First parasitic crossing effect on ILC headon scheme luminosity

(by T. Derrien & J. Brossard)

I. Context : ILC / Head-on scheme

II. Description : Program structure / Modelisation /Tools

III. Results

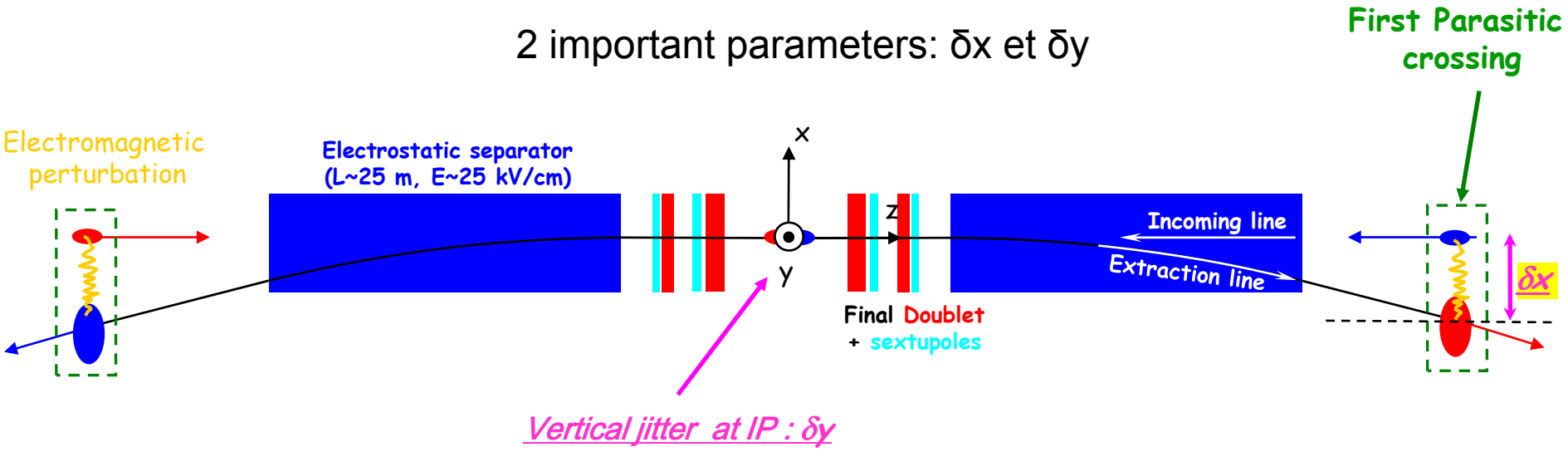
IV. Conclusions

I. Context : ILC, next linear collider

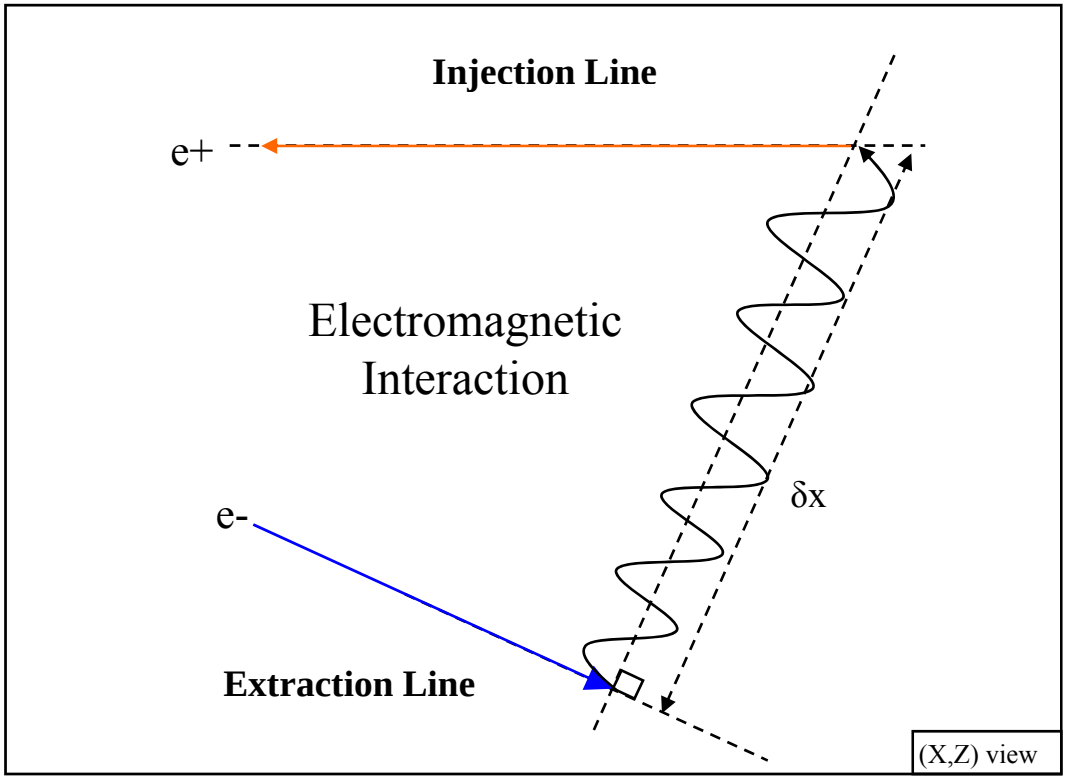
- ILC: e+/e- (*center-of-mass* = *laboratory rest frame*) 500 GeV collider
- Three schemes proposed
  - 14 mrad scheme
  - 2 mrad scheme
  - Head-on scheme

