Particle identification with ROSY®

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ADAMAS, Zagreb, November 27th, 2017

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ROSY® - Real-Time Data Acquisition and Processing System

- Real-time and dead-time free data processing with FPGA
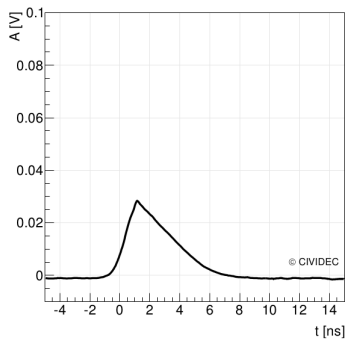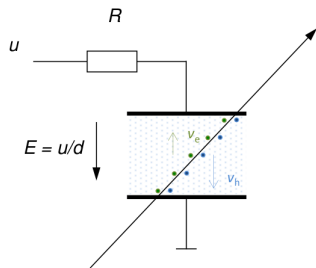- Embedded Linux-based server controls the data acquisition

ROSY® - II

- 4 input channels, max. sampling rate 5 GS/s (with 1 channel)
- Analogue bandwidth 250 MHz, ADC 8 bit
- Ethernet connection to control system
- EXT trigger input, DAC output, USB, VGA

Pulse-shape analysis for particle identification
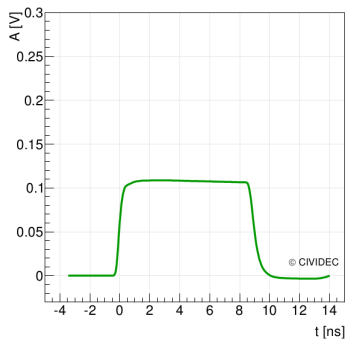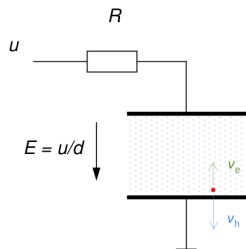
Homogeneous ionization

- MIP, γ-particle

- Low-energetic charged particle

Measured pulse parameters: Amplitude h, area a, FWHM, base width w_b

Form factor

$$F = \frac{\text{Calculated area}}{\text{Measured area}} = \frac{h \cdot w_b}{a} \qquad (1)$$

- $F = 1$ for rectangles
- $F = 2$ for triangles

Selective Spectroscopy Application: ^{241}Am

- 5.5 MeV α-particles
- Electron readout
- Point-like ionization

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- Electron readout
- Point-like ionization
- FWHM $>$ 8 ns
- Mean F=1.3

- 1.17 MeV and 1.33 MeV γ-particles
- Homogeneous ionization

- 1.17 MeV and 1.33 MeV γ-particles
- Homogeneous ionization
- FWHM < 8 ns
- Mean $F=1.8$

$$^6\text{Li} + \text{n} \rightarrow {}^3\text{H}(2.73 \text{ MeV}) + \alpha(2.05 \text{ MeV})$$
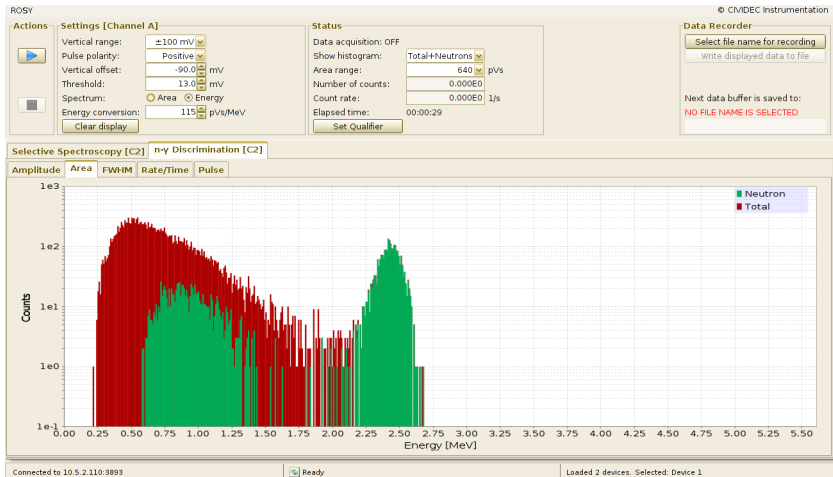

