

Development of an EDUGATE simulation toolkit for the easyPET scanners family



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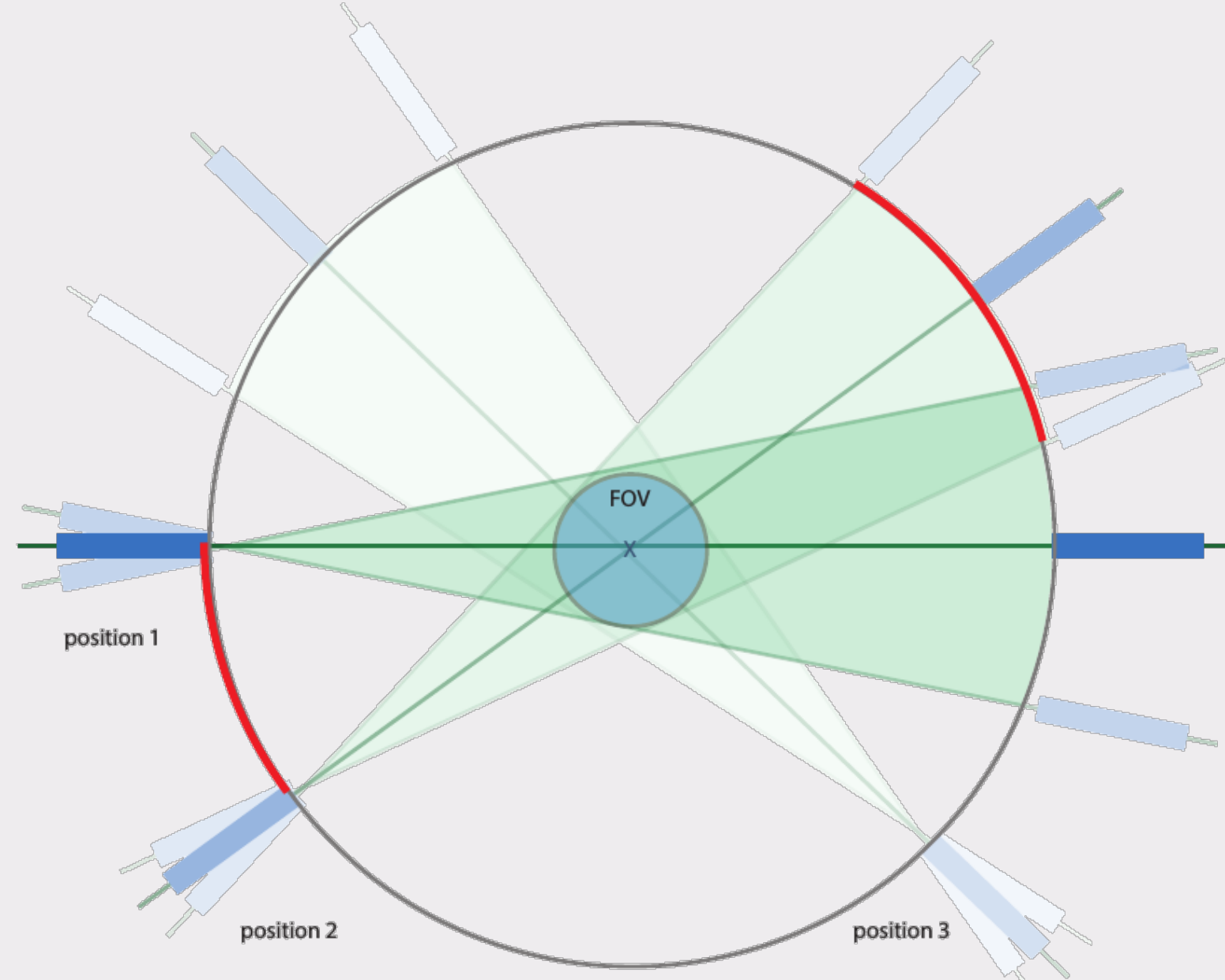
Abstract

EasyPET is a new concept of a PET scanner using an innovative acquisition method based on two rotation axes for the movement of detector pairs. Due to its simplicity, its suitable for education purposes, to teach students about the PET technology and its basic concepts, from the radiation detecting and analog pulse analysis to the coincidence sorting and image reconstruction. The concept allows achieving high and uniform position resolution over the whole field of view (FoV), by eliminating parallax errors due to the depth of interaction (DOI).

