

Design and Performance Evaluation of a Compact PET Scanner Setup

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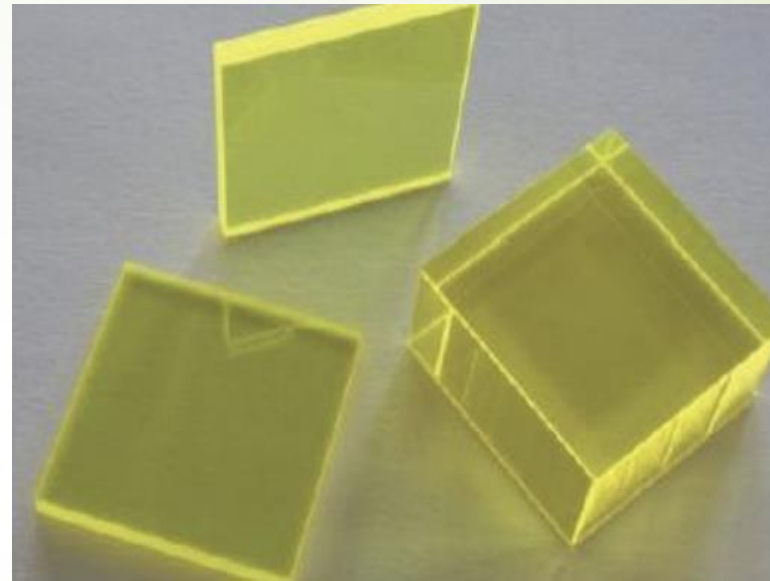
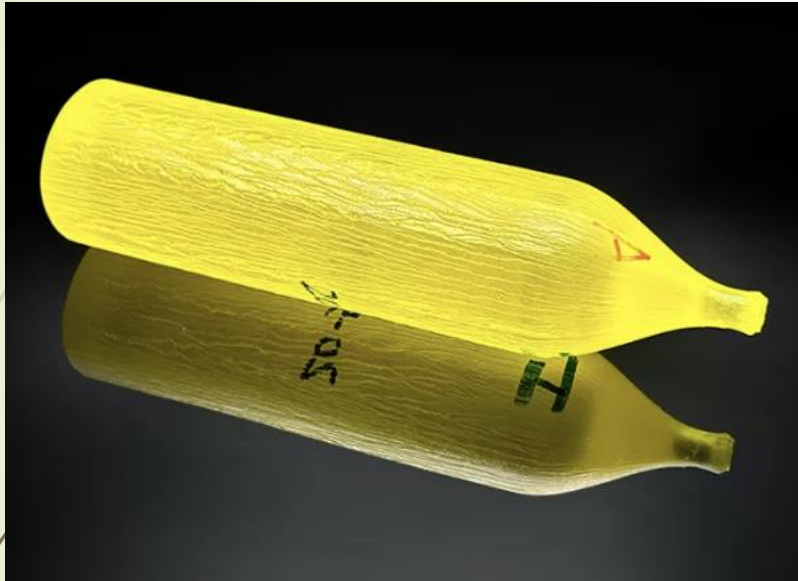
TIFR Mumbai

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3 February, 2026

Introduction of GAGG:Ce crystal



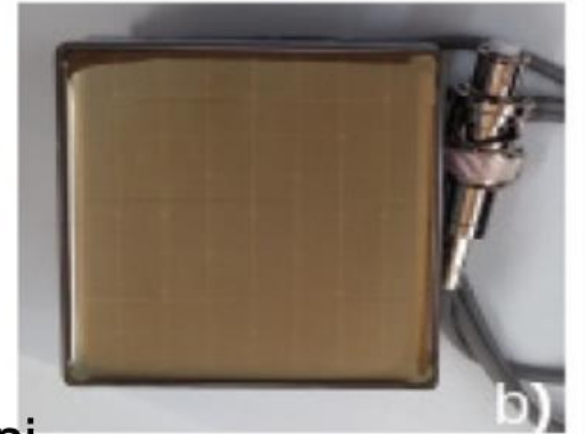
- Cerium-doped GAGG (Gadolinium Aluminum Gallium Garnet : $Gd_3Al_2Ga_3O_{12}$) is a novel scintillator.
- High density (6.63 g/cm^3).
- High light yield (56,000 photon/MeV).
- Fast scintillation decay time ($\sim 100 \text{ ns}$).
- Very good radiation hardness.
- Non-hygroscopicity – easy to handle.
- Extremely low internal background.

