The National Nuclear Array (NANA)
&
Fast-timing Algorithms using the CAEN Digital

Giuseppe Lorusso

NPL
National Physical Laboratory

Motivation

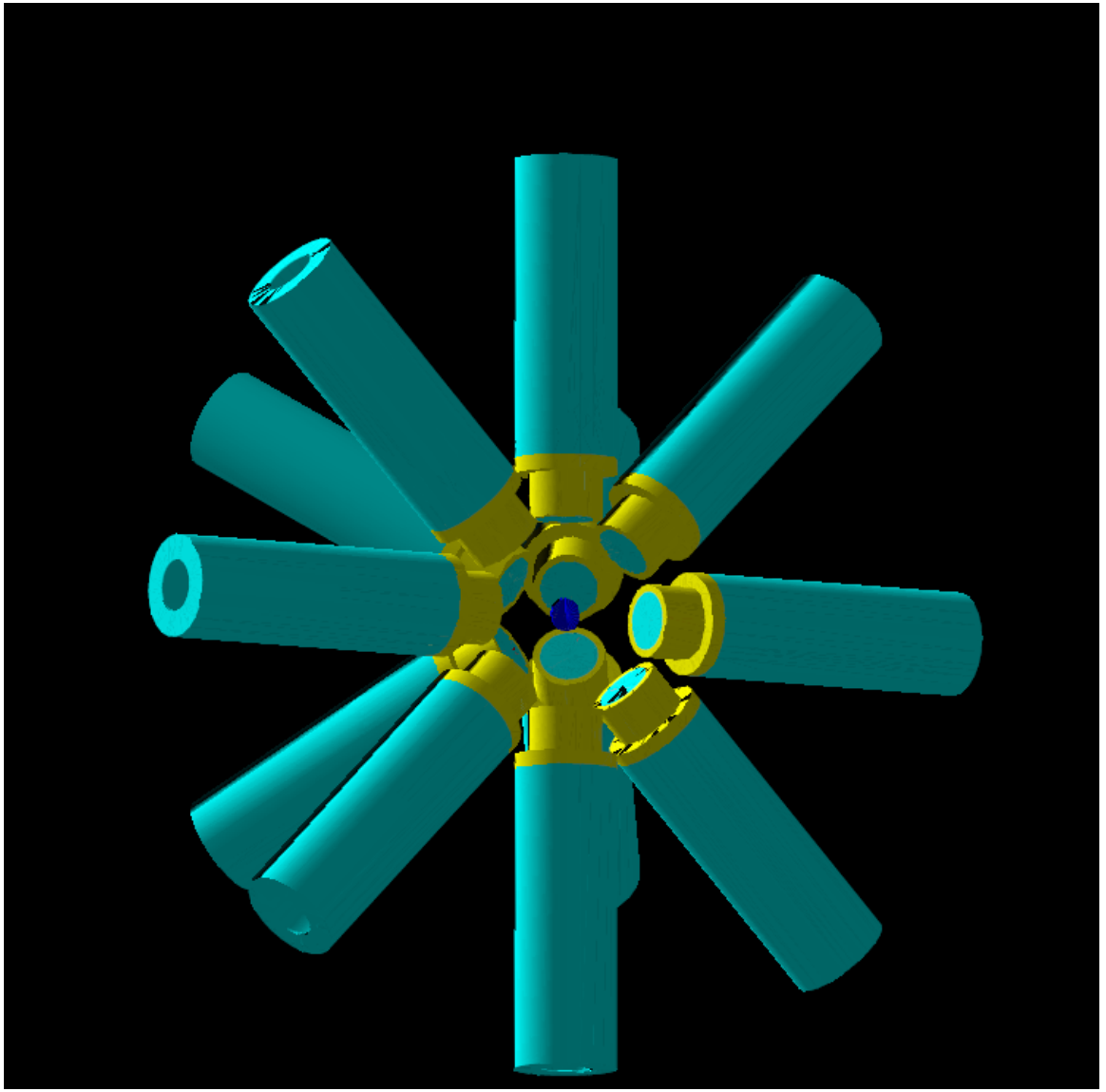
Use **gamma-ray coincidence array** for radioactive source decay measurement for:

a) Standardisation and use as a traceable primary radiation standard.

b) Use for nuclear assay and identification of which radionuclides are present and in what amounts (activity).

c) Use for nuclear structure / decay data measurements to improve nuclear decay and energy level scheme knowledge based for specific radionuclides (e.g 223Ra)

Conceptual design



GEANT4 simulations by R.Shearman

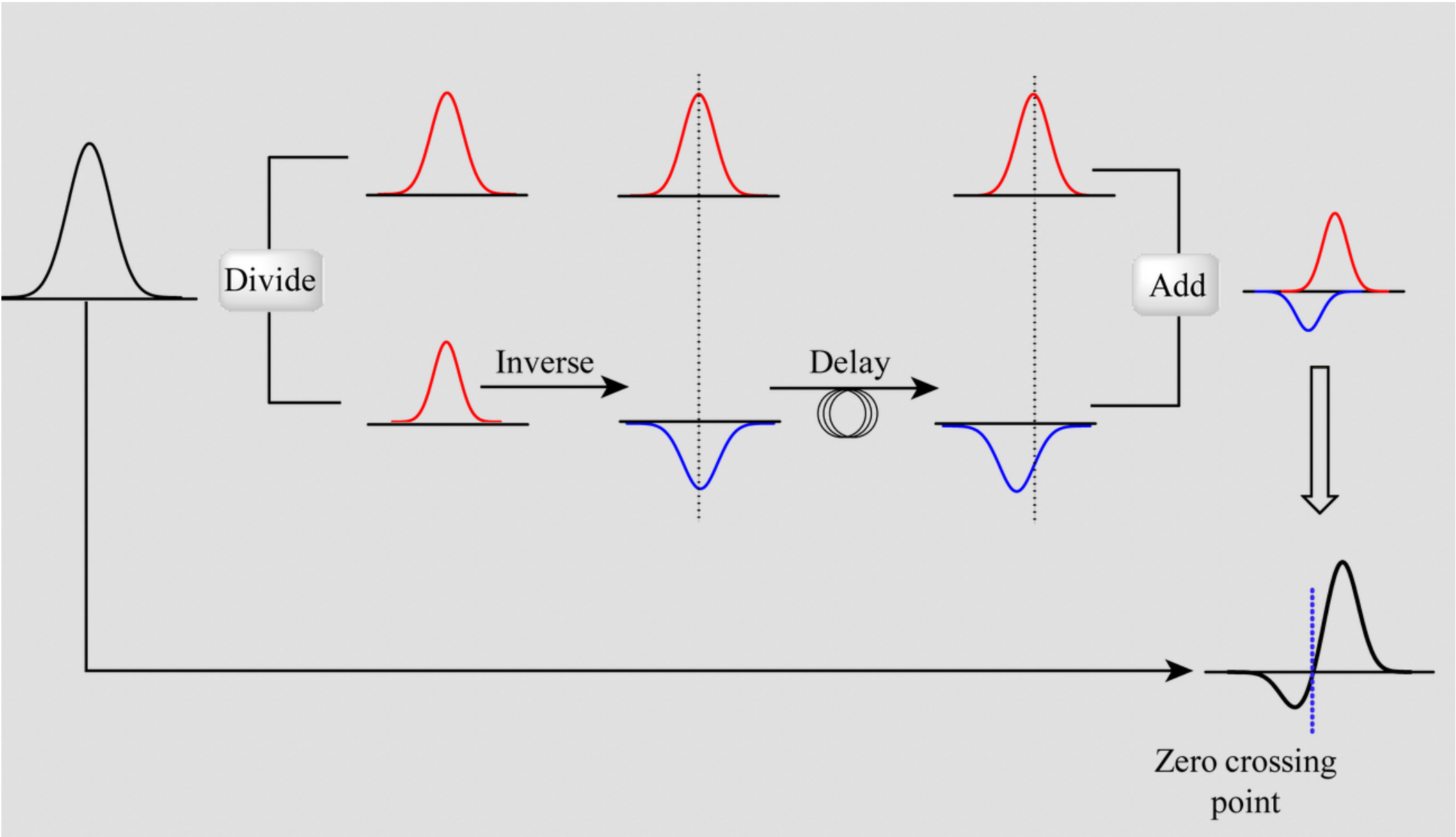
12 detectors in fixed geometry with source in central position.