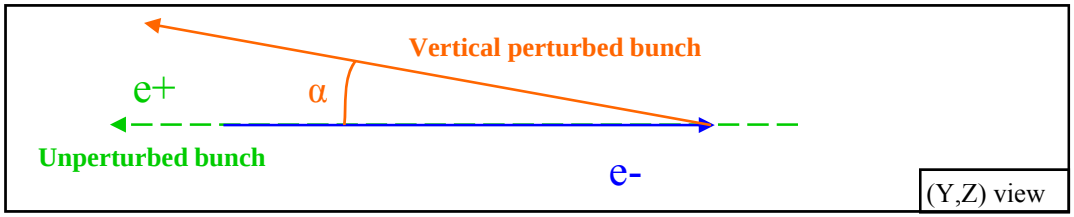
⇒ Challenge for head-on scheme : **electrostatic separator design.**

2 important parameters: δx et δy



ILC, First Parasitic Crossing (FPC)





- Vertical electromagnetic perturbation induced by outgoing bunch on the next incoming bunch.

$$\vec{F} = q(\vec{E} + \vec{v} \wedge \vec{B})$$

II. Modelisation

- Extraction line tracking performed with « Dimad ».
- Parasitic crossing interaction based on a relativist electrodynamic model (see « Beamstralung & Disruption », *L.Z. Rivkin). Each macroparticle is approximated by a cylindrical gaussian distribution.*

$$\alpha_y = -\frac{2R_{e^-}}{\gamma}\frac{N_{particules}}{N_{macroparticules}}\sum_{i=1}^{N_{macroparticules}}\frac{y_i}{(x_i-\delta x)^2+y_i^{\,2}}$$

α_y: angle vert. perturbation

Re : classical electron radius

γ: Lorentz factor

X,Y : distances between injection particle, and i^{-th} of extracted particle

- *Vertical* jitter simulation (Box-Müller method for creating gaussian distribution)
- Adapting GuineaPig grid (under progress).

II. Modelisation

Injection Line Tracking

- Injection line nominal particle tracking : multiplicative constant.
- Nominal particle coordinates rest frame.

Initial DIMAD second order tracking

$$X_i = R_{ij} X_j + T_{ijk} X_j X_k \qquad X_i = \begin{pmatrix} x_i \\ x'_i \\ y_i \\ y'_i \\ s_i \\ (p_i - p_o)/p_o \end{pmatrix}$$

becomes…

$$\Rightarrow y = R_{34}.y' + T_{344} y'^2 \approx 0{,}5436\, y' + o(y')$$

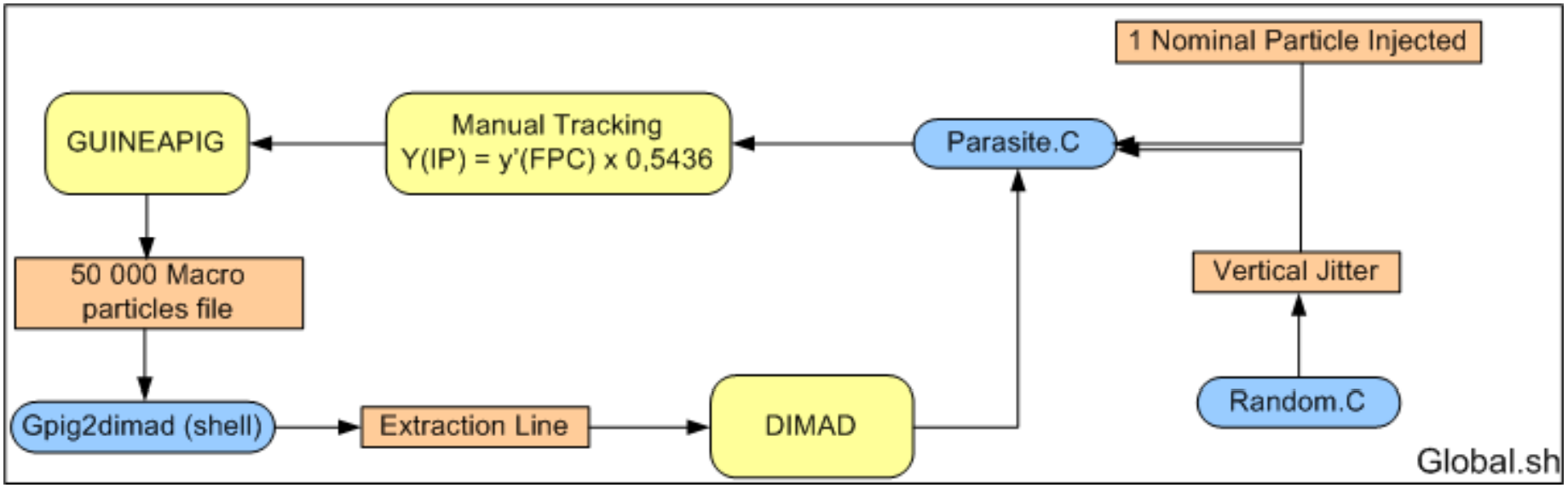
History of simulations

Eurotev report (cf CEA)	April 06
Simulation Matlab (Julien) with 1 macroparticle	Jan 07
My software has been requested in order to work with thousands of macroparticules in extraction line, under a portable environment (→Linux/Unix)	since May 07

