Response function and linearity for high energy γ-rays in large volume $LaBr_3$:Ce detectors

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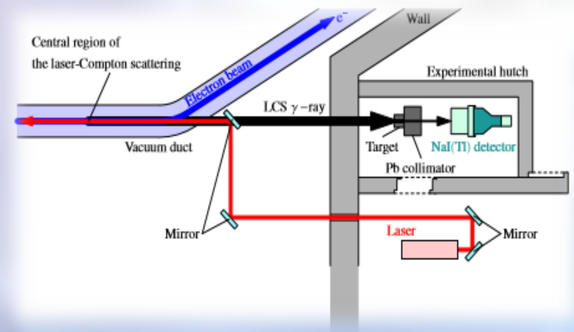
Introduction

The study of the collective properties of nuclei, like the Giant Dipole Resonance usually implies the measurement of a continuum of high energy γ-rays (5 < Eγ < 30 MeV) and requires the knowledge of the detector response function. Montecarlo simulation are usually used to calculate the response function, supposing an ideal behaviuor of the detectors.

Quasi-monochromatic γ-rays in the energy range **6–38 MeV** were produced using the Laser Compton Scattering(LCS) mechanism at the NewSUBARU facility and sent into two large volume LaBr3:Ce crystals (3.5"x8"). The goal of this work was to study the responce function and linearity of the crystals and the coupled PMT's.

Experimental setup



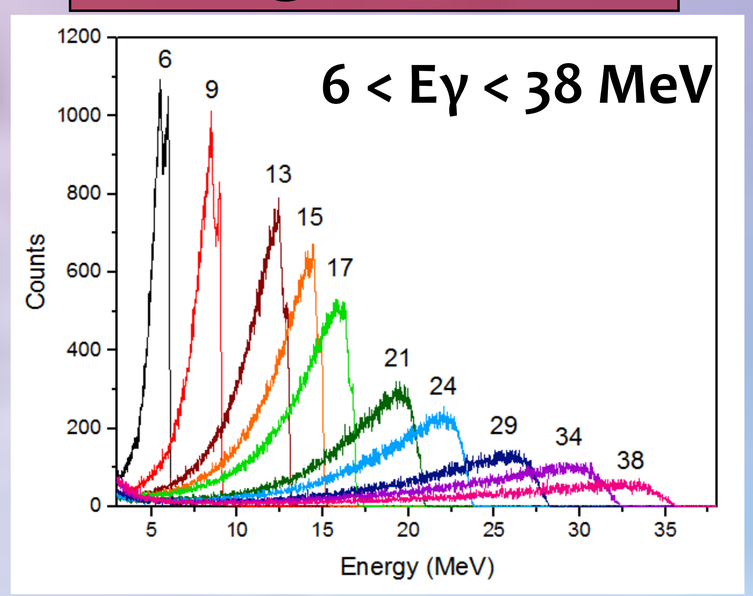
Quasi-monochromatic γ beam produced by **Laser Compton Scattering (LCS)**

High energy electrons (0.5–1.5 GeV)

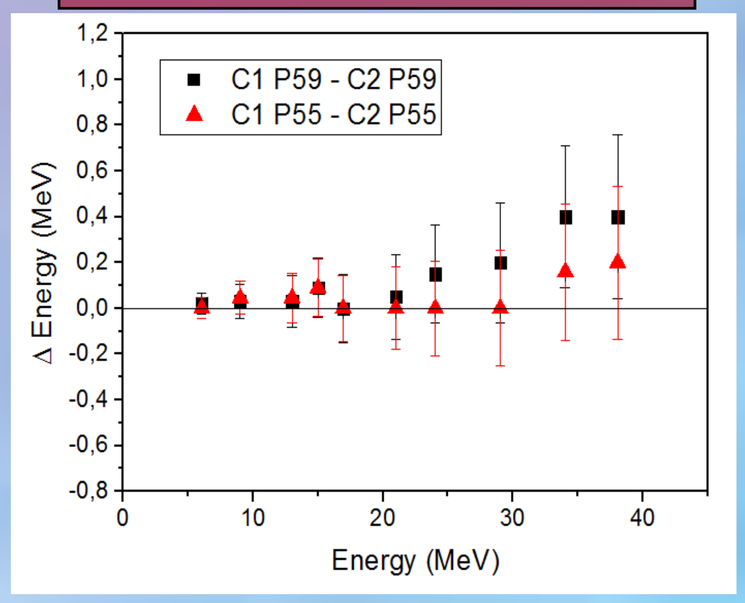
1064 nm CW photons produced by a Nd:YVO4 laser

- We investigated the behavior of the crystal, of the PMT together with the Voltage Divider and the electronics to handle the signals in a separate way.

