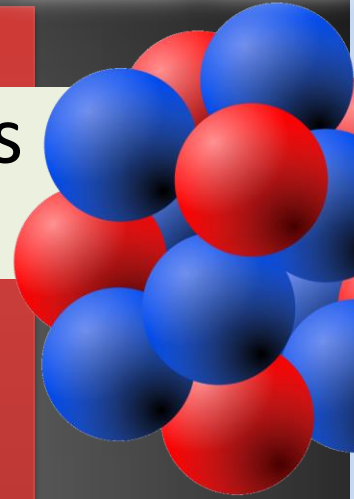


# Timing correction for Germanium Detectors via Signal Rise-time Analysis



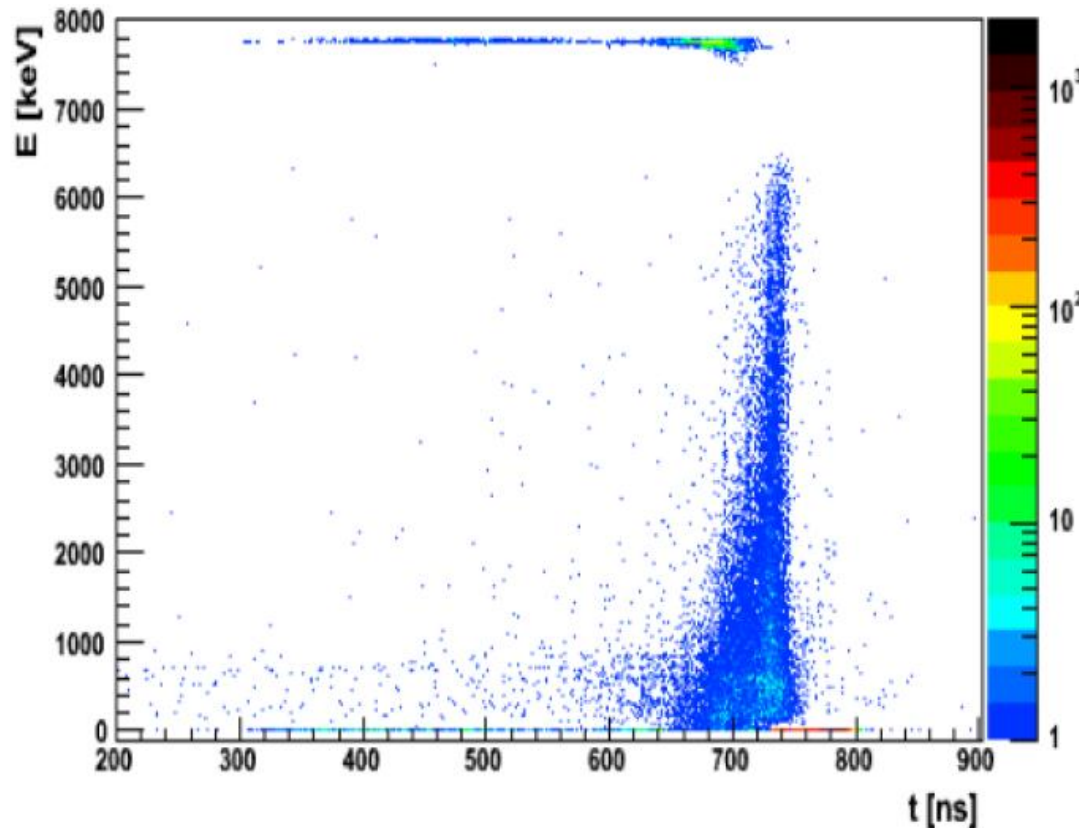
Dr. Tobias Habermann,  
Dr. Jürgen Gerl

Matúš Balogh



## Motivation

- Technique to improve time resolution by using pulse rise time
- Precise timing information can be used to suppress background radiation



<sup>104</sup>Sn experiment  
courtesy of Giulia Guastalla  
[g.guastalla@gsi.de](mailto:g.guastalla@gsi.de)