GAGG(Ce) coupled with PSPMT

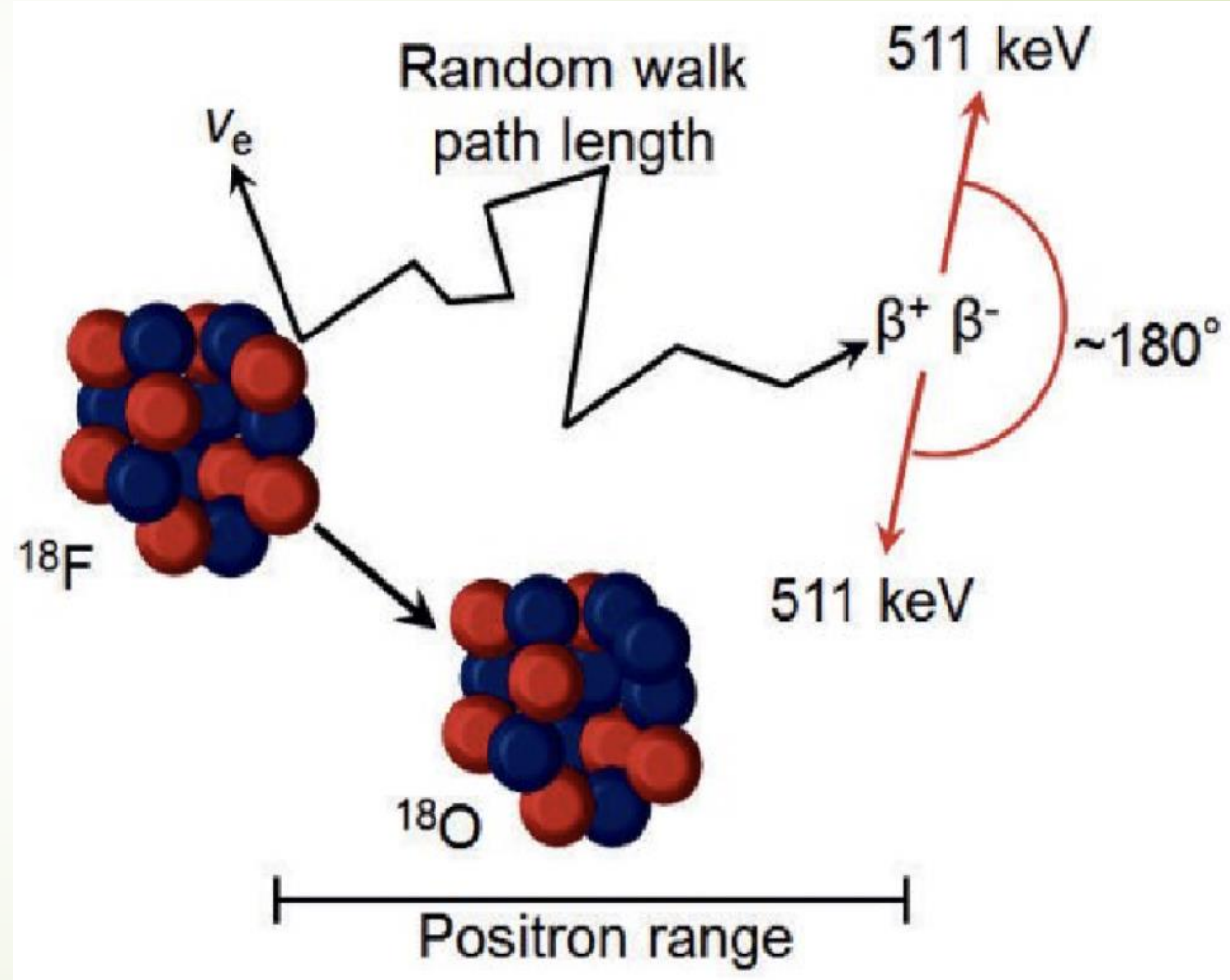
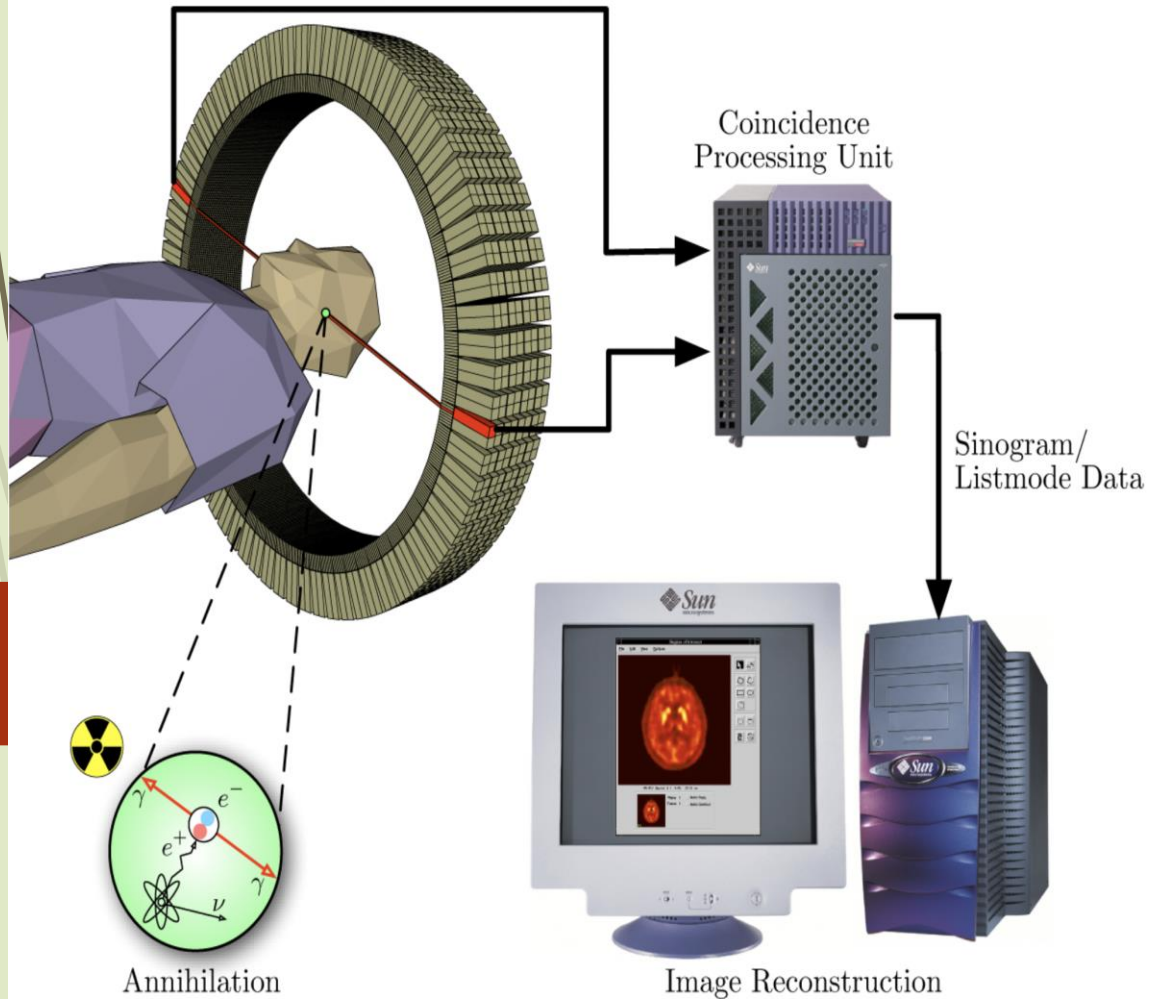
- Crystal size : 5.08 cm × 5.08 cm × 0.6 cm
- PSPMT : Hamamatsu 8500C (65 readouts)
- Resistive chain network
- Position resolution throughout the crystal