Cylindrical LaBr3 Scintillation crystals, 1.5” diameter and 2.0” in length.

Digital time stamped DAQ Using CAEN 1 GHz Digitizers.

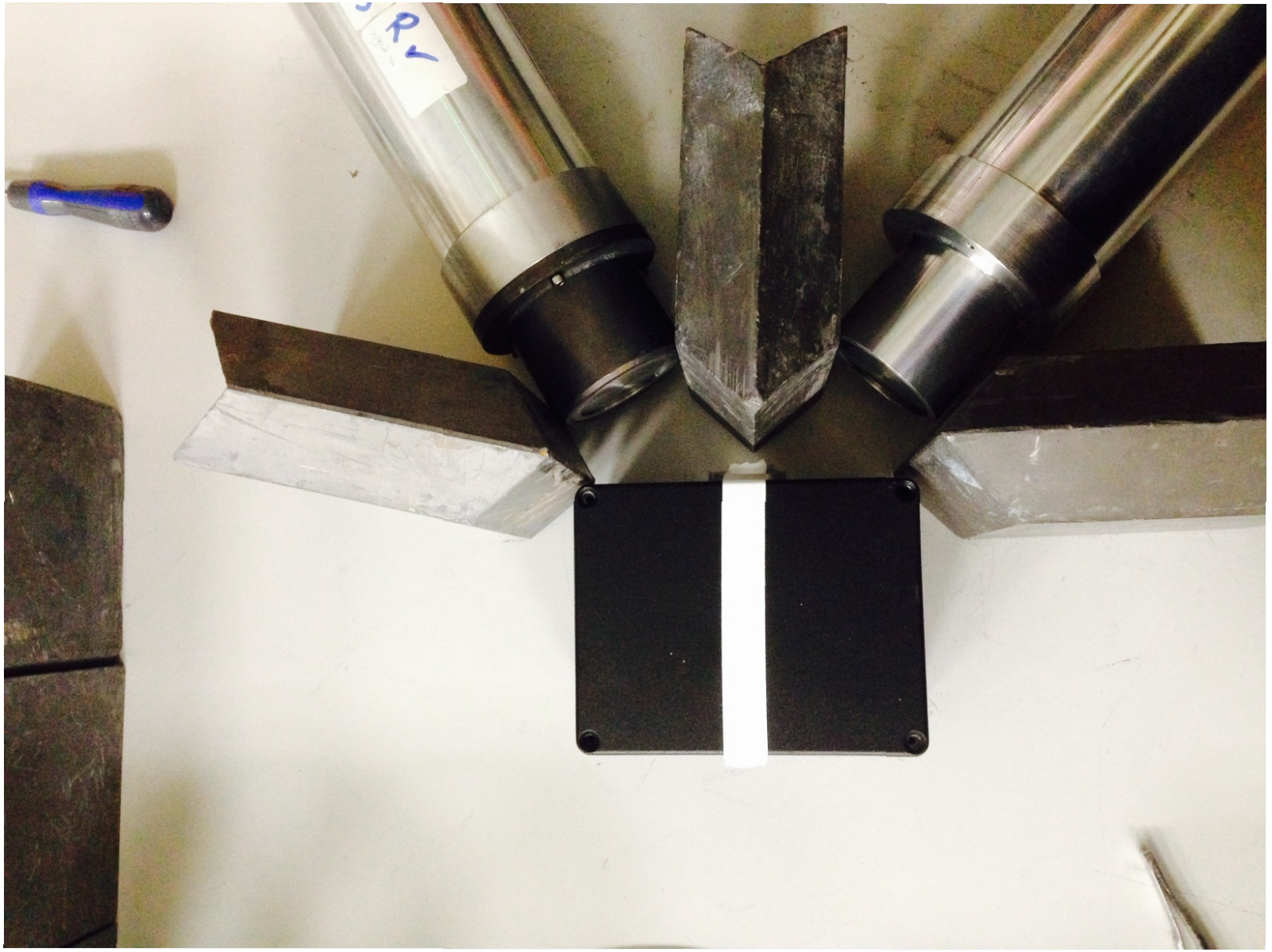
Processing CPU
10 core / 3.1 GHz

Constant fraction discrimination



Time resolution measurement setup

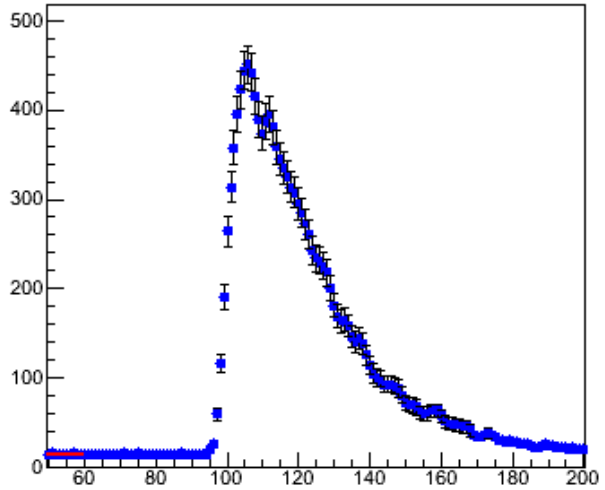
NPL National Physical Laboratory



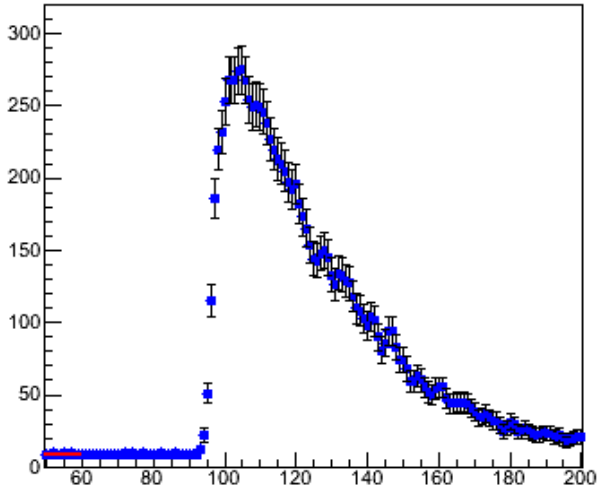
Zero crossing method

NPL National Physical Laboratory

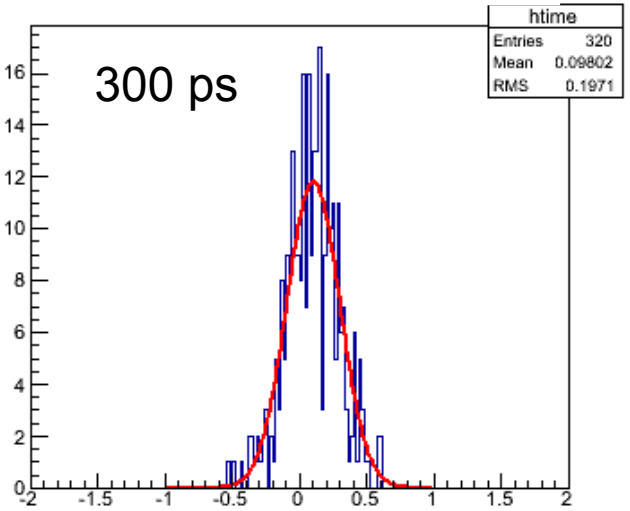
LaBr3 (start)