## Experimental setup

Coincidence measurement using

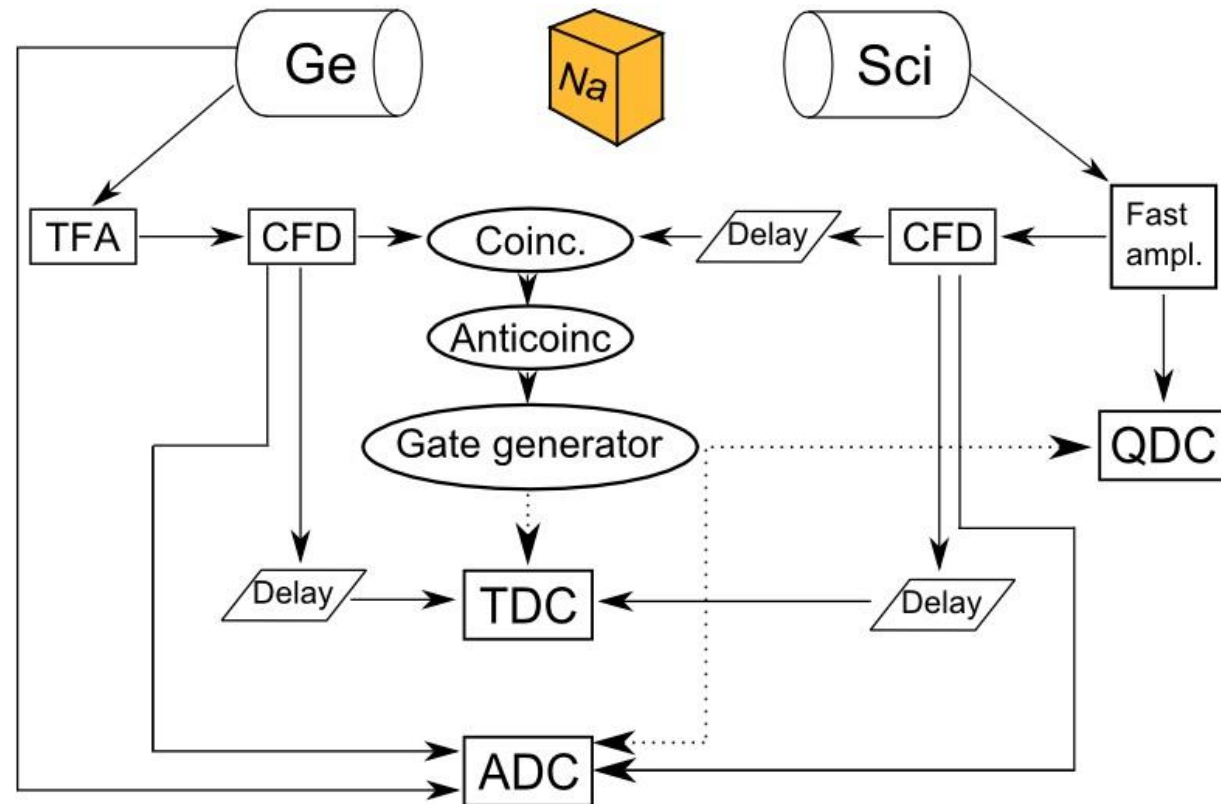
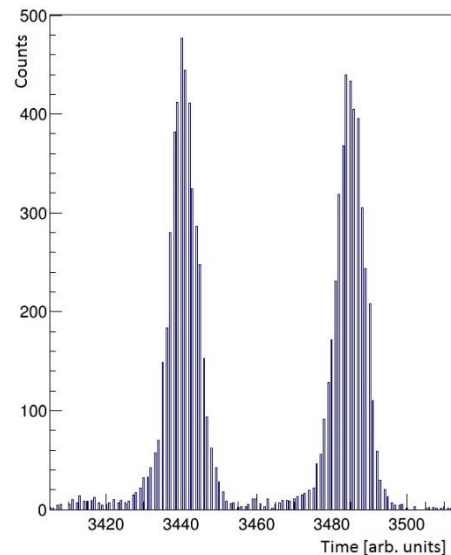
- Ortec GEM 28185-P HPGe
- LaBr fast scintillator

