中国科学院高能物理研究所
Institute of High Energy Physics
Chinese Academy of Sciences

The Chinese Academy
of Sciences

Study on performance test of glass scintillator

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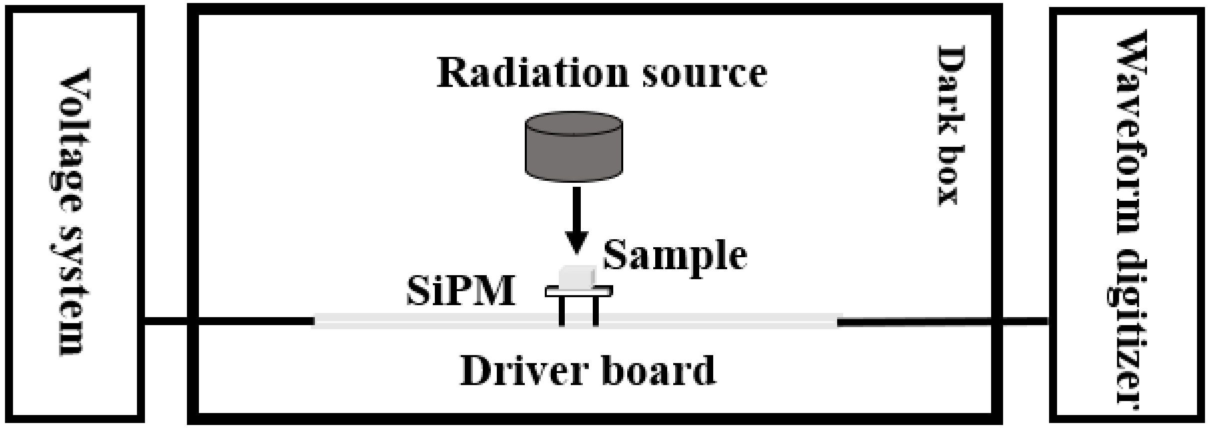
1.1 Light yield—facility



Test facility of light yield

	LY（ph/MeV）
NaI(Tl)	40000
$LaBr_3$:Ce	70000
BGO	8000
LYSO:Ce	27000
GAGG:Ce	50000

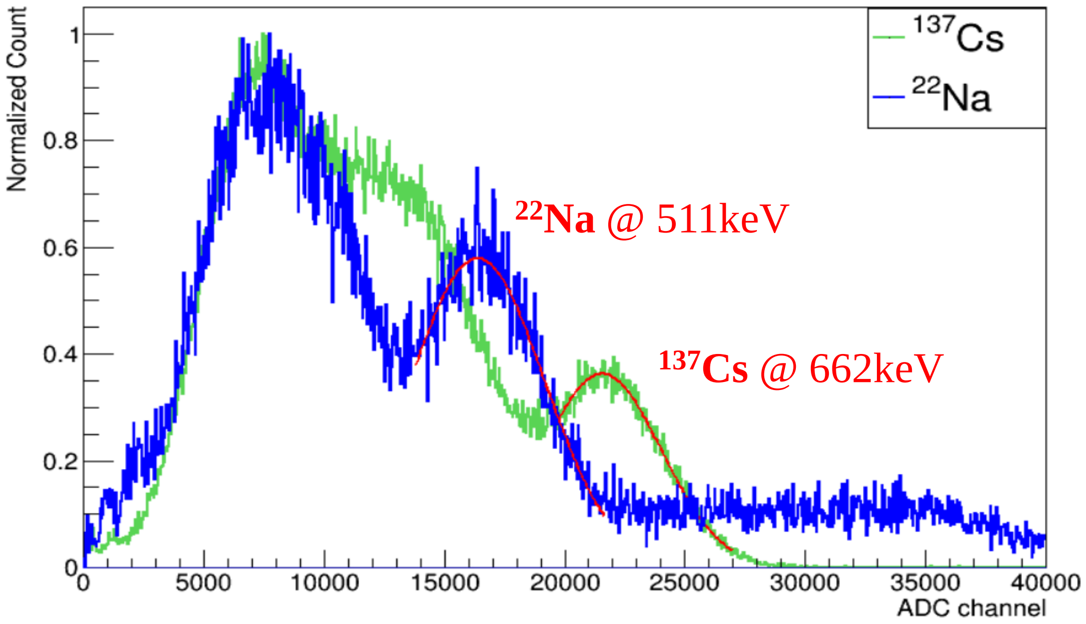
- **Light yield**: the luminescent capacity of the scintillator; Efficiency of particle deposition energy into scintillation photons. The unit is photons/MeV—The number of photons excited by the energy deposition in the scintillator of radiation with energy of 1 MeV.
- The higher the light yield of the scintillator, the more photons that can be detected, the smaller the statistical error of the system, and the higher the test accuracy obtained.

