Neutron Inelastic Cross Section Measurement at the GAINS Spectrometer

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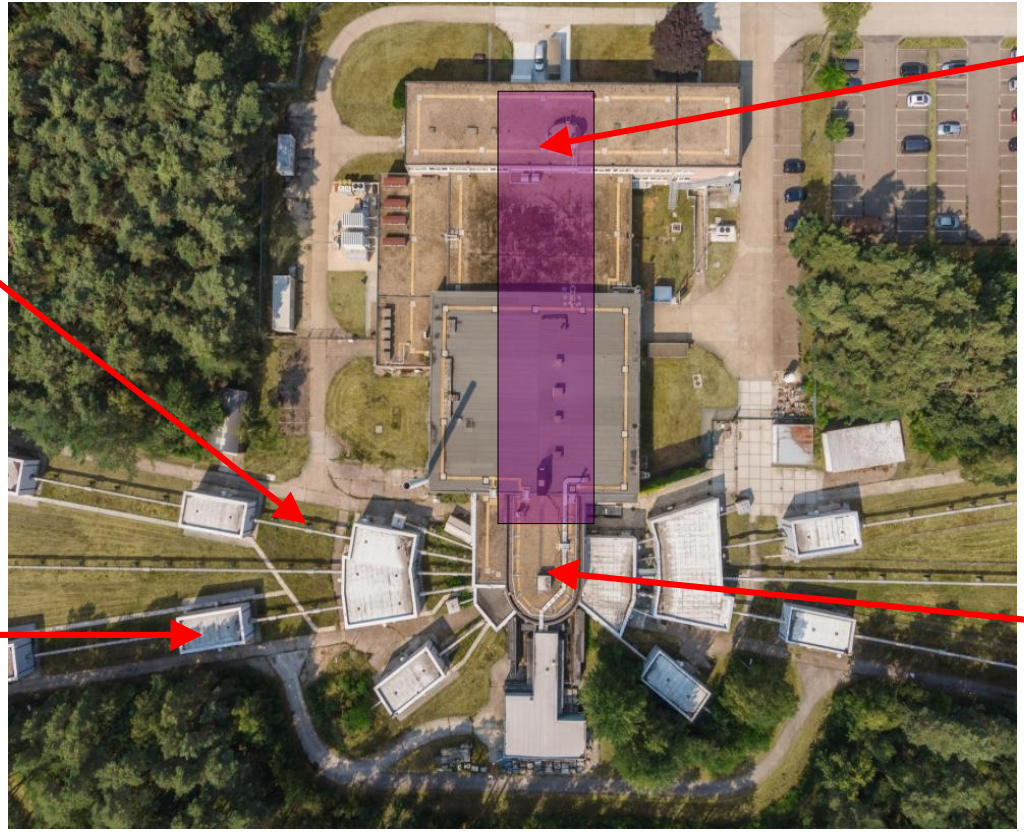
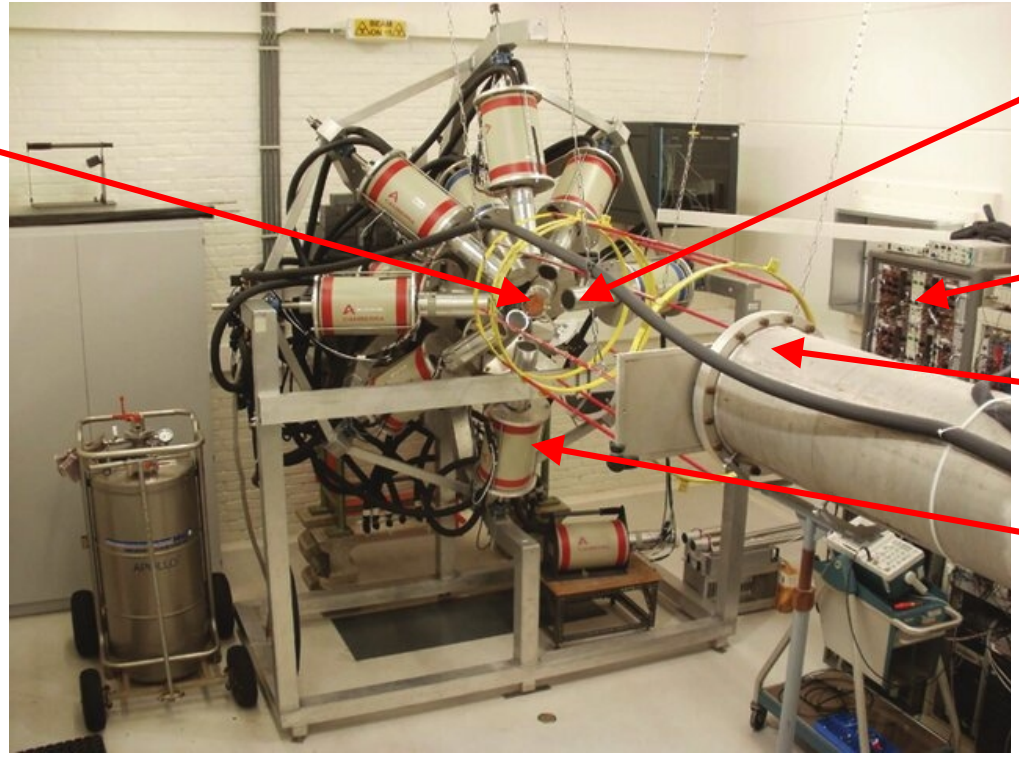
Photo is taken from
https://joint-research-centre.ec.europa.eu

