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MERIT beam spot size

(Saturations & projections)

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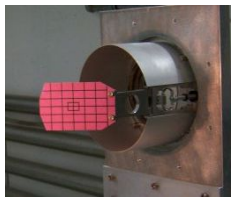
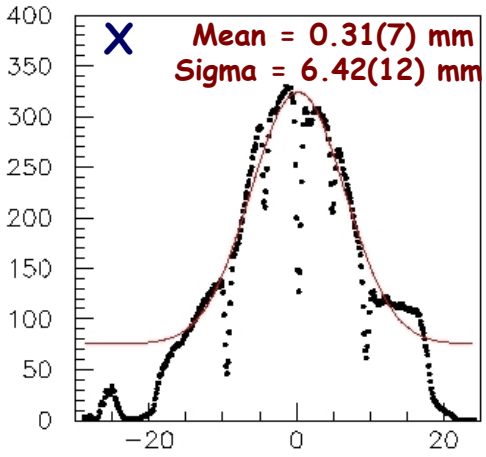
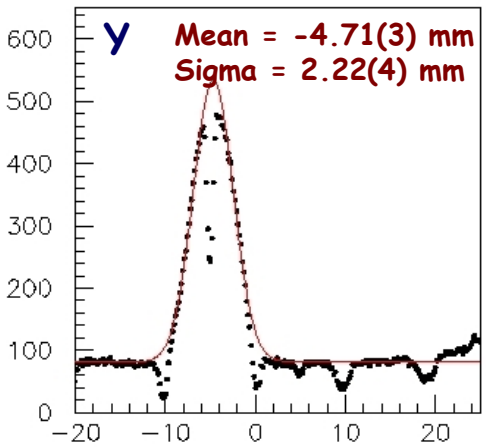
We have 3 beam 'cameras' -> 3 images for every beam pulse



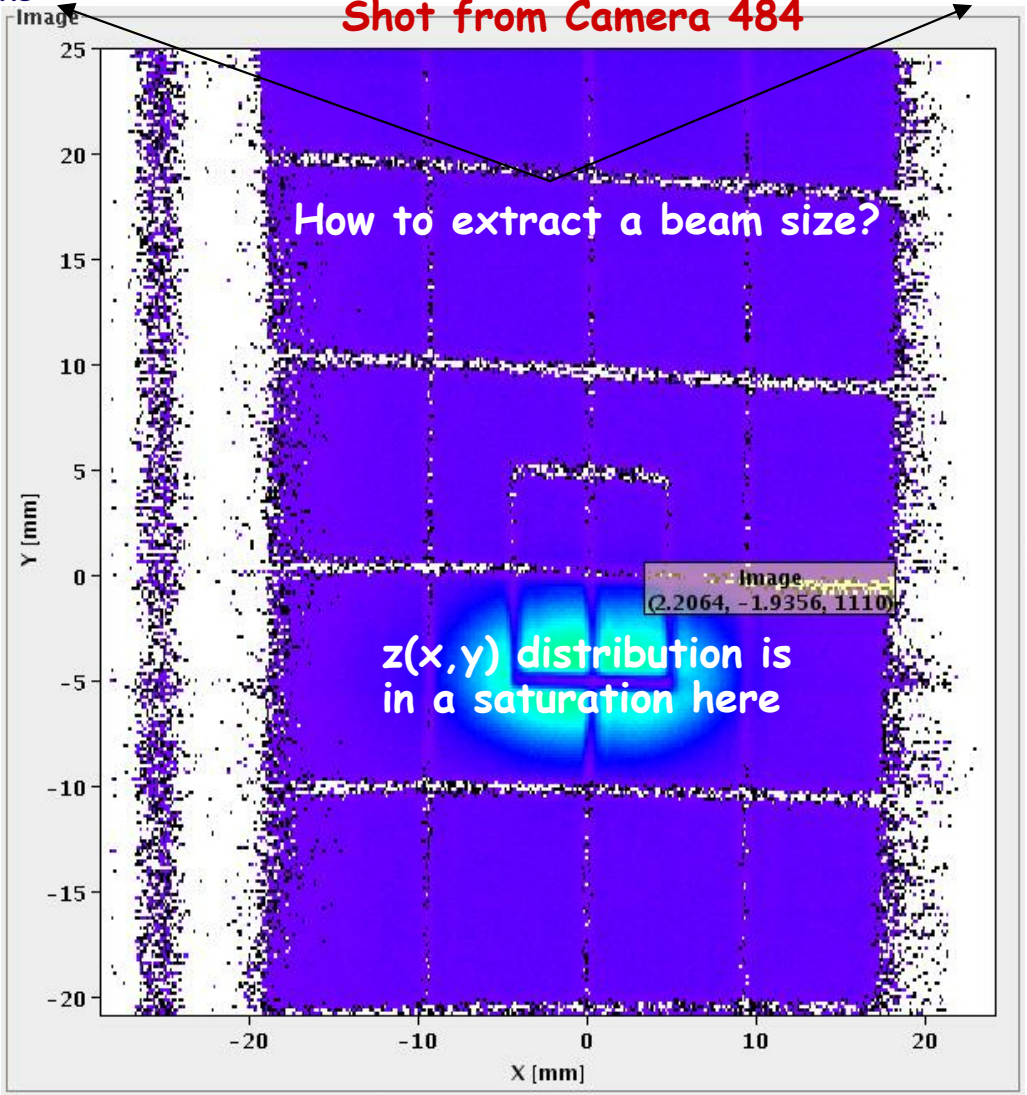
Camera positions: Camera 414, Camera 454, Camera 484 — BEAM → TARGET