Simulation tools

- 3 programs needed
  - 1 for tracking particles : Dimad
  - 1 for bunches interactions : GuineaPig
  - 1 for interaction at « first parasitic crossing »
- « First Parasitic Crossing » Interaction simulation code with C langage.
- Englobe these programs : Shell (bash/sh)

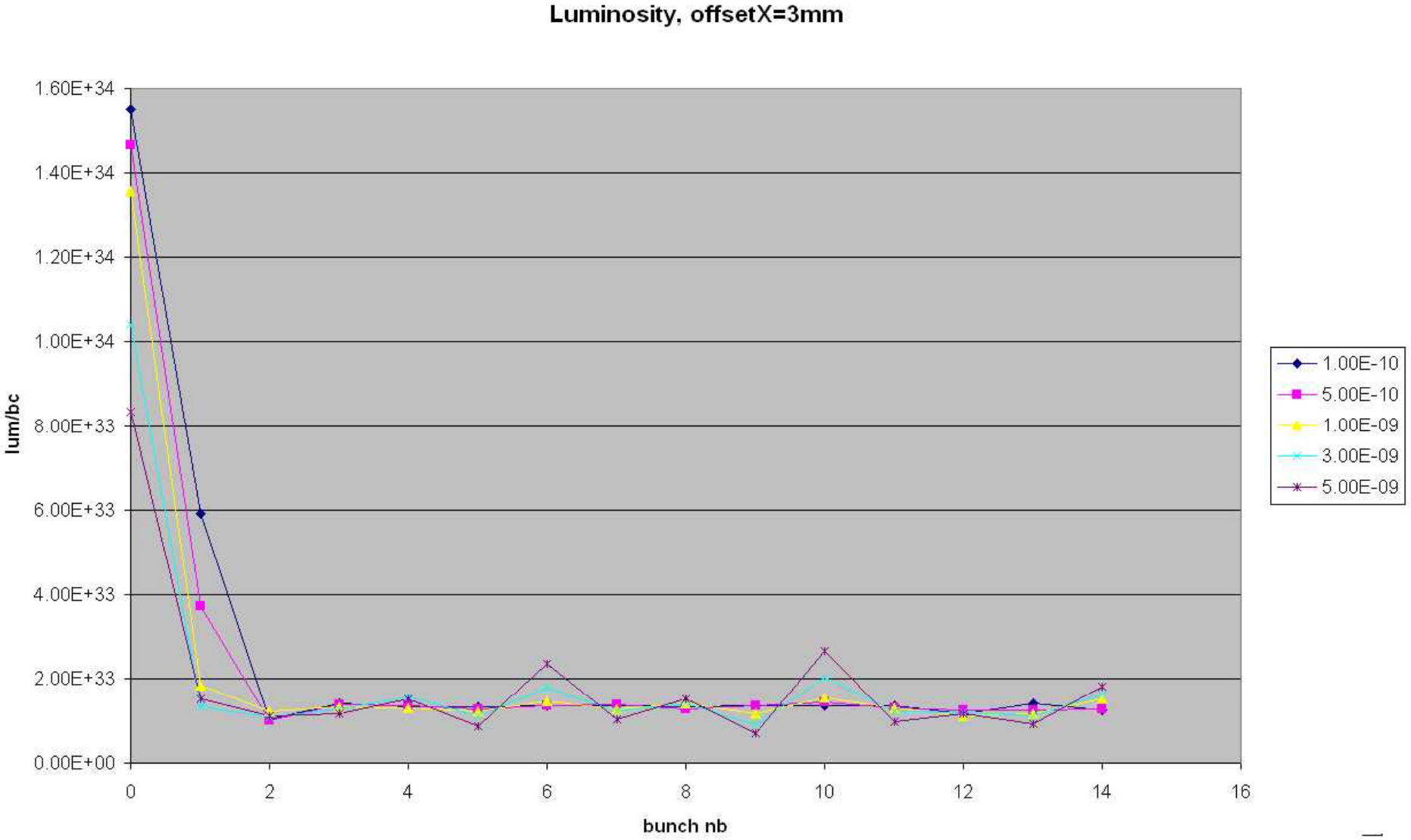
II. Program structure