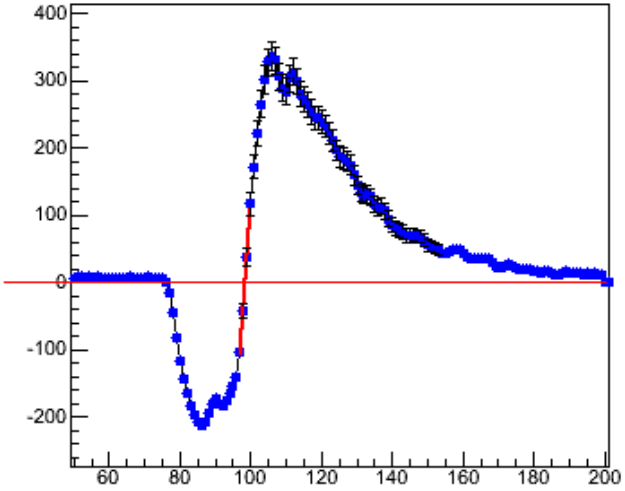
LaBr3 (Ce) stop



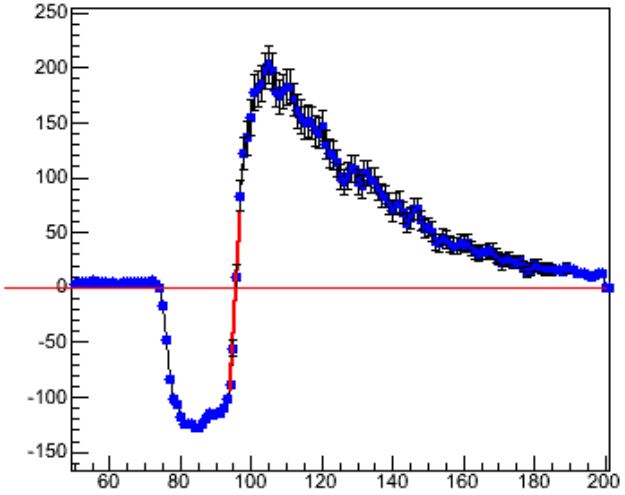
start – stop



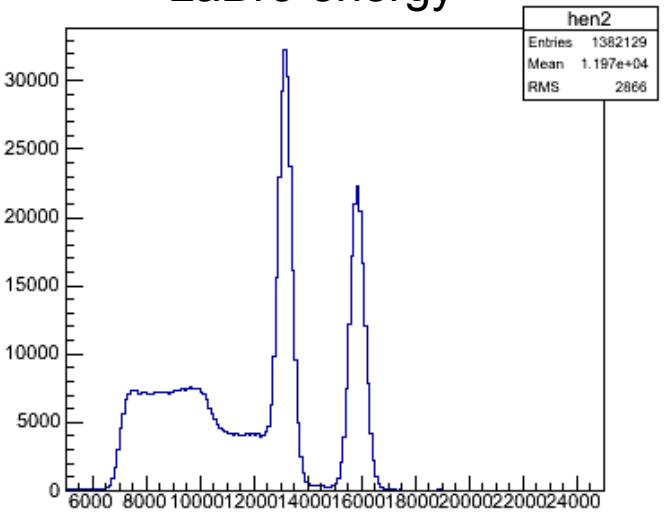
Graph



Graph

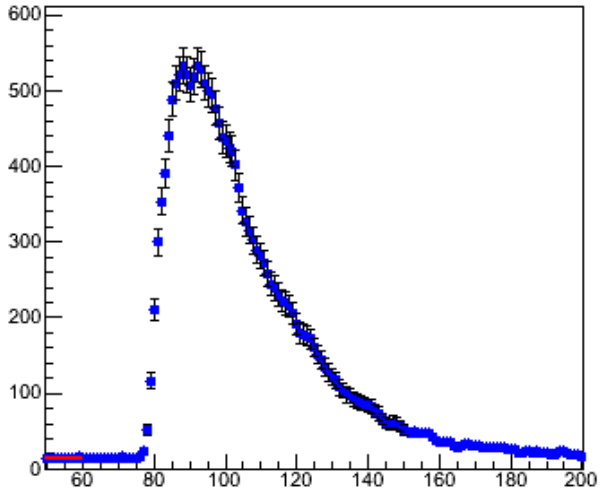


LaBr3 energy

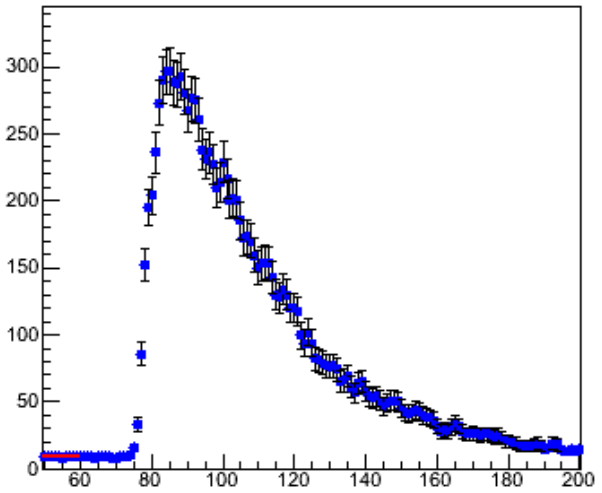


Zero crossing method

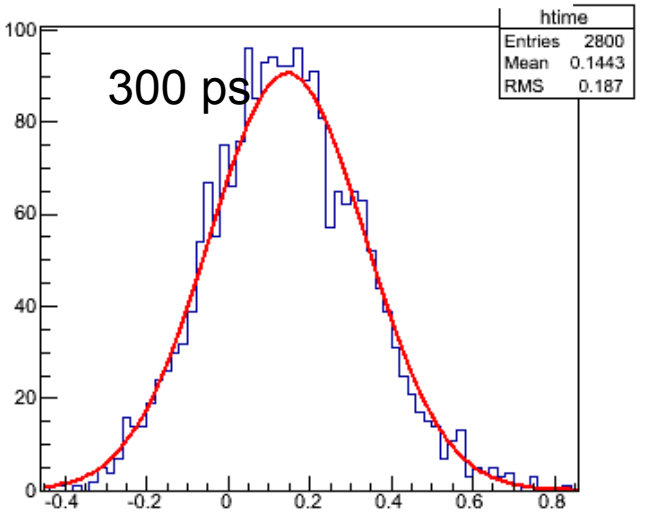
LaBr3 (start)