1st approach: To fit projections*

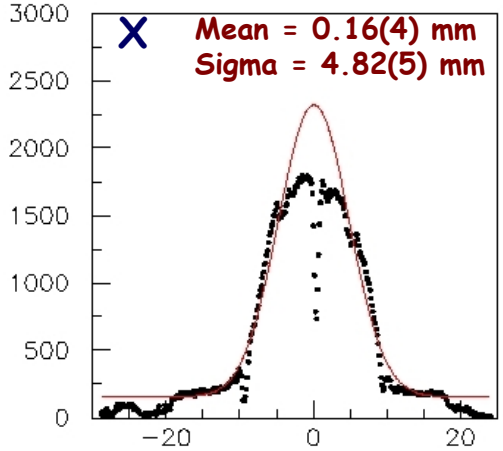


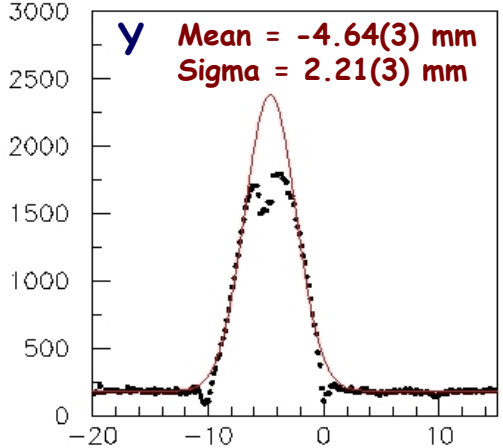


Shot from Camera 484



2nd approach: To fit shadows**





* 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.

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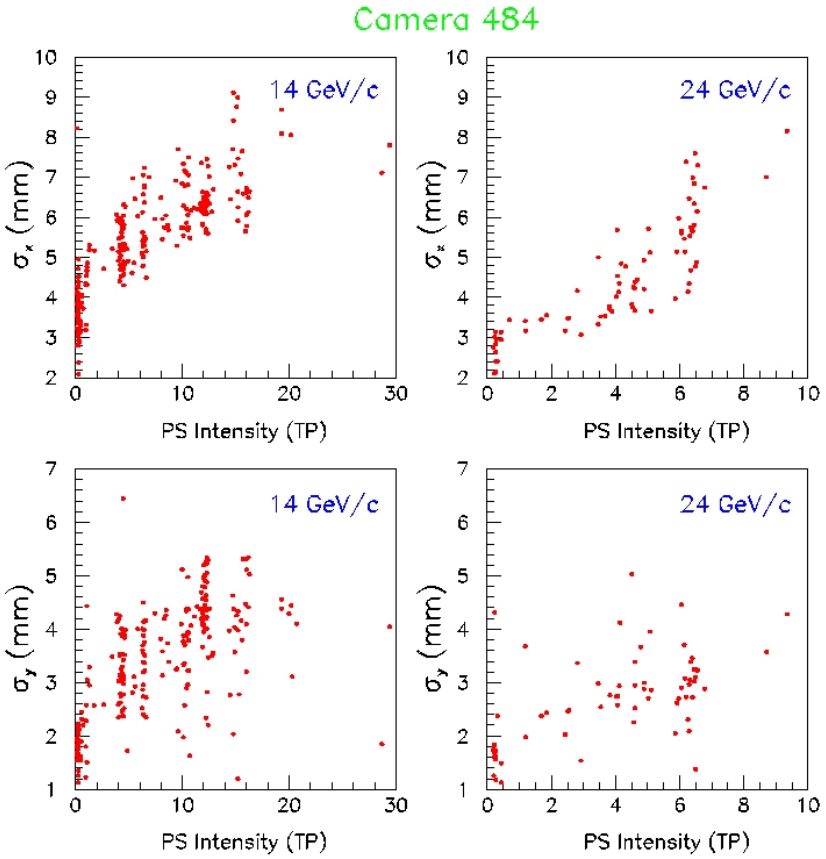
Fitting of projections result

Similar results have been obtained by fitting of shadows.

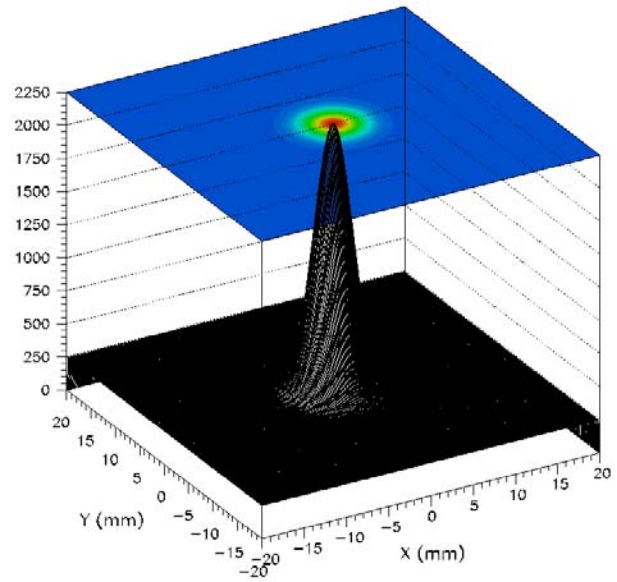


Objections:

1) Saturation is a problem ('we could have many sigmas hidden here')

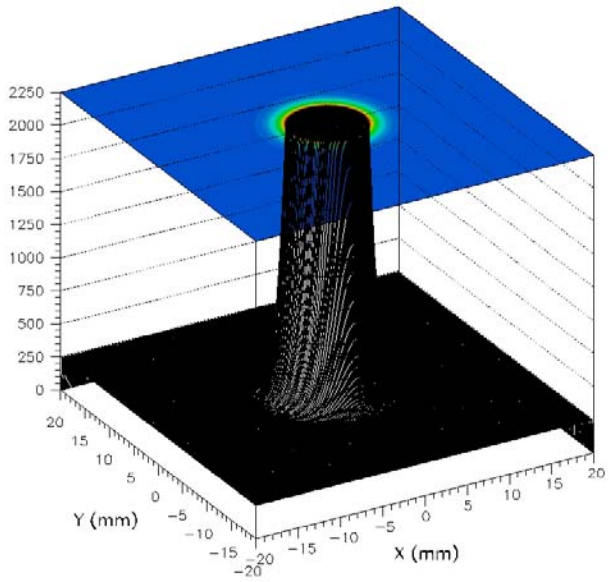
2) Shadows approach looks problematic for the highest beam intensities (only a few points left to fit tails)

If we assume that the 'light intensity' (from the screens) is proportional to beam intensity (before we reach a 'saturation intensity') we can, at least, to estimate the correction factor when fitting the projections.



This is not a problem (intensity is below the saturation level) and a projections approach will give us correct value of beam width(s)

This is a problem (intensity is 10x higher than the saturation level)



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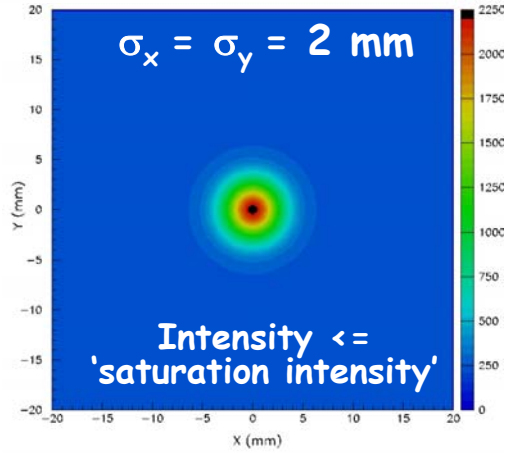
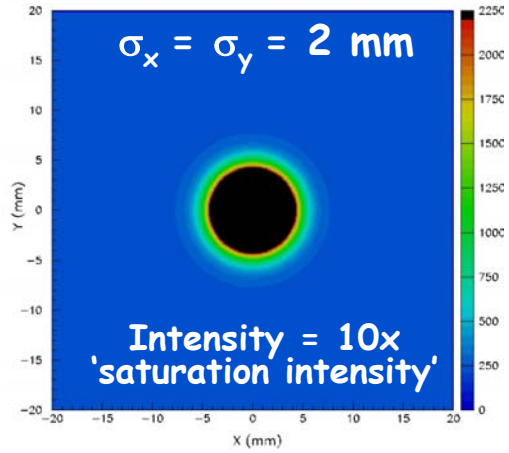
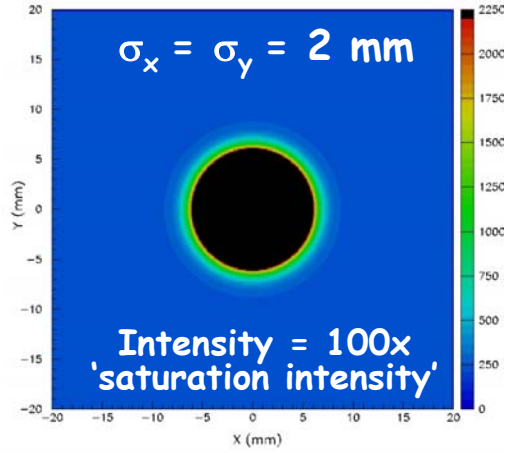
Simulation: Saturation effects



(1)