The technology developed at the University of Aveiro with a patent-pending, is licensed to CAEN S.p.A, and included in the educational catalog of the company. In this work, a simulation toolkit based in the easyPET available from CAEN is presented. It can simulate all the physical aspects of the product, such as the scanning range, variable Field-of-View (FOV), scintillator energy resolution, coincidence time and energy window, among others. A simple image reconstruction algorithm based on FBP is implemented. The toolkit allows a quick analysis in classroom of the simulation results. The platform was also used to study the new EasyPET 3D version, and a simulation of a NEMA NU 4-2008 IQ phantom was performed, demonstrating the capability of the platform not only for education purposes but also for research.

Patent - Universidade de Aveiro: PCT/IB2016/051487

Operation Principle



Acquisition method - based on **2 rotation axes** for the movement of detector modules.

Allows full axial imaging (full animal body) with a small number of crystals.

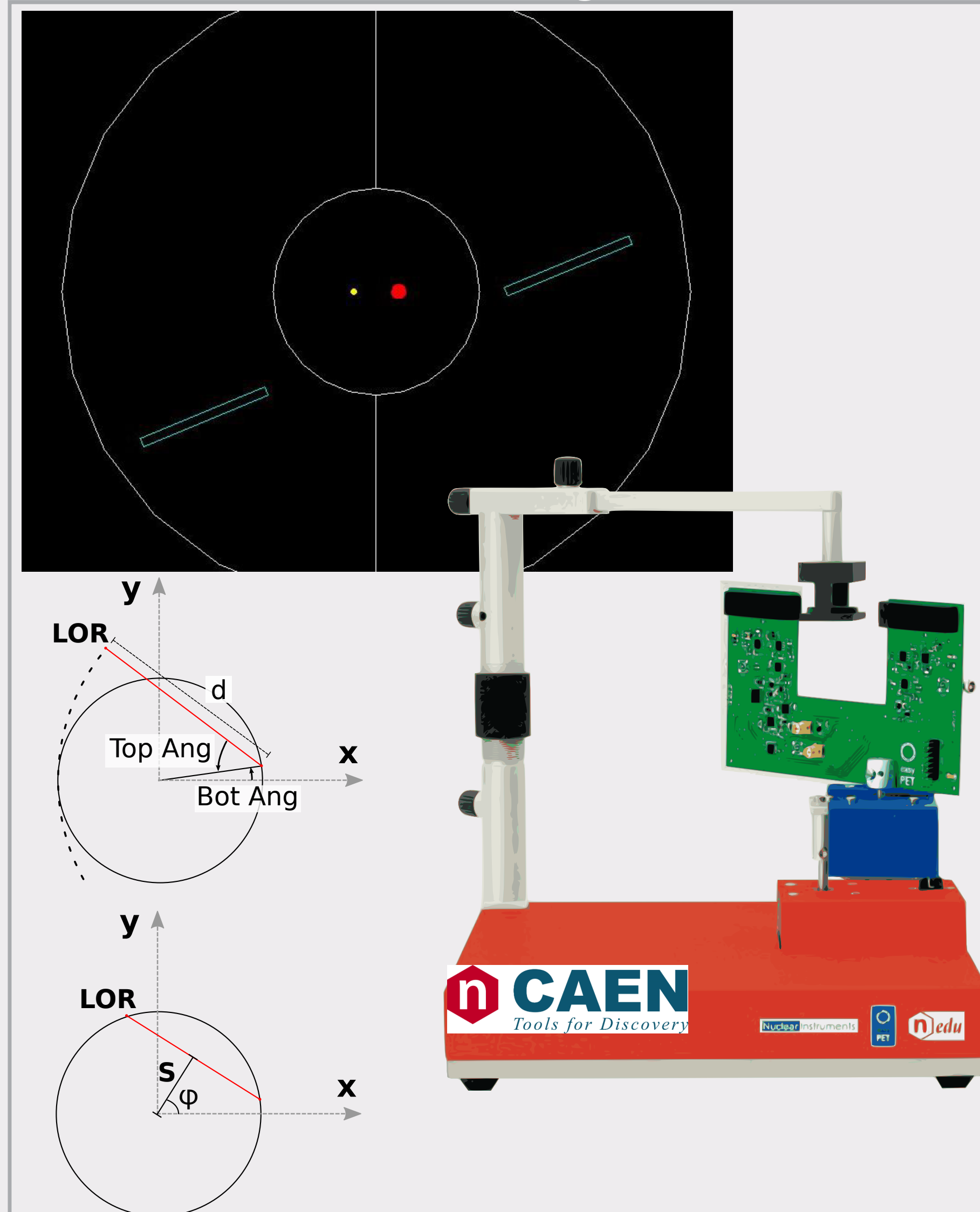
High spatial resolution and uniformity over the whole FOV.