Customisable Parameters

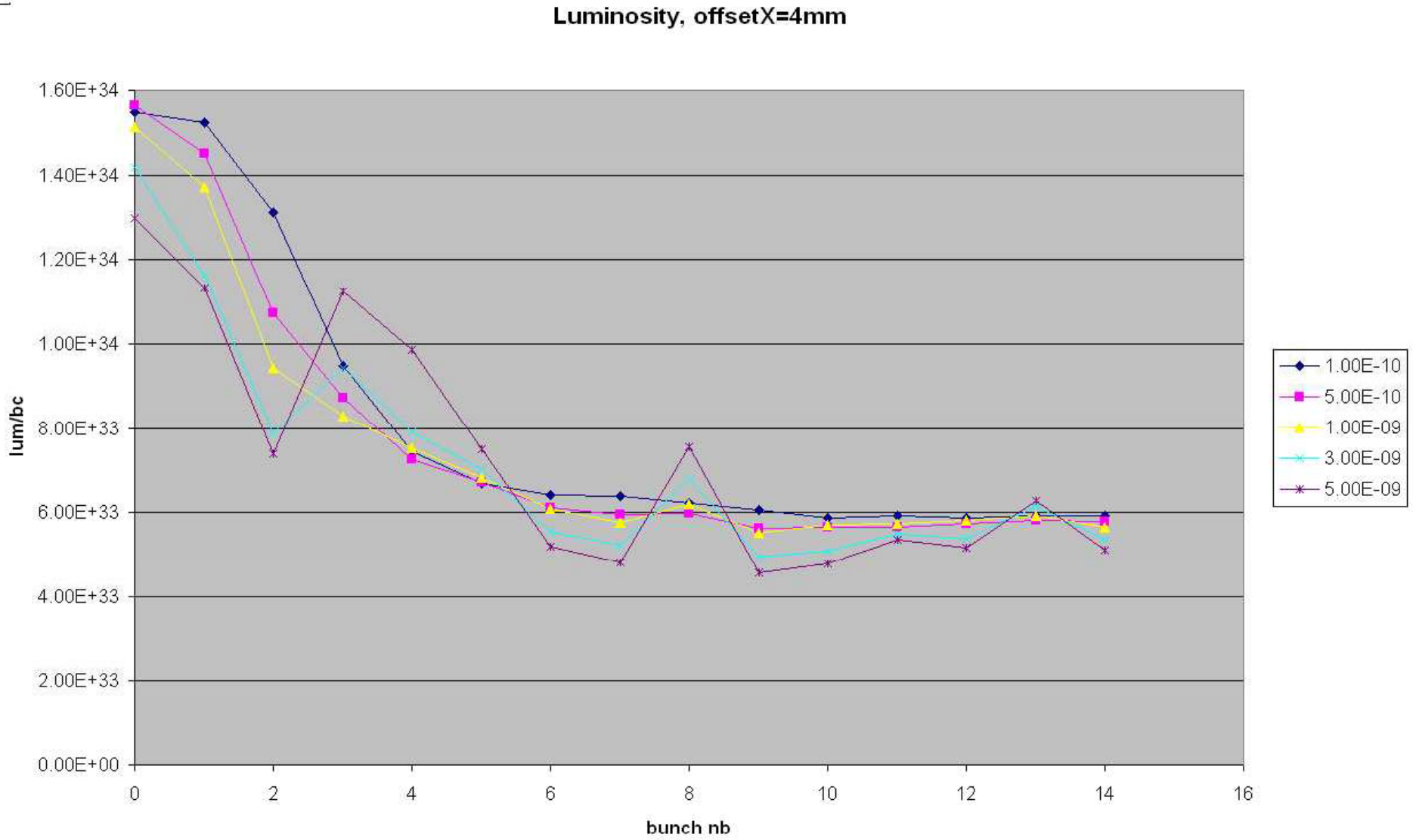
- RMS of V-Jitter randomly generated (box-muller method)
- Number of bunches per horizontal offset
- Horizontal offsets

Results



LAL/IN2P3 - ILC. Julien Brossard,
Thibault Derrien.

Results



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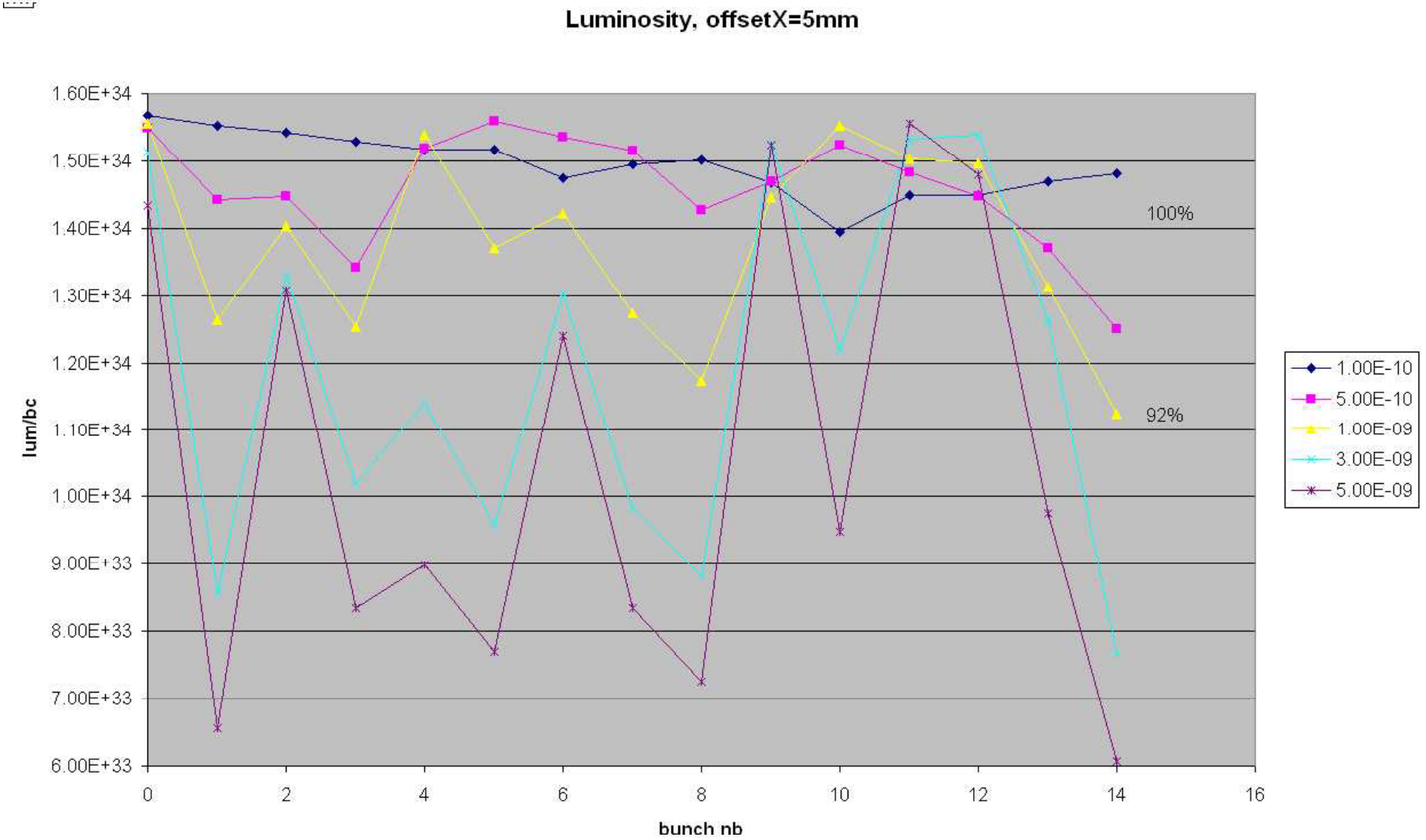