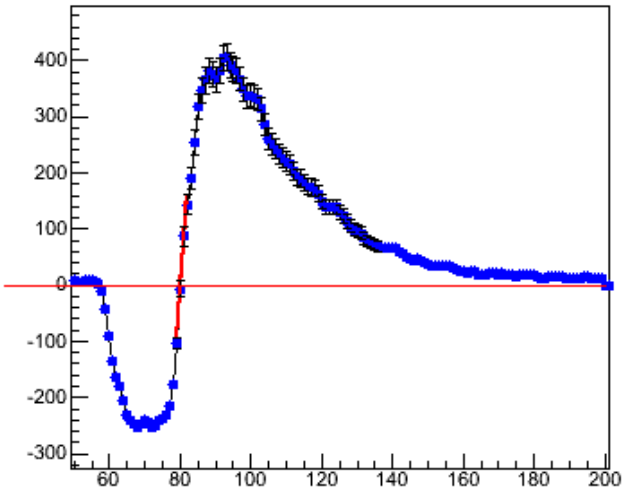
LaBr3 (Ce) stop



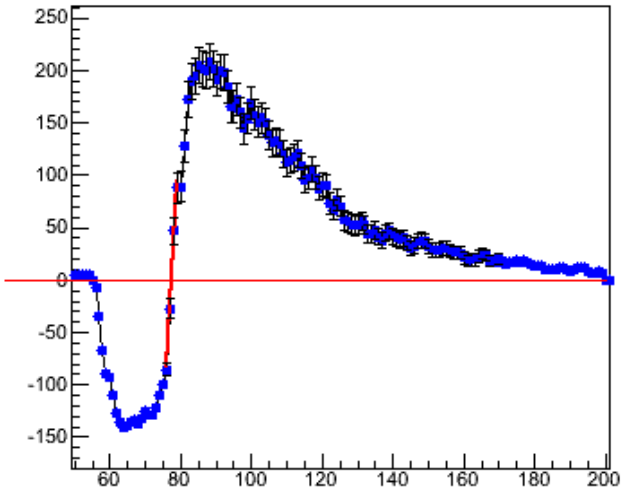
start – stop



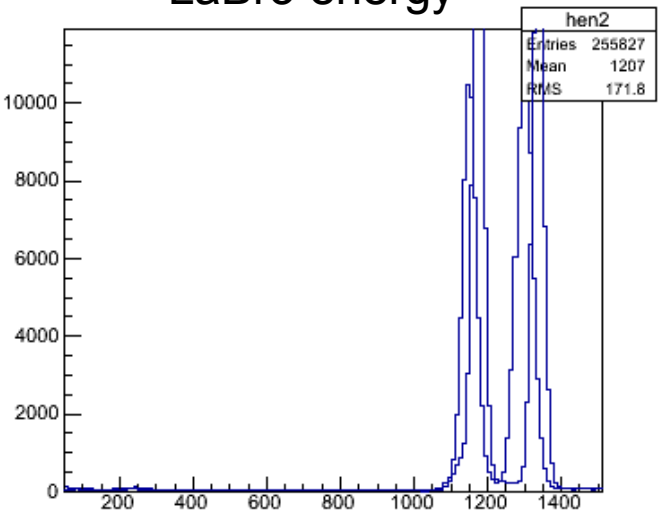
Graph



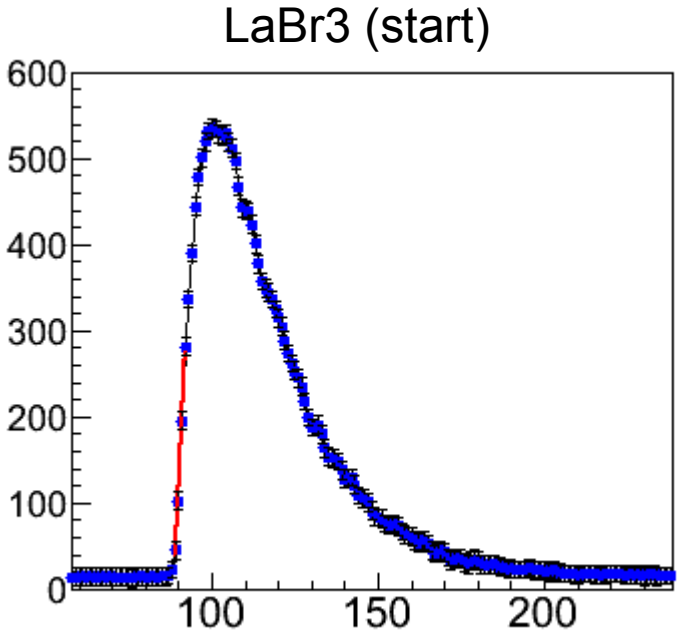
Graph

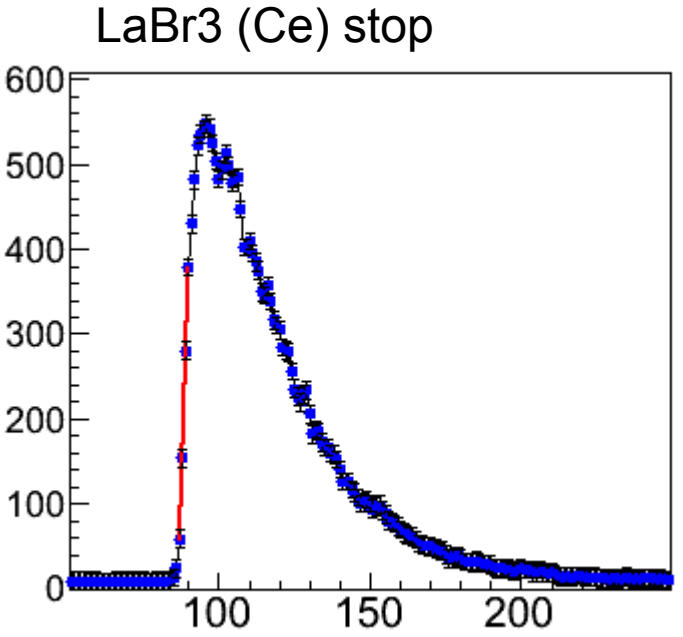


LaBr3 energy

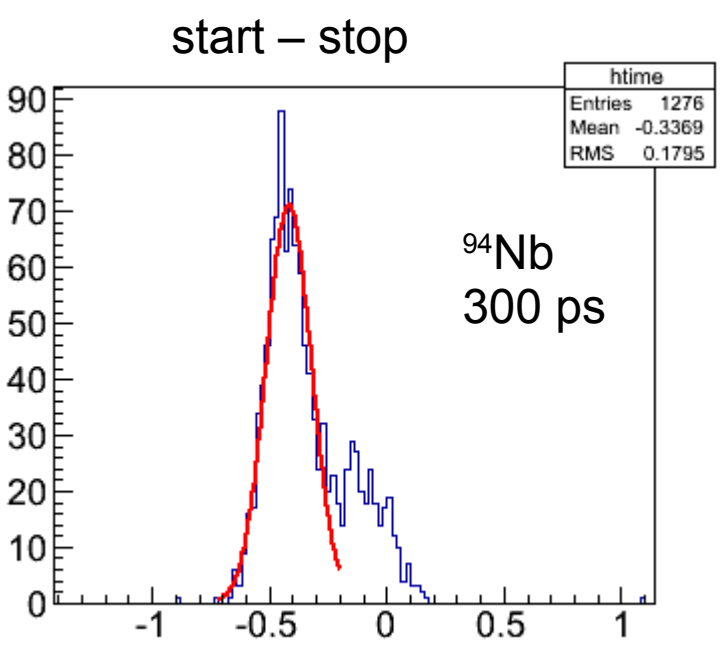


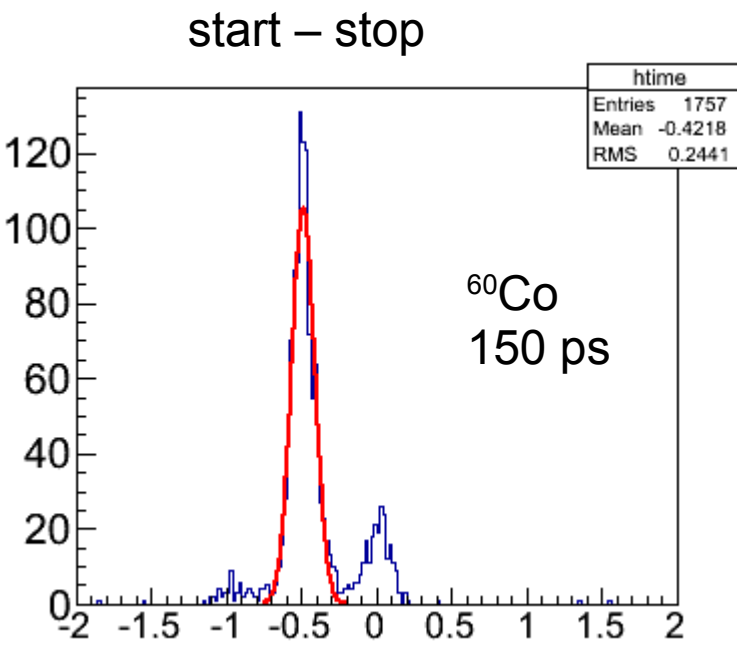