Eliminate the parallax error due to depth of interaction (DOI):

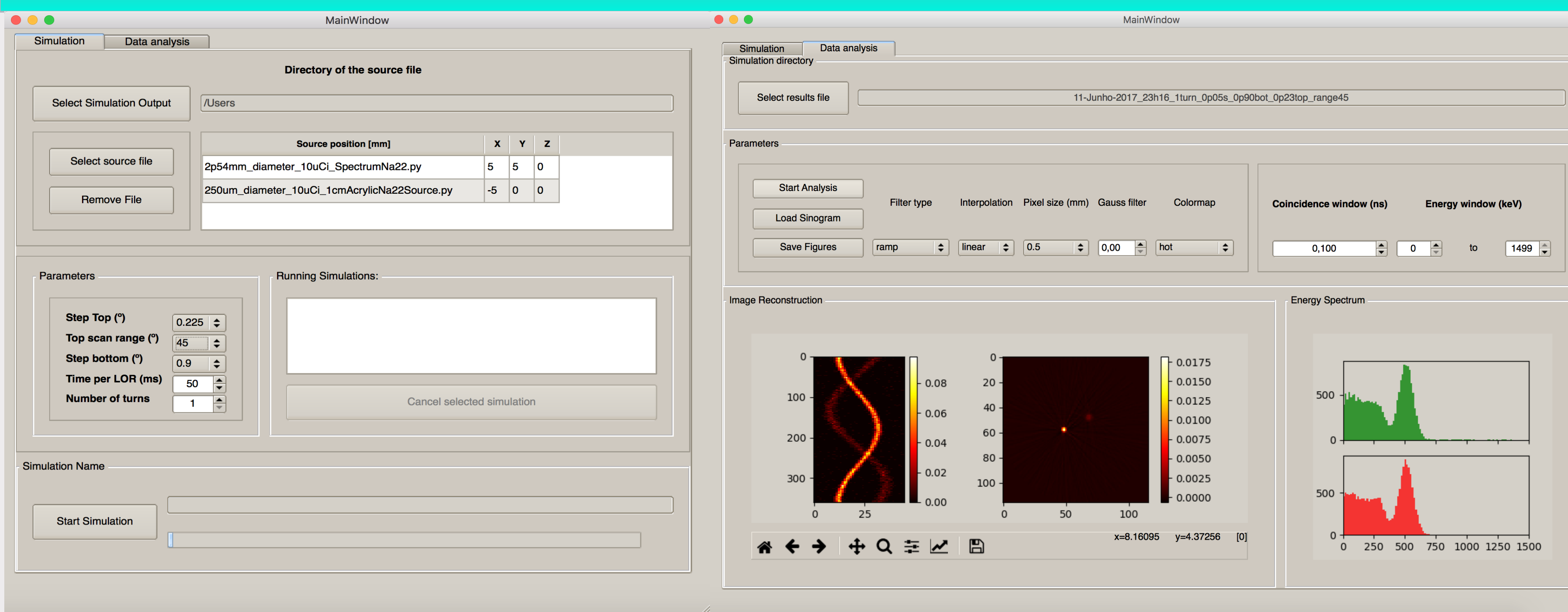
-does not impose limitations on the proximity of the detector elements to the FOV;

