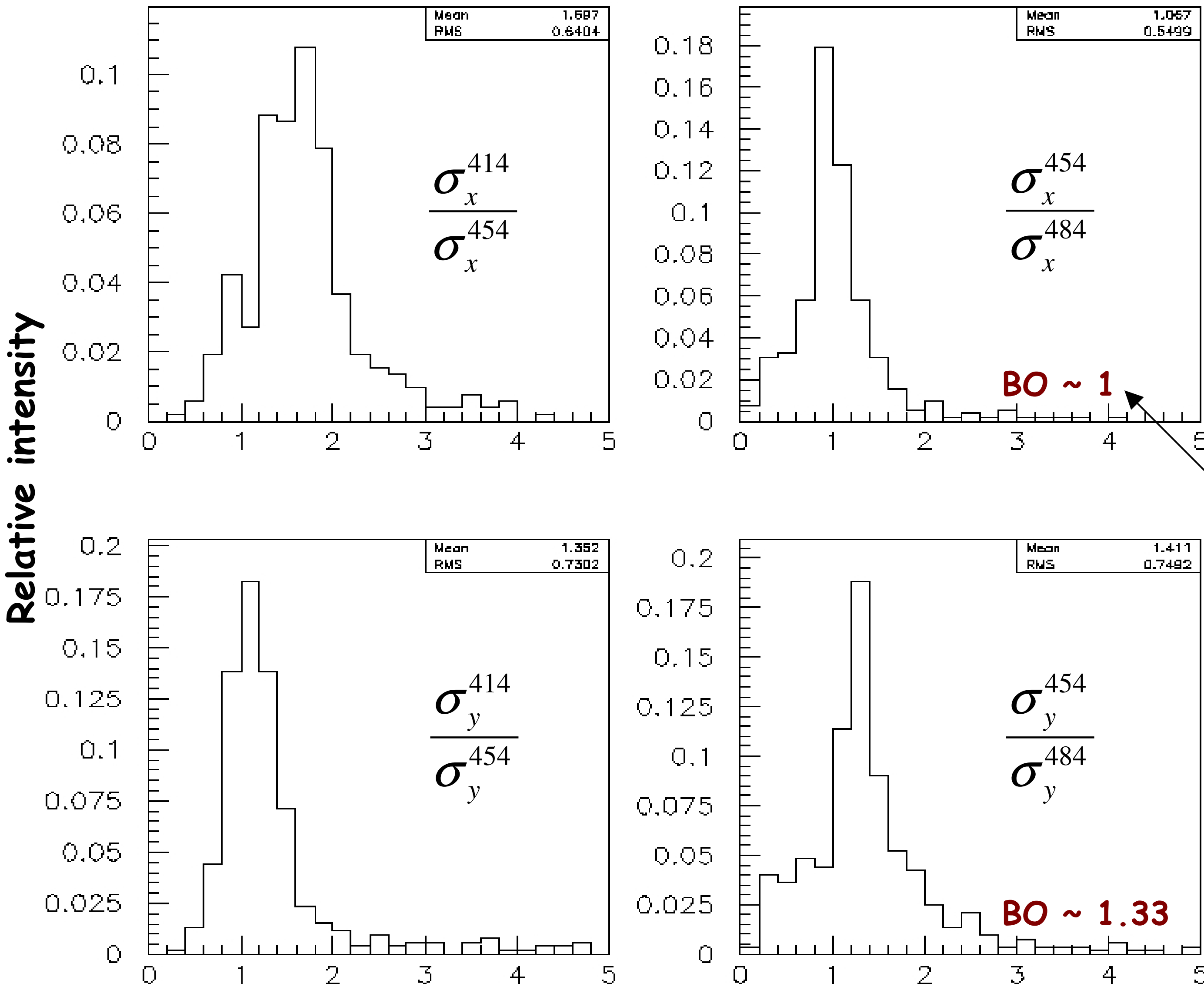
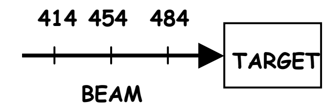
Results: Shadows

Distributions of the ratios of the Gaussian sigmas

$$\left(\sigma_x^i \big/ \sigma_x^j\right), \left(\sigma_y^i \big/ \sigma_y^j\right)$$