Radioactive sources

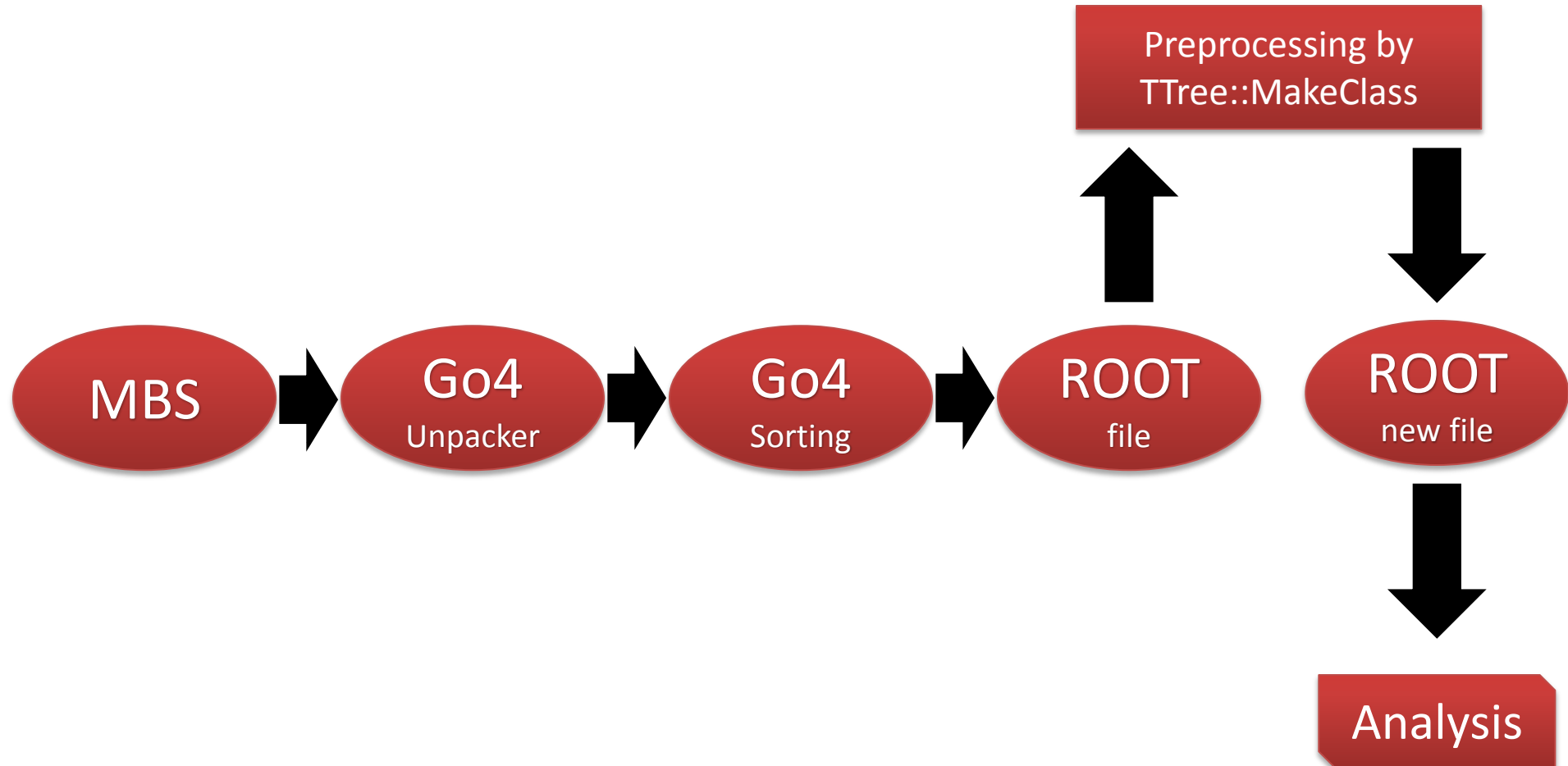
- $^{60}\text{Co}$
- $^{22}\text{Na}$

FADC with 10 ns sampling resolution

TDC with 90 ps resolution

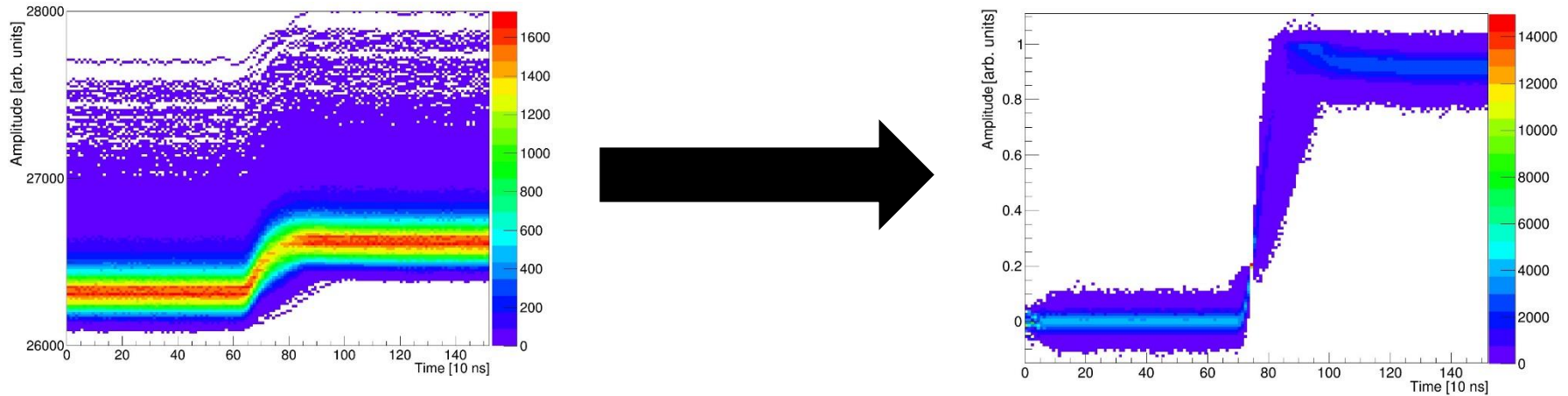


## Data acquisition

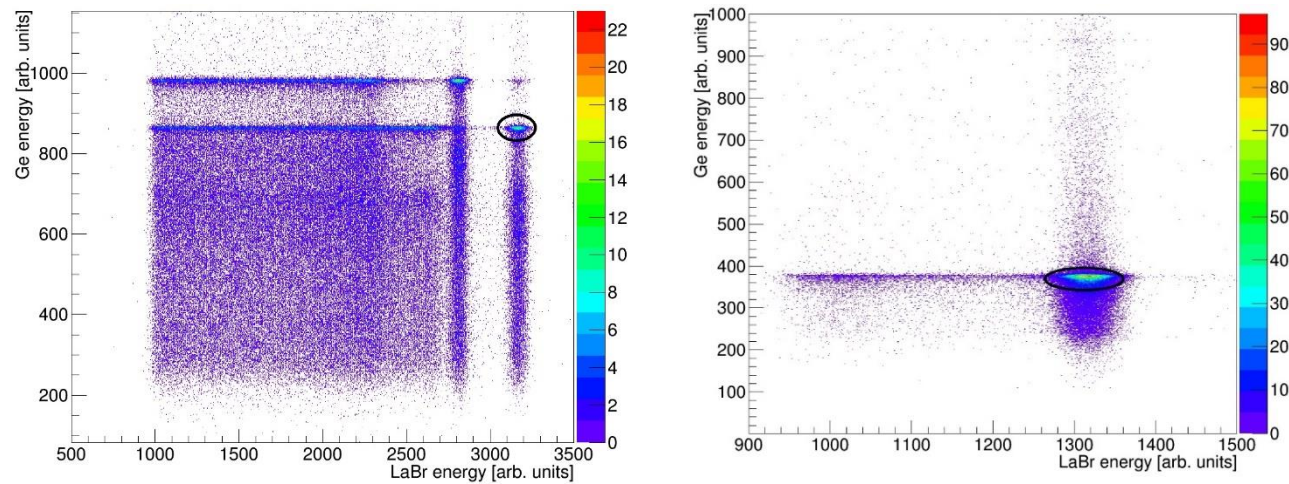