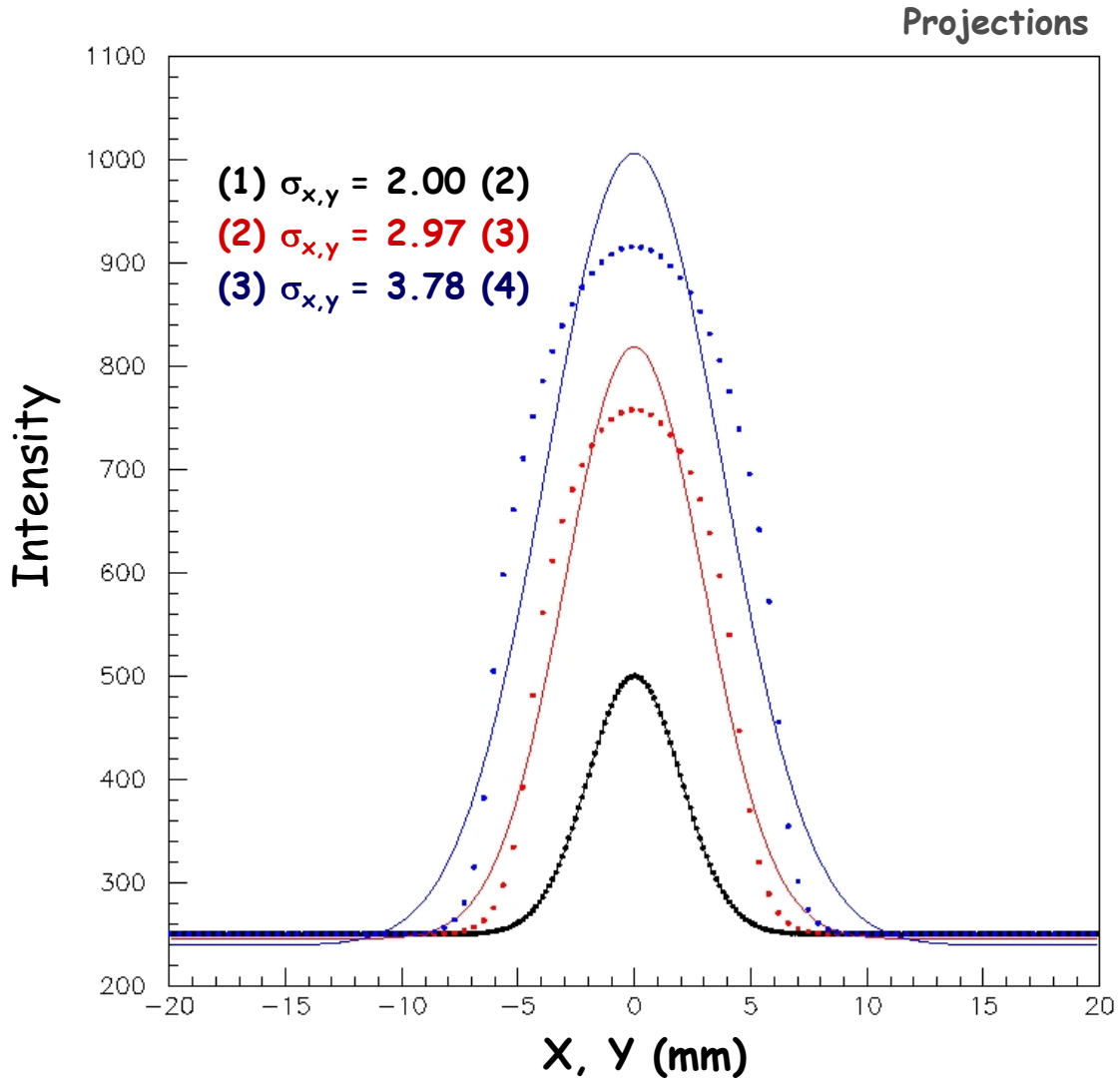
(2)



(3)

It is obvious that an extraction of projections from (2) and (3) will not give us gaussians

But, what will happen if we try to fit corresponding projections by using gaussian(s)?



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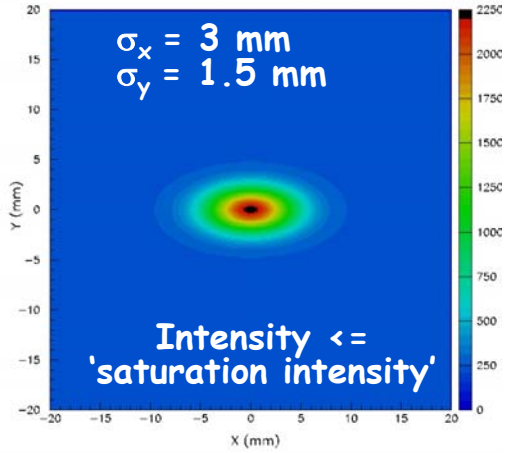
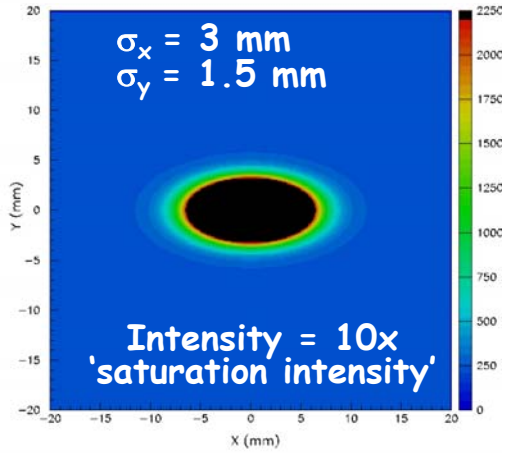
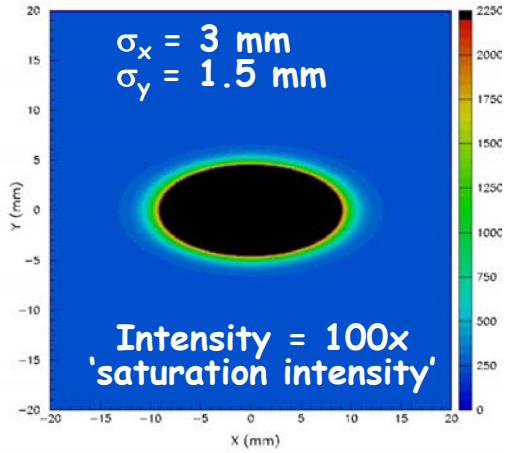
Simulation: Saturation effects