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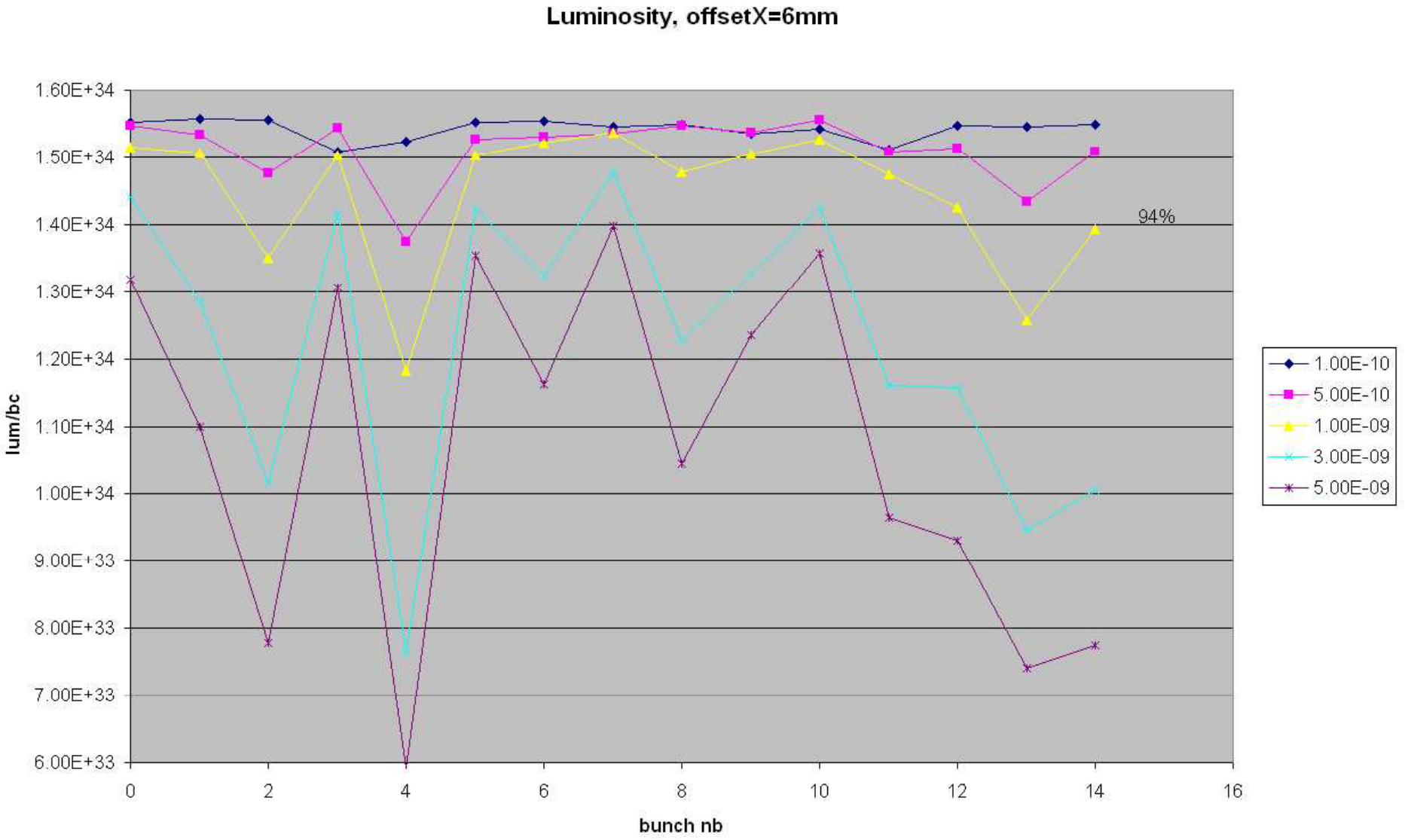