1.2 Light yield—method

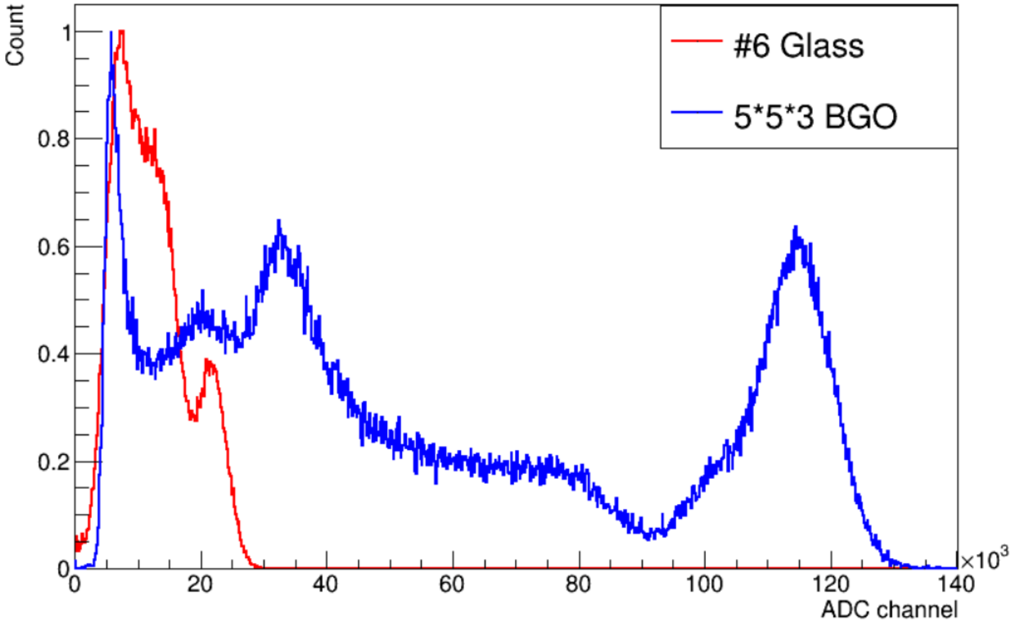
- **Absolute light yield:** The formula of the light yield: $LY_s = \frac{Mean_{energy} * 1000\text{keV}}{Mean_s * PDE_w * PCE * Energy}$

  Calculated by different full energy peak of radioactive source, the light yield of the glass is **802 ph/MeV;**
- **Relative light yield:** Calculate the relative light yield of glass through BGO standard crystal,

  the light yield of the glass is **845 ph/MeV**;
- The light yield of the glass calculated by the two methods is the same.