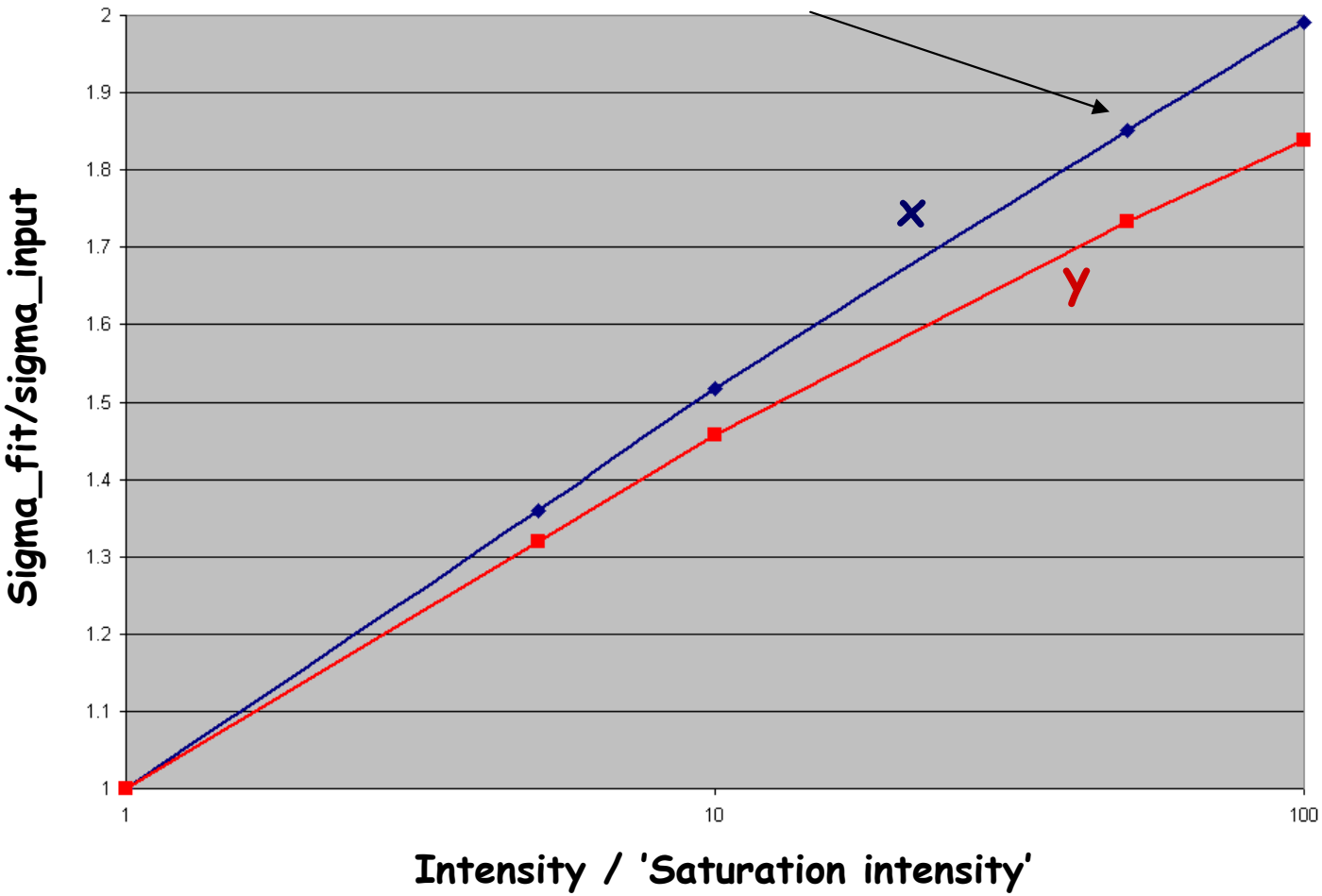






- Previous slide is for sigma_x = sigma_y
- In our case, expected value of sigma_x/sigma_y ~ 2
- By plotting sigma_output/sigma_input as a function of intensity we can estimate a correction function