Better agreement with 'Beam Optics' values

Results for projections are shown on Slide 6

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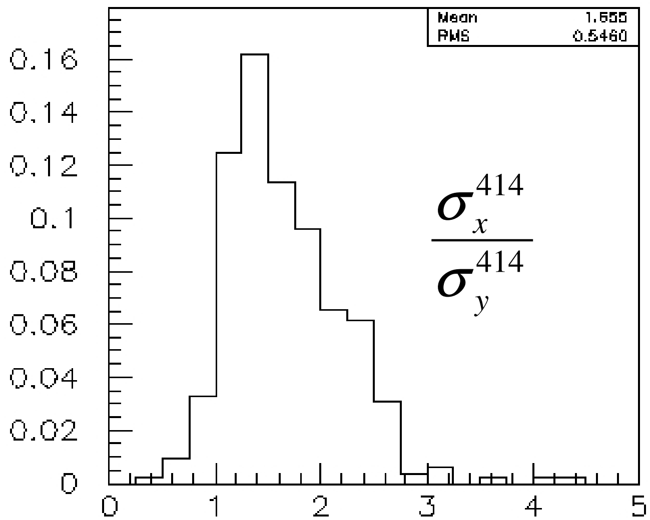
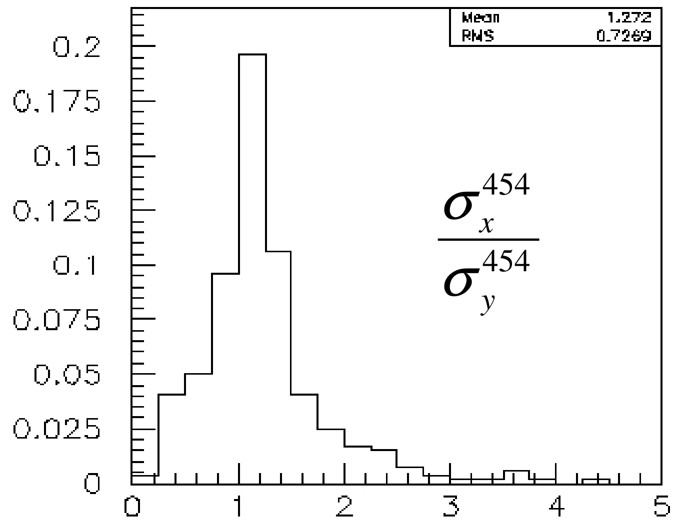
Results: Shadows

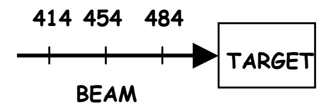
Distributions of the ratios of the Gaussian sigmas

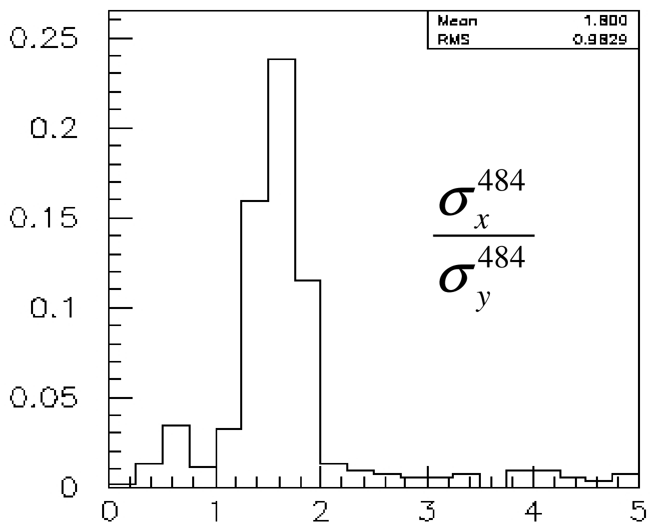
$$\left(\sigma_x^i \big/ \sigma_y^i \right)$$