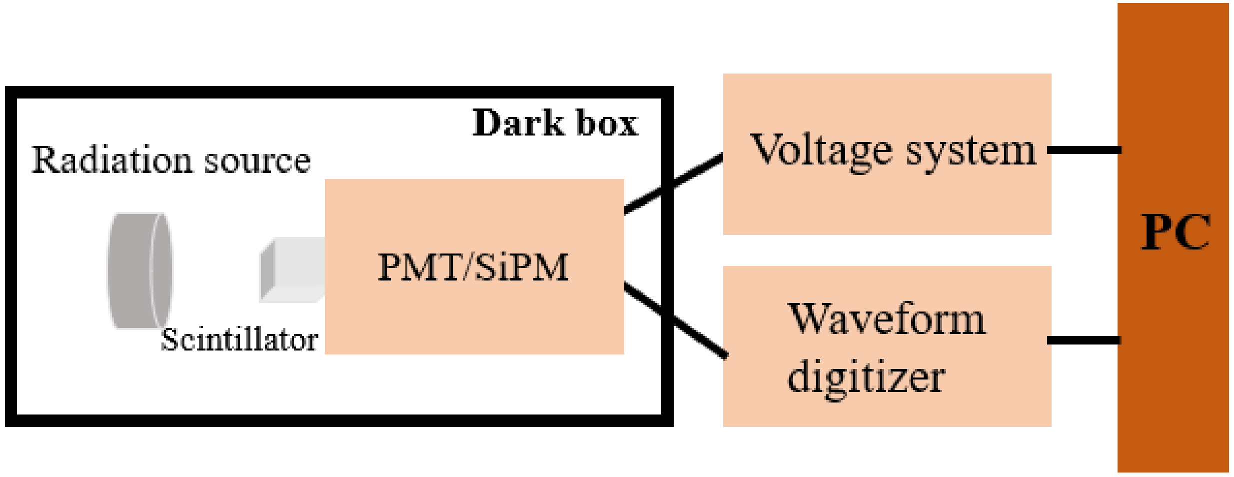


- LY of the GS =802 ph/MeV



- LY of BGO=8000 ph/MeV
- LY of the GS =845 ph/MeV

2.1 Energy resolution—facility



Test facility of energy resolution

	ER（%）
NaI(Tl)	5.6
CsI(Tl)	4.3
$CdWO_4$	6.8
BGO	9.0
BaF_2	7.7
YAP:Ce	4.4

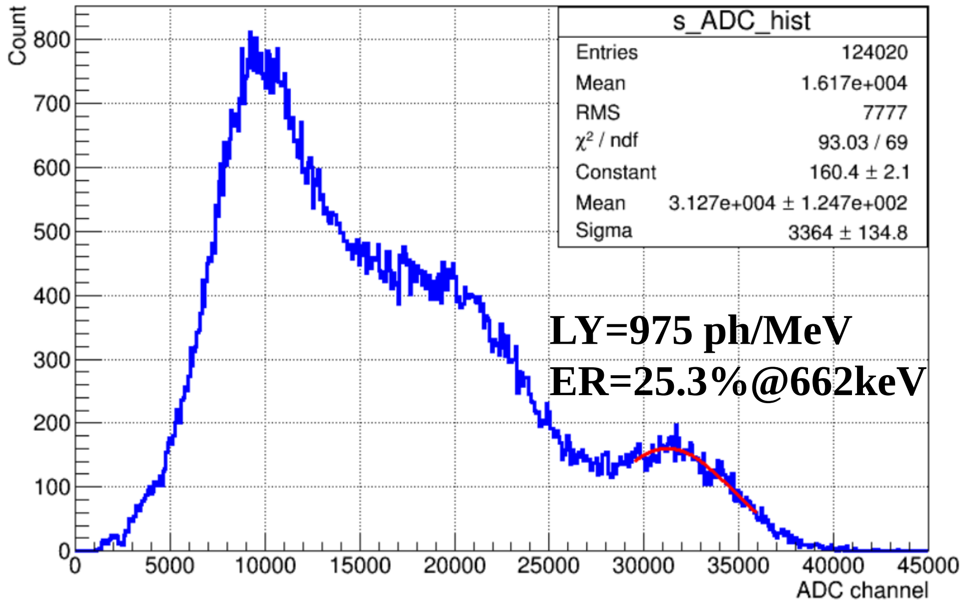
- **Energy resolution**: For two different energies of particles, **the minimum energy interval** that measured by detector.

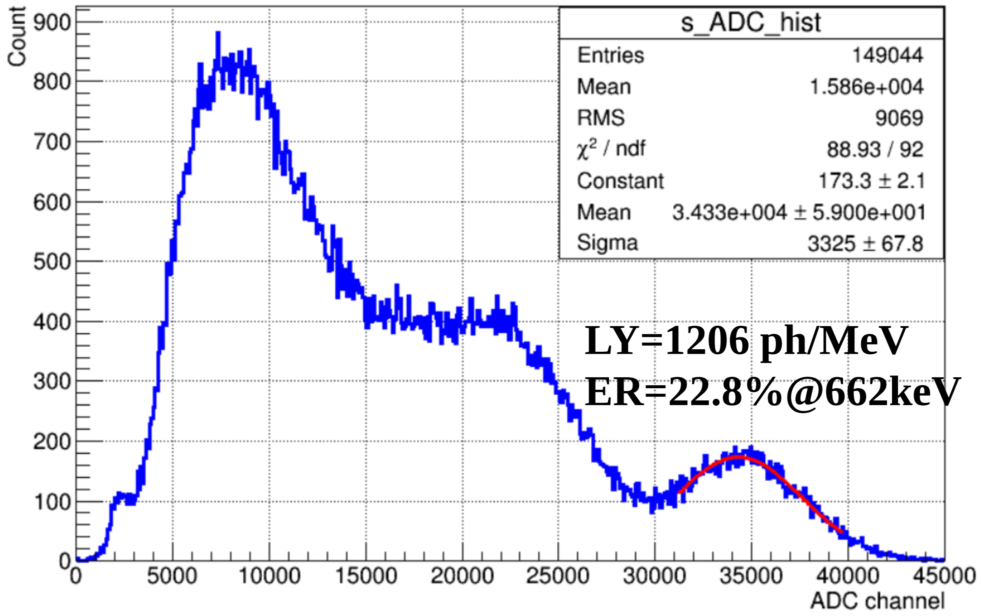
- **Energy resolution:** $\boldsymbol{\varepsilon = \frac{\Delta p}{p} = \frac{\Delta E}{E}}$ $\Delta p — FWHM\ of\ full\ energy\ peak$