'Symmetry' between x and y is broken



Next step: To find a value of 'saturation intensity' in our case

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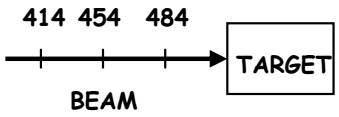
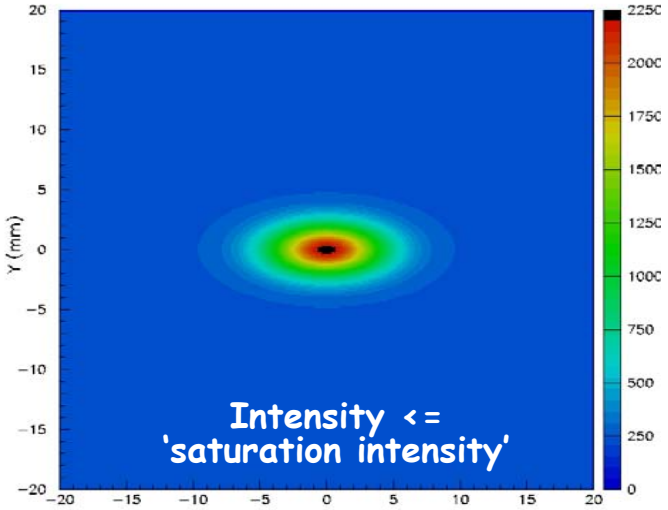
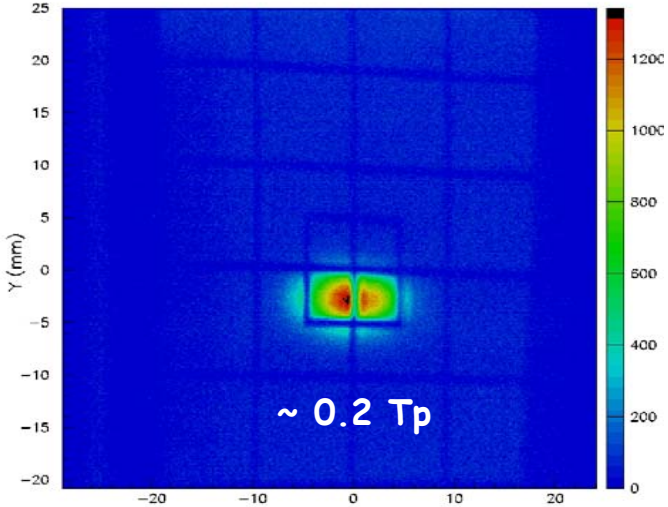
Reality vs Simulations

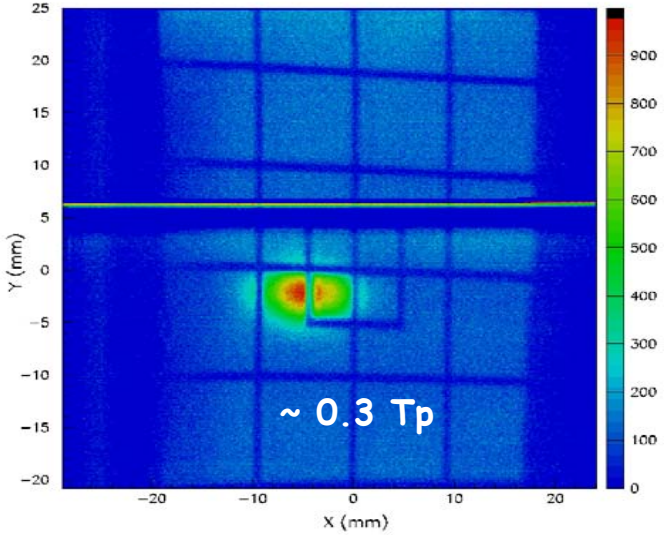


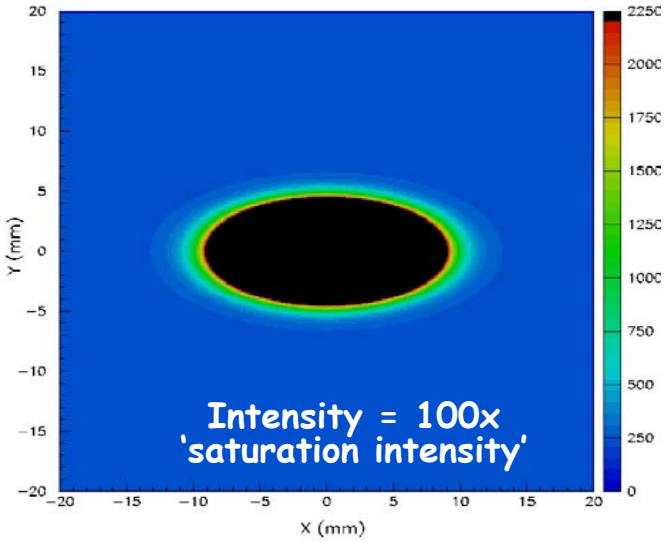
Simulations

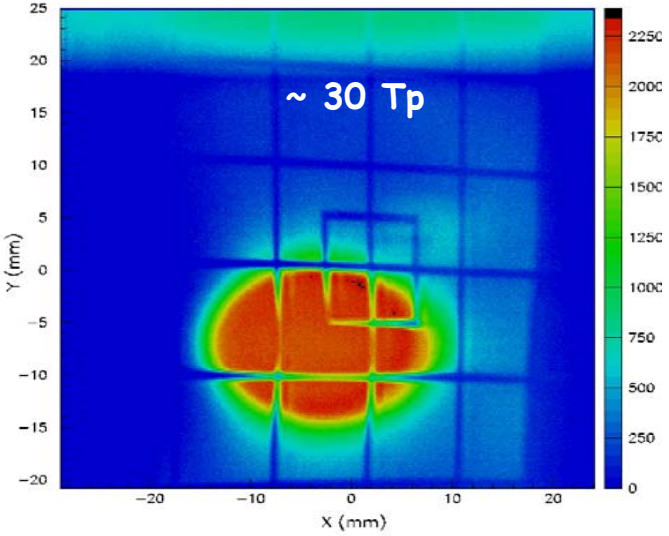
Experiment (Camera 484)