Rising edge linear fit





Intercept the baseline and the extrapolation of the linear fit of the rising edge of the signal

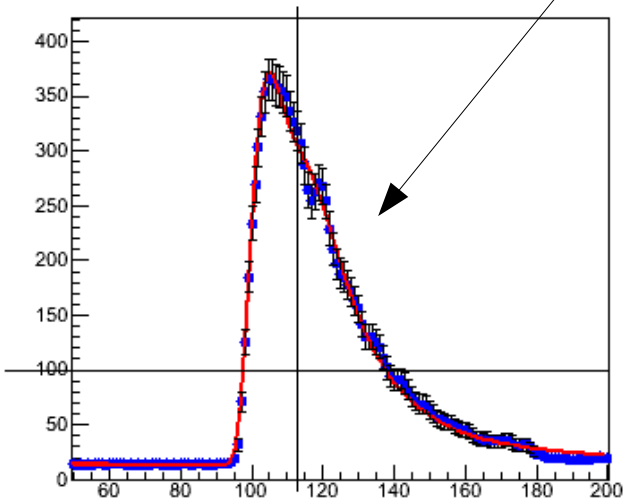




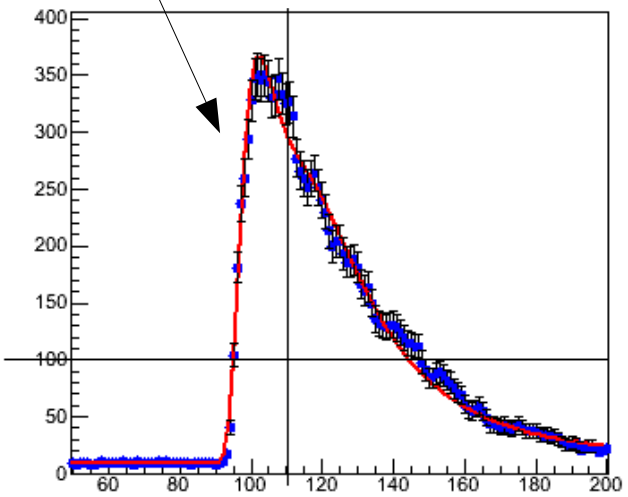
Fit of the full signal

Using a modified Landau fitting function

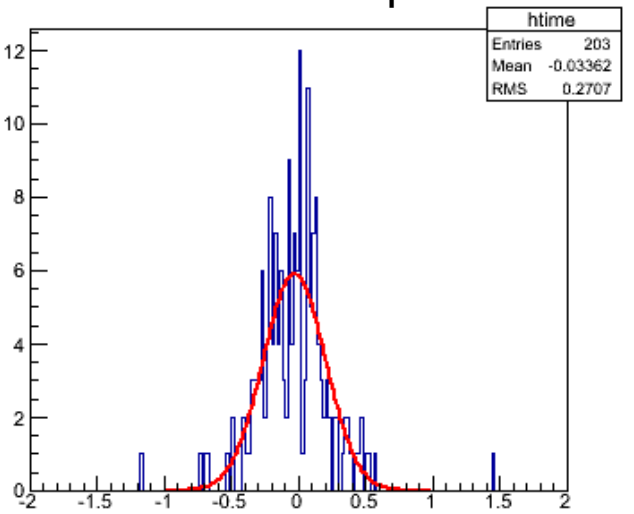
LaBr3 (start)