## Preprocessing

- Subtracting baseline, normalizing and aligning pulses



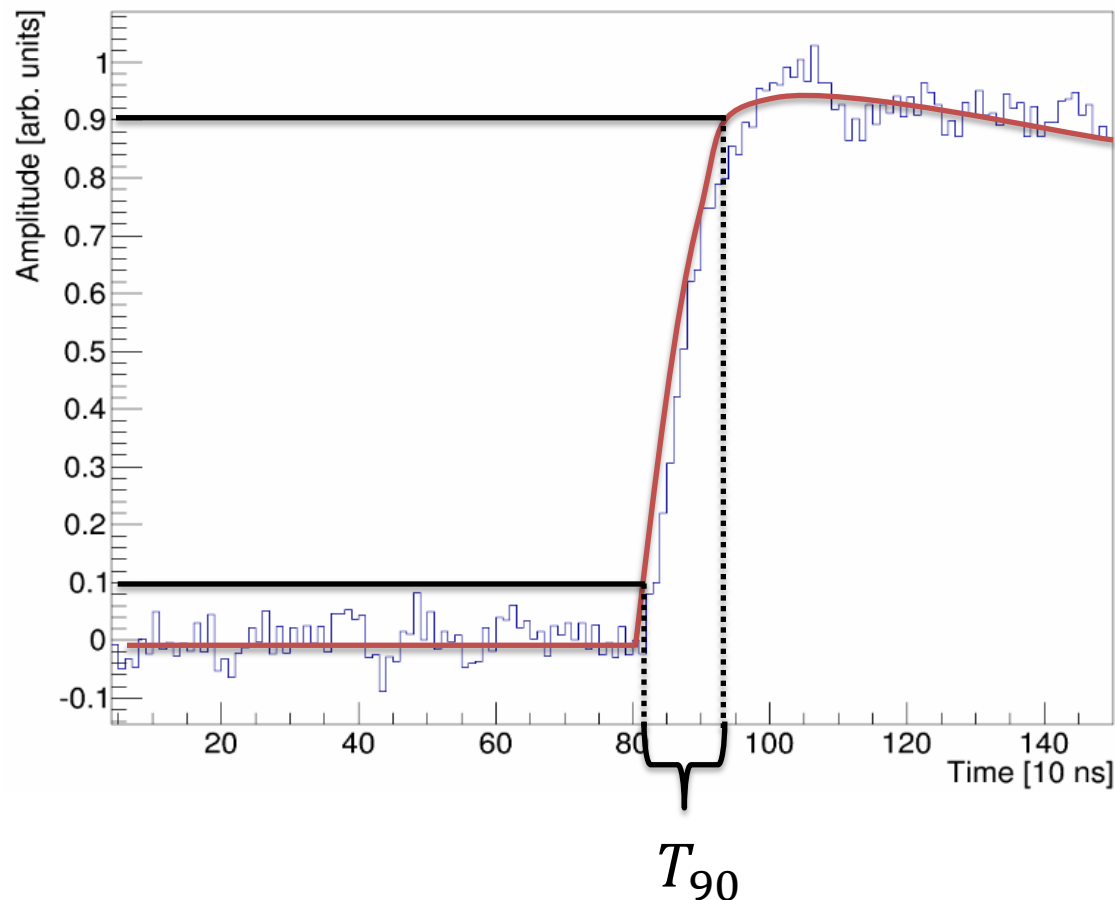
- Pulses only from photopeak events



## Preprocessing

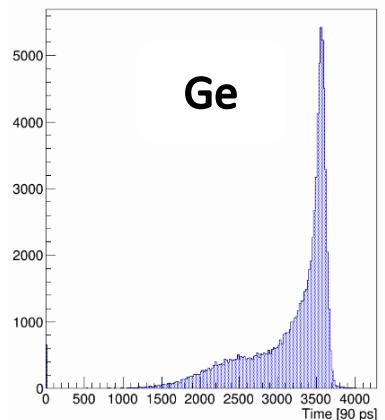
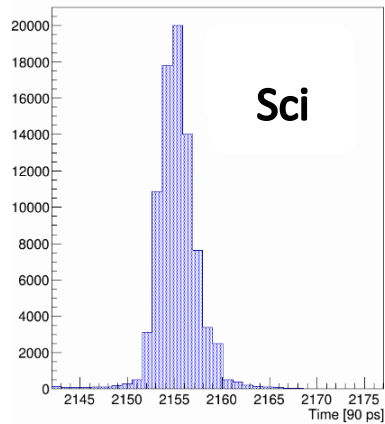
Rise time analysis – need to get rise times