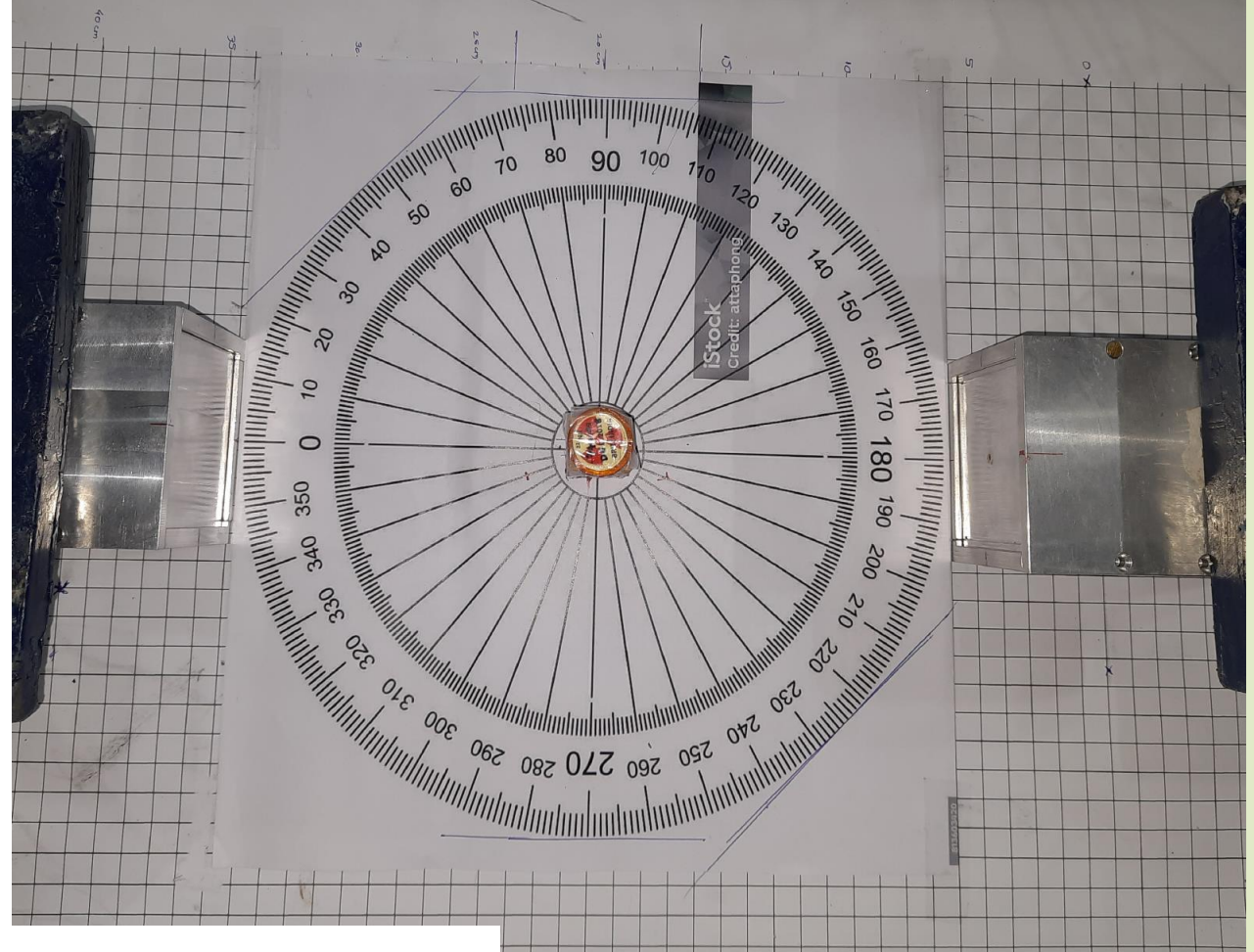
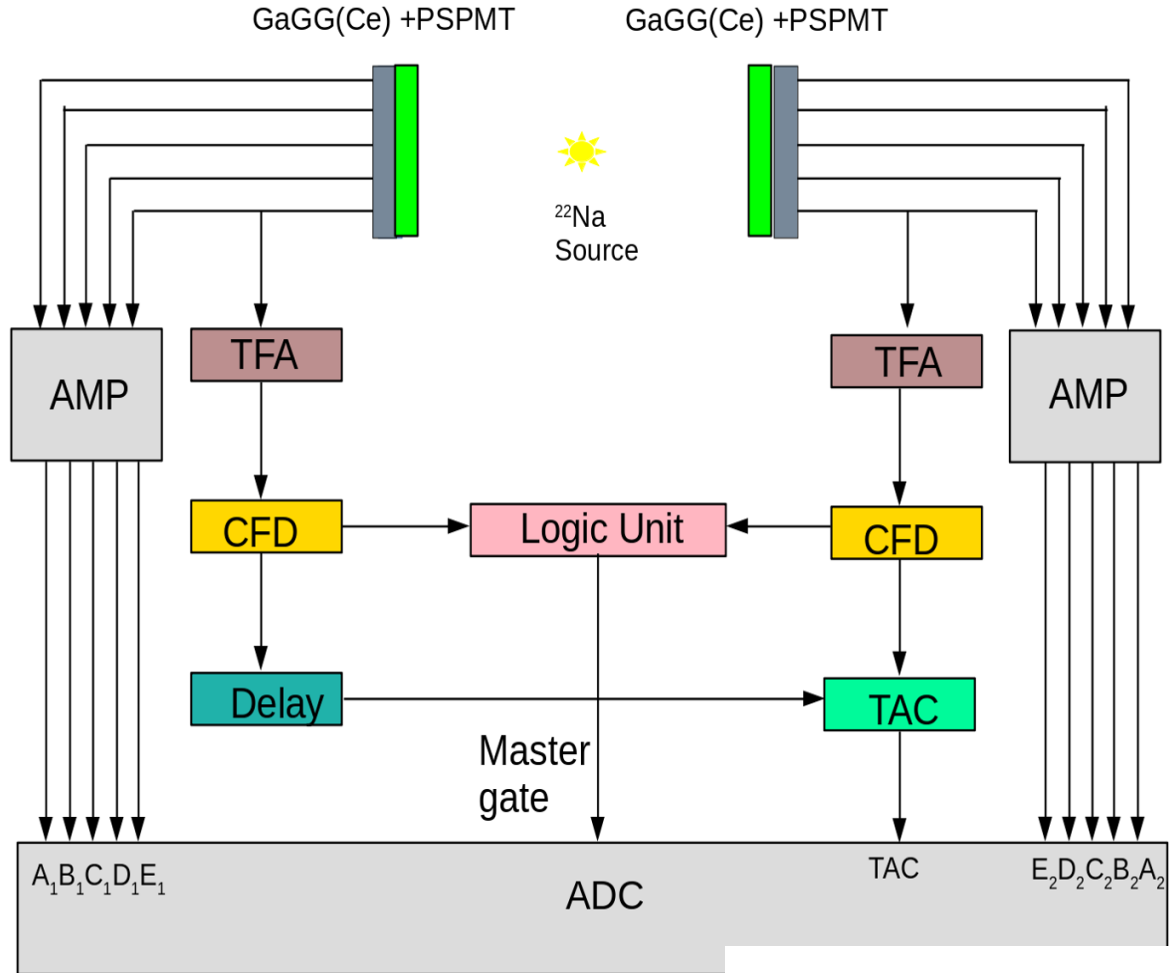
4 Anodes and 1 Dinode



PET (Positron emission tomography)



