

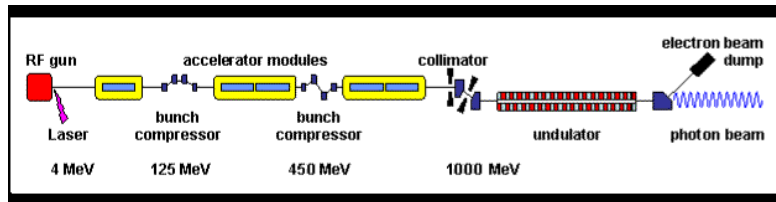
Monte Carlo Error Analysis for Wire Scanner Measurements at FLASH

Adriana Huerta Viga
Supervisor: Dr. Pedro Castro García

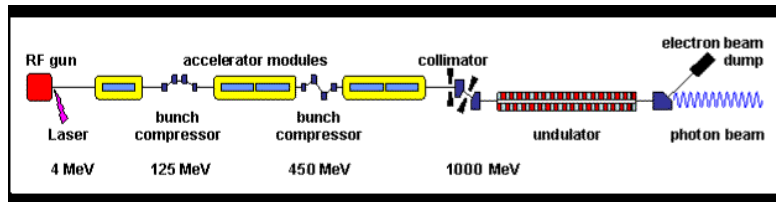
Cinvestav Mérida

DESY Summer Student Program
September 17th, 2007

Study the error contribution to measurements of the transverse electron beam profile with wire scanners.

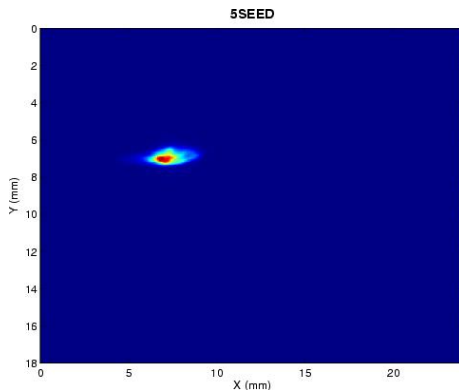


- Very straight beam trajectory along the undulator.
- Very high electron density inside bunches.
- → Instrumentation for transverse beam size.

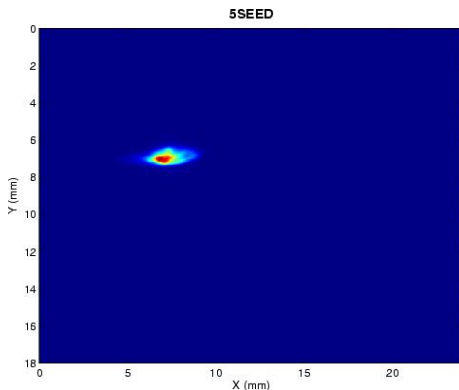


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View Screens

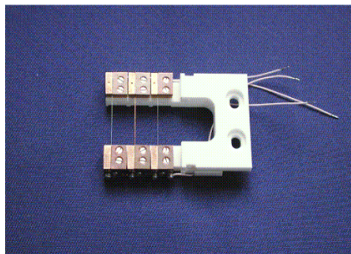


- Interaction with the screen destroys the electron beam.
- Radiation emitted would damage undulators.



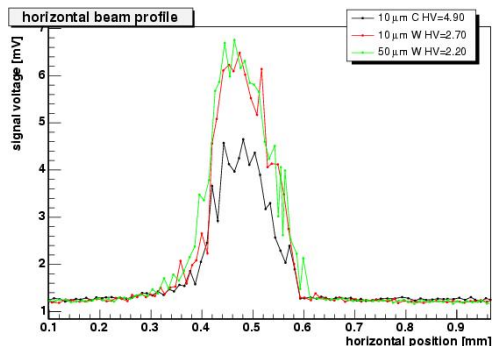
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Wire Scanners



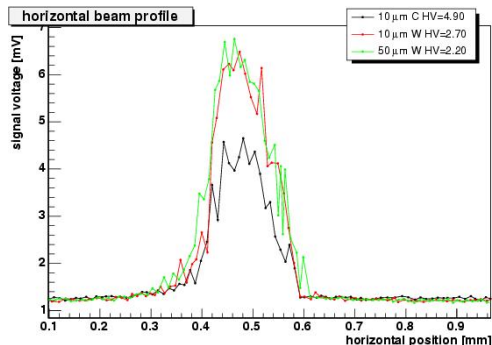
- Electrons interact with the wire and unleash a cascade of electromagnetic radiation.
- This is detected by a photomultiplier positioned downstream.

