# Performance characteristics of multi-mouse imaging on monolithic large flat panel PET

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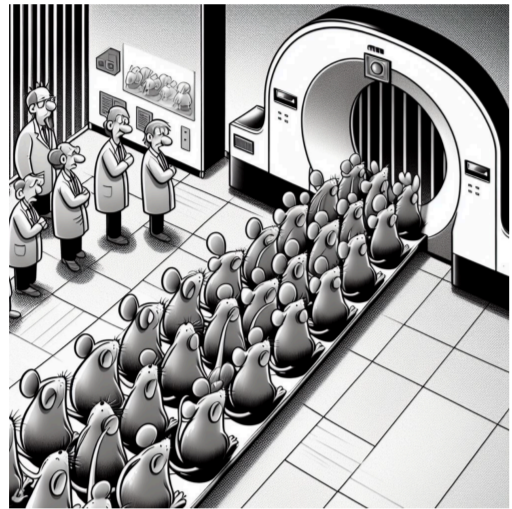
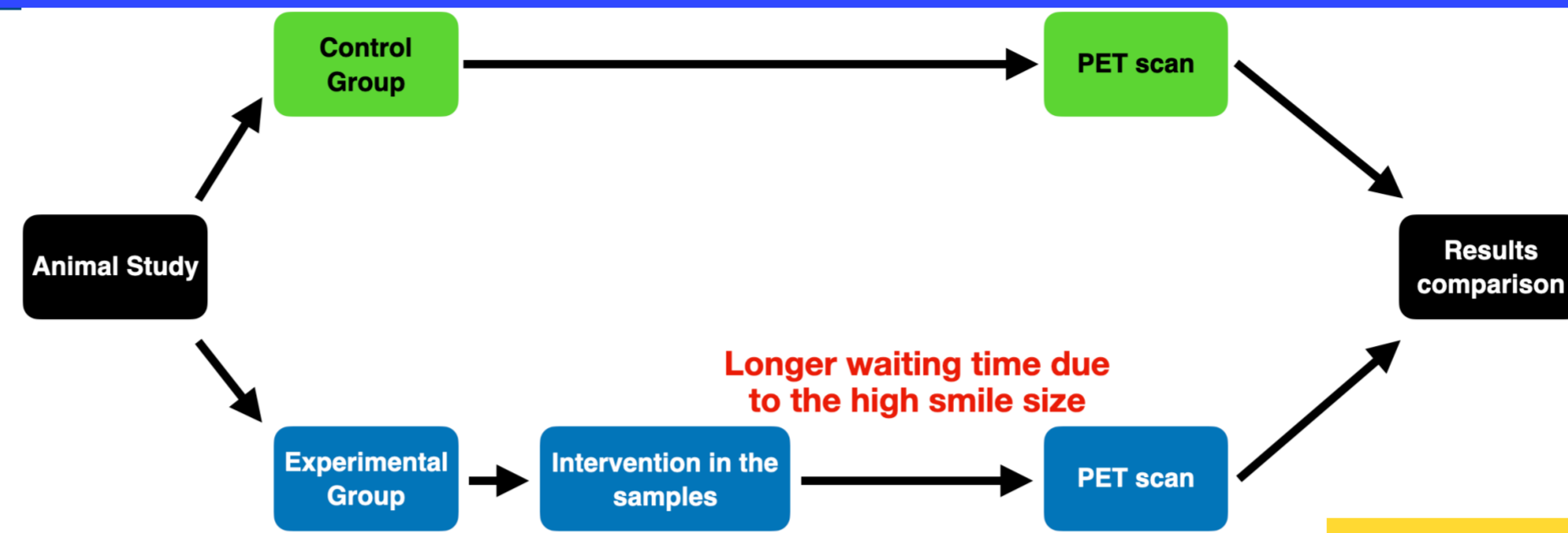Meysam.Dadgar@Ugent.be

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## Introduction

Small animal PET imaging:

- Cancer Research
- Neuroscience
- Cardiovascular Imaging
- Drug Development and Pharmacokinetics



Study population is important

**Long scan time due to the high sample size:**

- Difference in the parameters of the study between first and last sample
- Limits the sample size in the preclinical studies.
- Reduces reliability of the results compared to the high sample size studies.