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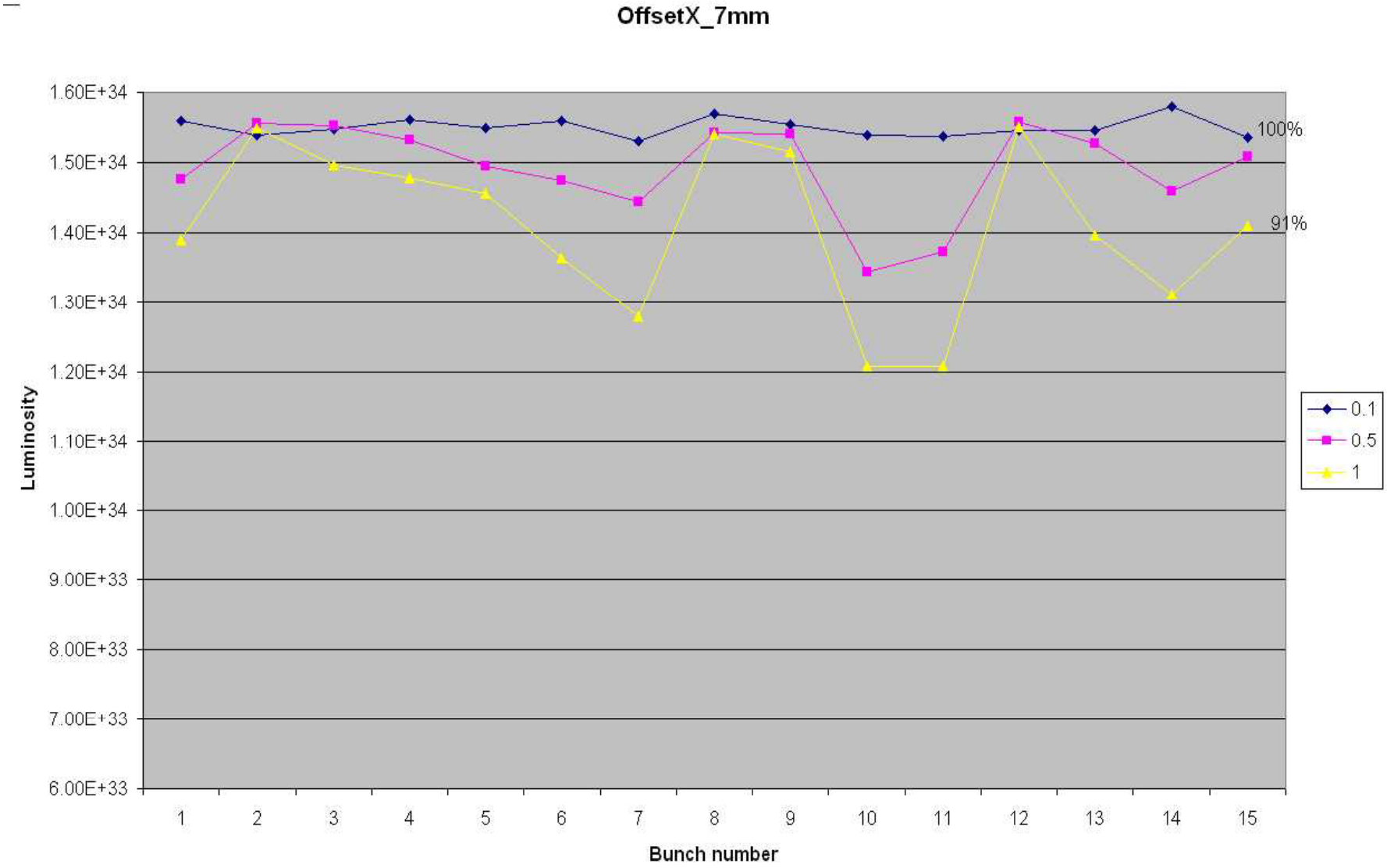