-favours system sensitivity.

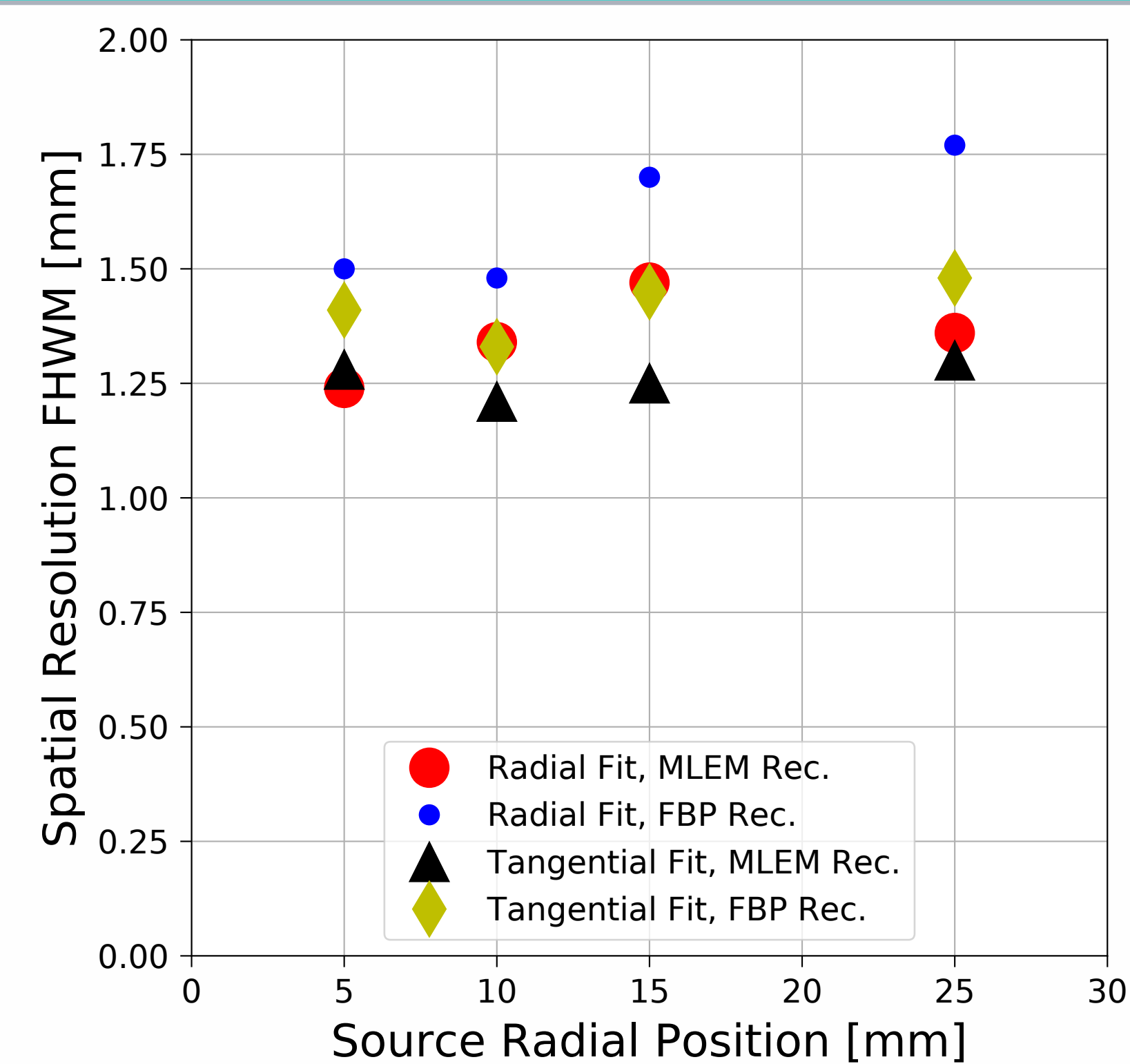
The easyPET



User Interface

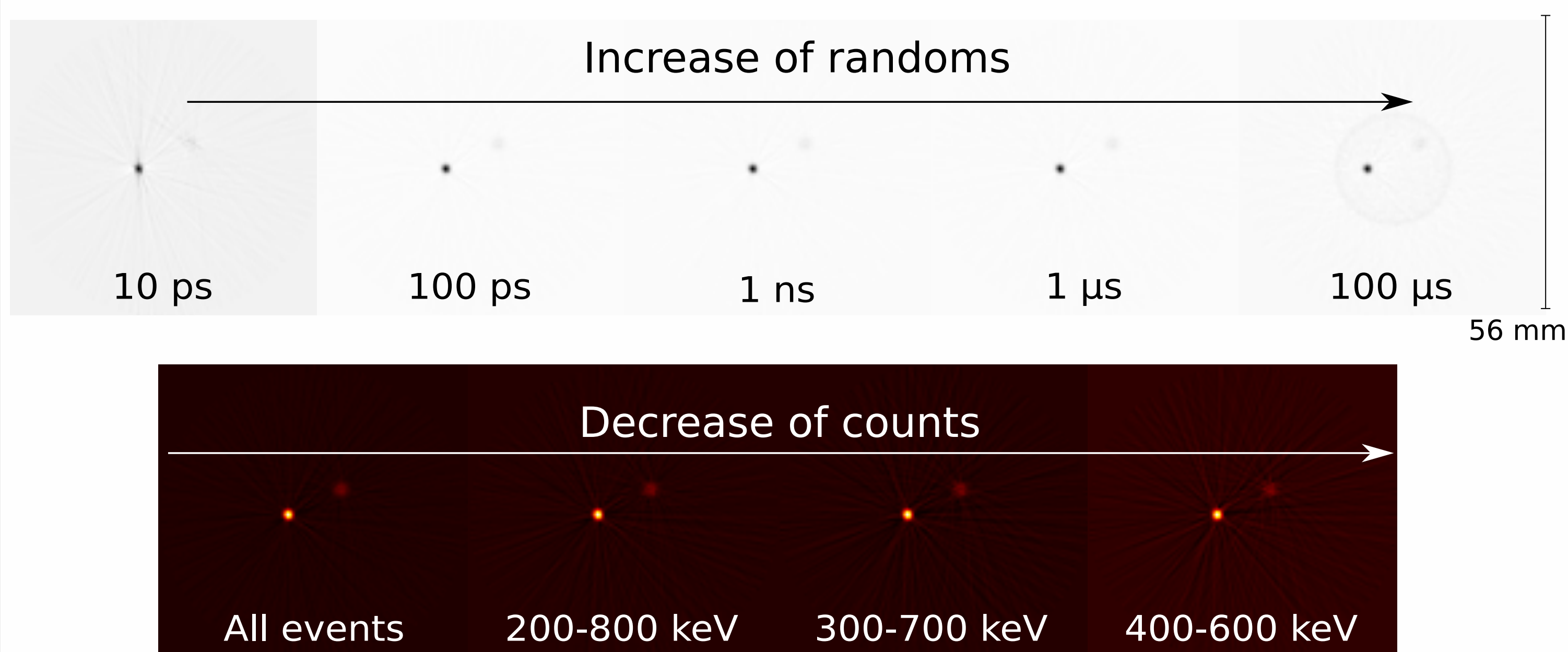


Spatial Resolution

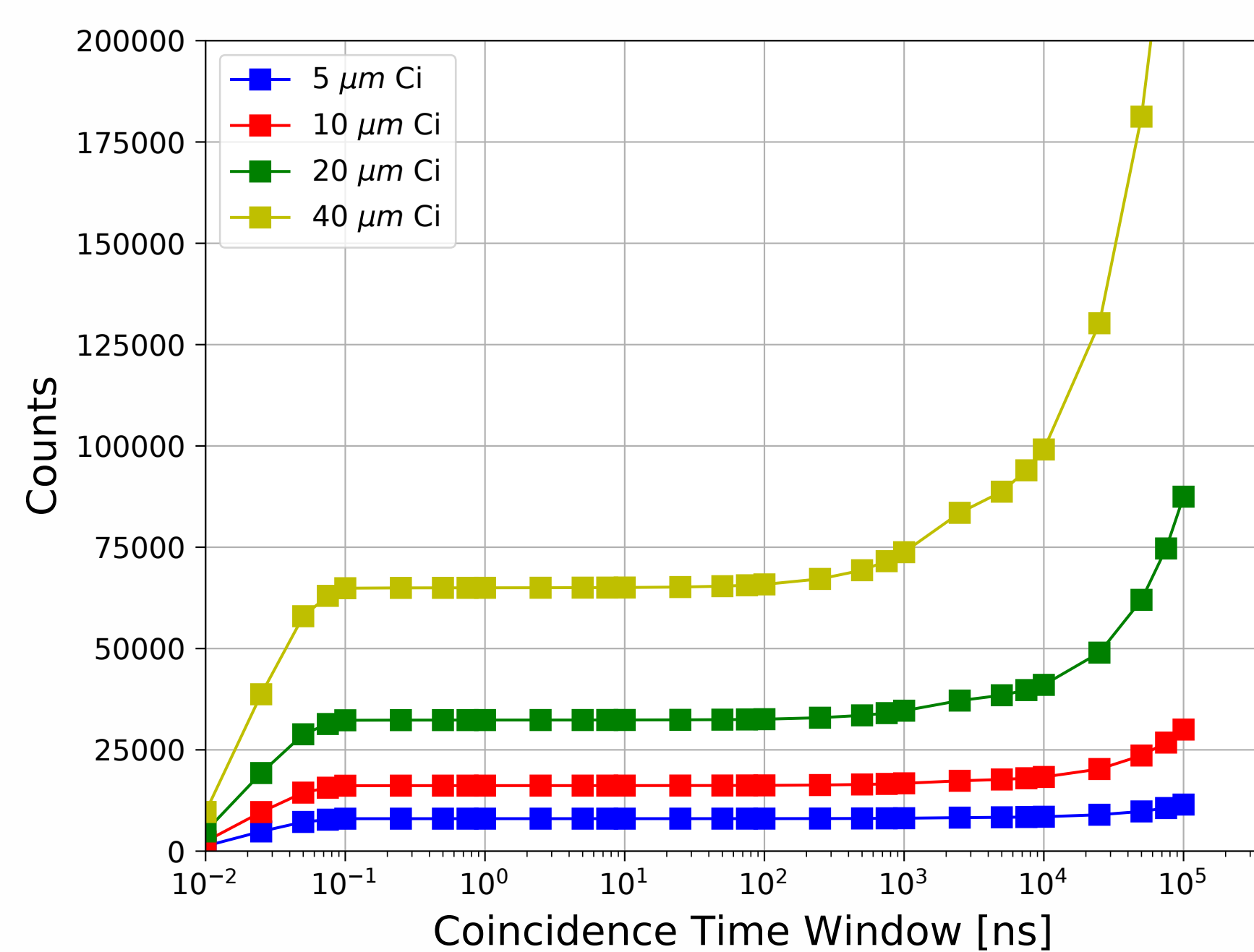


Educational Activities