GELINA Facility



The GAINS Spectrometer

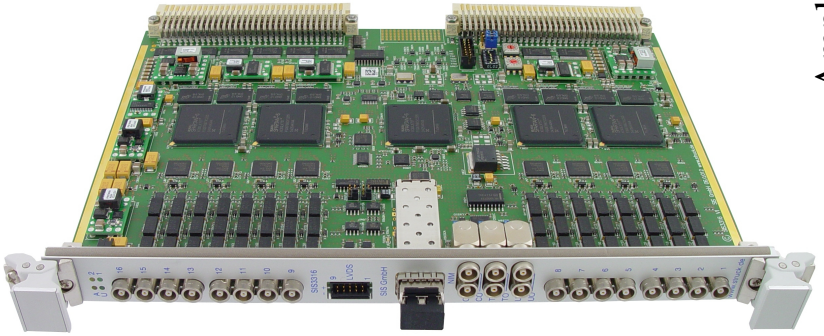
GAINS: Gamma Array for Neutron Inelastic Scattering

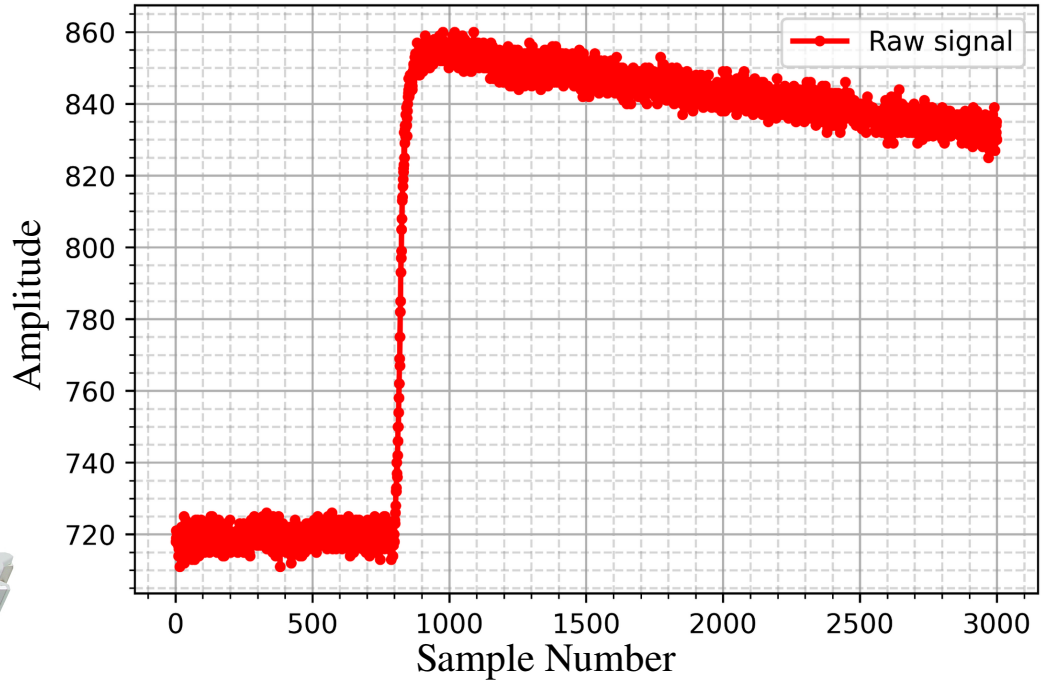


Upgrading of Data Acquisition System

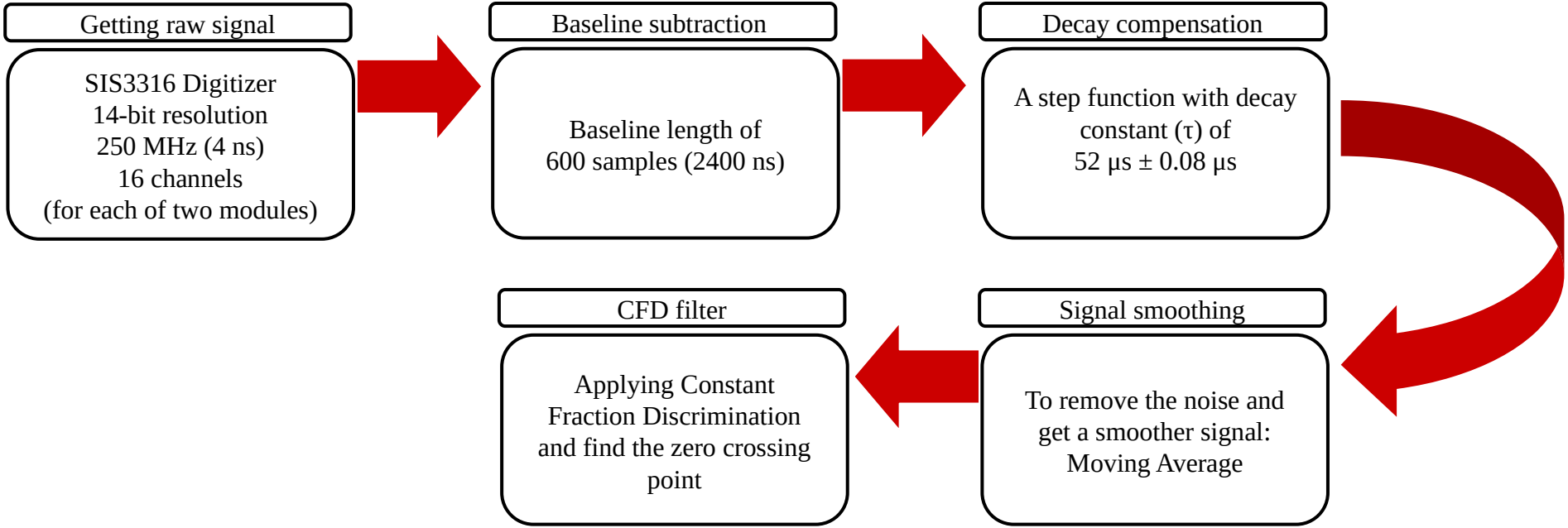
Struck SIS3316-250-14