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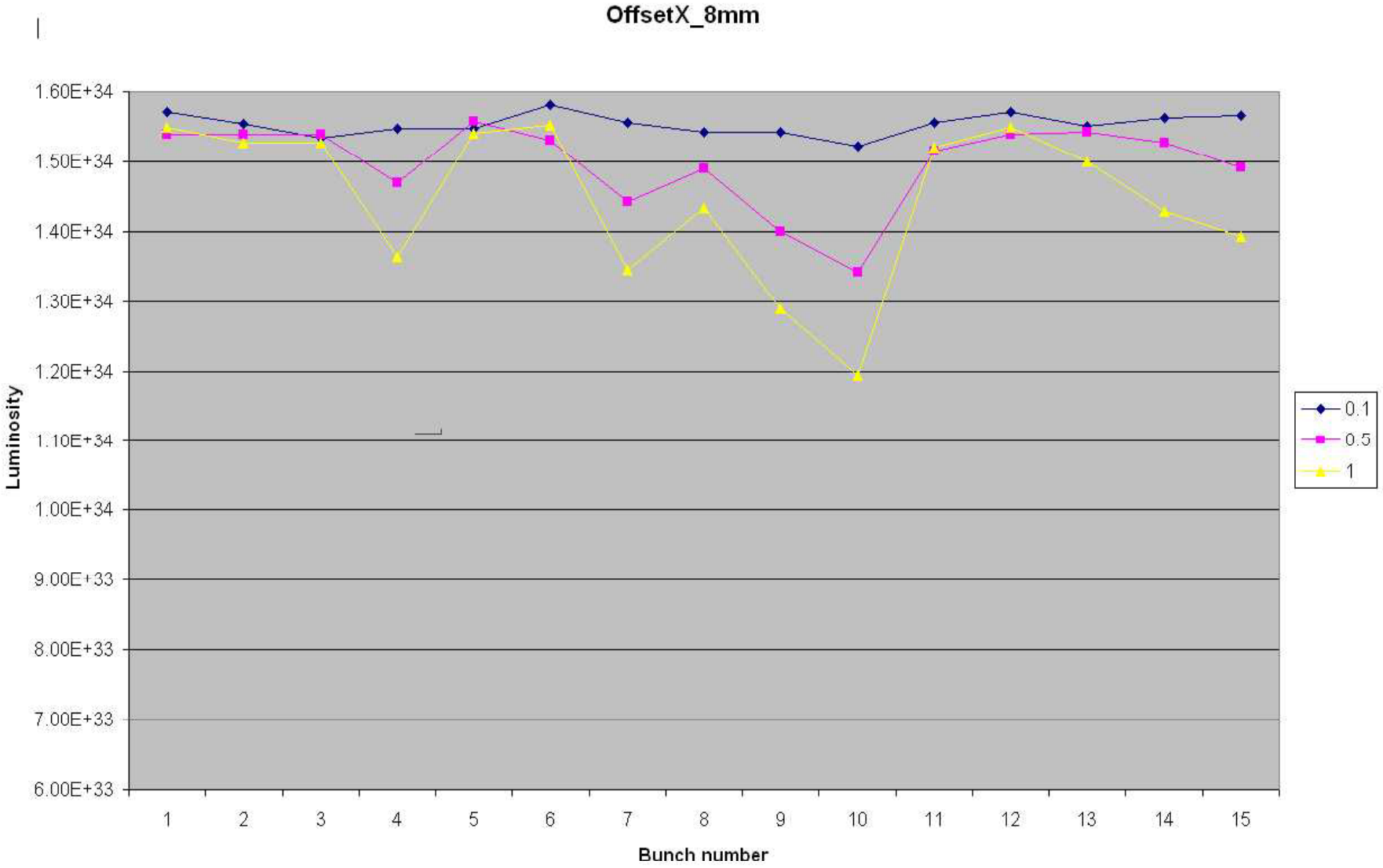

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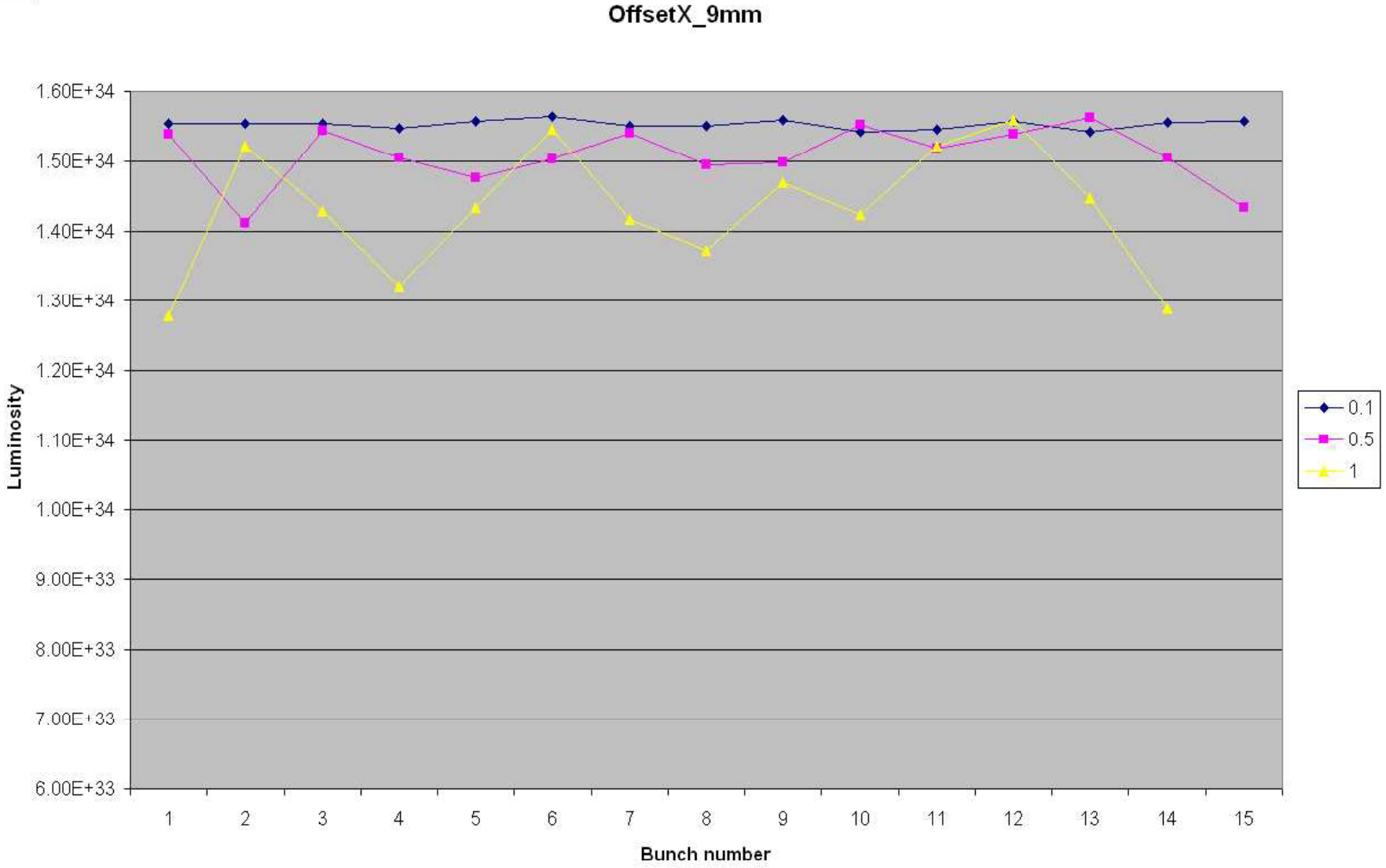