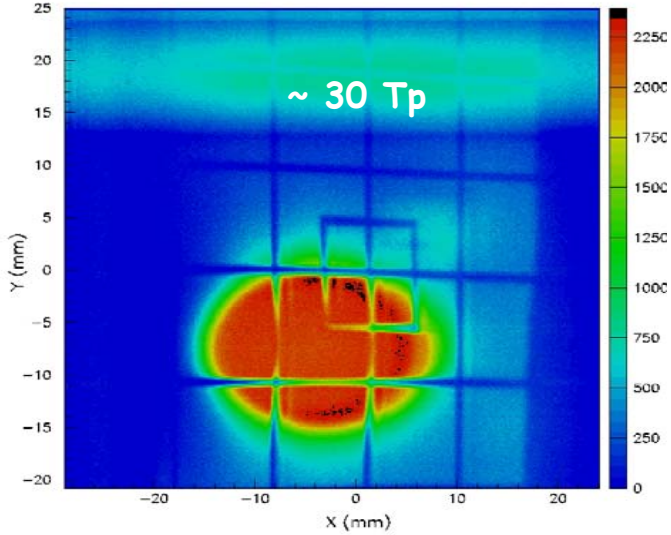












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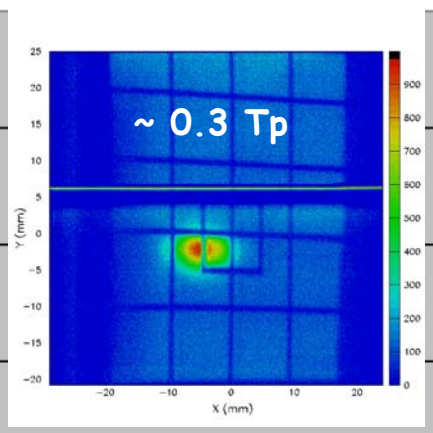
Results: 'Correction' function



'Saturation intensity' ~ 0.3 Tp

x

y

We can use these 'functions' to correct the data

Sigma_fit/sigma_input

2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1

1
10
100

0.3 Tp

Intensity / 'Saturation intensity'

30 Tp

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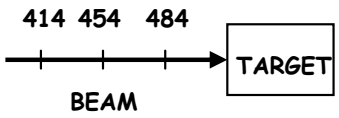
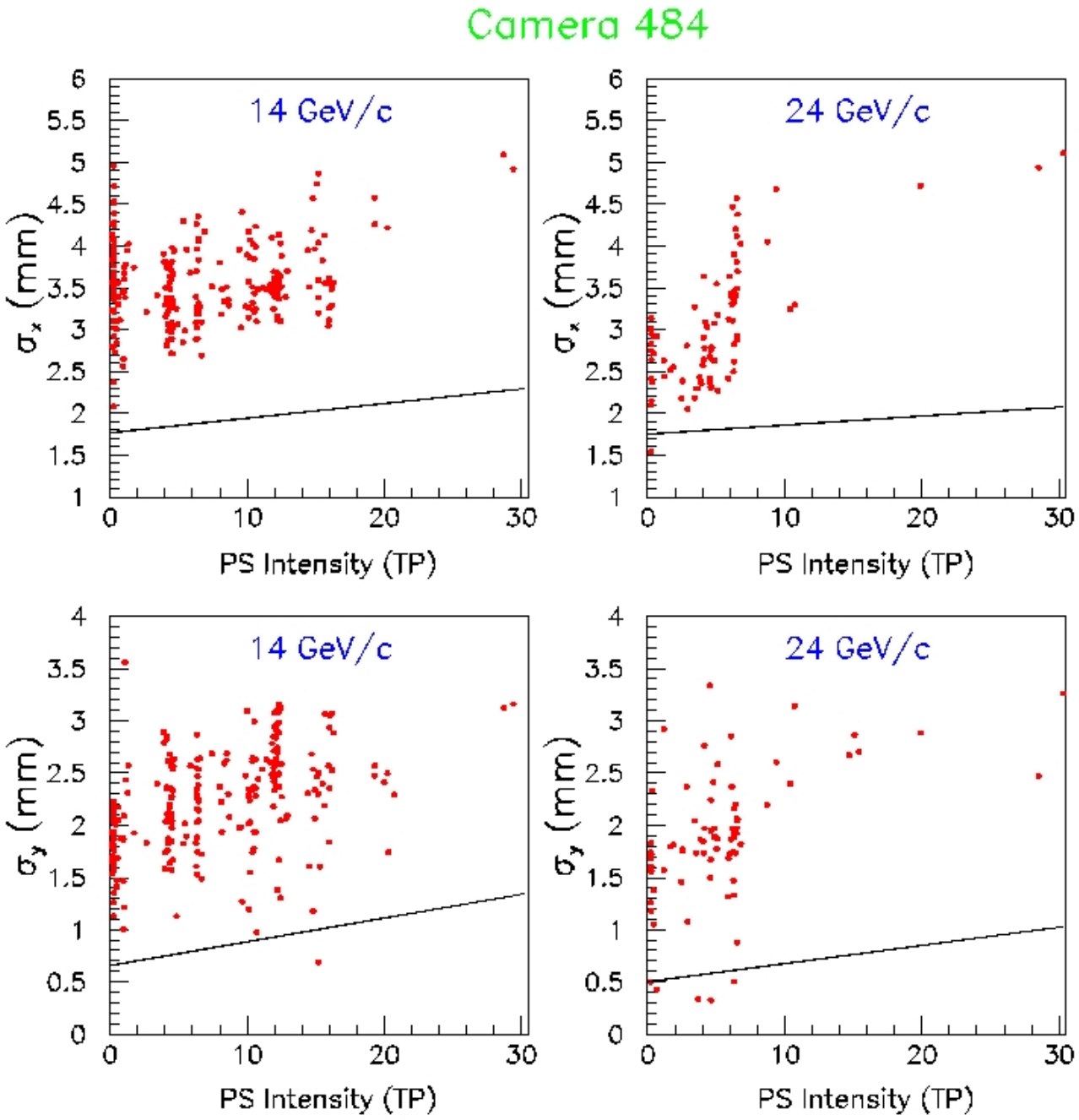
Results: Beam size vs beam intensity (after correction)