Profile measured with WS



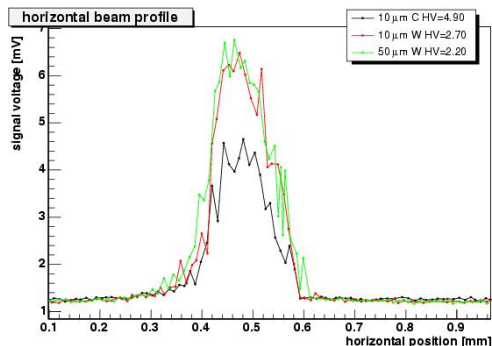
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- They do not have same position nor charge.

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- 1 A Gaussian points profile is generated with sampling frequency n_s
- 2 Errors are introduced to the coordinates:
 - **ex** → successive bunches motion.
 - **ey** → detector noise.
 - **ey2** → charge variations between bunches.
- 3 The σ of the new profile is obtained.

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Monte Carlo simulation

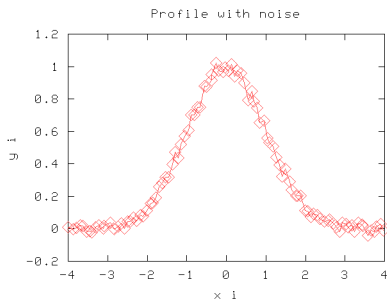
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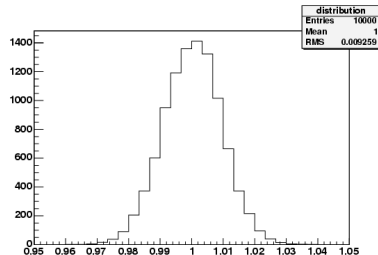
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Simulations

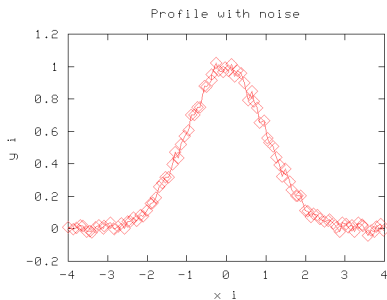


- $ex = ey = ey2 = 2\%$ and $n_s = 12.5$

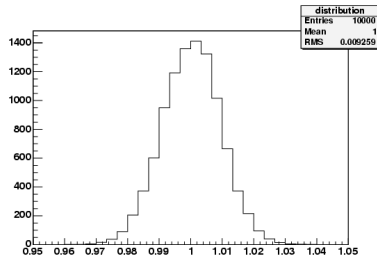


- Every σ_k goes in the histogram
→ Standard deviation: σ_{sd} .

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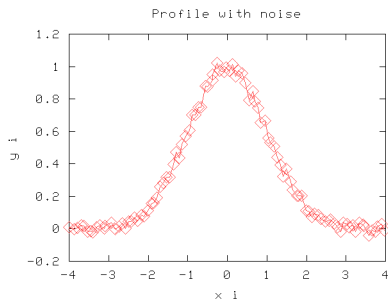


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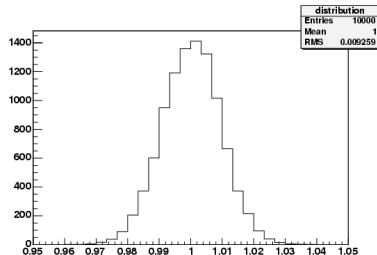