- 16 Channels
- 14-bit Resolution
- 250 MHz Sampling Rate





Signal Processing Chain for Timing Measurements



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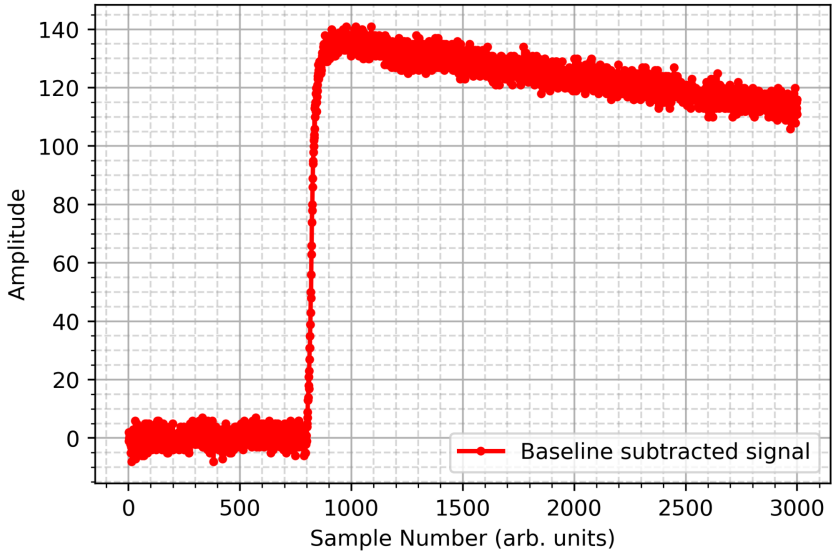
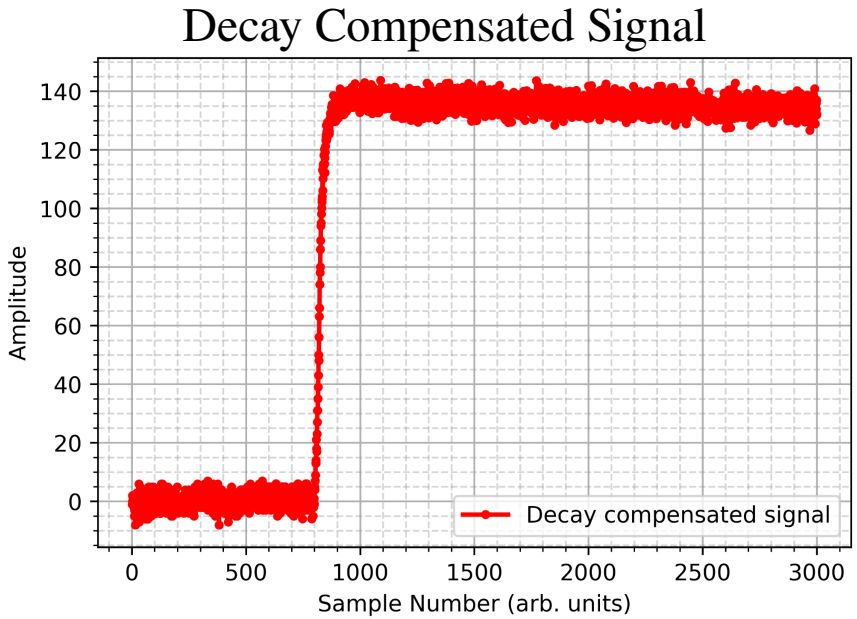
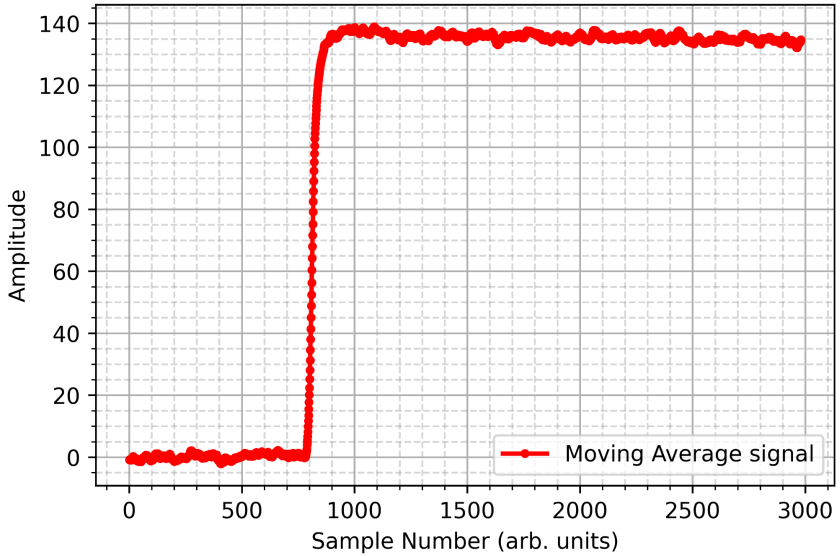