α

n

³H

LiF foil
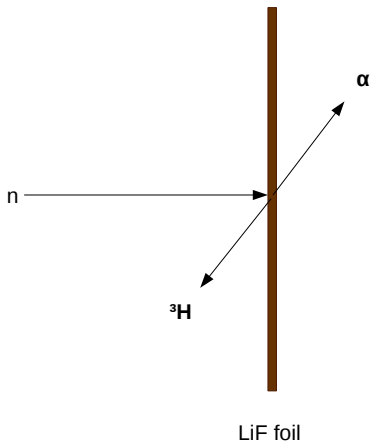
- Background: γ-particles
- Neutrons produce ^{3}H and α-particles
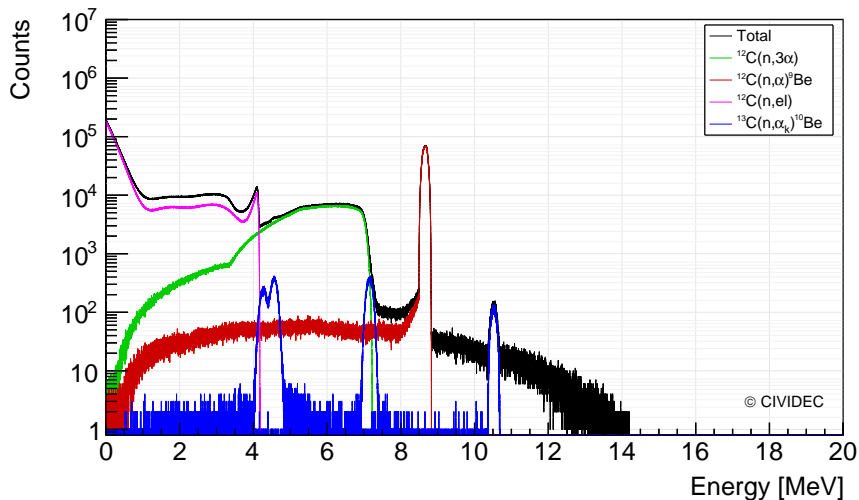- Qualifier: FWHM

Thermal neutrons: FWHM histogram
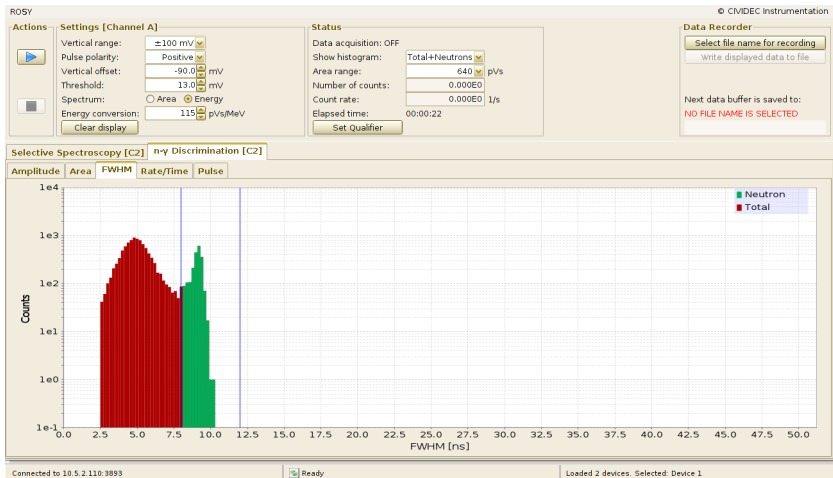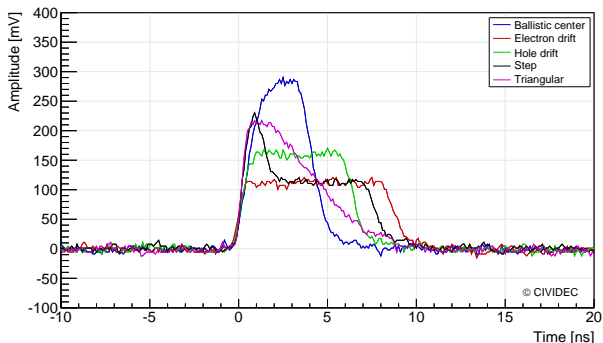
Thermal neutrons: Energy spectrum

14 MeV neutrons: Simulated spectrum

C. Weiss, "Neutron Diagnostics", ADAMAS-2016

- Fast neutrons interacting in the *ballistic center* produce **rectangular** pulses with a minimum **drift time**

- $^{12}C(n, \alpha)^9Be$ and $^{13}C(n, \alpha)^{10}Be$ reactions
- Background: elastic and inelastic neutron interactions, γ, recoiled protons

- ^{12}C(n, α)^{9}Be and ^{13}C(n, α)^{10}Be reactions
- Background: elastic and inelastic neutron interactions, γ
- Recoiled protons from the detector structure
- $F < 1.5$
- FWHM < 5.5 ns
- $w_b < 6.3$ ns

Selective Spectroscopy Application with 14 MeV neutrons

Thank you for your attention!

References

- P. Kavrigin, E. Griesmayer, F. Belloni, A.J.M. Plompen, P. Schillebeeckx, C. Weiss, $^{13}C(n,\alpha_0)^{10}Be$ cross section measurement with sCVD diamond detector, Eur. Phys. J. A **52**, 179 (2016)

- C. Weiss, H. Frais-Kölbl, E. Griesmayer, P. Kavrigin, Ionization signals of diamond detectors in fast neutron fields, Eur. Phys. J. A **52**, 269 (2016).