  $p — peak\ position\ of\ full\ energy\ peak$

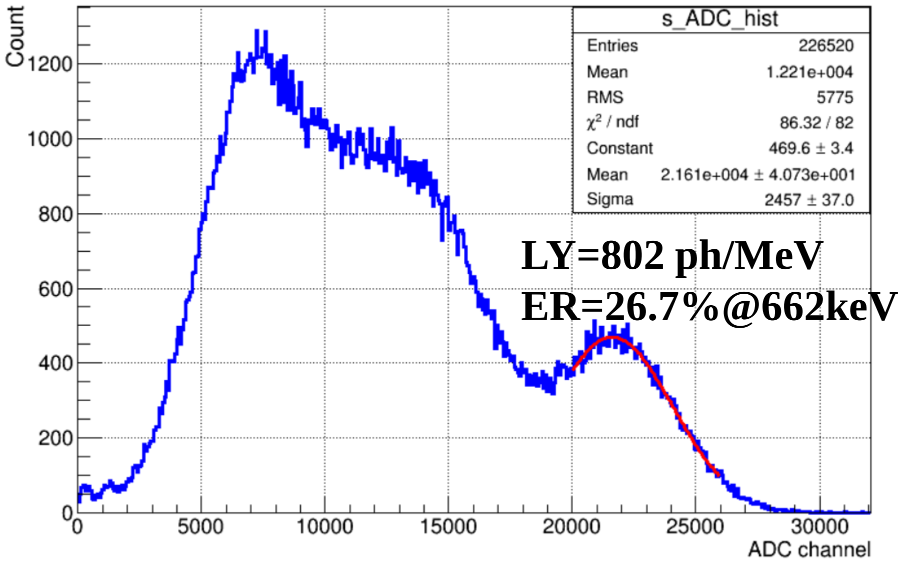
- **Gaussian Fitting:** $P(p) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(p-\overline{p})^2}{2\sigma^2}}$ $\sigma = \varepsilon/2.355$