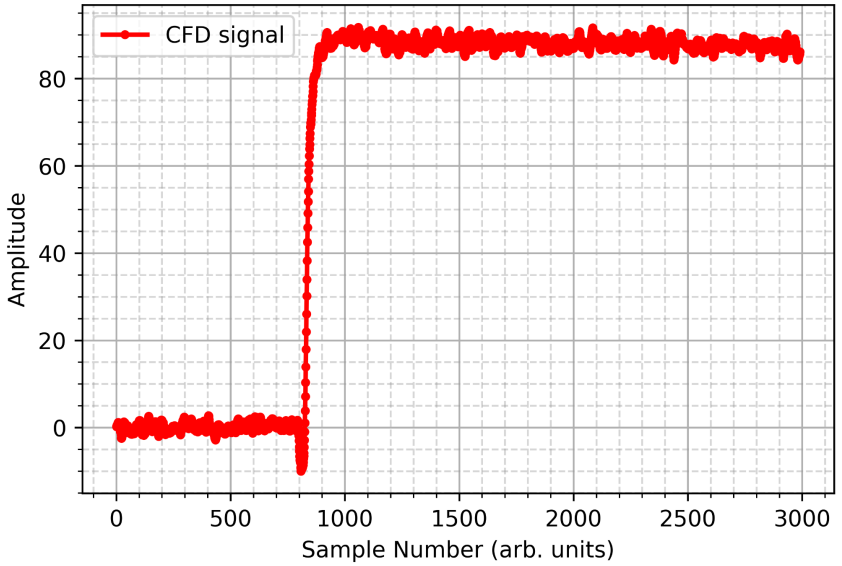
Decay compensation filter: $\Psi_{i+1} = \Psi_i + e^{\frac{\Delta t}{2\tau}}(x_{i+1} - x_0) - e^{-\frac{\Delta t}{2\tau}}(x_i - x_0)$