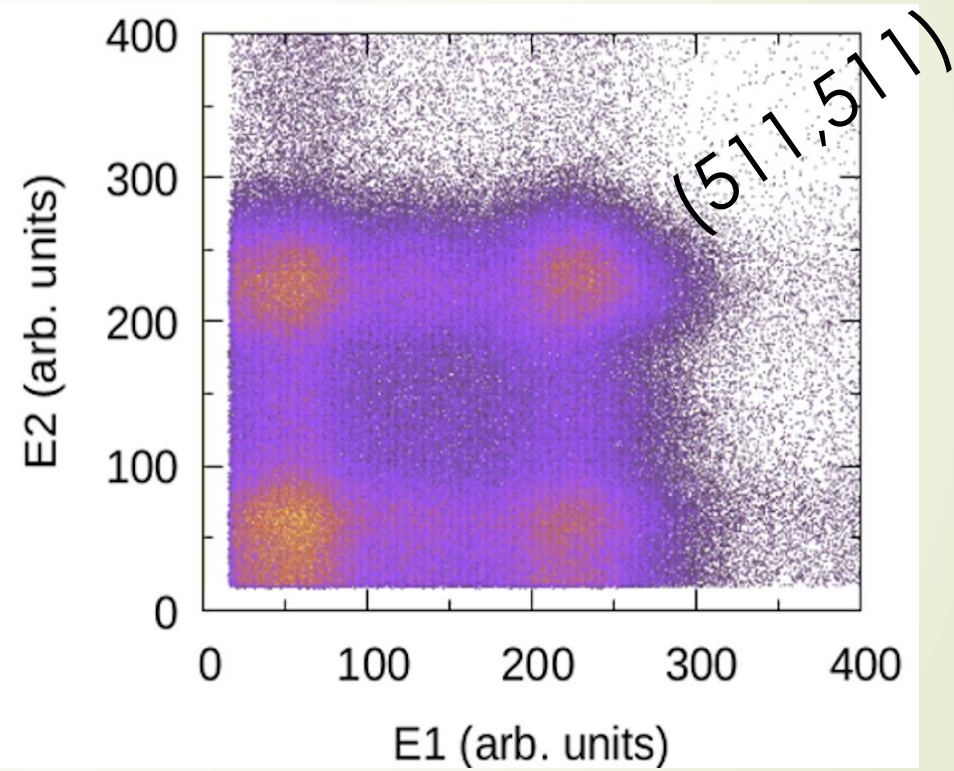
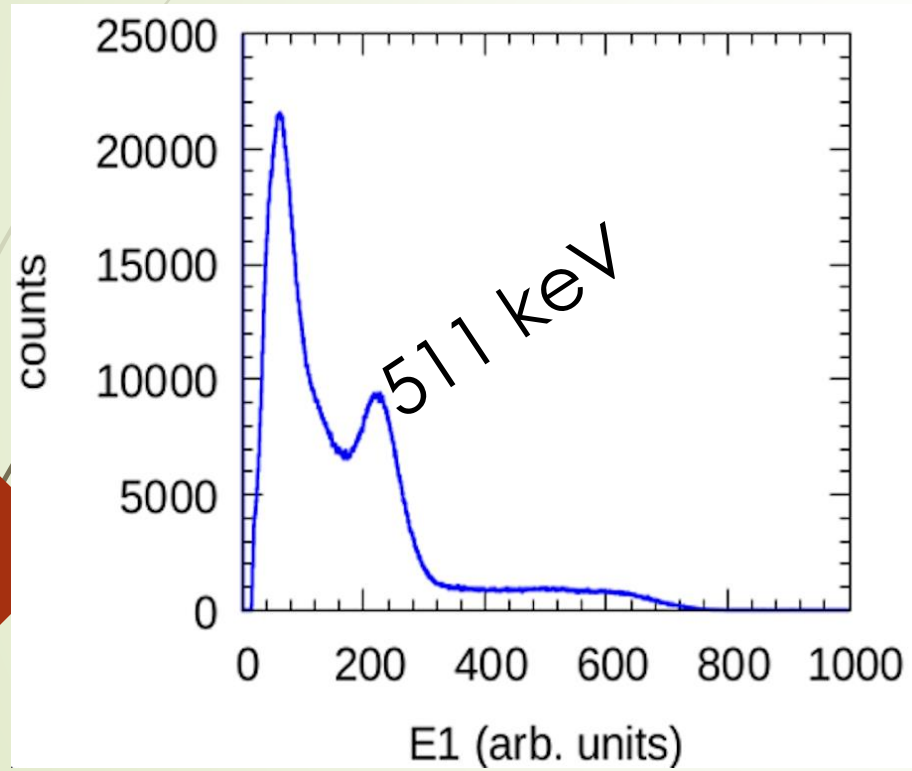
Gamma-ray imaging setup at TIFR



$$X_{\text{position}} = \left[\frac{(a_2 B + a_4 D)}{(a_1 A + a_2 B + a_3 C + a_4 D)} + b_1 \right]$$

$$Y_{\text{position}} = \left[\frac{(a_3 C + a_4 D)}{(a_1 A + a_2 B + a_3 C + a_4 D)} + b_2 \right]$$