Relative intensity

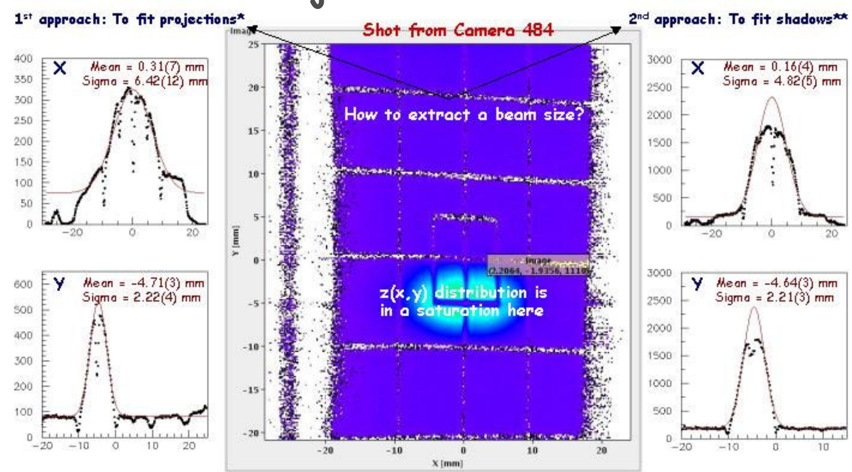








Projections vs Shadows

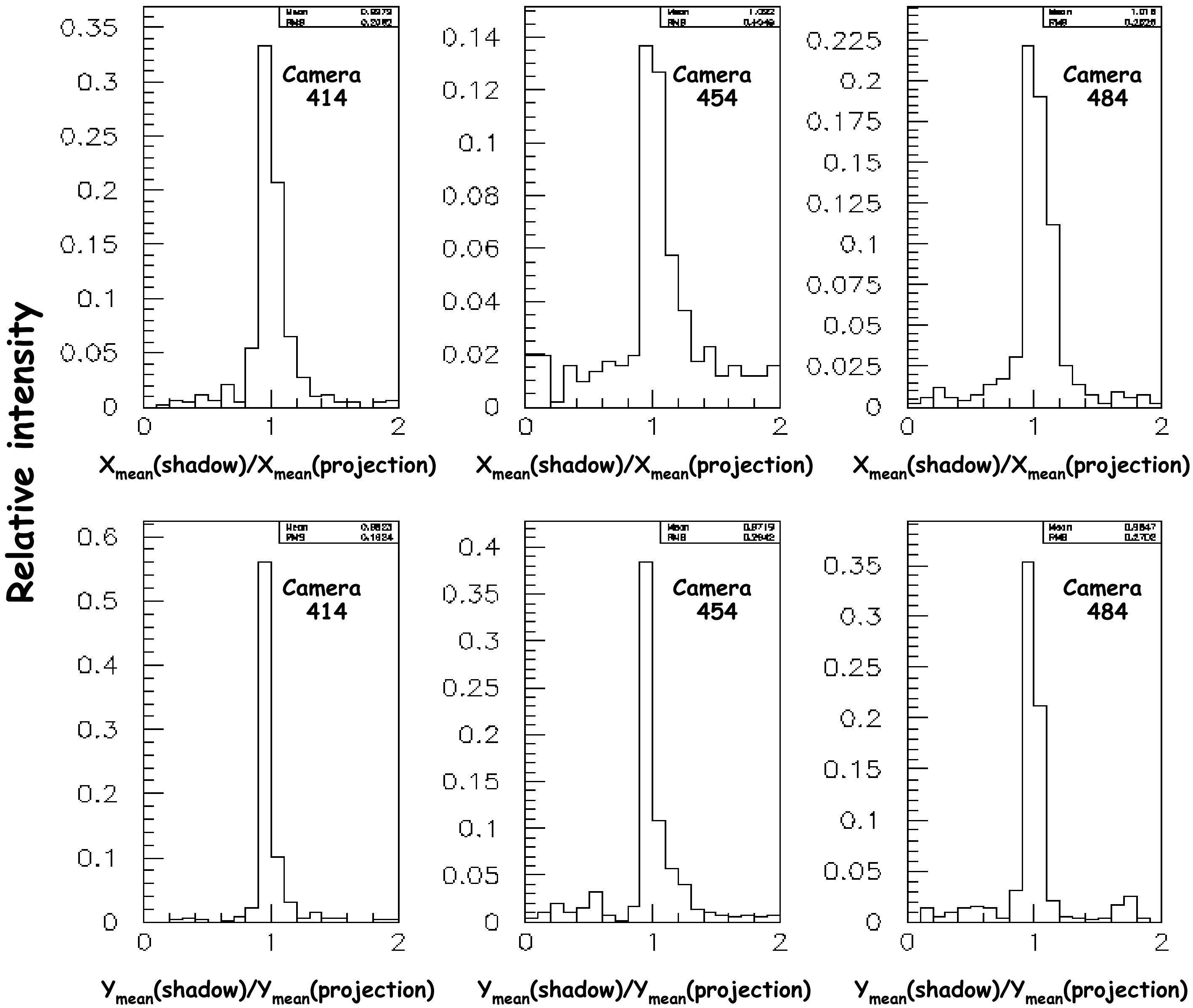


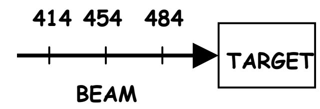
on following slides

Goran Skoro
The University Of Sheffield.