Signal Processing Chain for Timing Measurements

Smoothed Signal



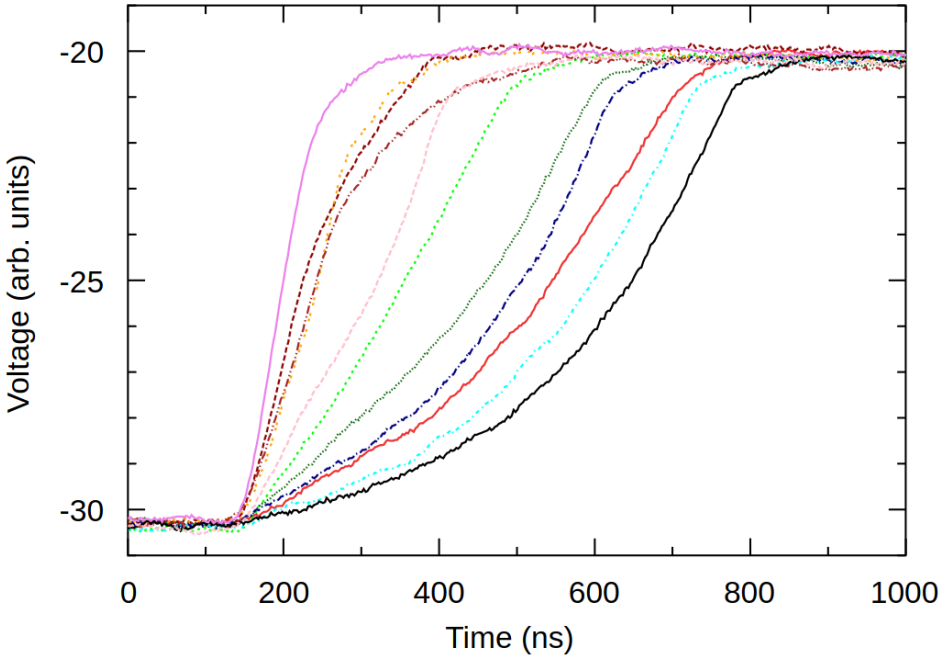
CFD Signal

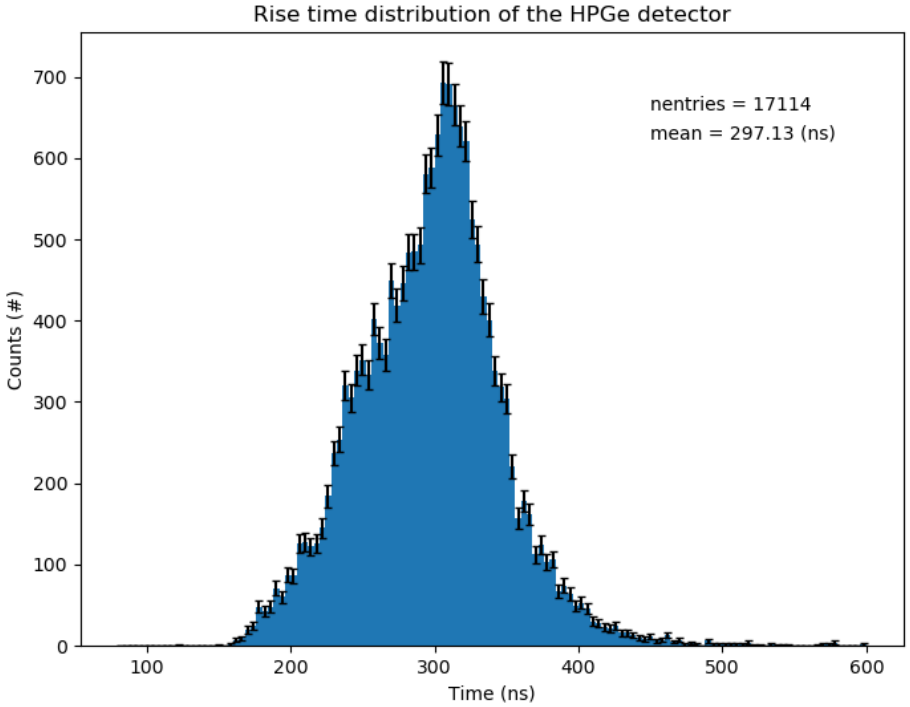


Moving average filter: $\Phi_i = \frac{1}{L}\sum_{j=0}^{L-1} x_{i+j}$

CFD filter: $\Lambda_i = x[i - d_{\mathrm{CF}}] - f_{\mathrm{CF}} \cdot x[i]$

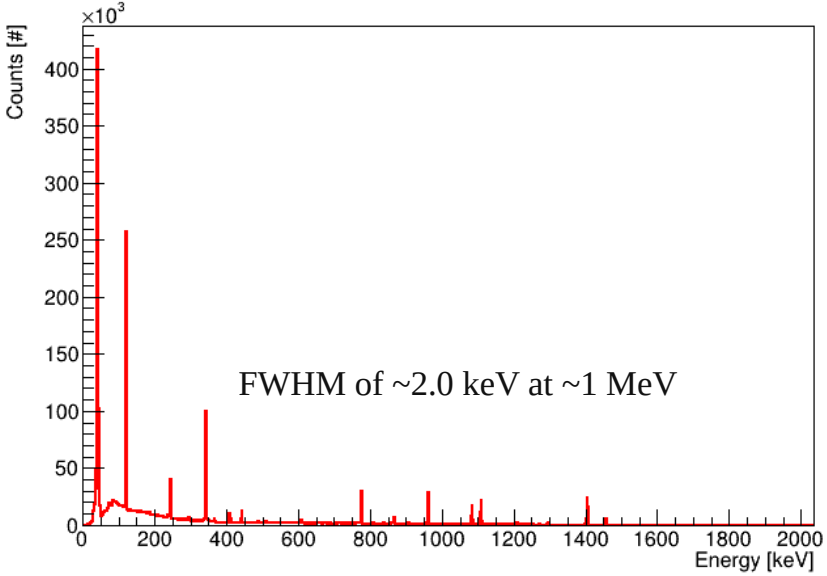
Rise time of HPGe detector



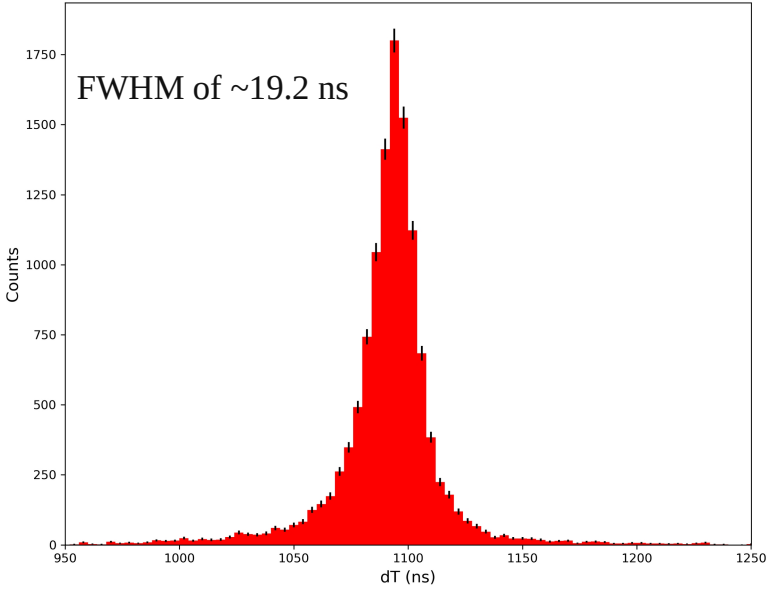


Energy and Timing Resolution of HPGe Detector

^{152}Eu Spectrum



Time difference between T0 and gamma-flash



Neutron Inelastic Cross-Section Measurement Formula

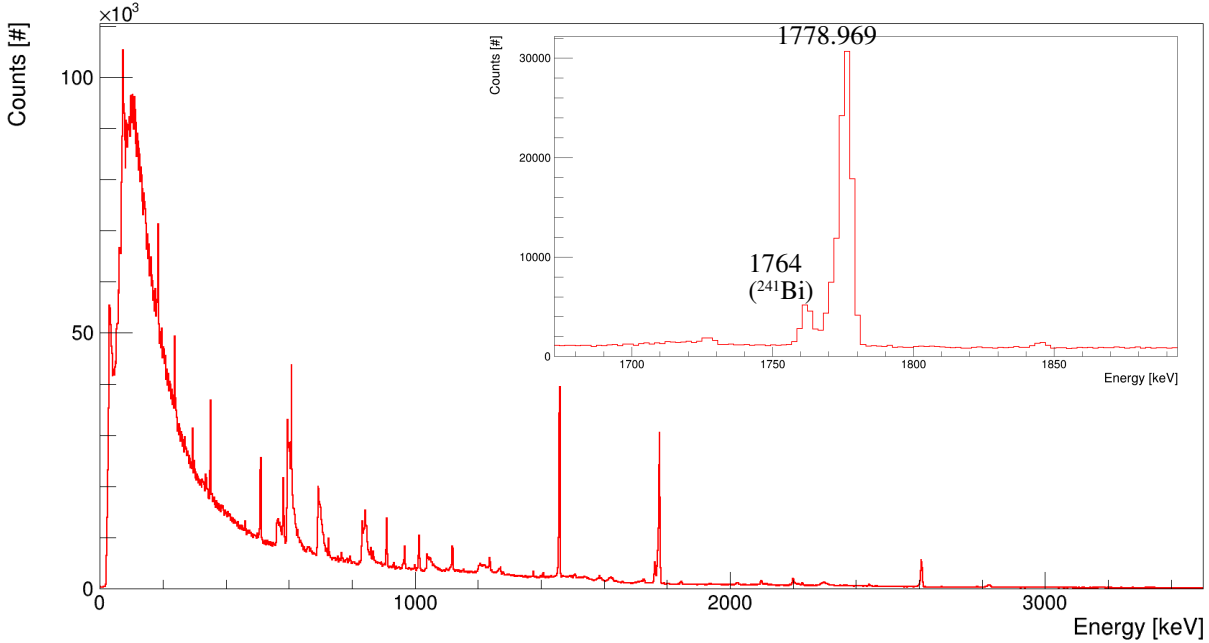
$$\frac{d\sigma_j}{d\theta}(\theta_i, E_n) = \frac{1}{4\pi}\frac{Y_j(E_n)}{Y_{FC}(E_n)}\frac{\varepsilon_{FC}\sigma_U(E_n)}{\varepsilon_j}\frac{\rho_U}{\rho_s}\frac{A_s}{A_U}\frac{1}{c_{ms}(E_n)}$$