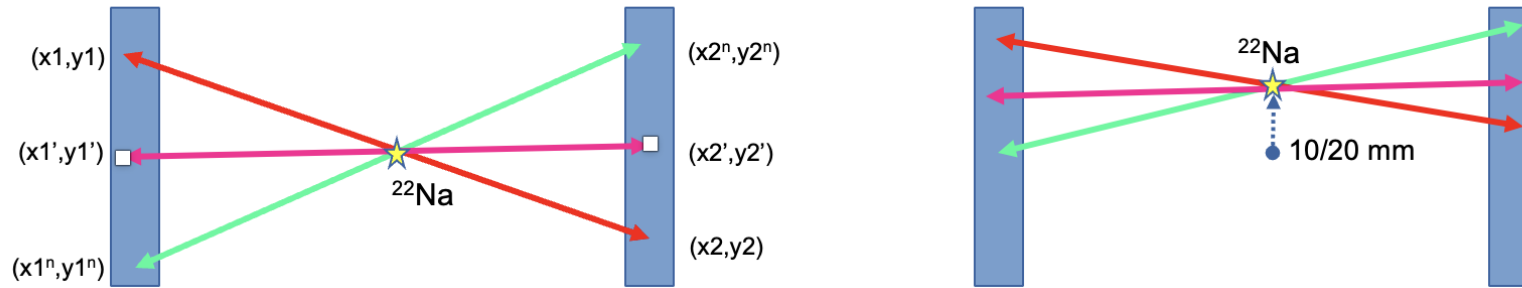
Energy Spectrum



Gamma-ray imaging setup at TIFR

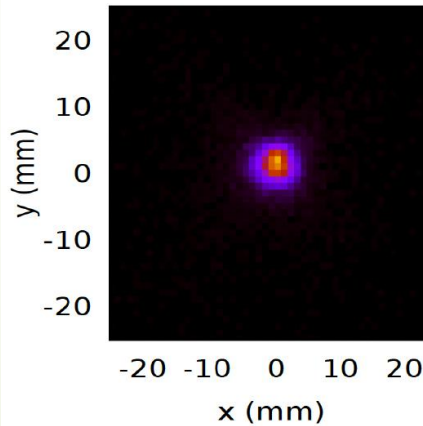
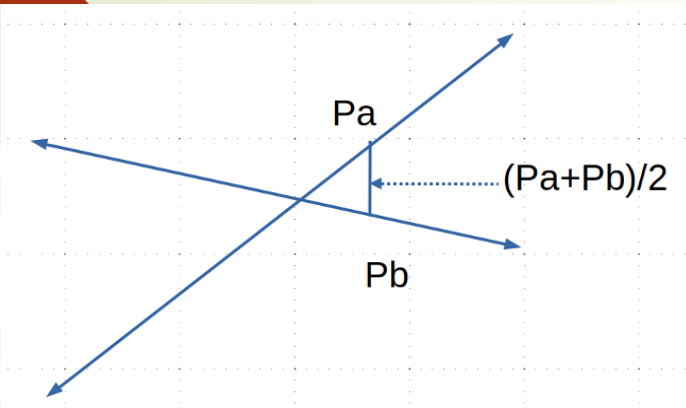
GAGG(Ce) coupled with PSPMT

- Reconstruction of source position

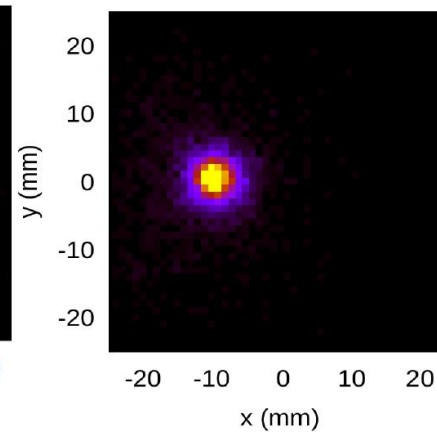


$(X_1, y_1), (x_2, y_2) \rightarrow$ slope, offset \rightarrow point of intersection for ${}^n\text{C}_2$ combinations

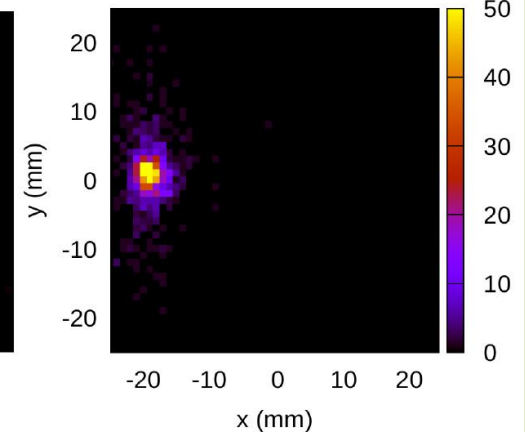
- Distance of closest approach



Source is at (0,0)

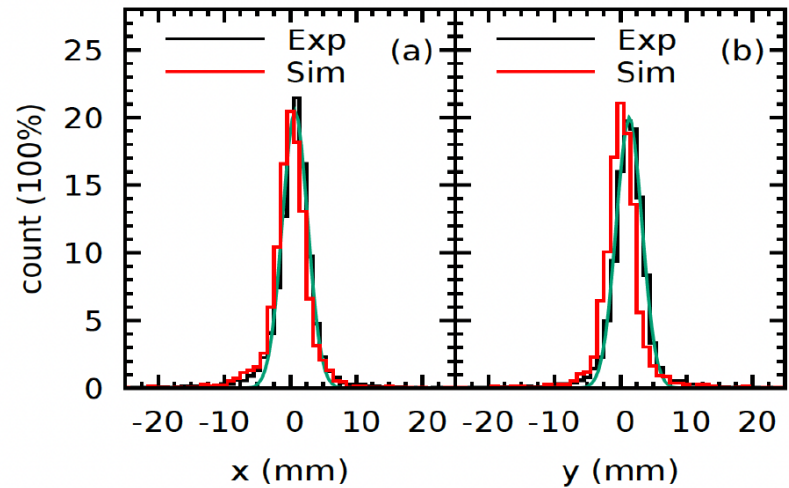
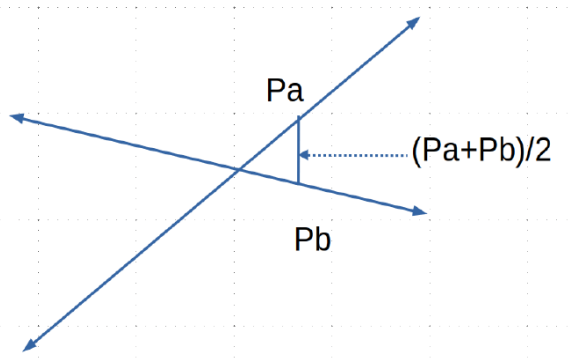
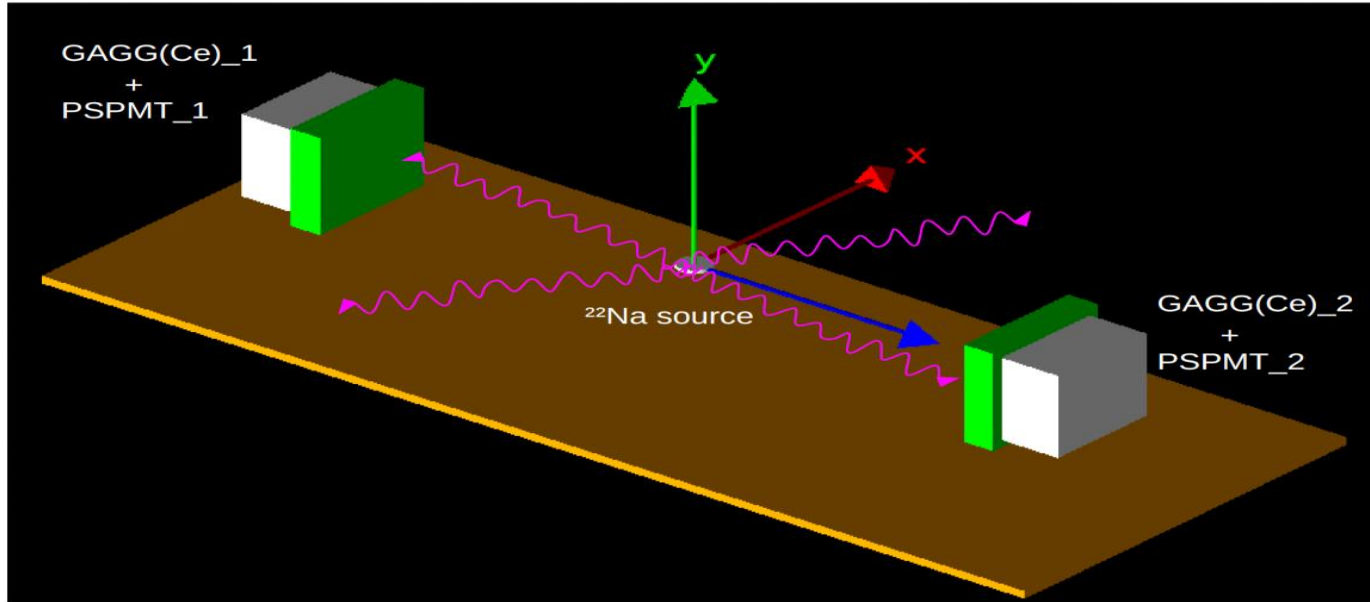


