BINP Hands-on exercises 2, 3

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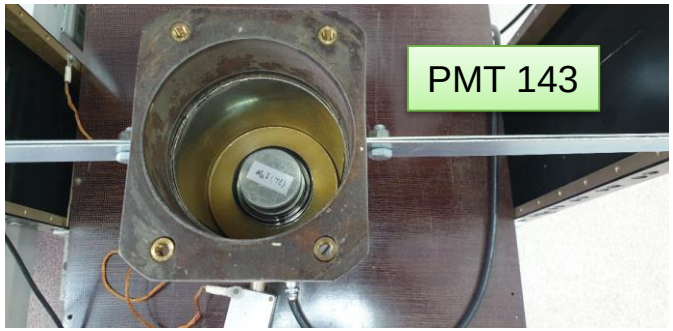
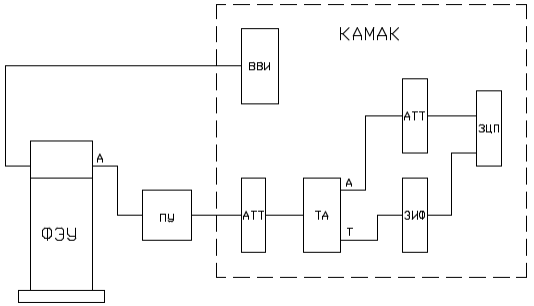
Exercise Proposal 2: Scintillation spectrometer detectors (I)

Setup

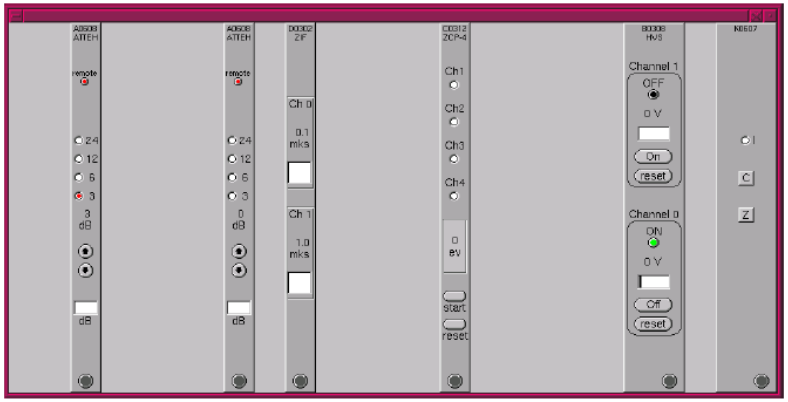
Scintillators



CAMAC DAQ system



GUI for setup control and DAQ

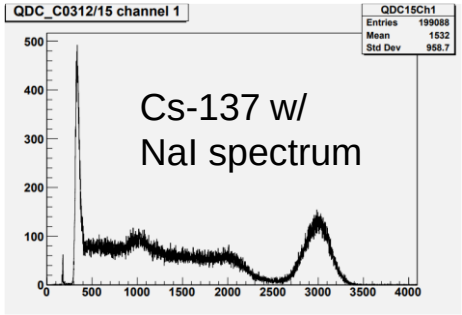


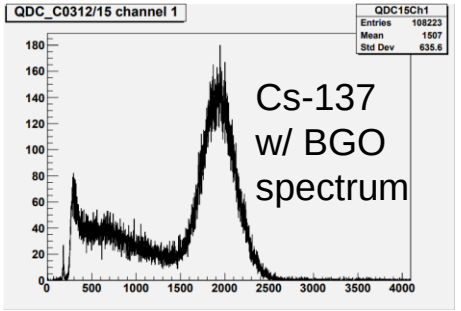
Exercise Proposal 2: Scintillation spectrometer detectors (II)

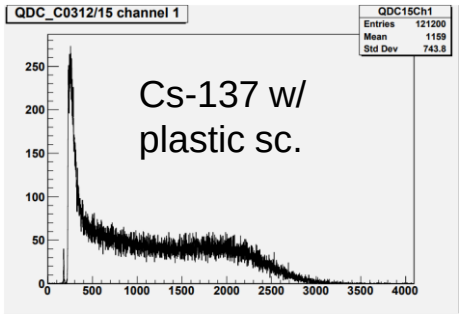
- Detection of gammas from Cs-137 in NaI, LYSO, BGO, plastic. Understanding principle. Difference of scintillation mechanism in crystal inorganic and organic scintillators. Dependance on Z.
- Amplitude spectra acquisition. Understanding spectra. Energy calibration. Measuring single photon amplitude with dark counts.
- Absorbed energy per photoelectron. Number of photoelectrons $N_{p.e.}$.
- Energy resolution. Excess noise factor.