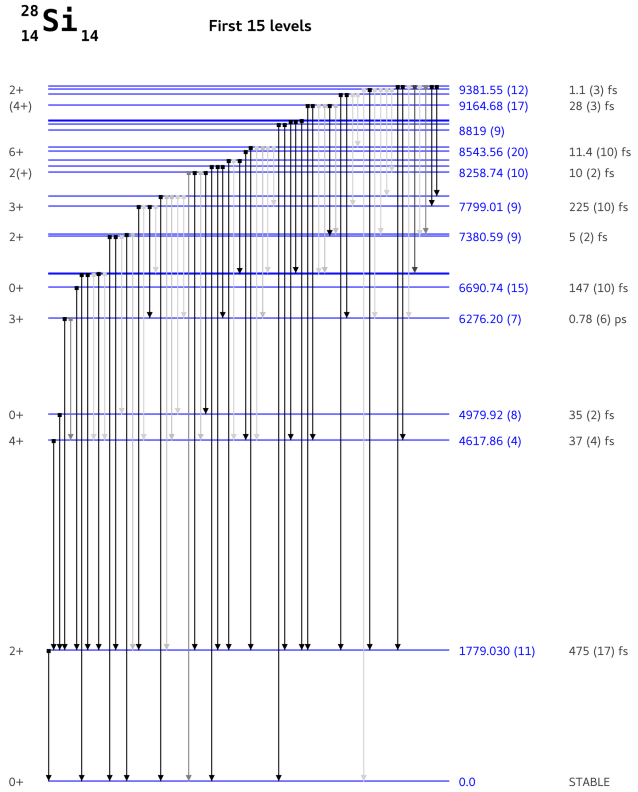
Y_j: γ yield in the detector j,
Y_{FC}: Fission chamber yield,
ε_{FC} Fission Chamber Absolute Efficiency
ε_j: Absolute Photopeak Efficiency of the Detector j
σ_U: ^{235}U(n, fission) Cross Section
ρ_U: Areal Density of the Uranium Deposit
ρ_s: Areal Density of the Sample
A_U and A_s: Atomic Masses of Uranium and Sample
c_{ms}: Neutron Multiple Scattering Correction Factor

$$\sigma(E_k) = 2\pi\left[w_{110^\circ}\frac{d\sigma}{d\theta}(110^\circ, E_k) + w_{150^\circ}\frac{d\sigma}{d\theta}(150^\circ, E_k)\right]$$

E_k: Incident Neutron Energy
$\frac{d\sigma}{d\theta}(110^\circ, E_k)$ and $\frac{d\sigma}{d\theta}(150^\circ, E_k)$: Differential Cross Section at 110° and 150°
w_{110°: 1.30429
w_{150°: 0.69571