Solution:

Developing a high throughput small animal PET systems

**Aims:**
- Investigating the sensitivity, spatial resolution, and scatter fraction of dual-panel PET for simultaneous multisample imaging.
- Comparing the performance of the proposed scanner with conventional pre-clinical PET systems.

## Methods

- Simulation by GATE software
- Iterative List_Mode reconstruction by QETIR
- A Medical Imaging Data Examiner
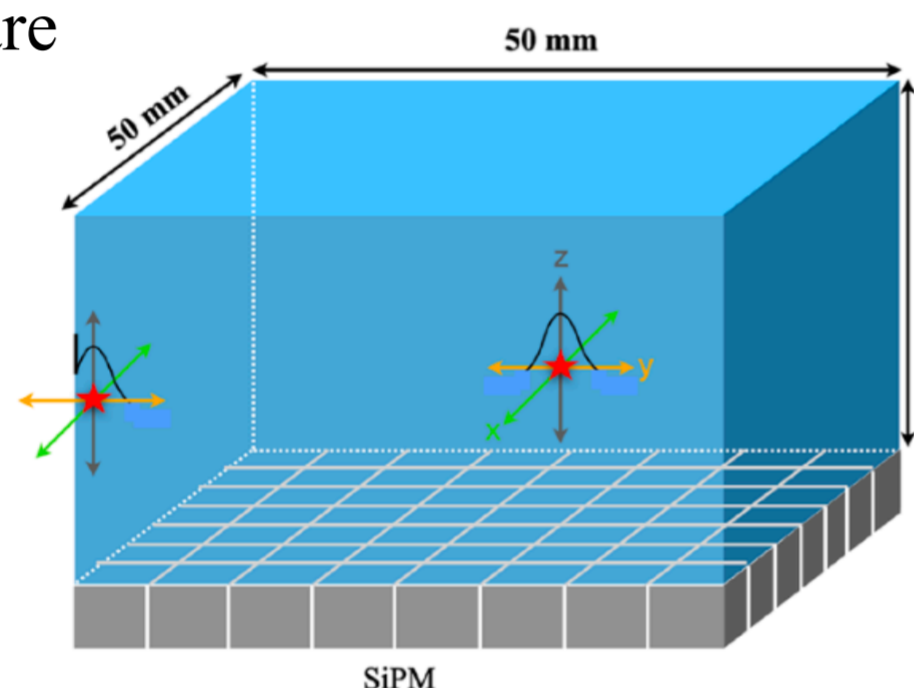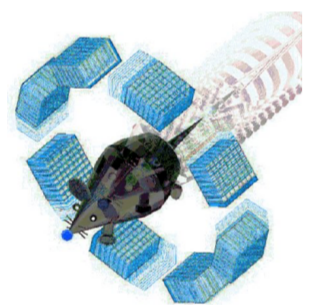
- Dual panel system (21.5x21.5 cm)
- BGO based monolithic detectors (50x50x16 mm)
- 327 ps of TOF resolution
- Simultaneous multi sample (12-60) imaging capability
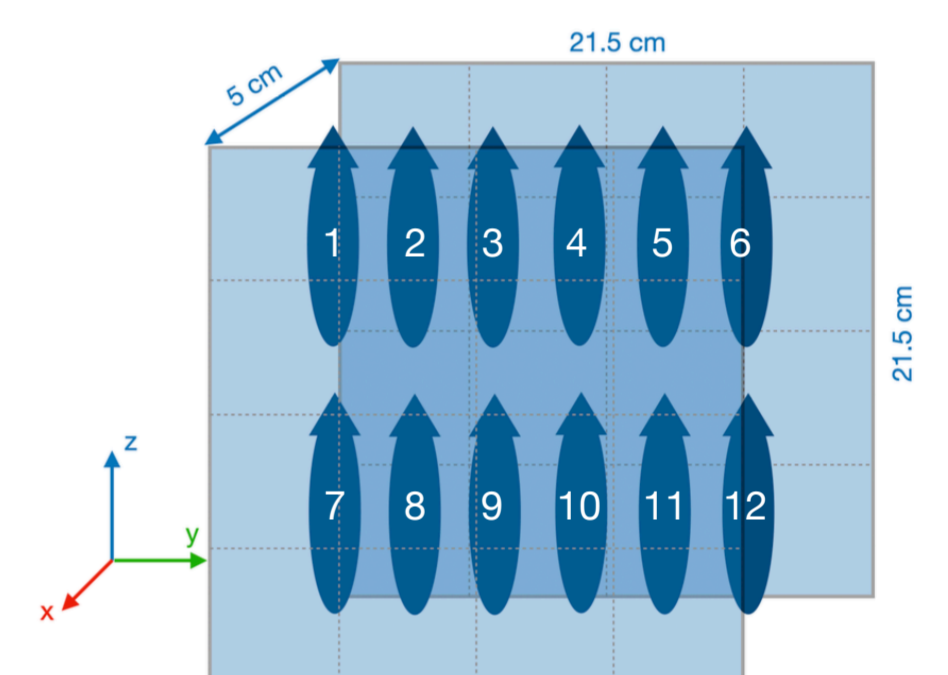
- The proposed scanner is capable of performing 15 times the number of samples compared to the currently existing fastest small animal PET scanner ($\beta$-Cube with 4 simultaneous samples).