Source is at (-10,0)

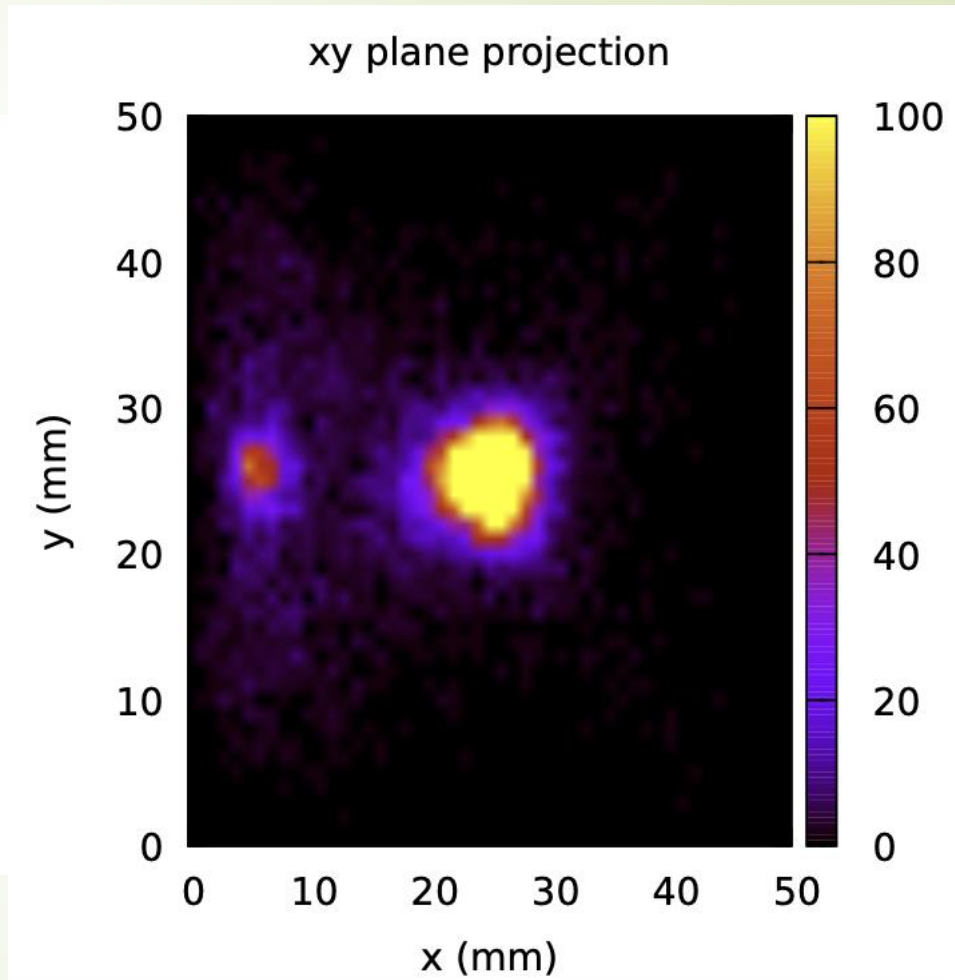
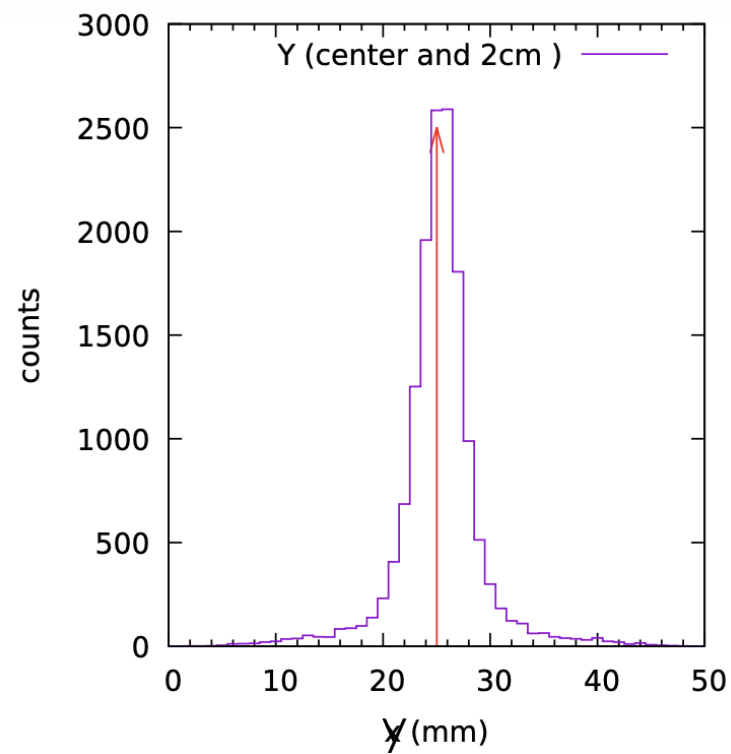
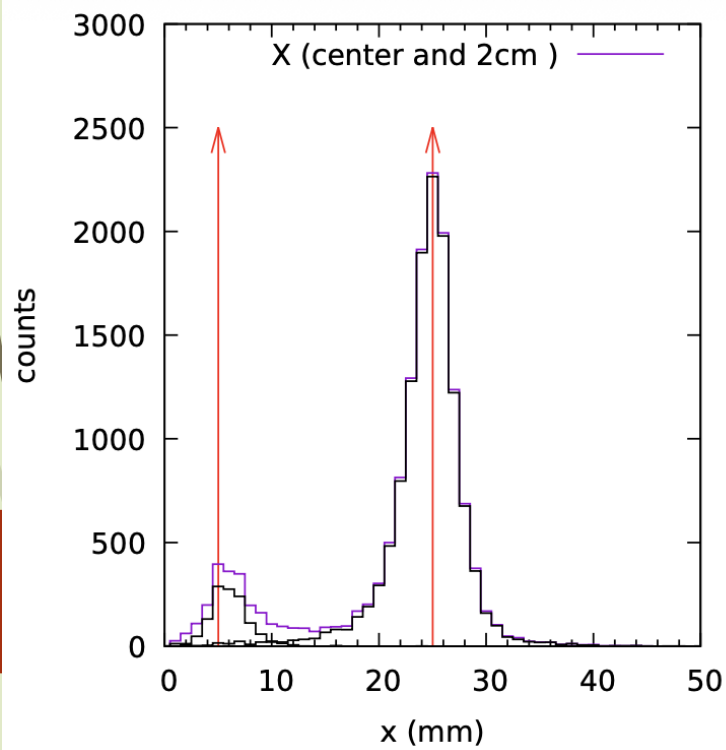