Preliminary Results for ^{28}Si for 1 Detector





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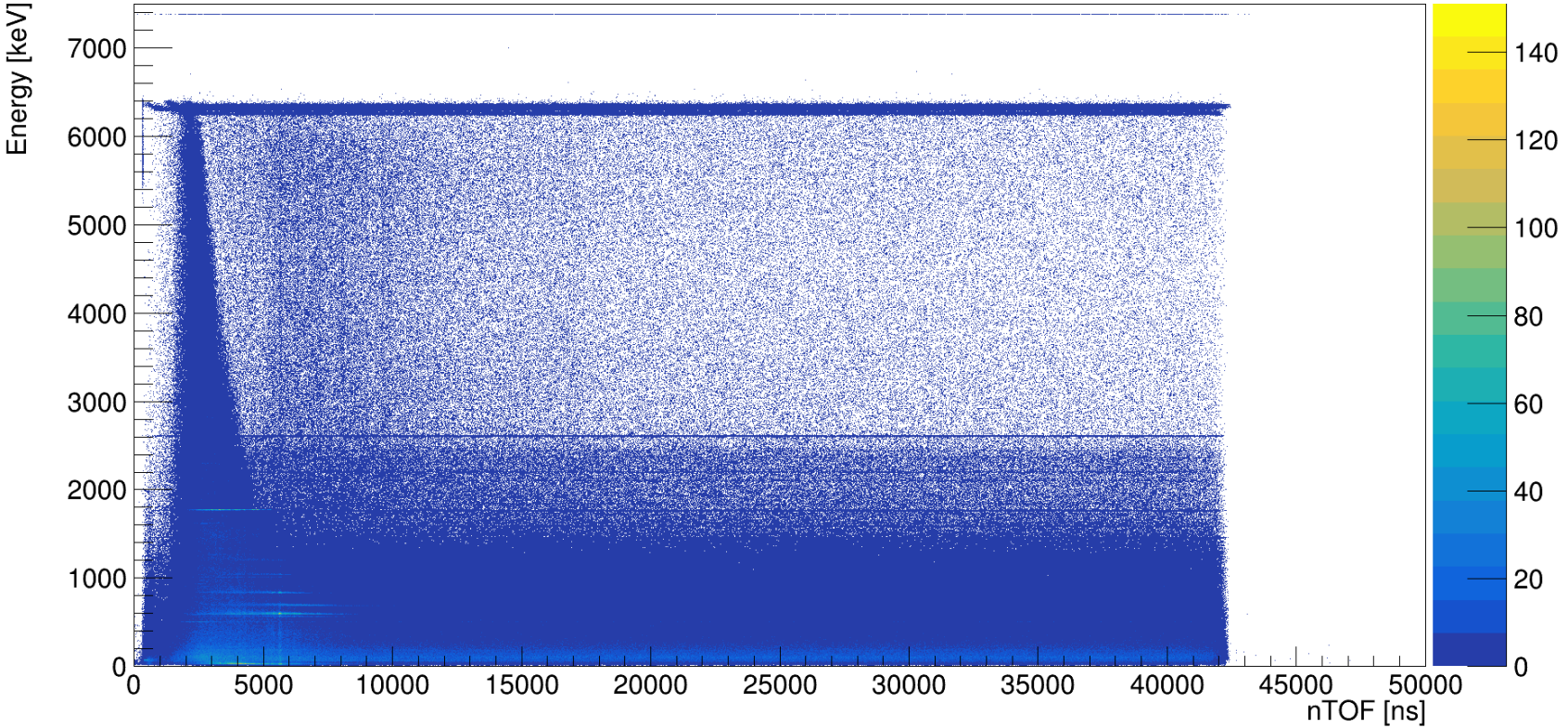