**High Throughput small animal PET system**

## Results
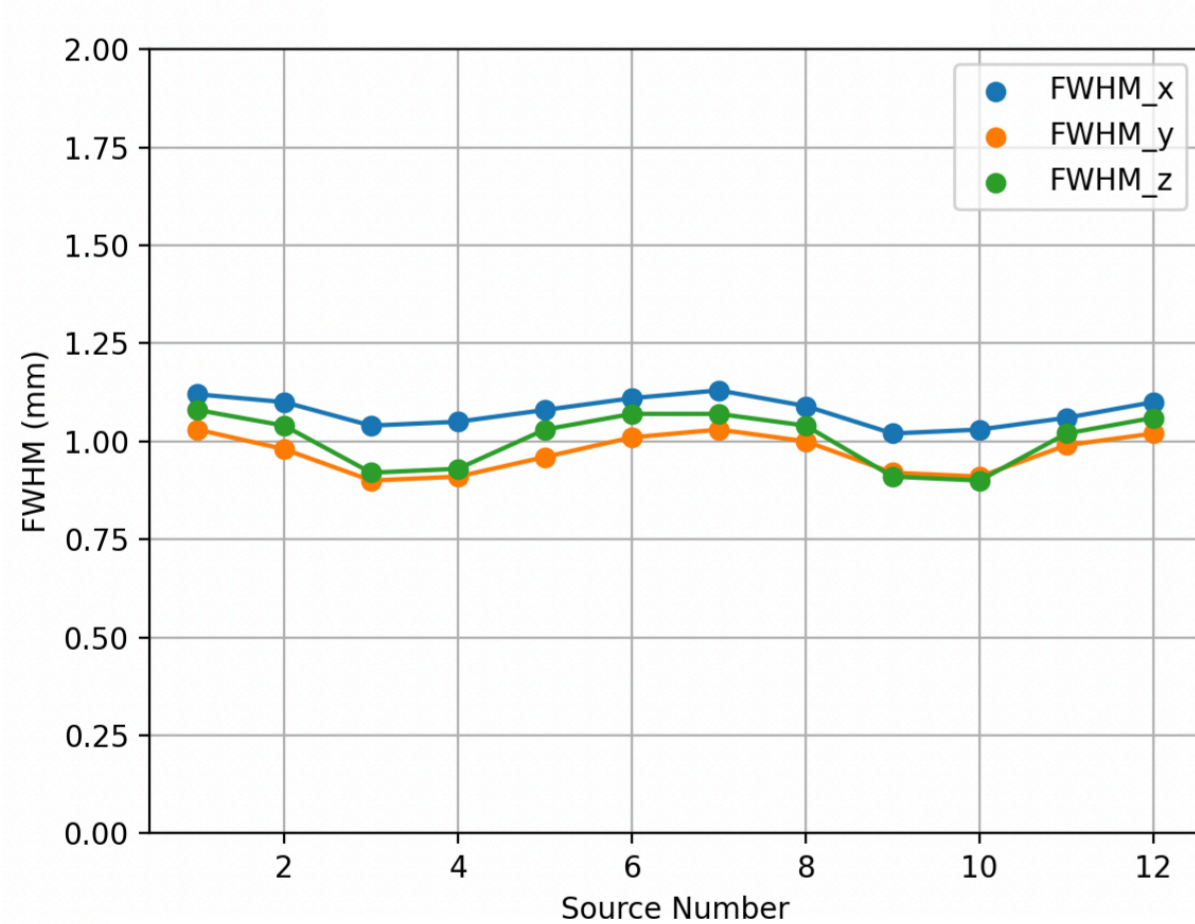


The FWHM values along x, y and z axes that each data