Silicon photomultiplier using a plastic scintillator

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Why use SiPM

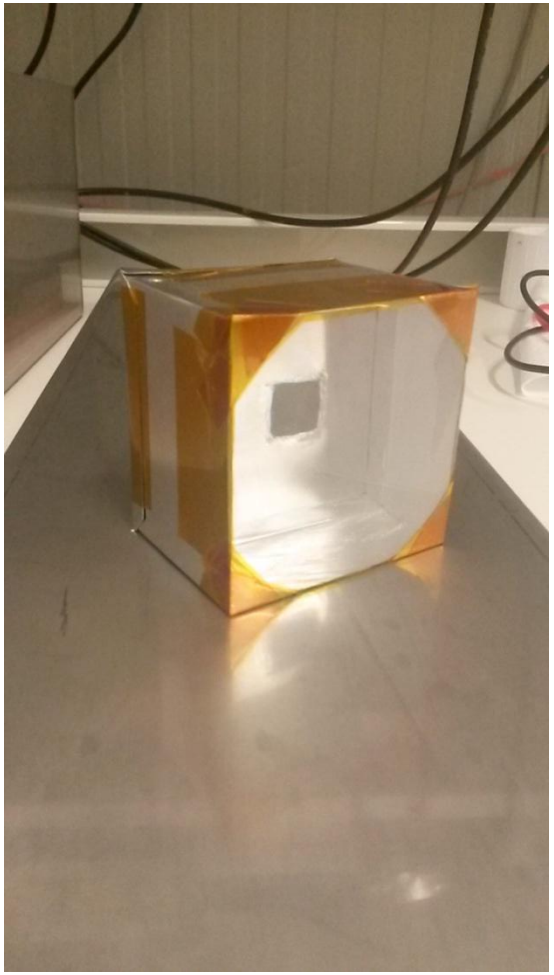
- Silicon photomultiplier (SiPM) is a solid state silicon detector with single photon sensitivity and is a valid alternative to photomultiplier tubes (PMT):

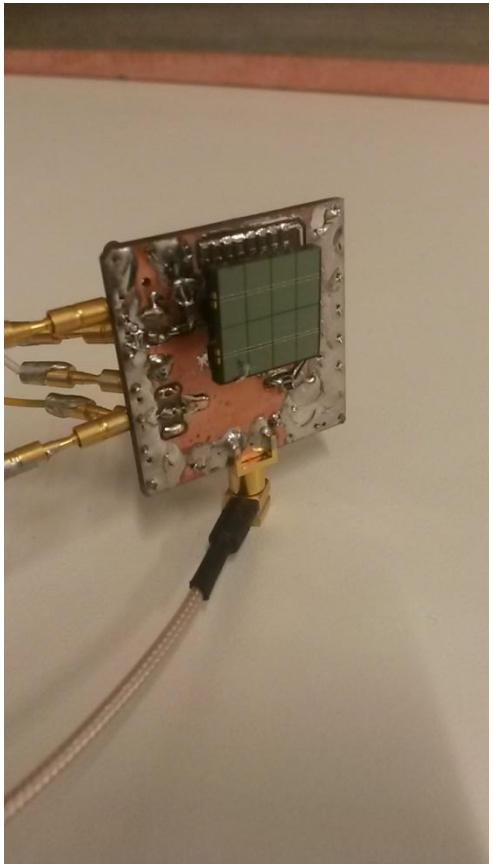
  - low operative voltage (30 V instead of 1500 V),
  - insensitivity to magnetic field,
  - high integration level.

  But:

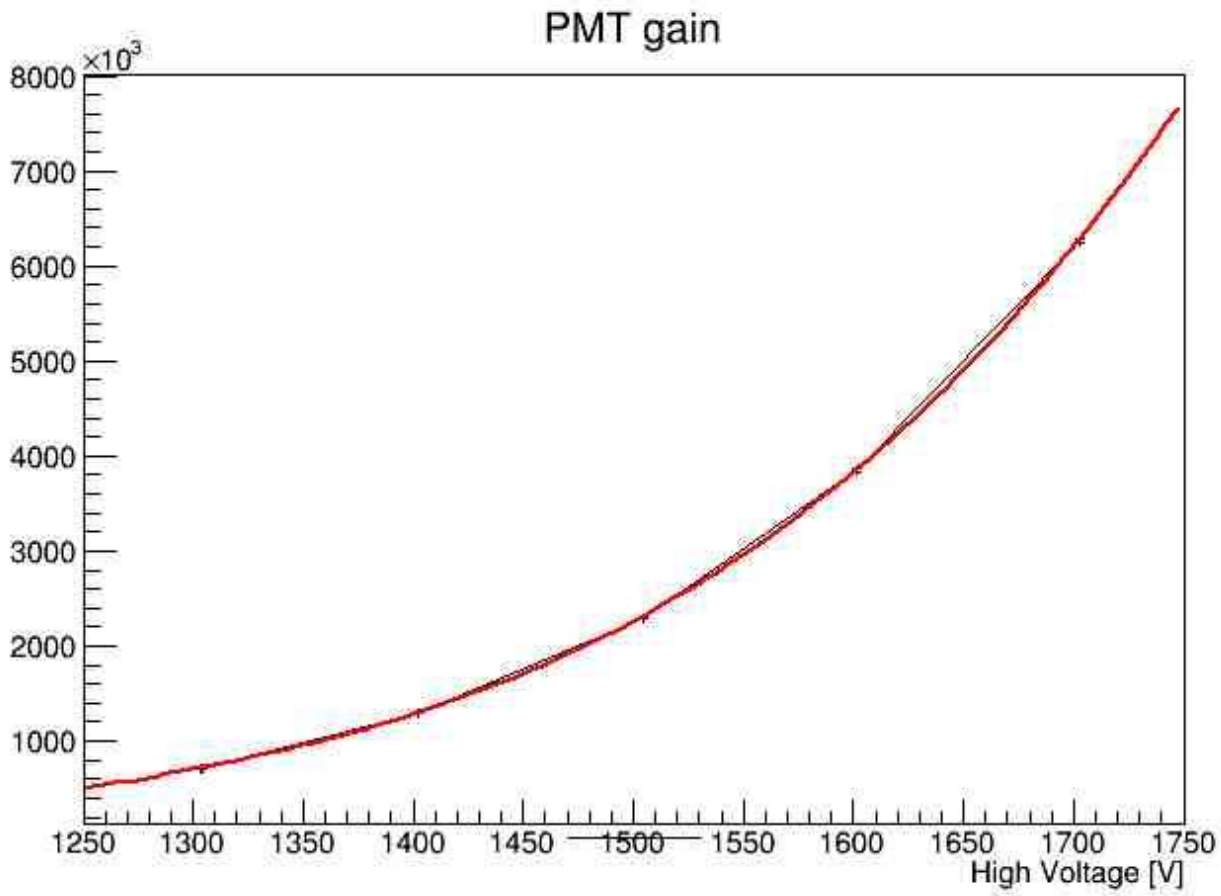
  - very high dark noise rate at room temperature,
  - small active surface.

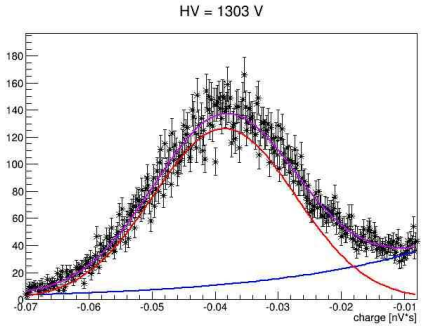
Setup

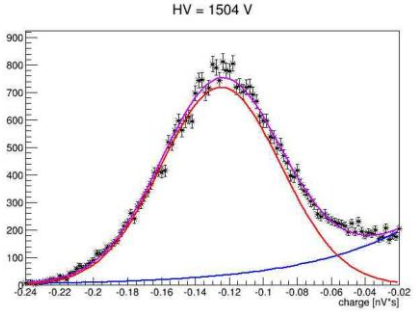


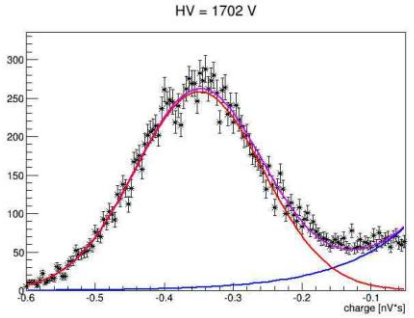


PMT GAIN









Measurements performed with HV = 1440 V

Single photoelectron charge of **12.2 pVs**

Efficiency estimation

$$L_d = L_y \cdot E \cdot \varepsilon_g \cdot \varepsilon_q$$

- Using muons:

E = 1.8 MeV cm^2/g · 5.7 cm · 1.03 g/cm^3 = **10.6 MeV**

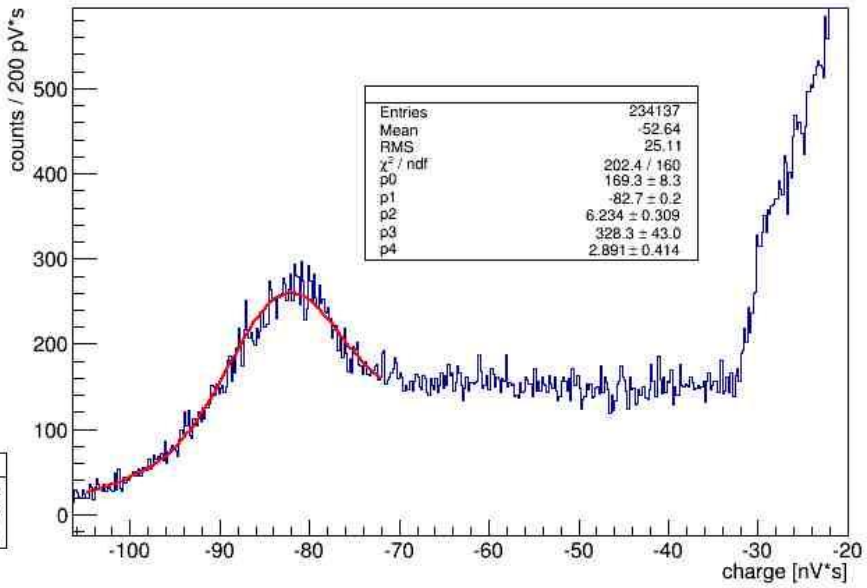
- L.Y : 64% of anthracene: **11070 γ/MeV**
- Signal at 82.7 pVs

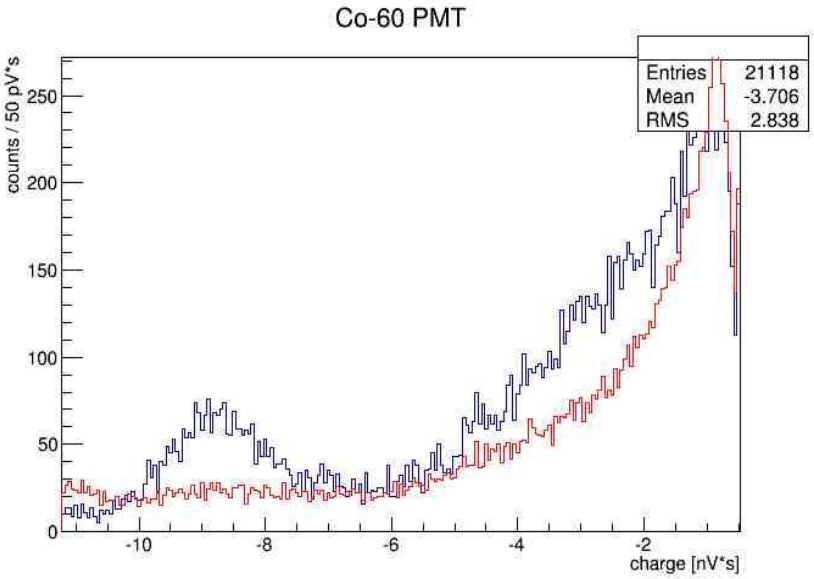
Light collection:

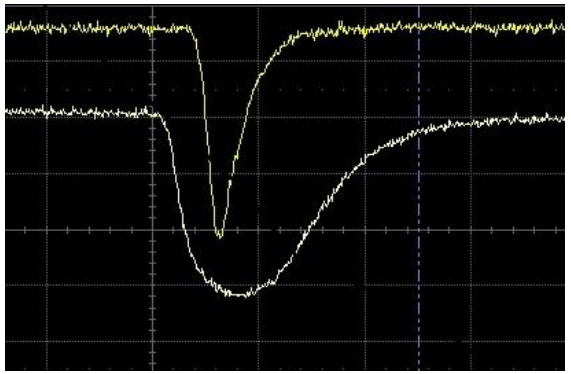
640 γ/MeV

Geometrical efficiency:

19%

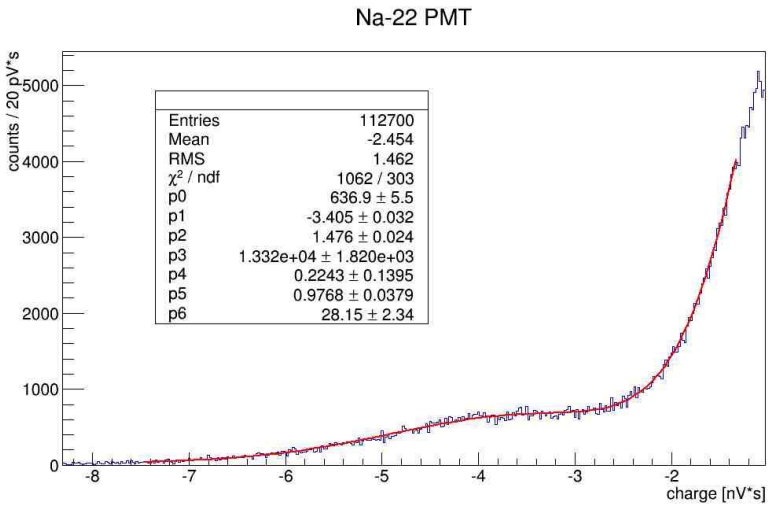


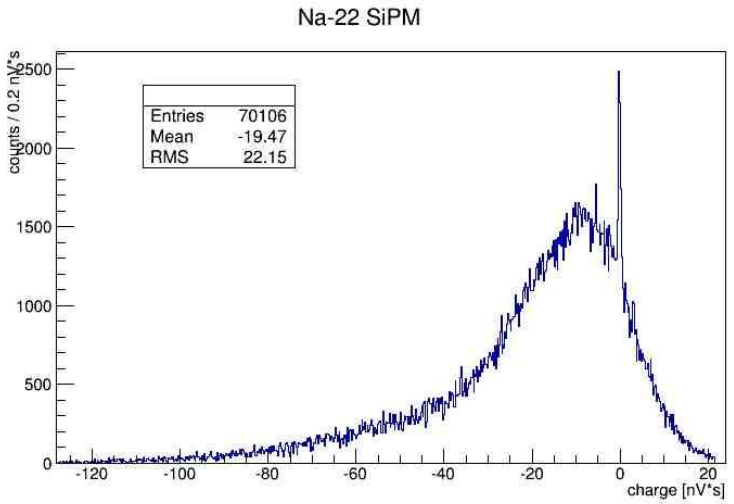


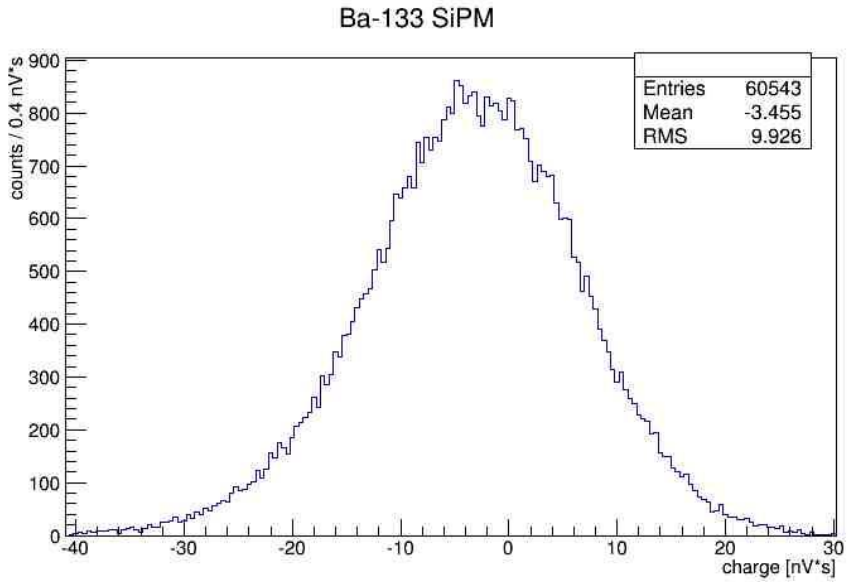


EFFICIENCY

- SiPM geometrical efficiency is 5.9% of the one of PMT.
- Aspected light collection of SiPM: 1.1%







Na^{22} gamma peak at **511 keV** and **1.2 MeV**.

Ba^{133} gamma peak at **80**, **300** and **360 keV**.

Conclusions

- Spectra obtained from SiPM present a low resolution. This because of the scintillator, and especially the small active surface.

- Try using different scintillators (larger and more dense)

- Main present and future tasks:

  - Increase the active surface of SiPM
  - Decrease the working temperature