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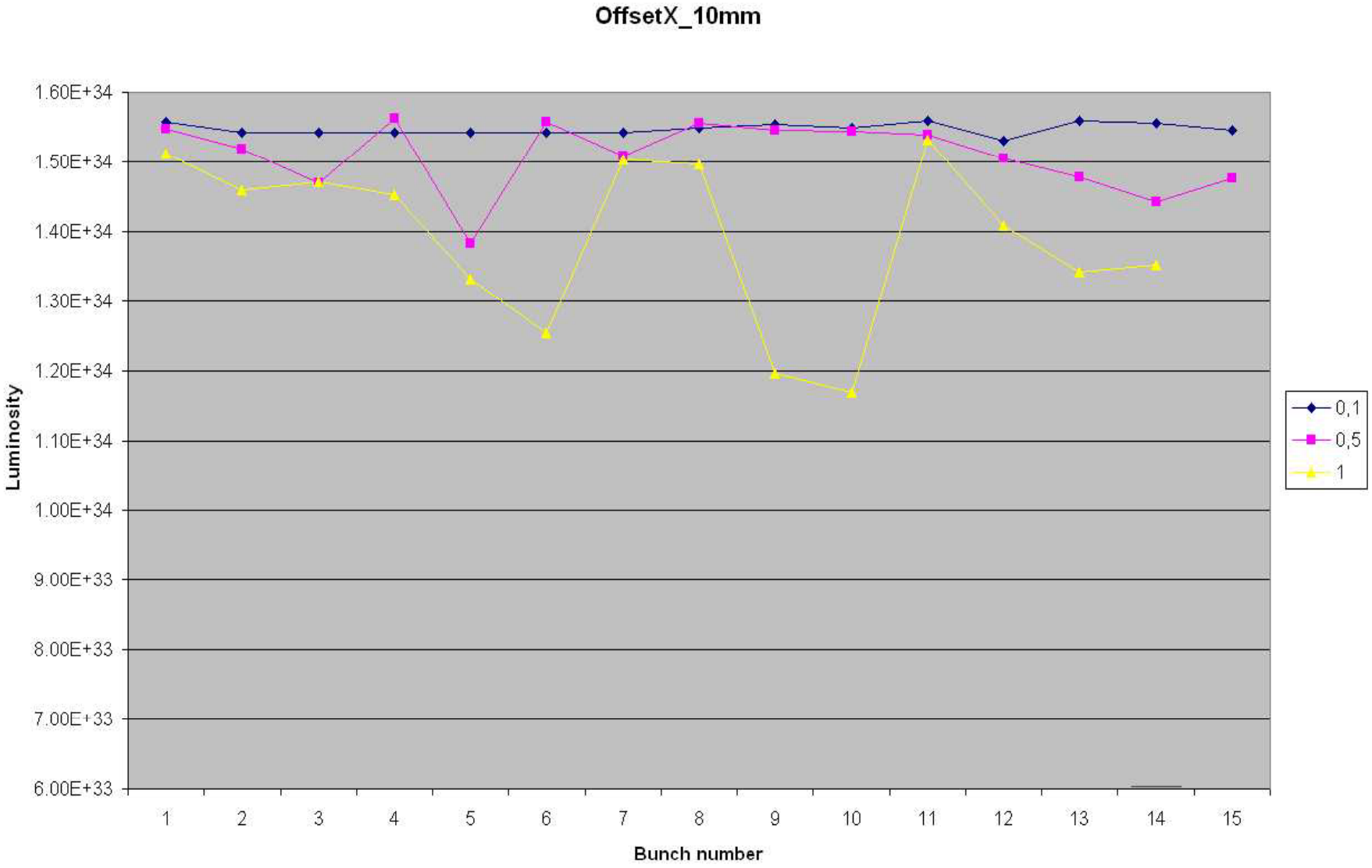

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Conclusion

- Software is now completly debugged !!

- Complete previous analysis with σ_{y_jitter} = 3 and 5 nm for offset_x = 10, 9, 8 and 7 mm

- Compare Simulation with Guinea-Pig distribution with 1 nominal particle….to be done !!