point are the averages of 3 point sources for each mouse, at each end of the body and one in the middle.
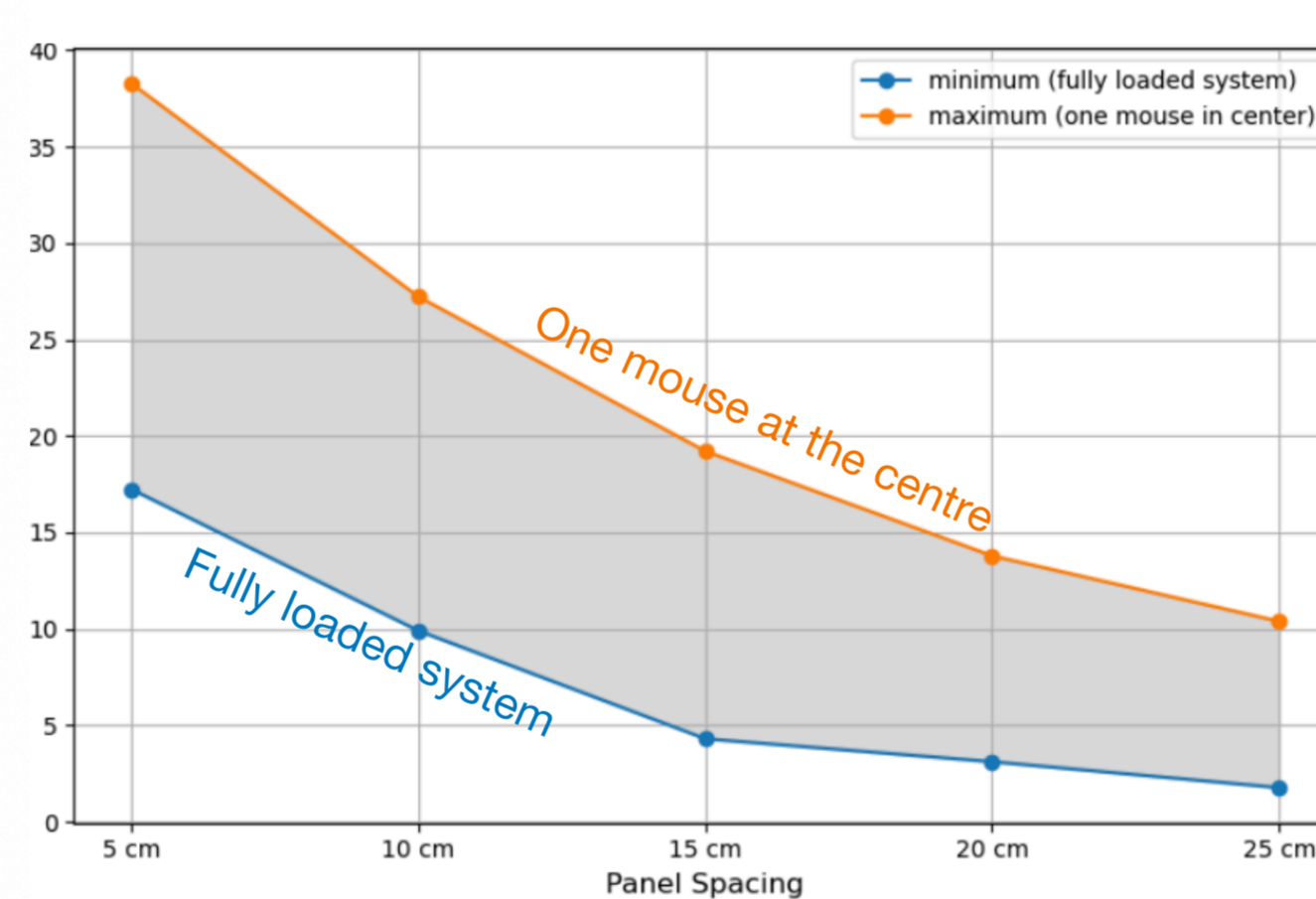