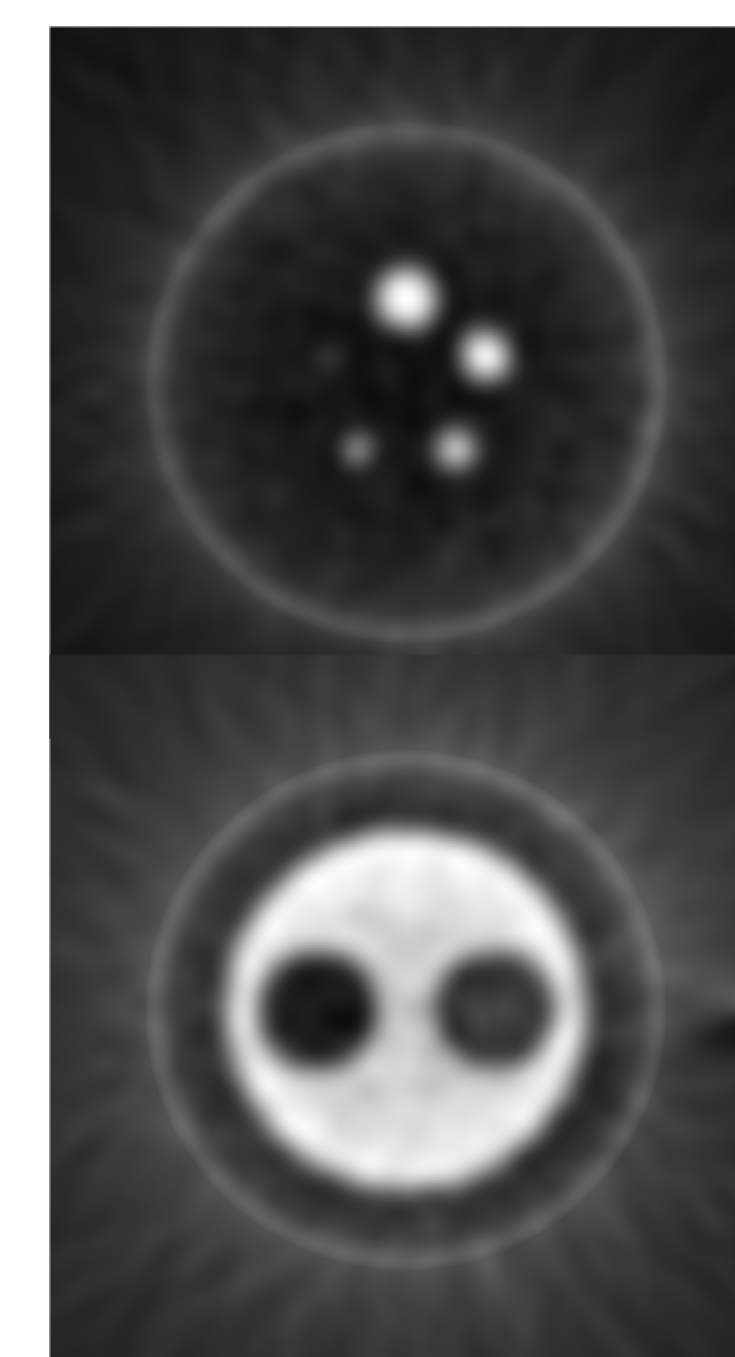
Image quality for different coincidence time and energy windows



Coincidences as a function of Coincidence time window



NEMA NU 4-2008 IQ phantom Simulation



Conclusions

The simulation toolkit presented in this work combines:

- Powerful tool for educational purposes, based on EasyPET kit from CAEN
- Teaching PET principles simulating simple PET scanner
- Allows simulating several acquisition aspects related with real EasyPET
- Simplified User Interface with basic tools for GATE simulations and data analysis, including Image Reconstruction
- Scaled up version of more complex scanners

References

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Acknowledgements

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