**MEDICAL APPLICATIONS: PET**

**Investigating DOI**

**Introduction**

PET-scanners are essential devices in the medical industry. A $\beta^+$- source is injected into the patient's body and emits positrons that annihilate with electrons and emit back-to-back photons, which are detected.

PET-scans close to the body entail a loss of resolution by not having the right information about the depth of interaction (DOI). Is there a useful relationship between the total light recorded ($P_{\text{tot}}$) and the amount of light that hits the crystal of interaction ($p_{\text{max}}$)?

**Hypothesis**

The ratio between the light collected by the detector in front of a given crystal and the total light collected by all the detectors is correlated to DOI of an incident gamma ray.

**Project Overview**

The aim of the project is to develop a setup that will prove this hypothesis and find out how reliable the new method is.

**Variables**

**Controlled variables**

- Back-to-back production of 511 keV photons
- The relative positions of the single crystal and the decay source to the crystal matrix
- The dimensions of the crystals

**Dependent variables**

- $P_{\text{tot}}$
- $p_i$: mean x-position
- $v$: mean y-position
- $w$: $p_{\text{max}}/P_{\text{tot}}$

**Procedure**

**Step 1**

Alignment

**Step 2**

Electronic setup

**Step 3**

Measurements

**Step 4**

Data analysis

**Results**

**Materials**

- Na$^{22}$
- Scintillator
- Photomultiplier: SiPM
- Digital caliper
- Reflector
- ADC-channel

**Conclusion**

It is proven that there is a correlation between the DOI and the ratio of $p_{\text{max}}$ and $P_{\text{tot}}$ and it has shown to be proportional. Therefore this method will improve the PET scans precision and help in the diagnose and intervention of cancer and other clinical conditions.

**Literature**