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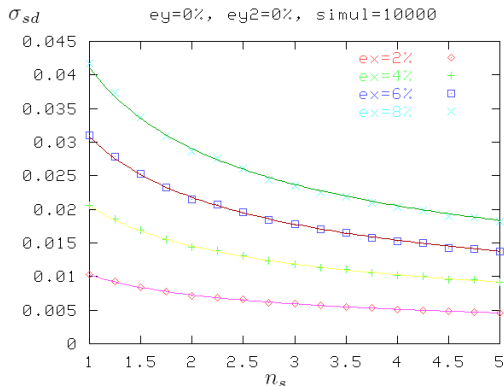
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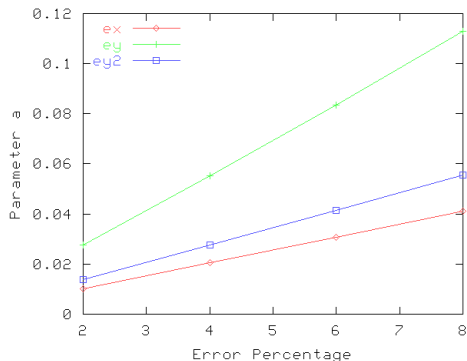


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- The curve $\sigma_{sd} = \frac{a}{\sqrt{n_s}}$ is fitted to the points.

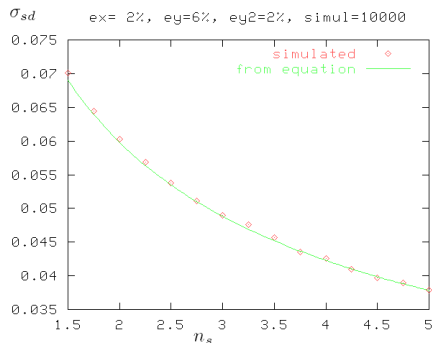
Fitting parameters



- The slopes define a unique parameter for each error.

A_x	A_y	A_{y2}
0.51	1.38	0.69

Combined errors in simulations

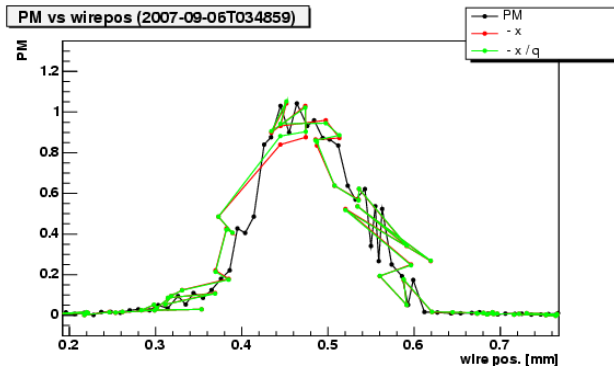


- It was proposed

$$\sigma_{sd} = \sqrt{\frac{(A_x ex)^2 + (A_y ey)^2 + (A_{y2} ey_2)^2}{n_s}}$$

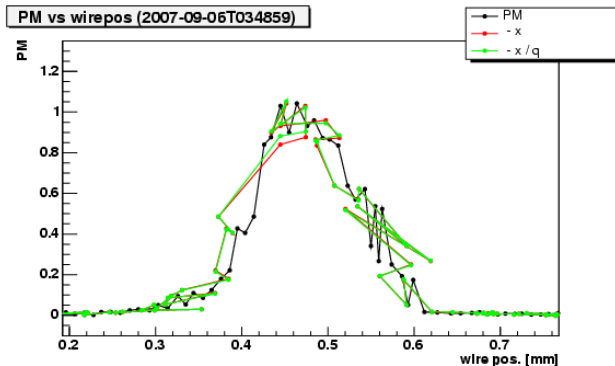
- From Analysis of real data $\rightarrow \sigma_x$ contributes the most to σ_{sd}

Introducing position and charge corrections



- The curve worsens when the corrections are introduced.
- Measurement error of position monitor is bigger than the corrections!

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- It is necessary to lower the error of the monitor.
- → Correlation method between several position monitors.