Projections vs Shadows

Distributions of the ratios (shadow/projection) of the Gaussian means





Everything is (more or less) symmetrical around 1. As expected, both approaches return similar values of x/y means.

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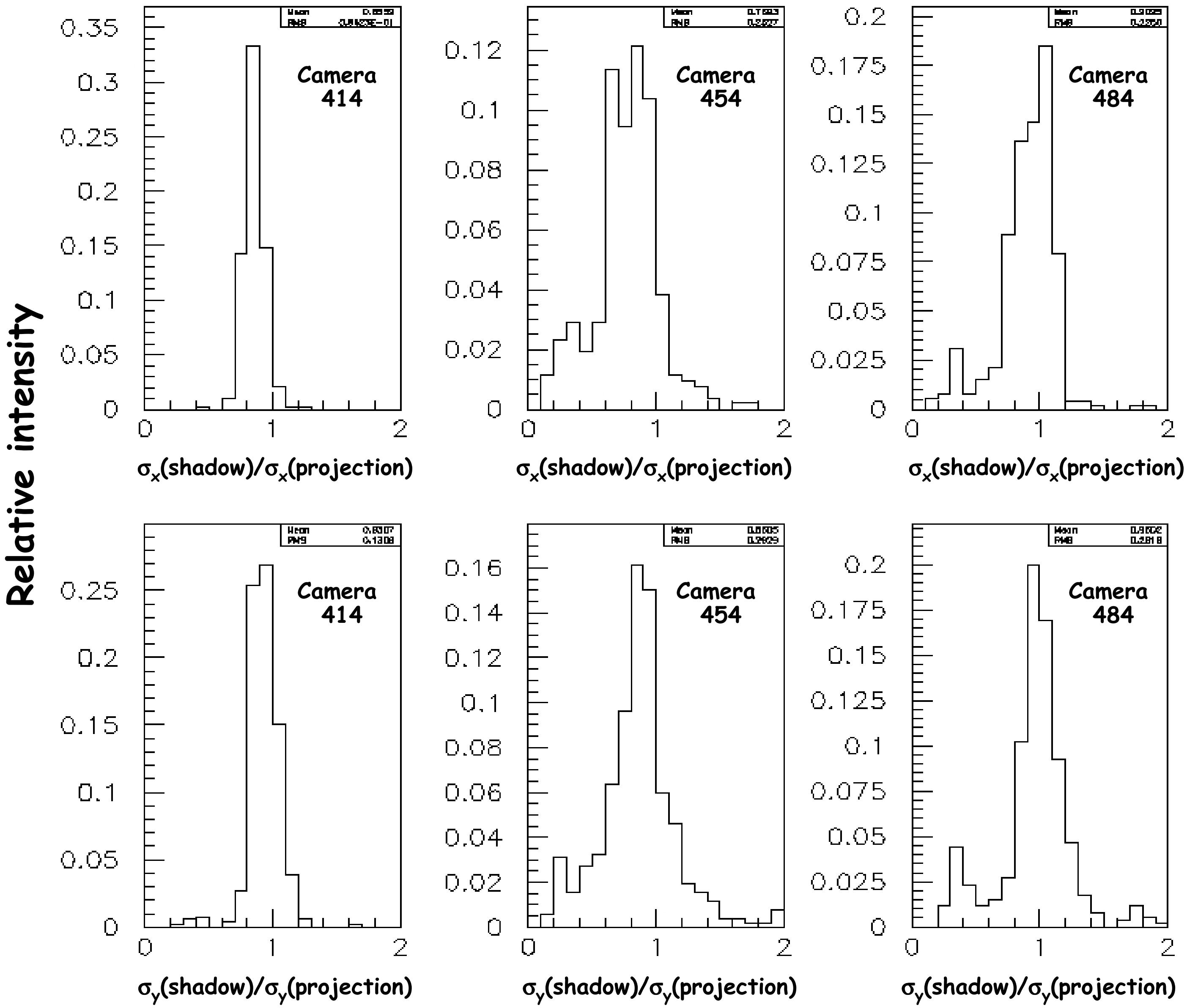
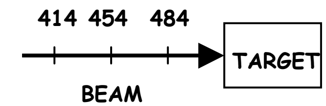
The University Of Sheffield.