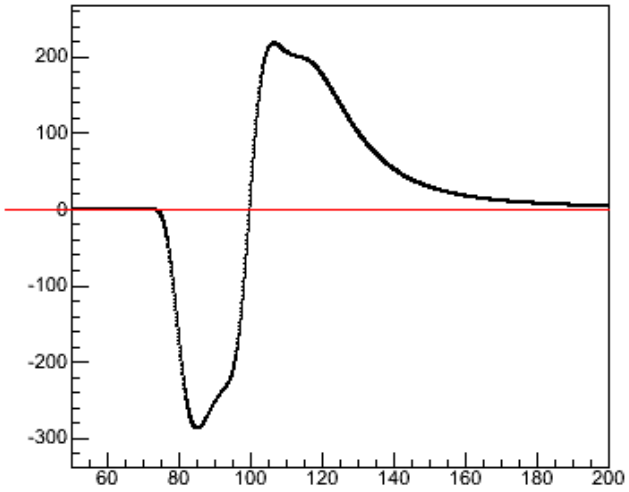
LaBr3 (Ce) stop



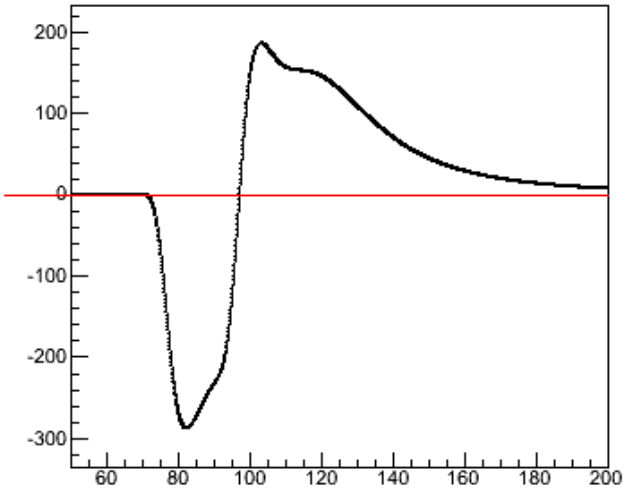
start – stop



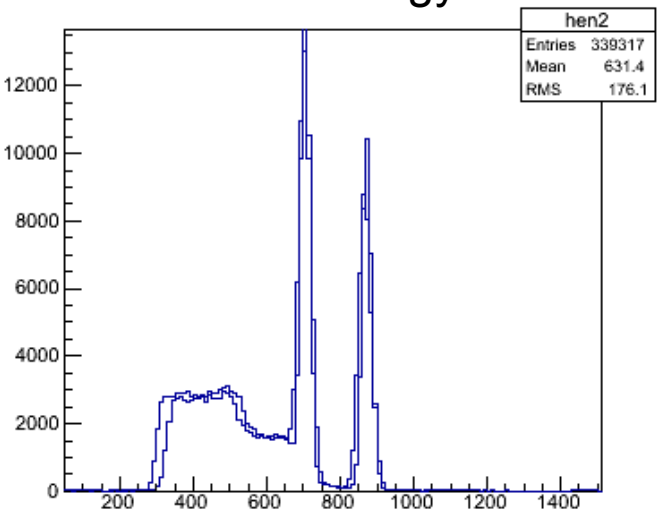
Graph



Graph

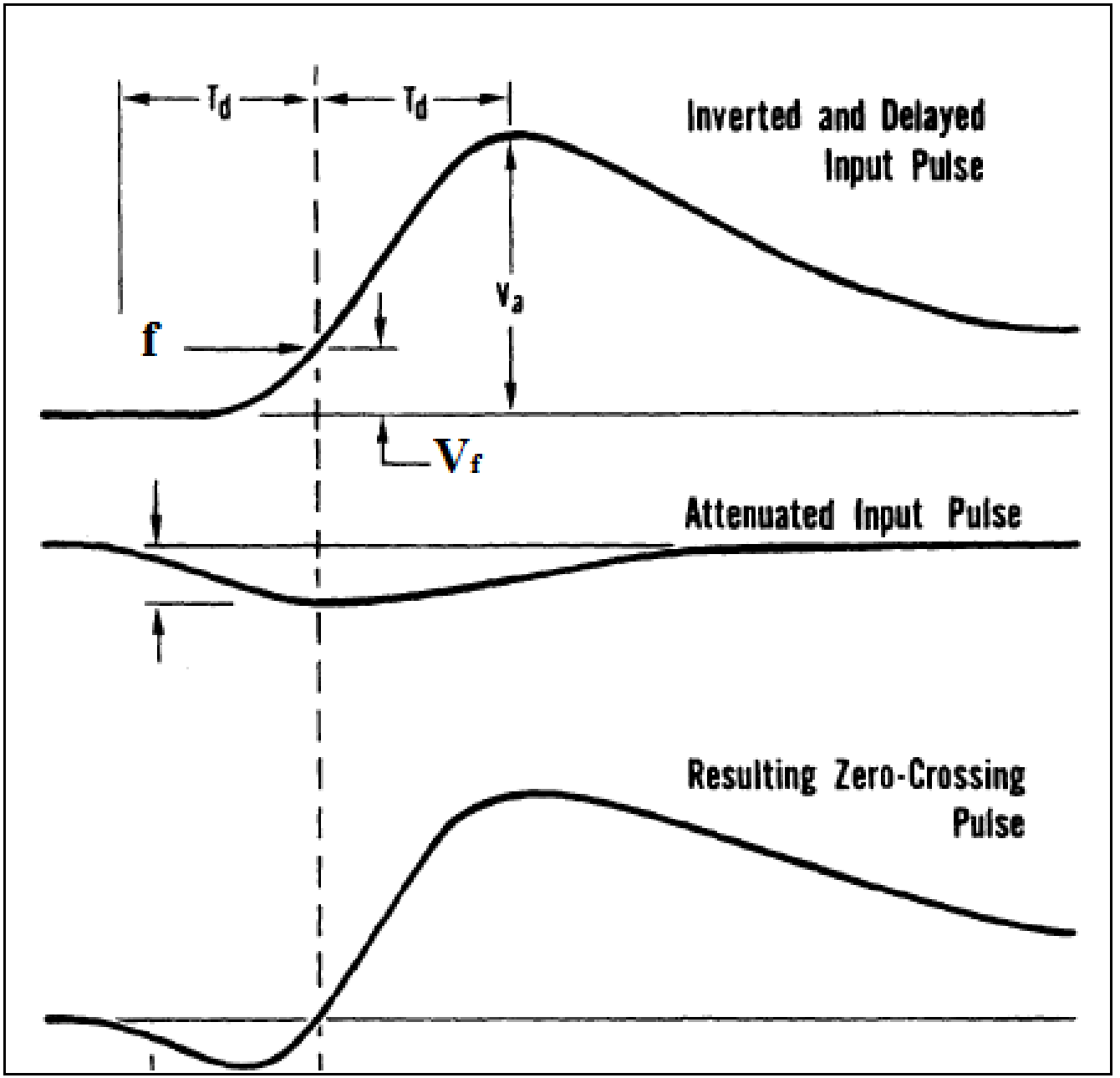


LaBr3 energy



Why the Landau fit does not work (so far)