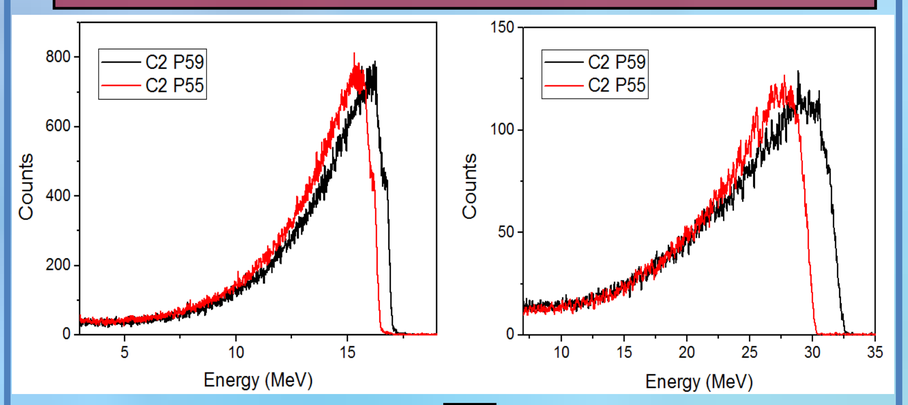
Energy spectra

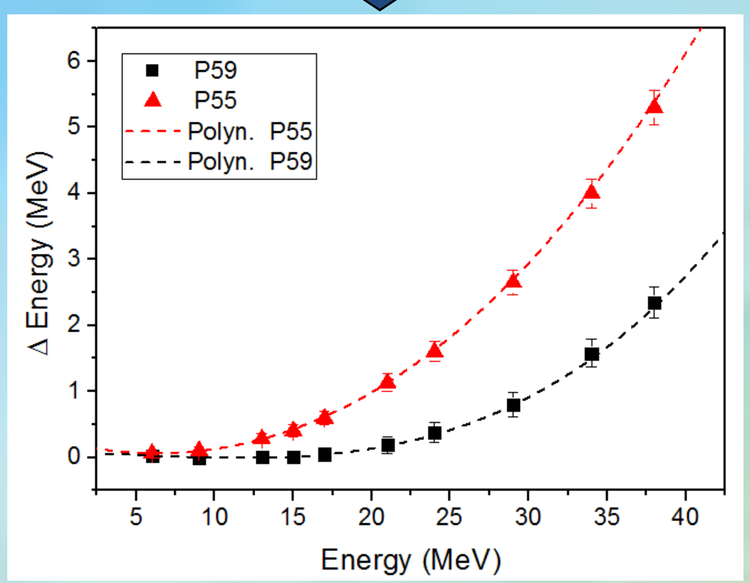


Crystal response



PMT's + VD response

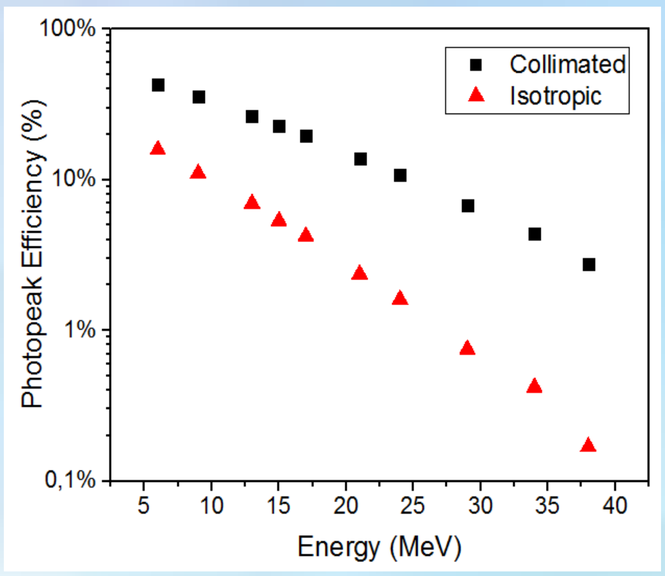


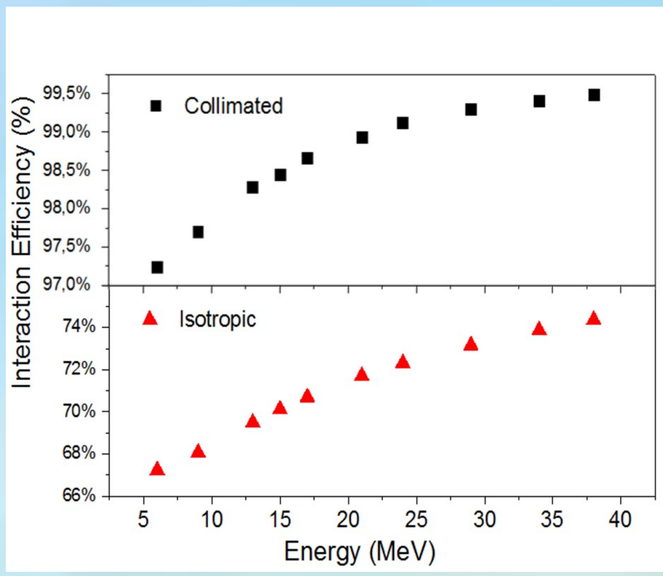


- A non-linearity curve for each PMT can be produced.
- The dashed lines show a fit performed using a third order polynomial.

Simulated Efficiency

- Collimated source
- Non-collimated source: Realistic situation of a nuclear physics experiment.





Conclusions

- We investigated the linear behavior of the crystal, of the PMT together with the VD and the electronics used to handle the signals in a separate way, so that we could identify the origin of possible non-linearity effects.
- The two crystals (3.5" x 8") respond in the same way to high energy γ-rays
  There is no evidence of non-linearity.
- The two PMT's suffer from a non-linearity at high energy,
  It depends on the PMT itself, the non-linearity curves seem to have a similar trend.

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