$$\frac{\Delta E}{E} = \sqrt{8 \log 2 \left(\frac{F}{N_{p.e.}} + \left(\frac{N_e}{G N_{p.e.}} \right)^2 \right)}$$

- 4 students in one take, 4 hours in total





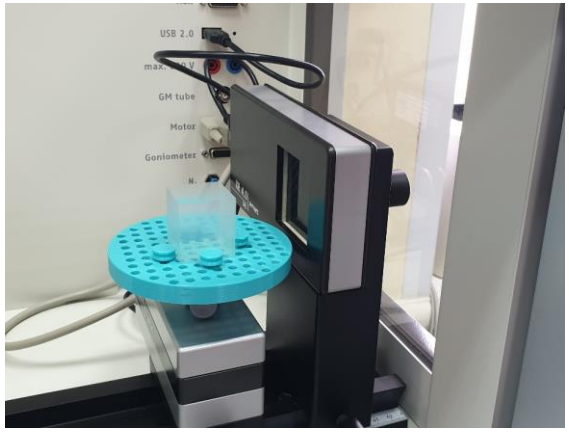


Exercise Proposal 4:
X-ray and CT experiments (I)

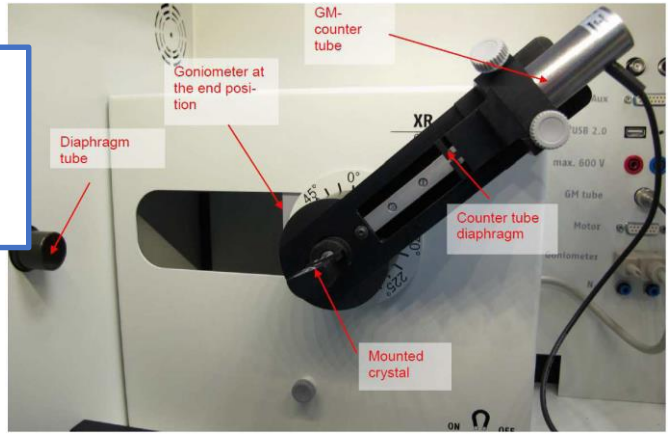
Based on PHYWE XR 4.0 expert unit, 35 kV

~50 experiments are possible in different configurations

Setup for Computed Tomography



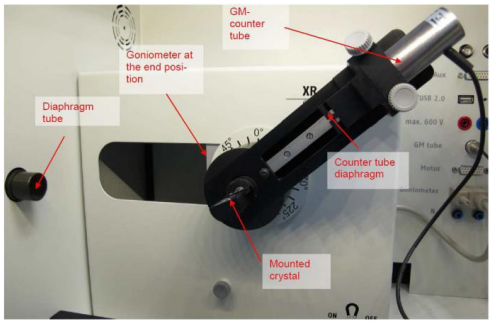
Setup for measuring spectrum of X-rays using Bragg's diffraction



Exercise Proposal 4: X-ray and CT experiments (II)

- Absorption coefficient of different materials. Absorption vs thickness. Absorption vs wavelength.

$$I = I_0 \, e^{-\mu(\lambda, Z) \cdot d}$$

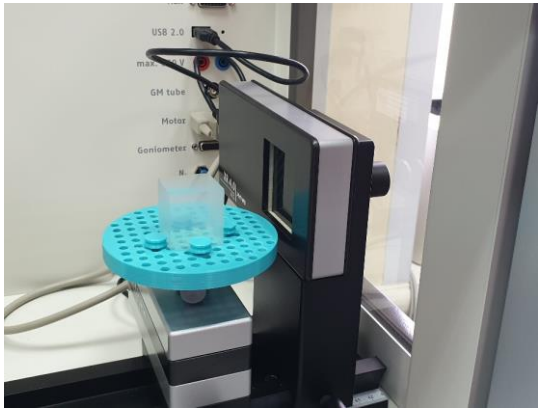


- Moseley's law. X-ray tubes with Mo, Fe and Cu anodes. LiF crystal for spectrum measurement.

$$f = \frac{\Delta E}{h} = \frac{m_e \, e^4}{8\varepsilon_0^2 h^3} (Z - \sigma)^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

- 4 students, 4 hours in total

Exercise Proposal 4: X-ray and CT experiments (III)



Computed X-ray tomography: automated rotation stage, CCD camera

Record CT of different small objects including silica aerogel

Understanding back-projection algorithm

Beam hardening effect. Dealing with artefacts from metal

4 students, 4 hours in total