Source is at (-20,0)

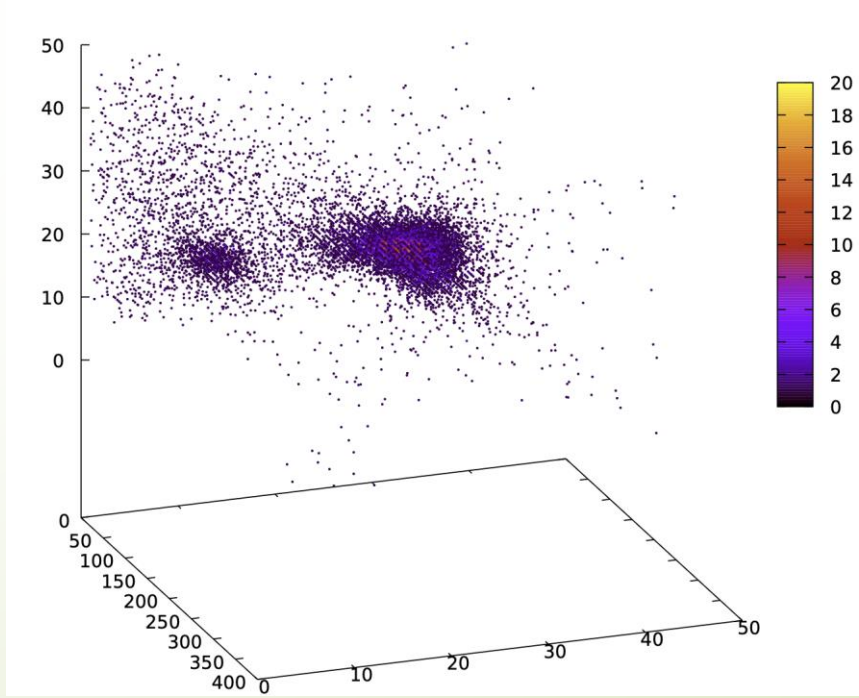
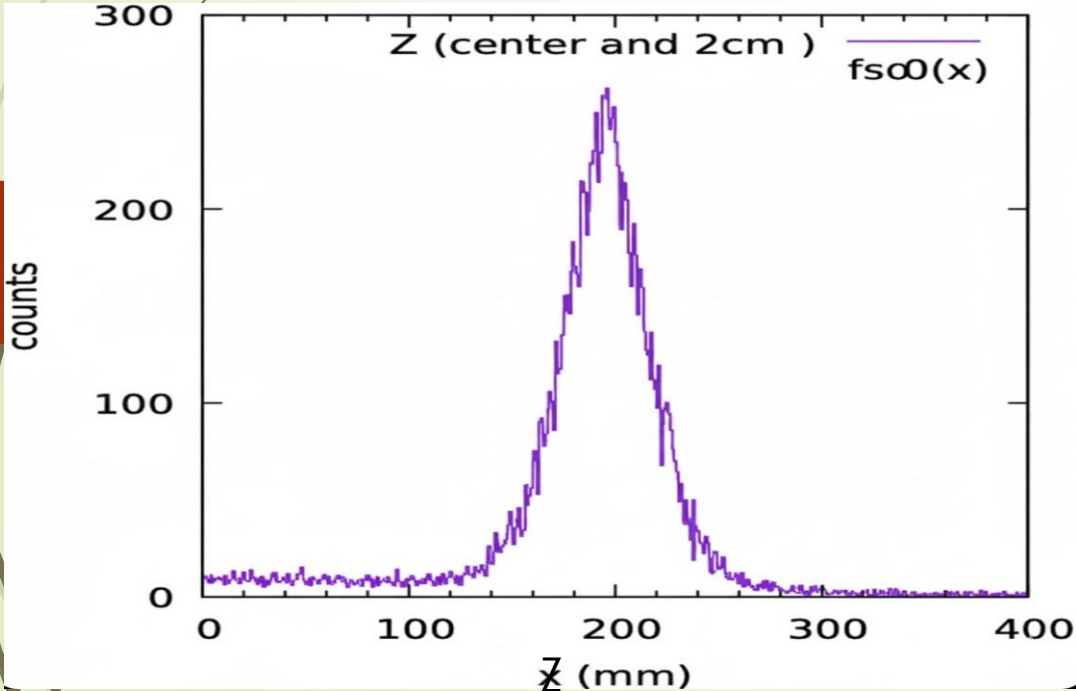
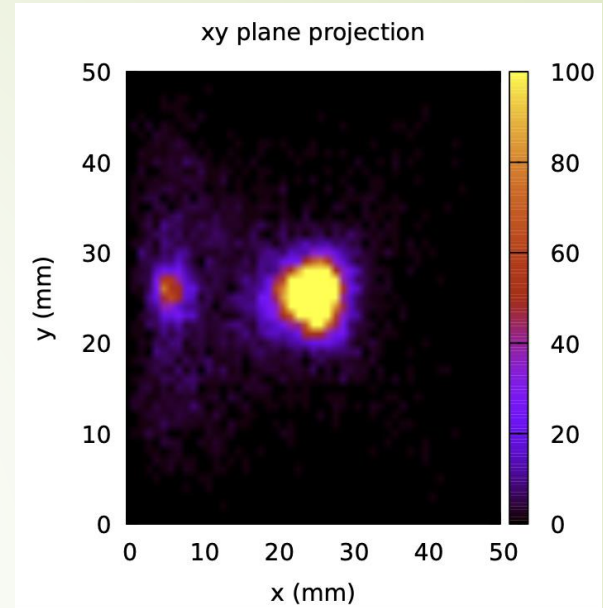
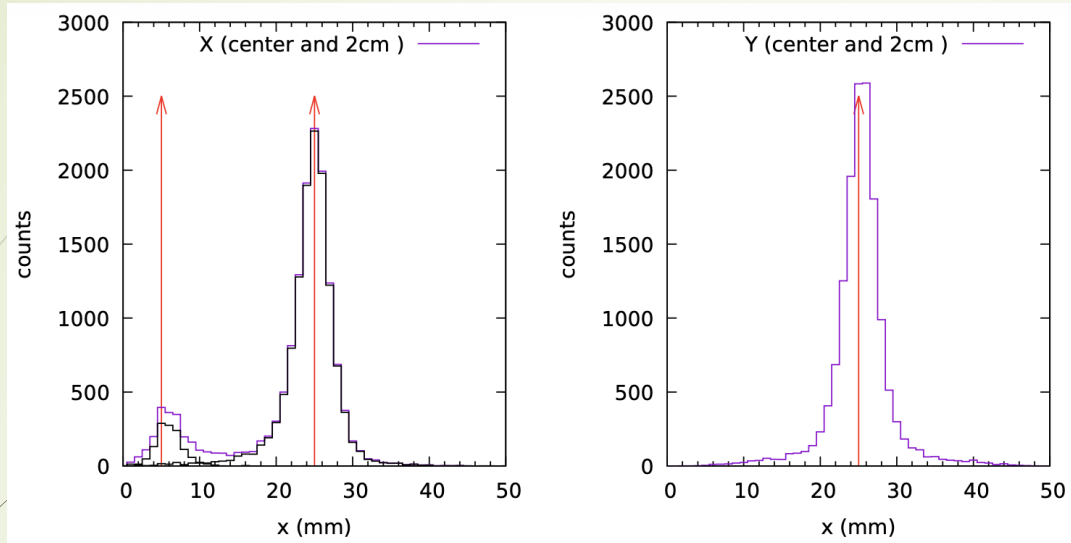
Gamma-ray imaging setup at TIFR