National Physical Laboratory

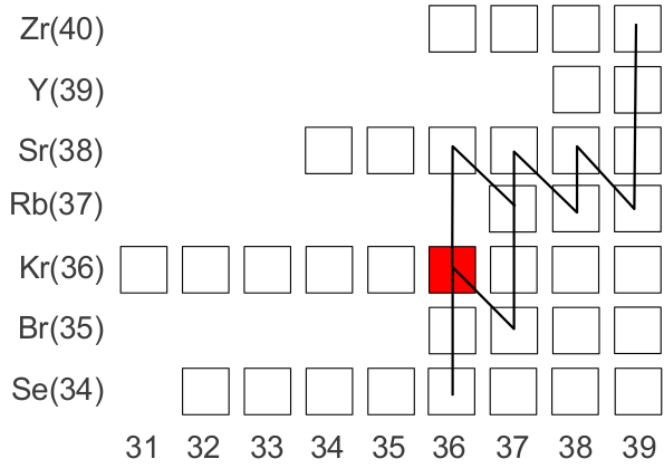


Beta-delayed proton emission of ^{73}Sr

rp-process + isospin symmetry

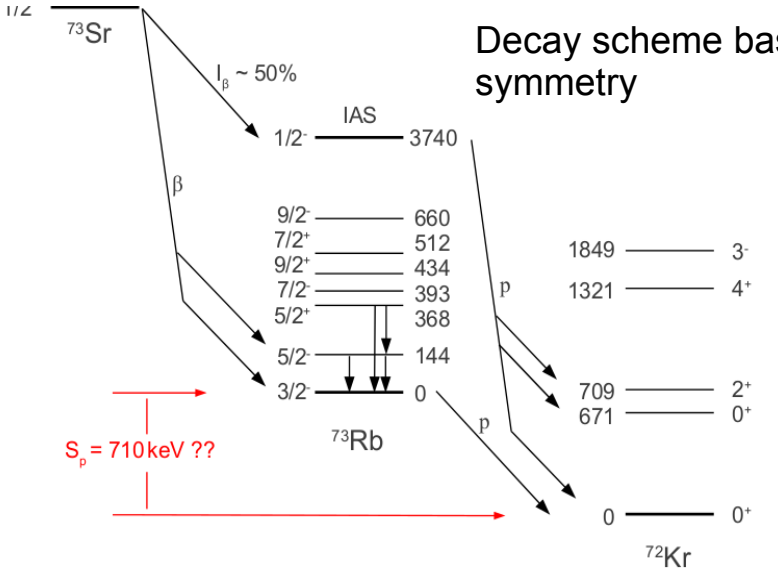
National Physical Laboratory

2p-capture along the rp-process path

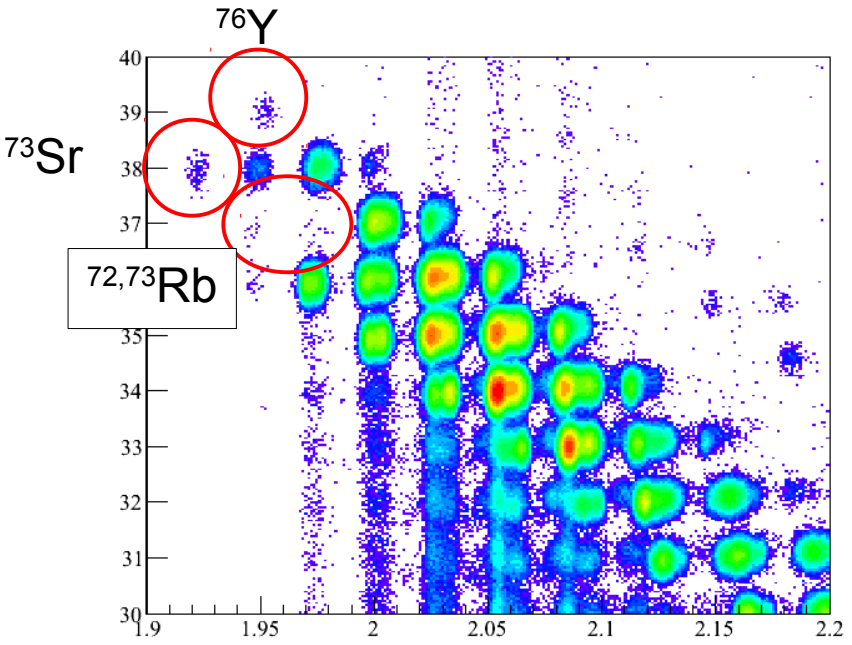


Measuring lifetime of proton decay requires a fast implantation detector

A problem in common with fast timing gamma-ray spectroscopy



Decay scheme based on mirror symmetry

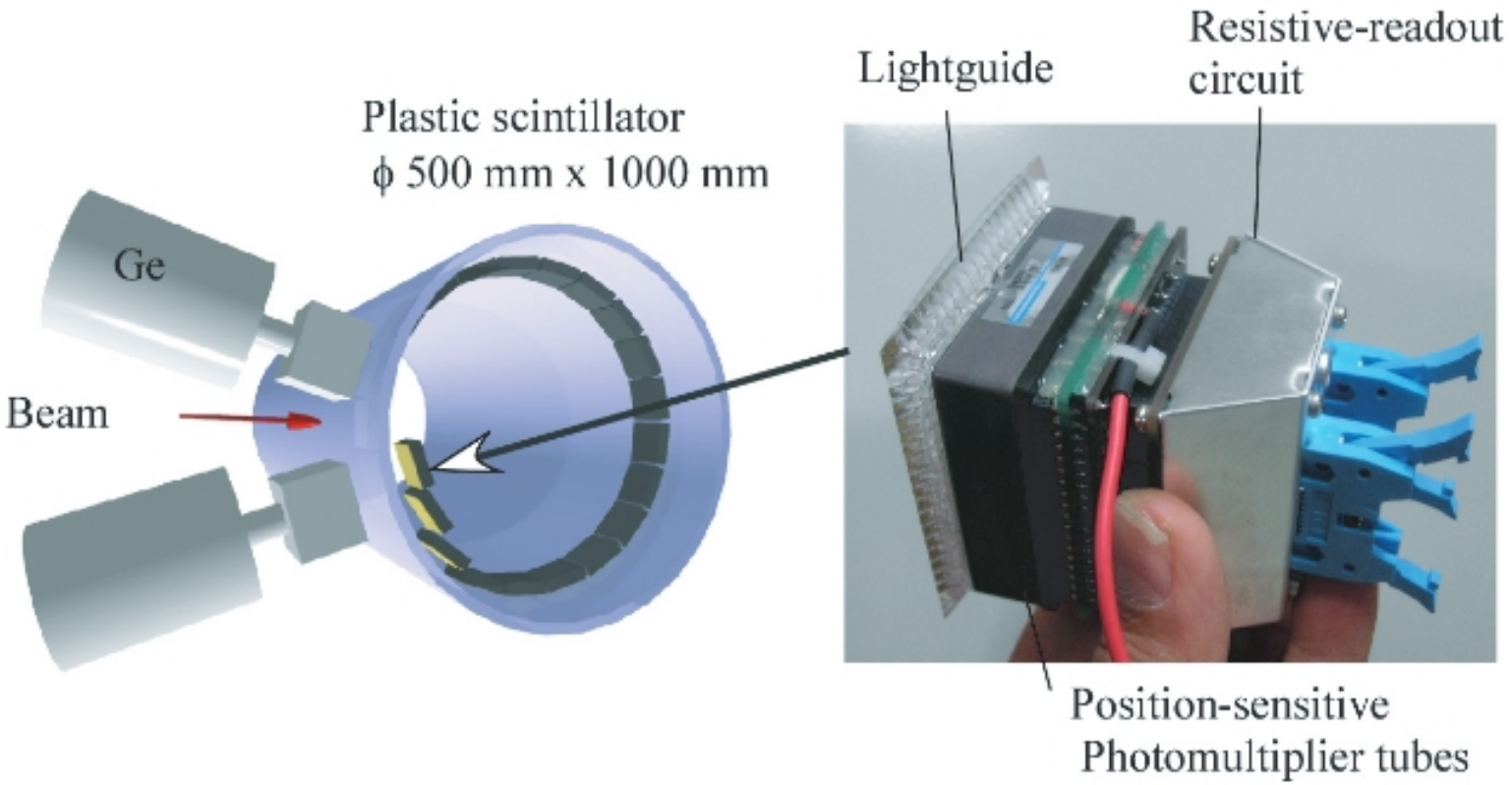