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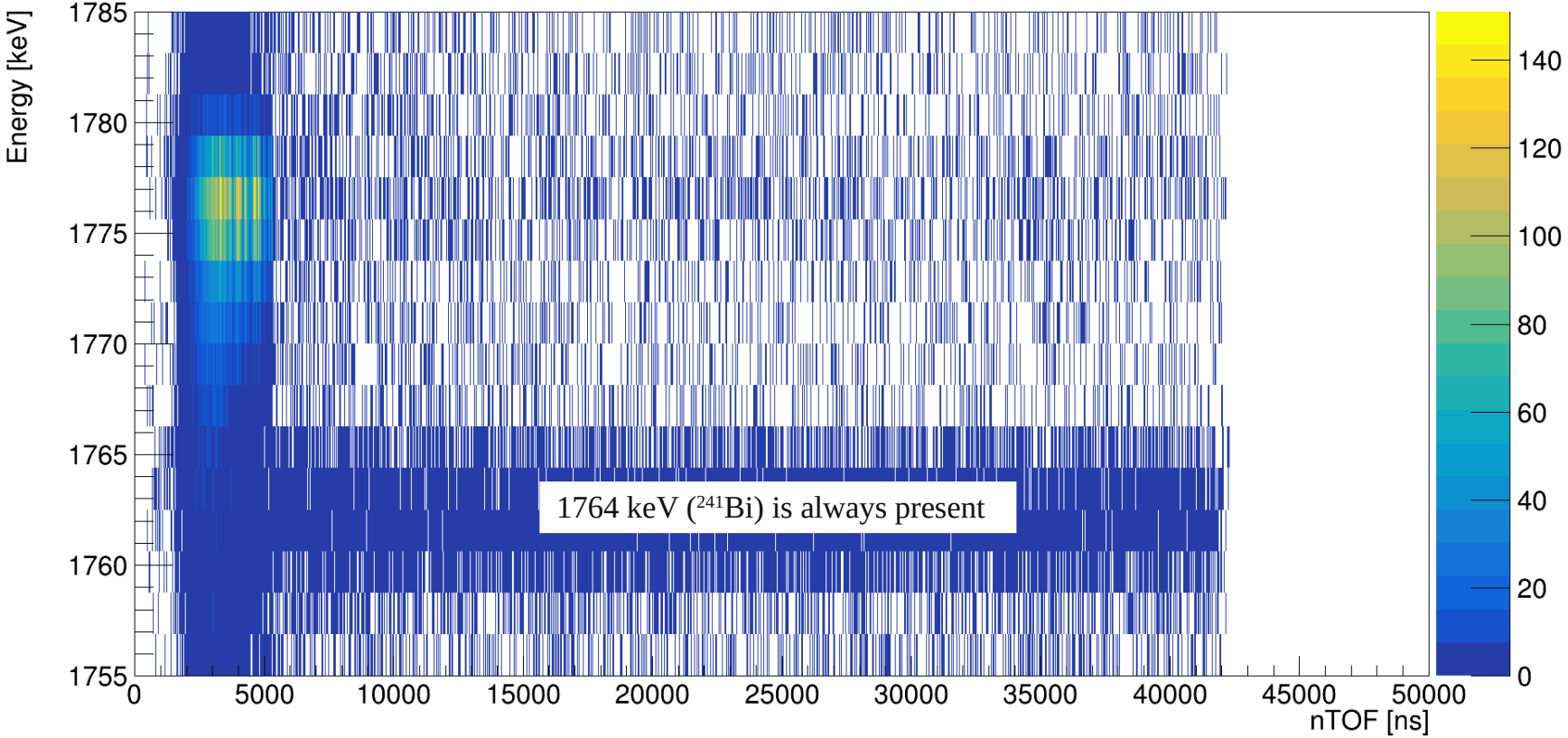

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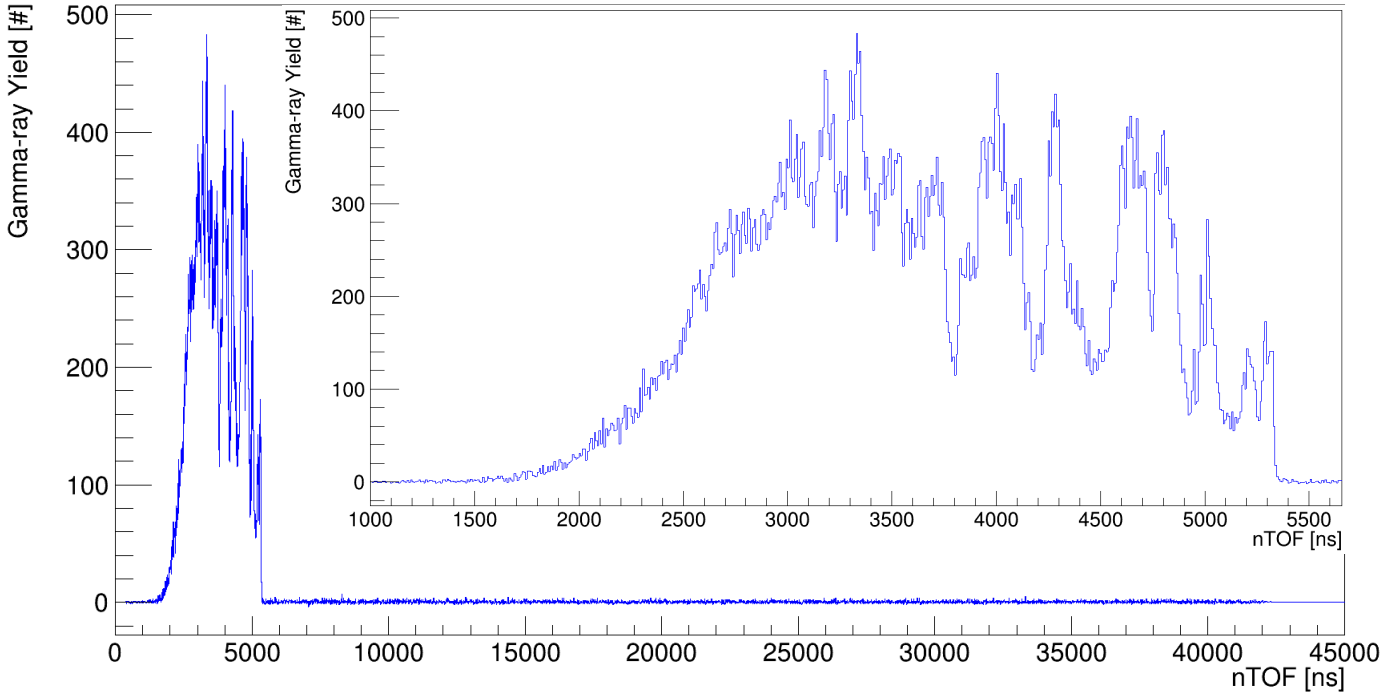

Thank you for your attention.

Any questions?