The percentage of detected emissions is analyzed as a function of the distance between detector panels, corresponding to the maximum number of mice that can undergo simultaneous scanning. The fully loaded scenario involves placing 12 mice for every 5 cm of distance between panels.

The scatter fraction of the proposed scanner: 4.83 % for mouse and of scatter fraction for mouse and 6.37% for rat
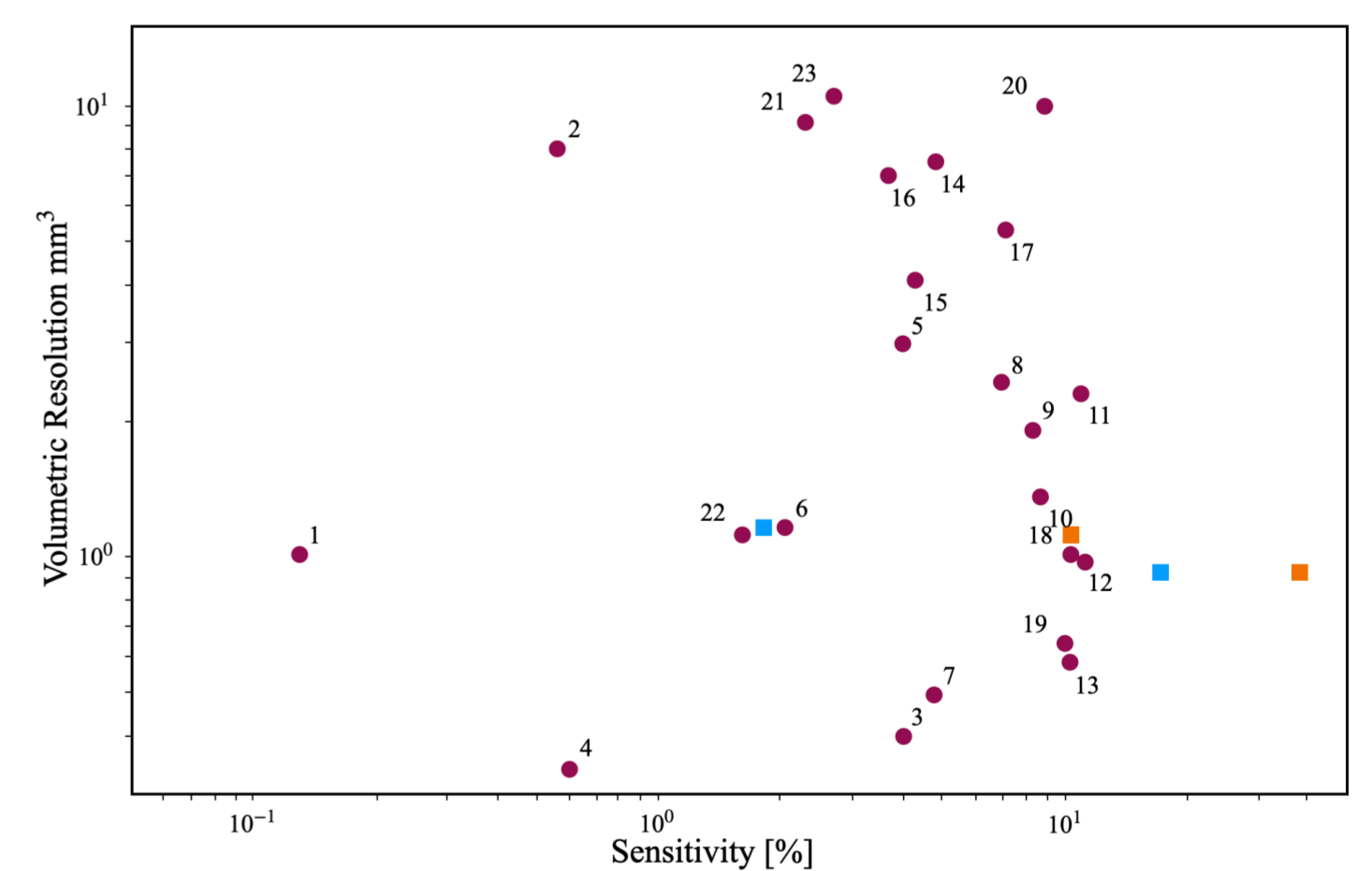