Projections vs Shadows

Distributions of the ratios (shadow/projection) of the Gaussian sigmas





Distributions are not symmetrical around 1 (shifted towards left). It means that sigmas for projections are, in general, bigger than sigmas for shadows.

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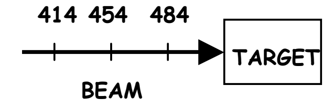
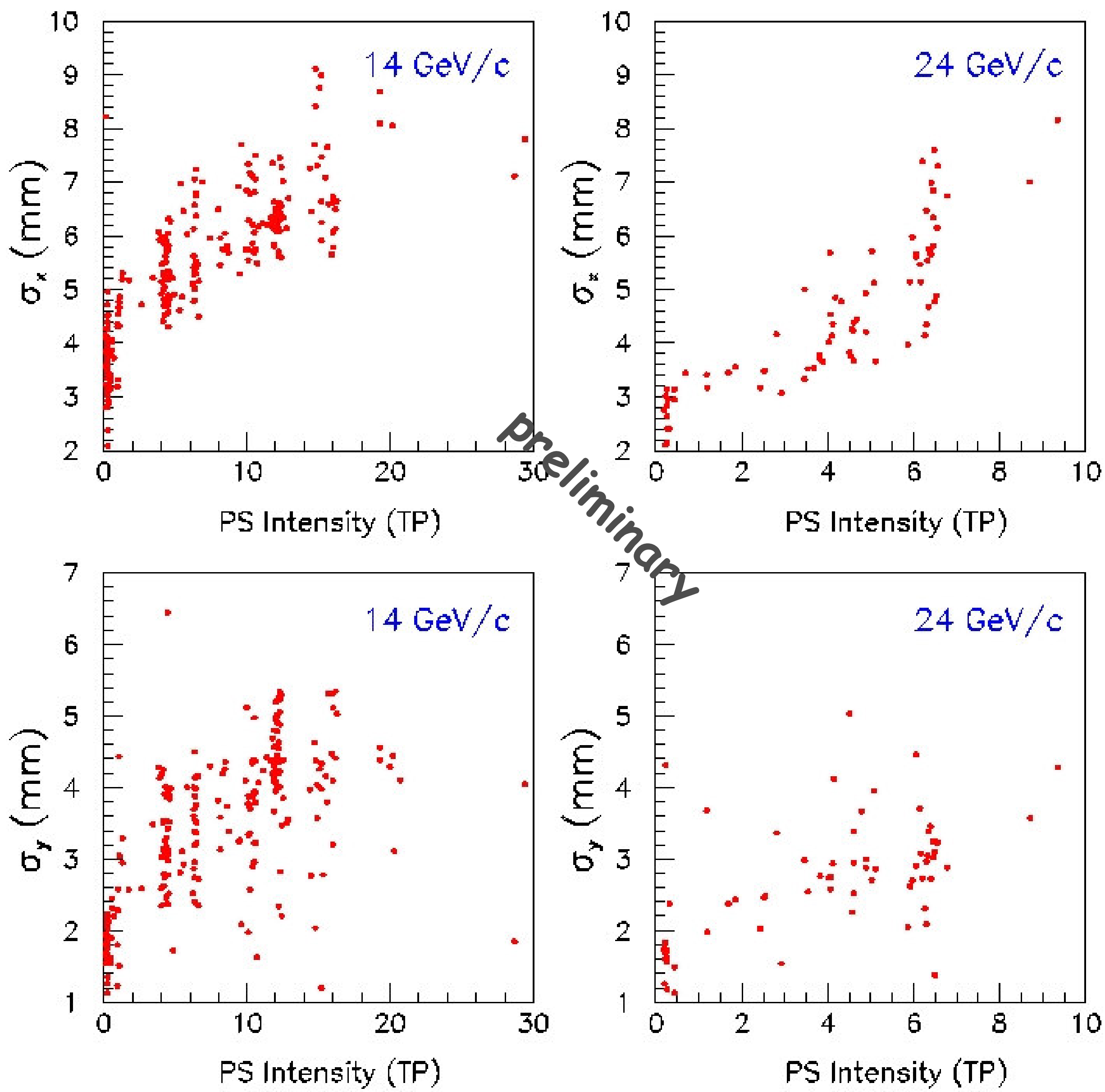
The University Of Sheffield.

Beam size vs beam intensity



Camera 484



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

This is a first, very preliminary, result about beam size dependence on beam intensity (and momentum)