2.2 Energy resolution—glass



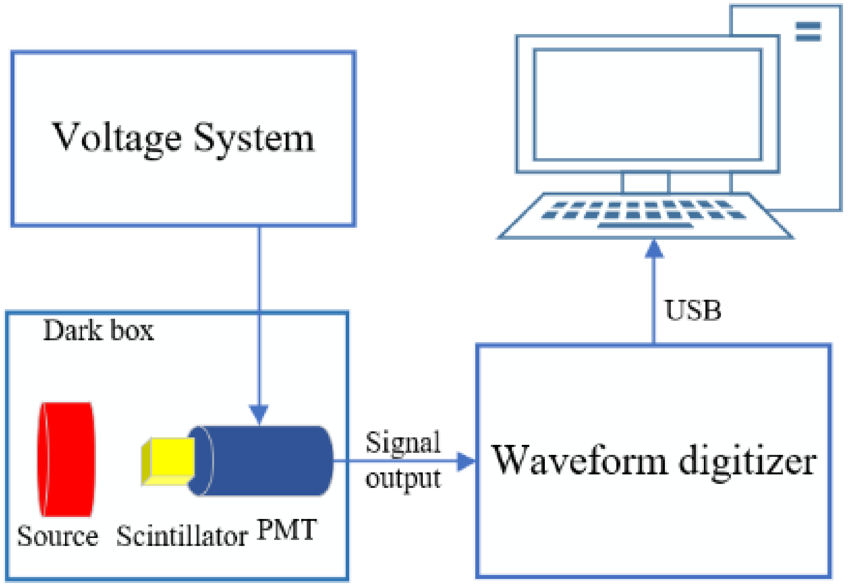


Energy spectra of scintillating glasses—CJLU

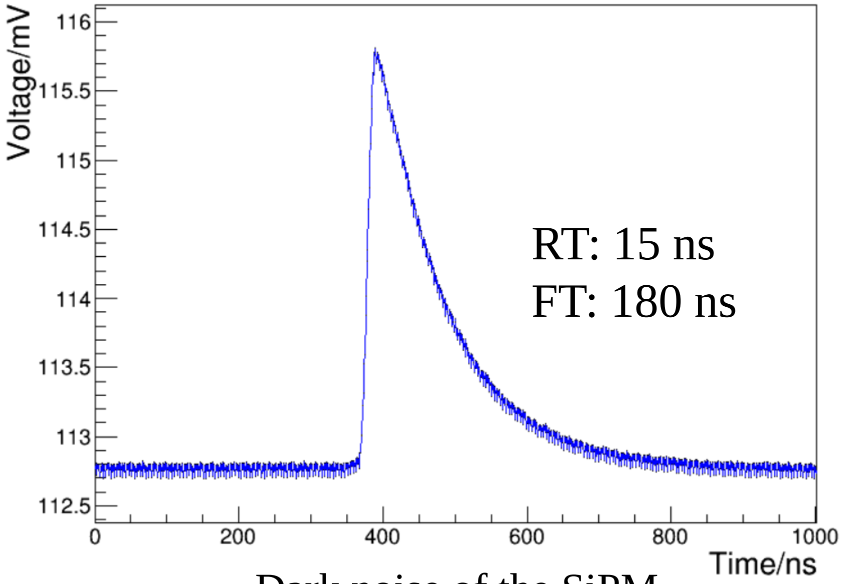


- The energy resolution of scintillating glasses is between 20-30%.
- The higher the light yield of the scintillating glasses, the better the energy resolution.

