

Bachelor and Master-Thesis 2025/2026

Gamma Ray Imaging for Medical Applications

Introduction:

Prof. Dr. Ivor Fleck

Gamma ray detection is crucial for medical imaging applications, such as monitoring dose delivery and range in particle beam therapy for tumor treatment, as well as in vivo, organ-specific functional imaging.

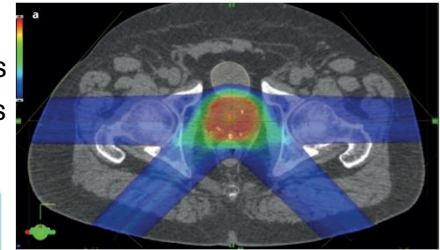
Gamma Imaging limitations

- ❖ Lose efficiency at gamma energies above 600 keV.
- ❖ High-energy photon scatter reduces image resolution.
- ❖ Collimator limitations

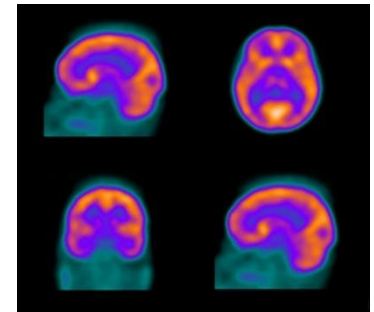
Challenges in Cancer Therapy

- ❖ Real-time dose monitoring.
- ❖ Range verification of charged particles.

Cancer therapy using charge particle.



Brain images using Gamma Detector.



These challenges can be addressed using a Compton Camera.

Current Project:

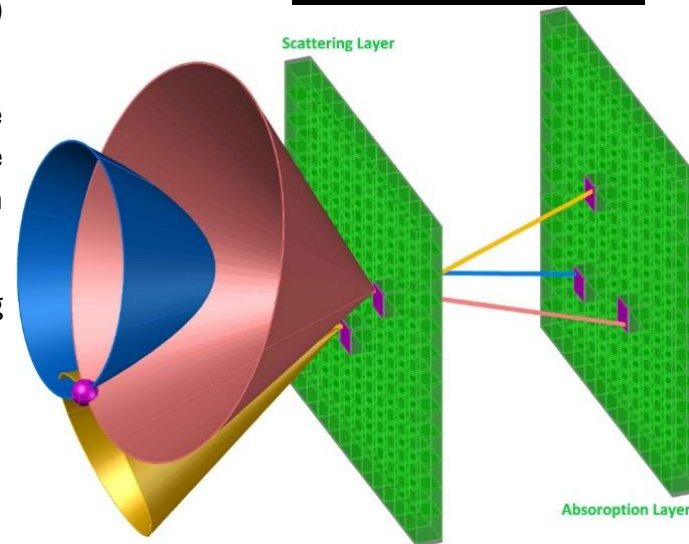
- Testing and Characterizing SiPMs (Silicon Photomultipliers) for scintillation and Cherenkov light detection.
- Conducting simulation studies using GEANT4 (a particle and detector simulation toolkit based on C++) to optimize the detection setup and test different scintillation materials.
- Developing gamma ray reconstruction algorithms using Machine Learning.

Potential Tasks for Bachelor/Master Thesis:

- Characterizing and testing SiPMs.
- Setting up and testing components of the Compton Camera in the laboratory.
- Improving reconstruction algorithms using Machine Learning for the incident gamma ray and Compton Camera using simulated and experimental data.
- Testing and characterizing different scintillation materials.

Requirements:

- Basic understanding of particle physics at the Bachelor level.
- Interest in data analysis and programming (Python and C++).
- Basic skills in laboratory experimental work.



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