Dots: from beam monitors data

Lines: from beam optics calculations

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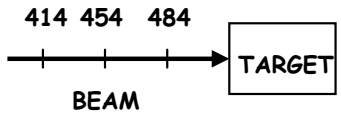
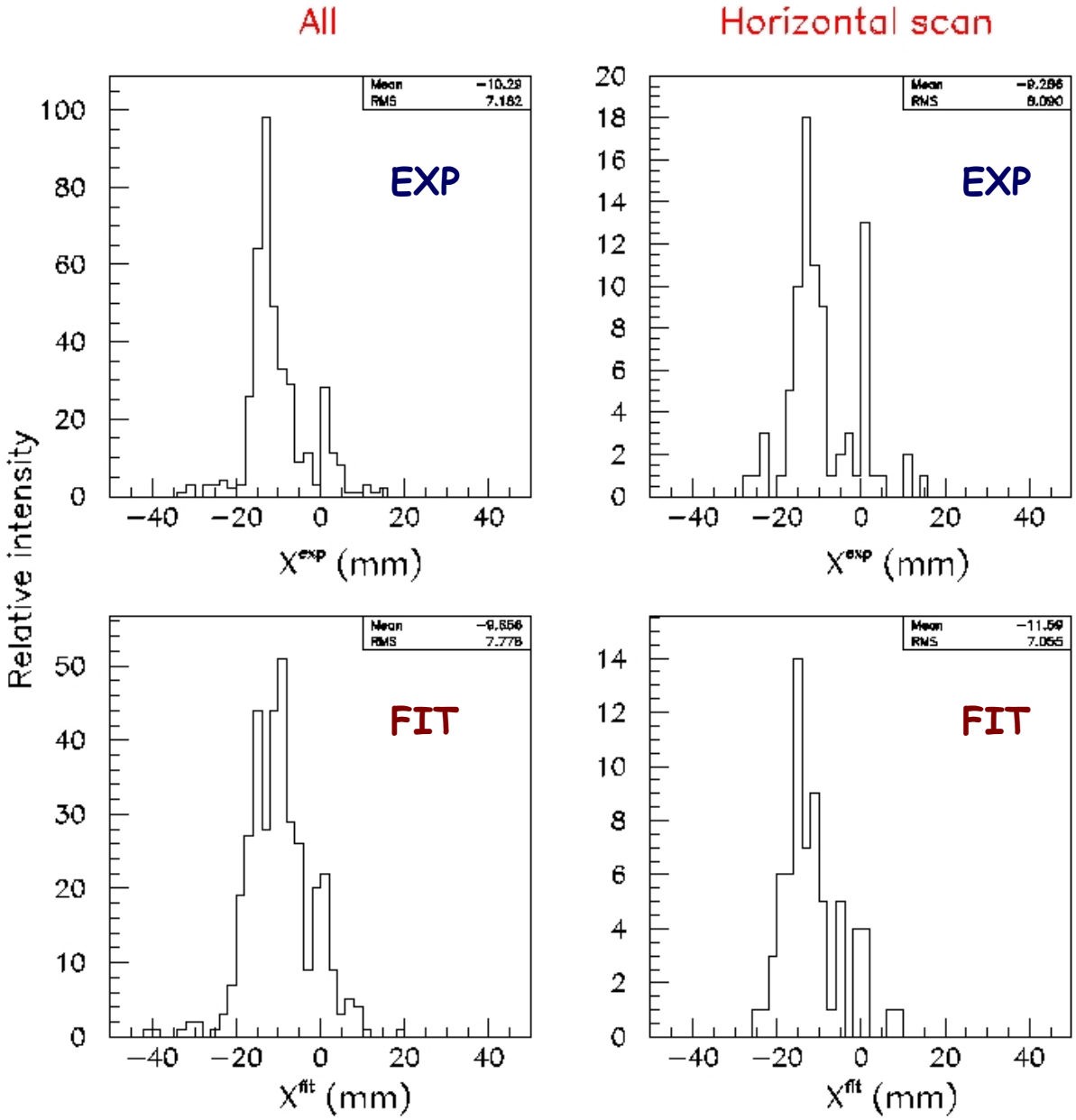
Results: Appendix



Beam position on target (horizontal scan)



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