- **not possible** to obtain full rise time -> using **partial rise times** ( $T_x$ ) instead

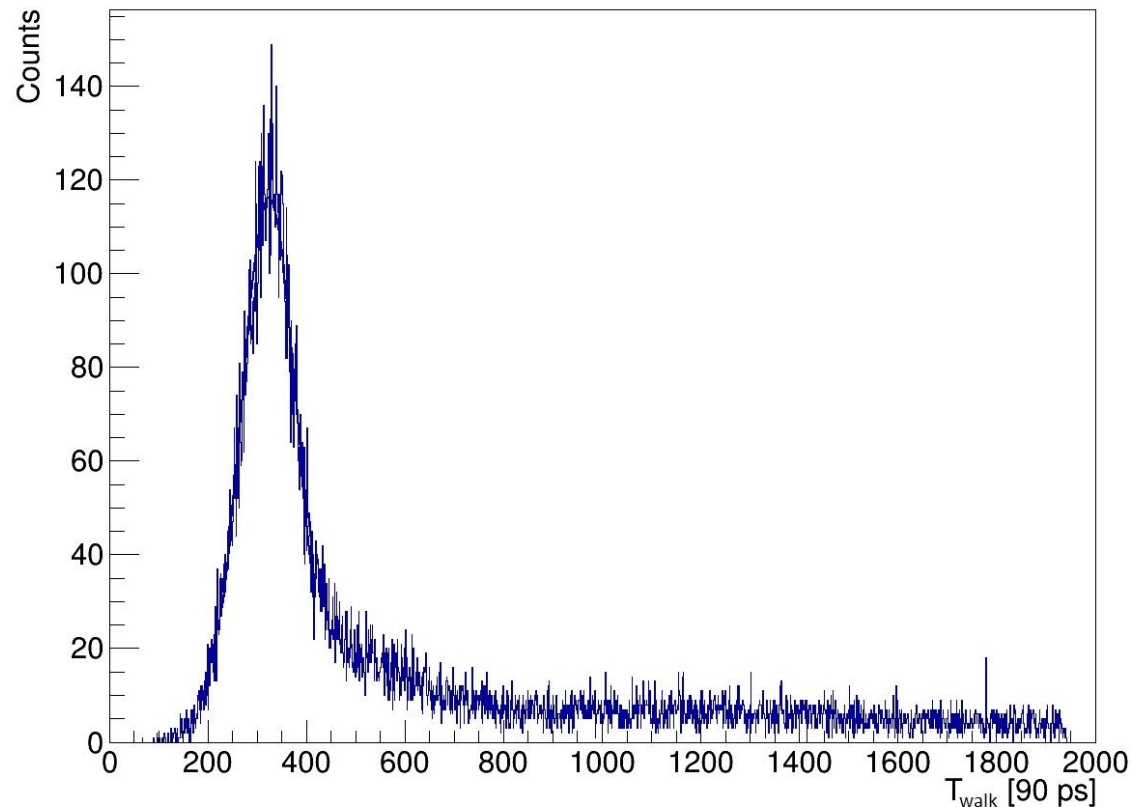


## Preprocessing

Calculating time walk – difference between timing signal from LaBr and HPGe



=



$FWHM = 13,8 \text{ ns}$

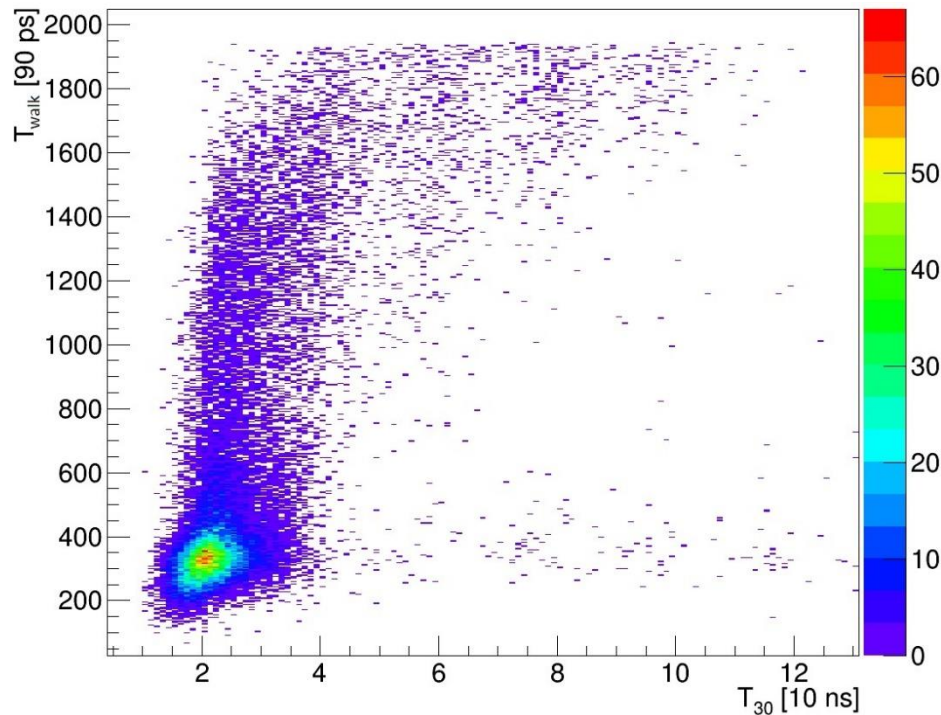
Full width of 167 ns



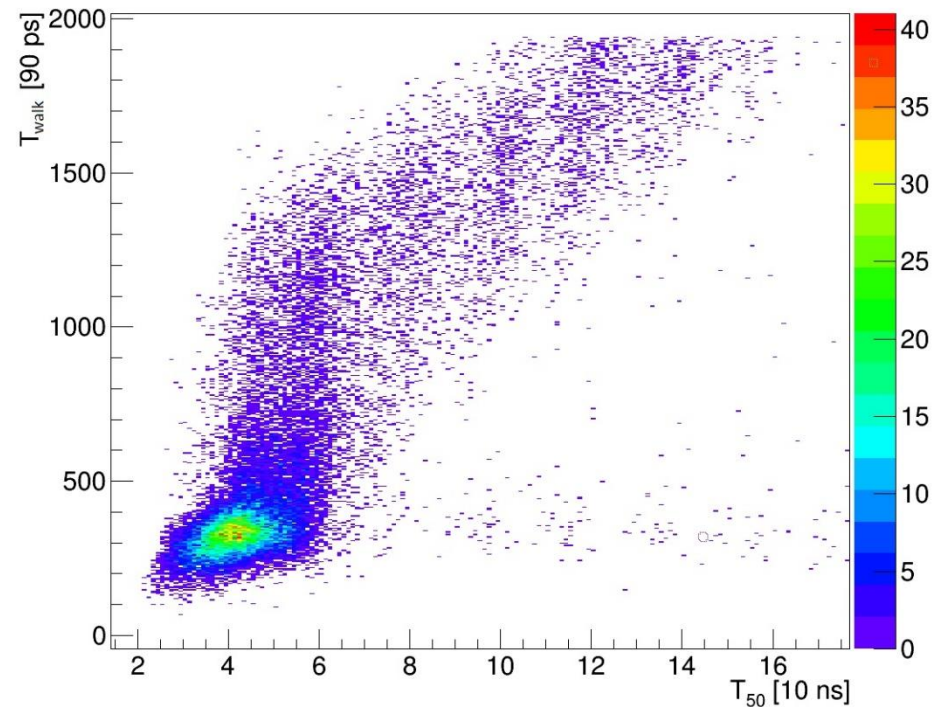
## Analysis

Confirmation of linear dependence between  $T_{walk}$  and the rise times

$T_{30}$  vs  $T_{walk}$



$T_{50}$  vs  $T_{walk}$





## Analysis

Dependence between  $T_{walk}$  and rise time ( $T_x$ ) was fitted by ROOT::TLinearFitter