| No. | Scanner | AFOV (mm) | No. | Scanner | AFOV (mm) |
|---|---|---|---|---|---|
| 1 | UCD mouse brain | 7 | 13 | SIAT aPET | 105.6 |
| 2 | MicroPET | 18 | 14 | ClearPET | 110 |
| 3 | CdTe | 26 | 15 | LabPET-12 | 114 |
| 4 | DigiPET | 32 | 16 | A-PET | 119 |
| 5 | GE VISTA | 48 | 17 | Inveon | 127 |
| 6 | MicroPET II | 49 | 18 | Beta Cube | 130 |
| 7 | Clip-on | 50.4 | 19 | Albira PET | 150 |
| 8 | F120 | 76 | 20 | ClairvivoPET | 151 |
| 9 | nanoScan | 94 | 21 | Mouse TB J-PET | 230 |
| 10 | nanoPET | 95 | 22 | quadHIDAC32 | 280 |
| 11 | PETBox4 | 95.05 | 23 | Rat TB J-PET | 300 |
| 12 | HiPET | 104 | 24 | Dual Panel PET | 215 |

The volumetric resolution of the conventional small animal PET systems (red circle) and our proposed multi-sample dual panel PET indicated by orange (one mouse) and blue (fully loaded) as the function of their sensitivity.

## Conclusion

In conclusion, our study's pre-clinical PET scanner greatly improves small animal research by handling larger sample sizes and offering multi-sample imaging. This advancement enhances experimental efficiency and expands pre-clinical research possibilities, promising significant insights and breakthroughs in biomedical science.

## References

1- Krishnamoorthy S, et al. Performance evaluation of the MOLECUBES β-CUBE-a high spatial resolution and high sensitivity small animal PET scanner utilizing monolithic LYSO scintillation detectors. Phys Med Biol. 2018 Jul 27;63(15):155013.

2- M. Dadgar *et al*., "Investigation of Novel Preclinical Total Body PET Designed With J-PET Technology: A Simulation Study," in *IEEE Transactions on Radiation and Plasma Medical Sciences*, vol. 7, no. 2, pp. 124-131, Feb. 2023.