3.1 Scintillating decay time—facility



Test facility of scintillating decay time

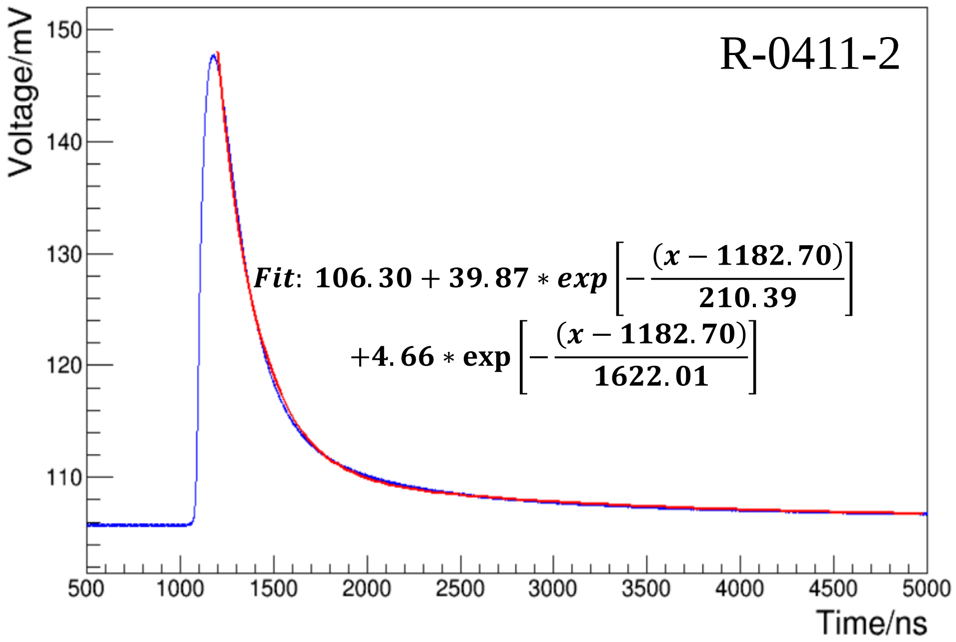


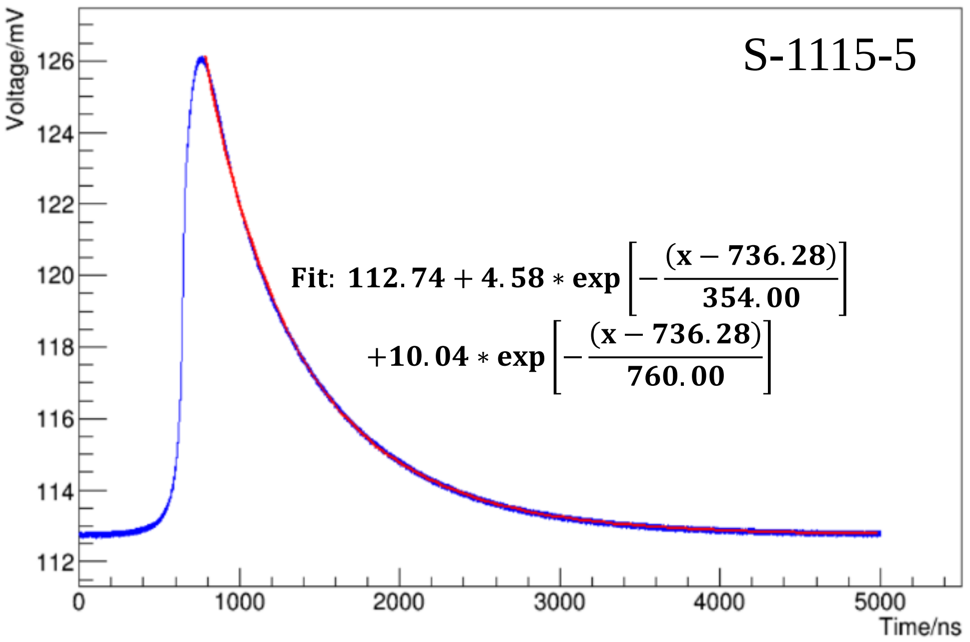
Dark noise of the SiPM

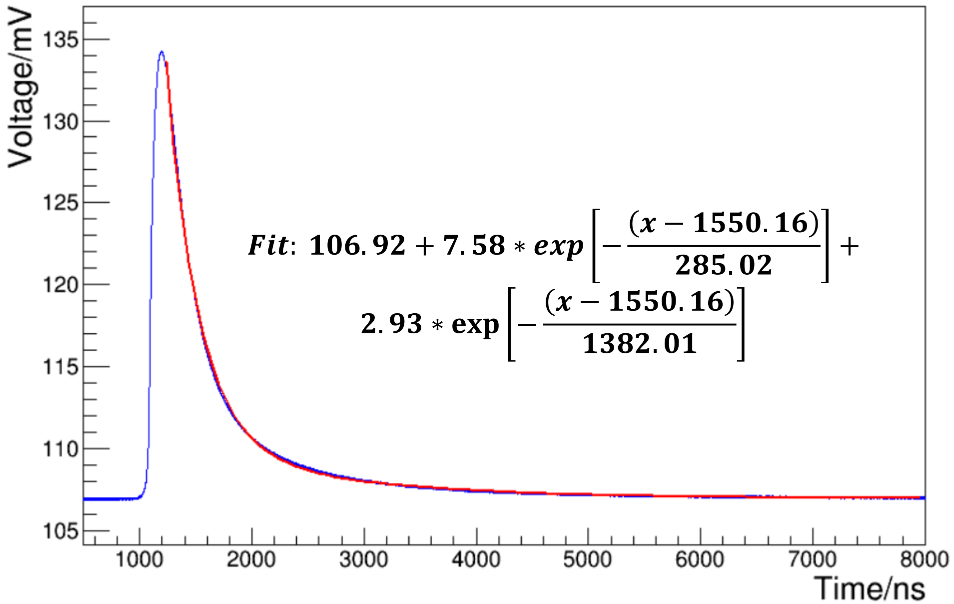
- **Decay time:** The time taken for its photoluminescence or scintillation luminescence to decay from the **peak to 1/e of the peak**.

- For scintillators used for time measurements, requiring shortest possible scintillation decay time. Due to different luminescent mechanisms, the decay time of some scintillators may have multiple components, which can be used in different fields such as particle discrimination.

3.2 Scintillating decay time—glass







- The scintillating decay time of the glasses usually has two components and is longer than that of crystal.
- The fast component originate from trapping processes during the transport stage, and slow component originate from **re-trapping processes (再捕获)**.

Thank you!