- In case of fitting  $T_{walk}$  with single rise time:

$$T_{walk} = \alpha T_x + \beta$$

- In case of fitting  $T_{walk}$  with all rise times:

$$T_{walk} = \beta + \sum_{i=20,30,\dots,90} \alpha_i T_i$$

Subsequently data set was shifted according to the one of the equation

- In case of single rise time fit:

$$T'_{walk} = T_{walk} - (\alpha T_x + \beta)$$

- In case of all rise time fit:

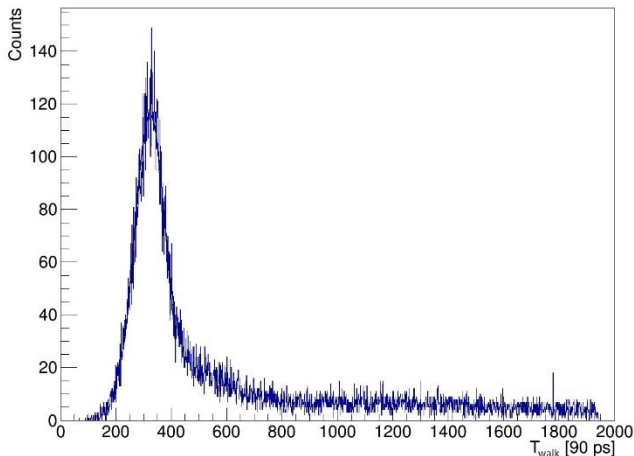
$$T'_{walk} = T_{walk} - \left( \beta + \sum_{i=20,30,\dots,90} \alpha_i T_i \right)$$