Laura Sinclair, University of York

Cylindrical Active Implantation Target for Exotic Nuclei CAITEN

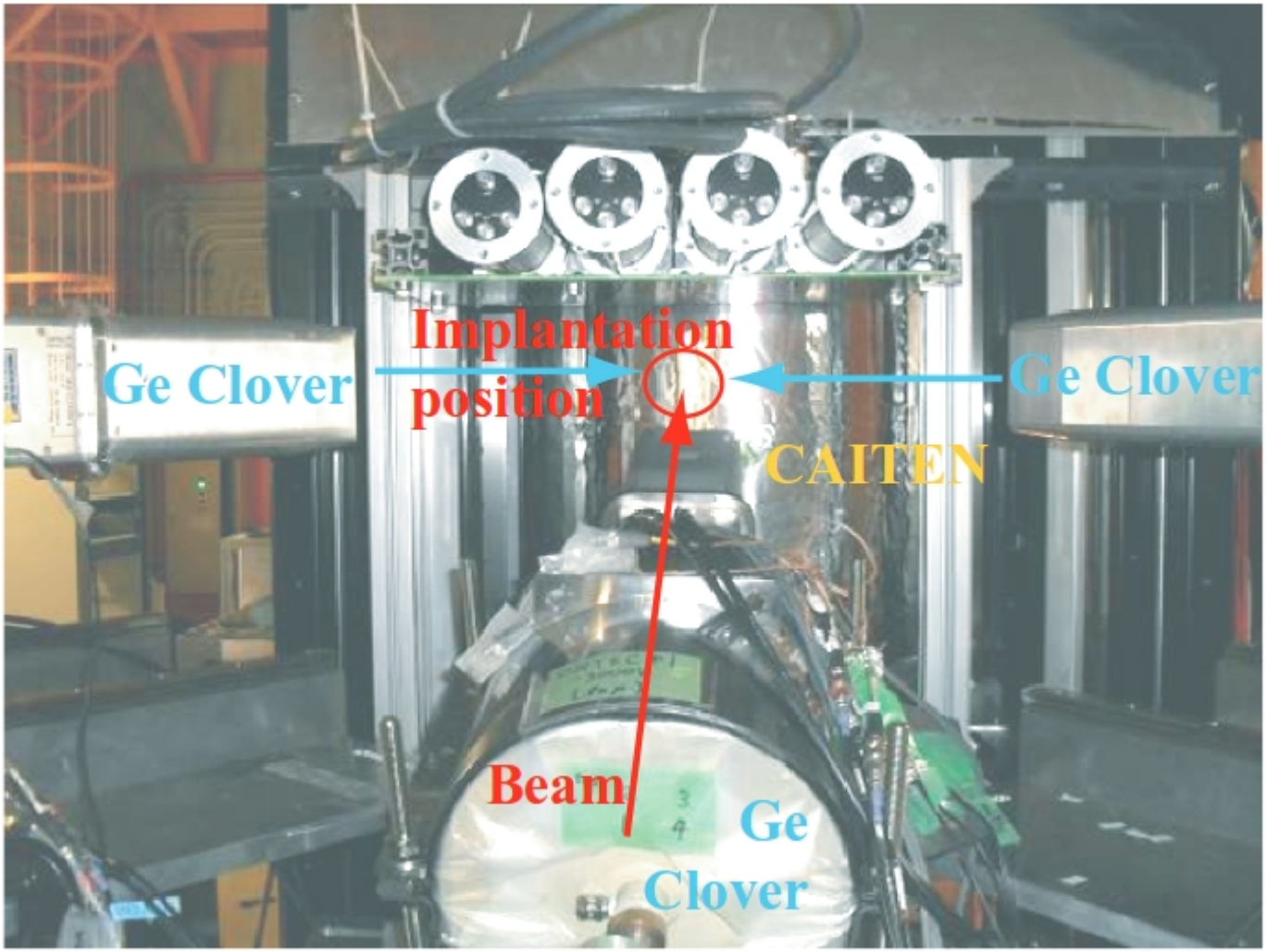
NPL National Physical Laboratory

A possible implantation detector for LaBr3 arrays



CAITEN

National Physical Laboratory



SUMMARY

1) a LaBr3 array is under construction at NPL for the standardization and use tracable primary standard

2) NANA will be operational in 2015

3) Improve digital trigger timing

4) gamma-gamma correlation for lifetime measurements