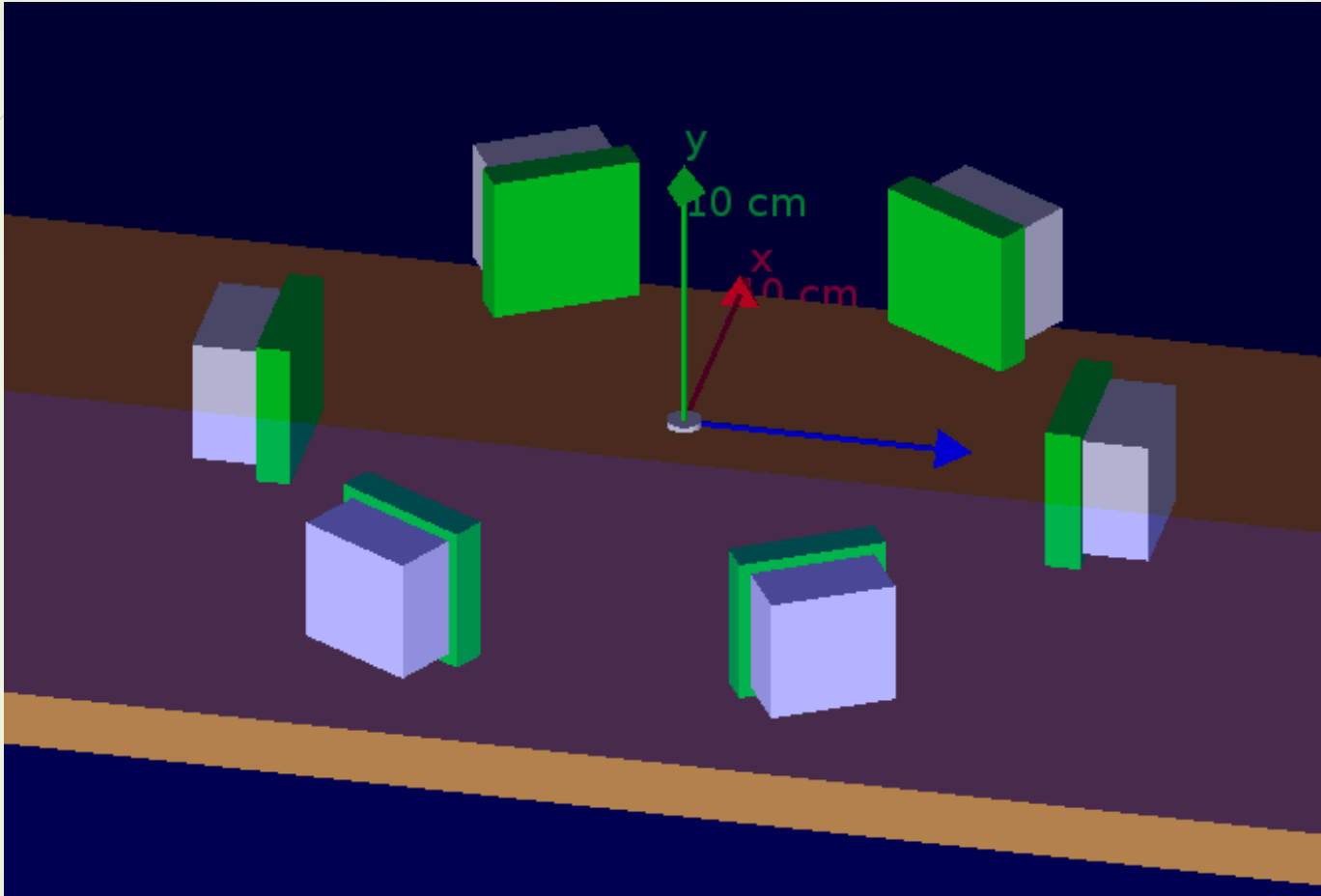
FWHM: ~ 4.7 mm



Gamma-ray imaging setup at TIFR



Future Plan



Building algorithm for 3d image using 6 detectors

Summary

- An imaging setup using GAGG:Ce and PSPMT was build.
- A reasonably good spatial resolution (FWHM \sim 4.7 mm) is achieved for the x and y positions of the source image.
- Experimental results are further supported by GEANT4 simulations, which account for all relevant physical processes.
- Identification of two sources can be made.
- Geant4 simulation with six such detectors was performed.
- Working on the algorithm for 3d image construction.

Thank you!!