## Analysis

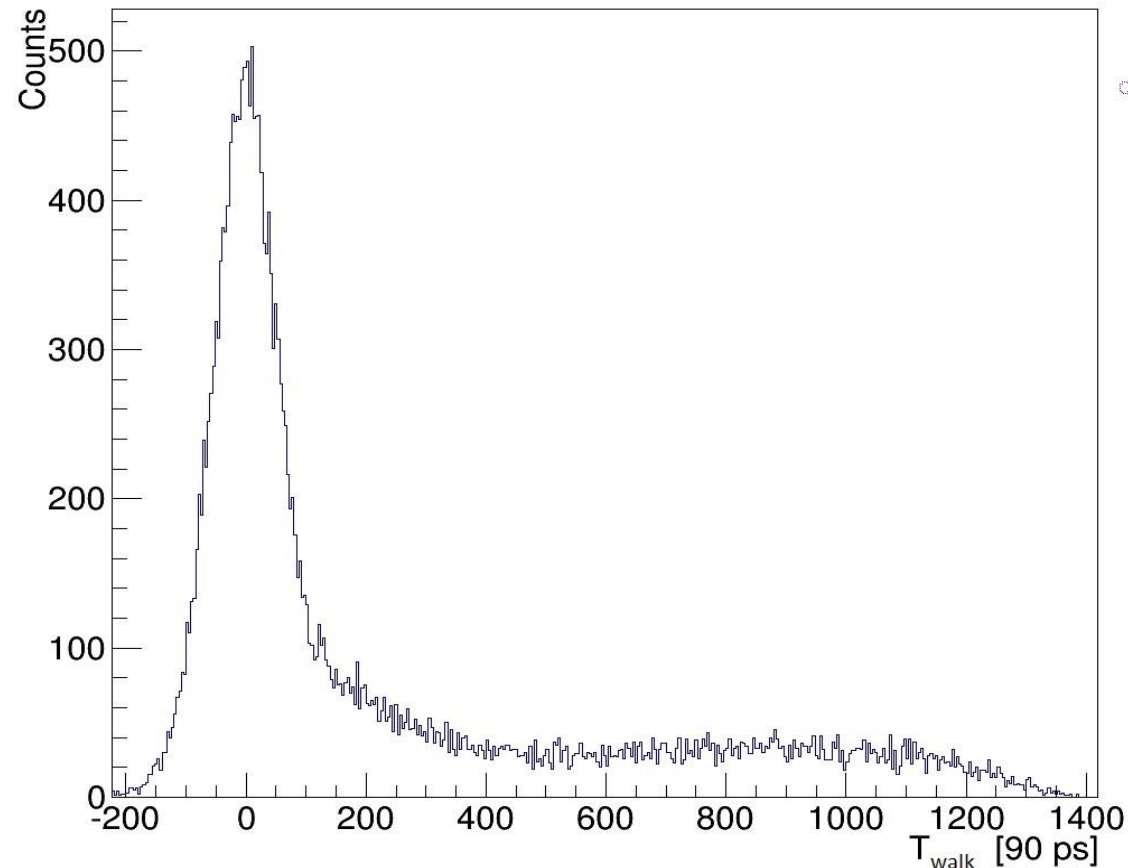
### Single dependence

Gated  $T_{walk}$  vs  $T_{50}$  dependence fitted using at least 70% of remaining data:

- $FWHM = 12,6ns$  (13,8ns)
- Full width of 138 ns (167ns)



Original spectrum



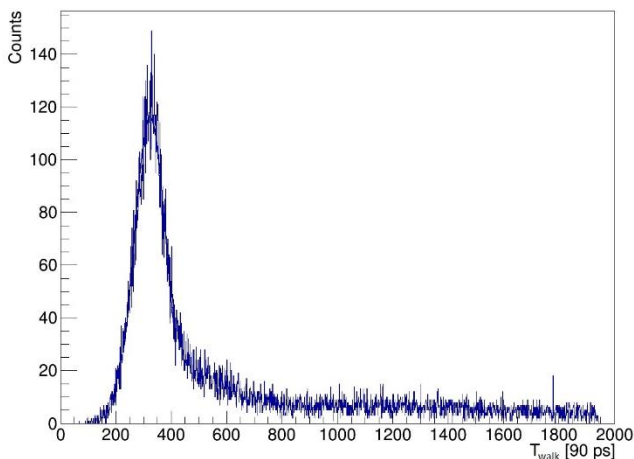
New spectrum

## Analysis

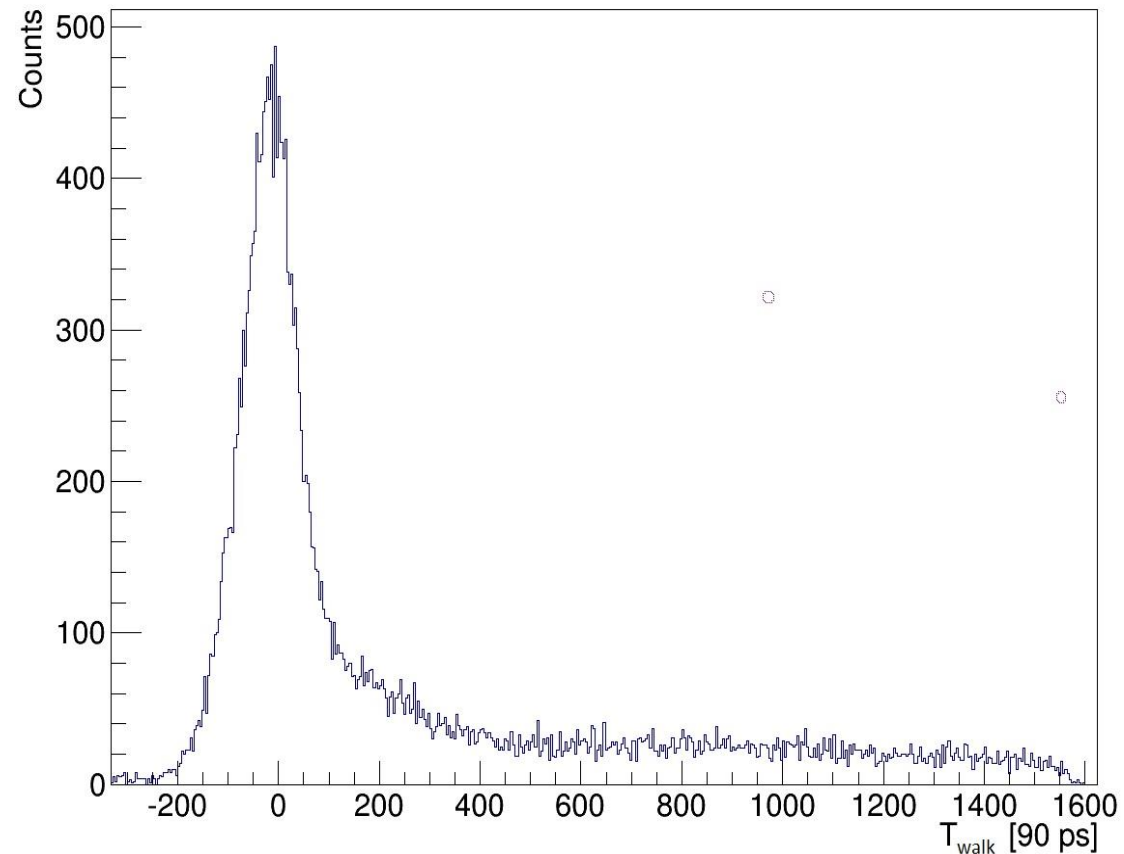
### Multi dependence

Gated  $T_{walk}$  vs all  $T_x$  fitted using at least 70% of remaining data:

- $FWHM = 14,2ns$  (13,8ns)
- Full width of 158 ns (167ns)



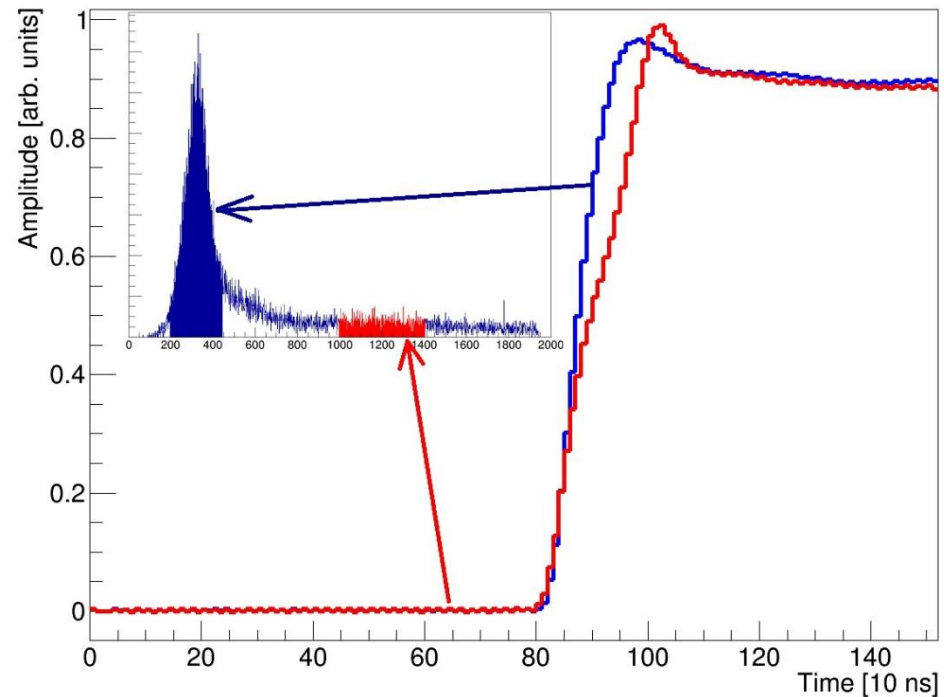
Original spectrum



New spectrum

## Outline

- Continue to explore possibilities of the Signal Rise time Analysis
- Application of Pulse Shape Analysis for further improvements in time resolution





Thank you for attention



# Questions?

