Update on the developments of a TAS for DESIR

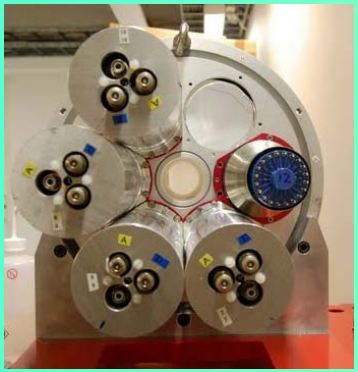
- **The first measurements with the segmented BaF2 TAS has been performed at JFLTRAP-IGISOL on several Br and Rb isotopes on November 2009**
- **The work until now has been concentrated on the development of the methods and tools for the analysis, the characterization of the spectrometer performance and the investigation of the response to laboratory sources and its reproduction by Monte Carlo simulations**

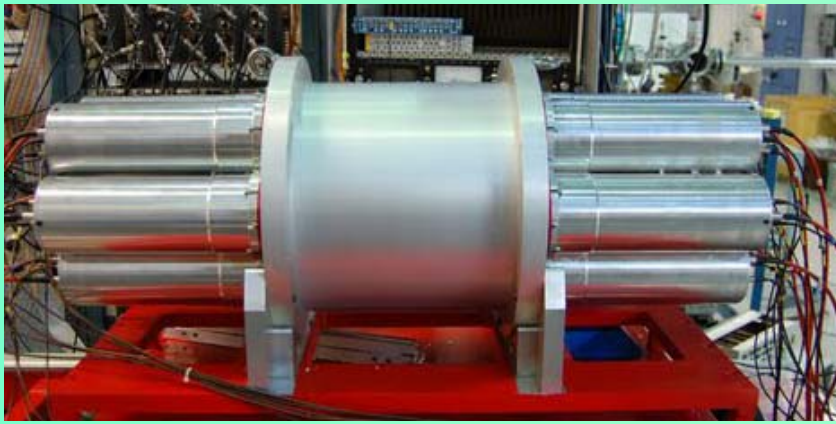
Jose L. Tain @ IFIC-Valencia

First results with a segmented TAS @ JYFL

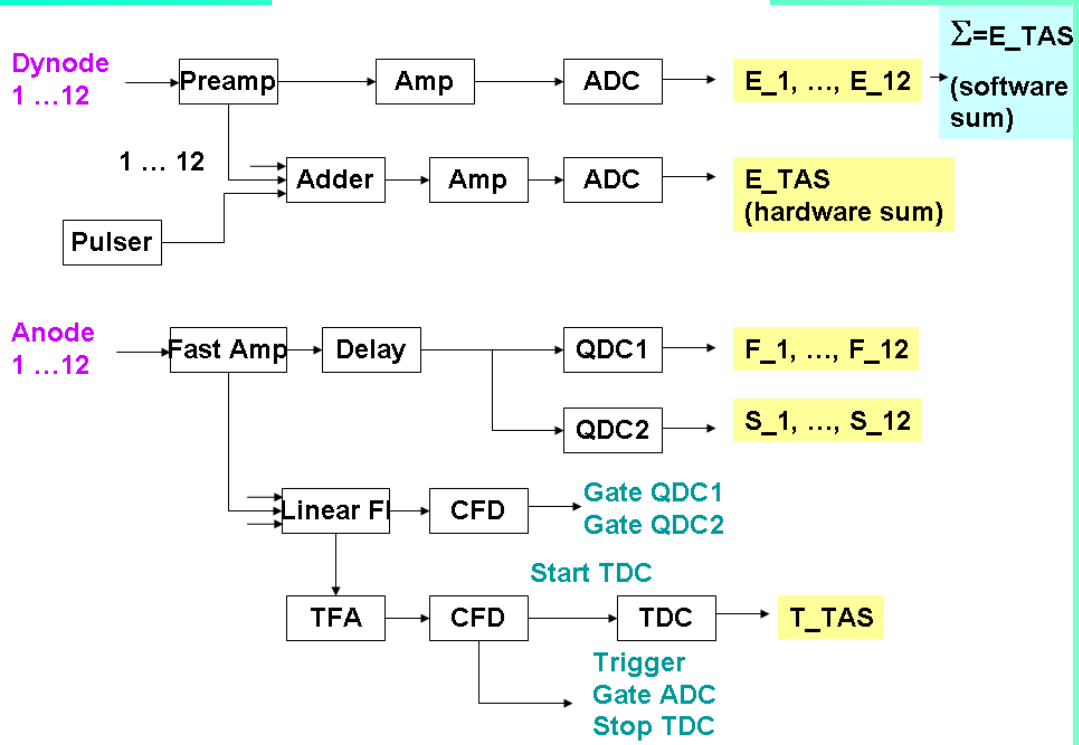
Characterization of the spectrometer

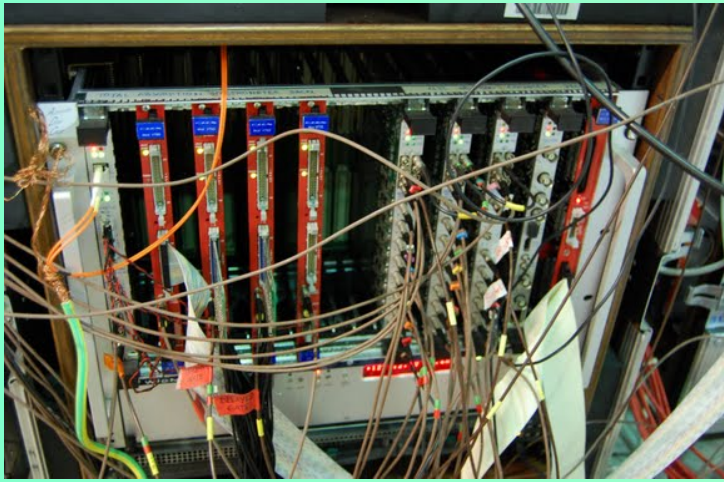
E. Valencia
Master Thesis (U. Valencia)





Electronics diagram



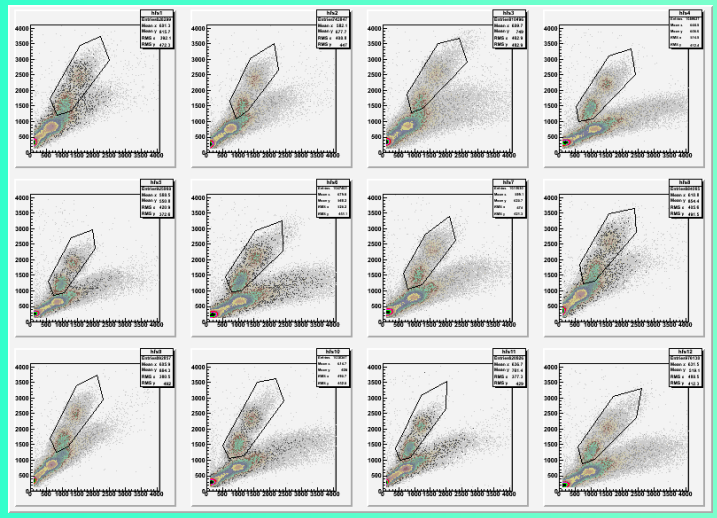


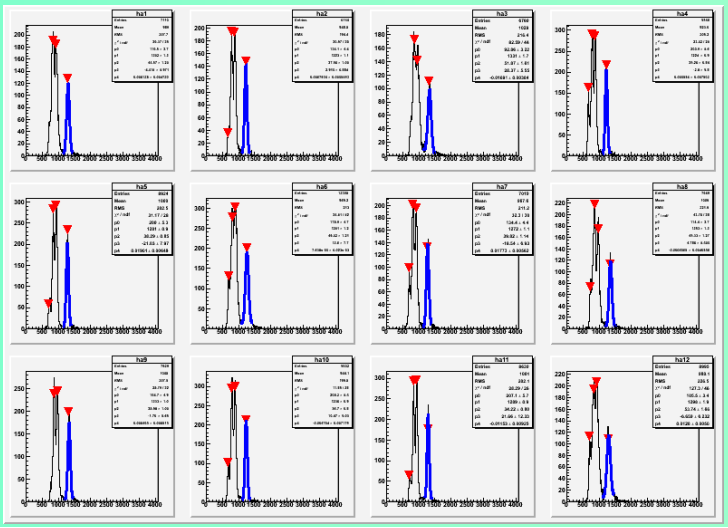
DACQ

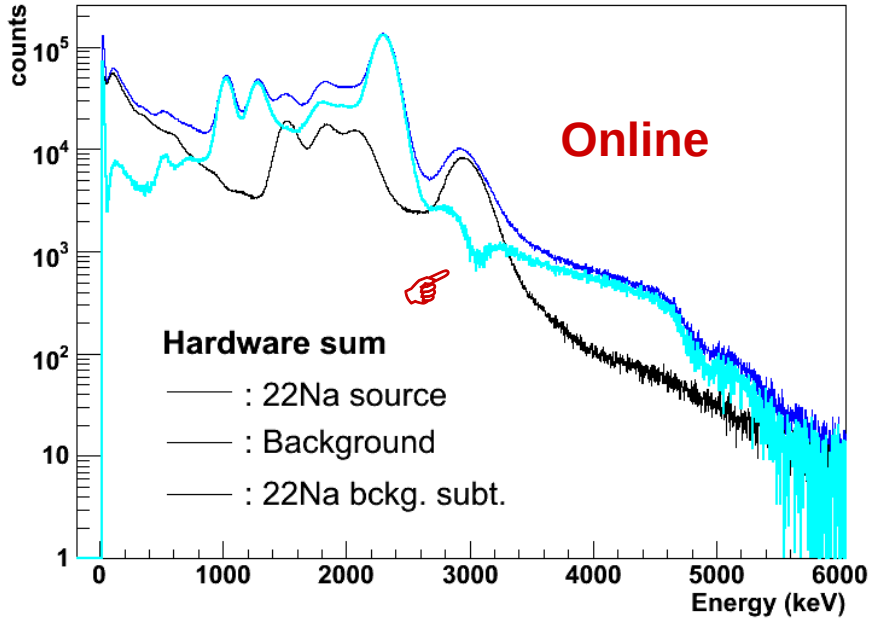
- ADC (V785)
- TDC (V775)
- 2×QDC (V792)

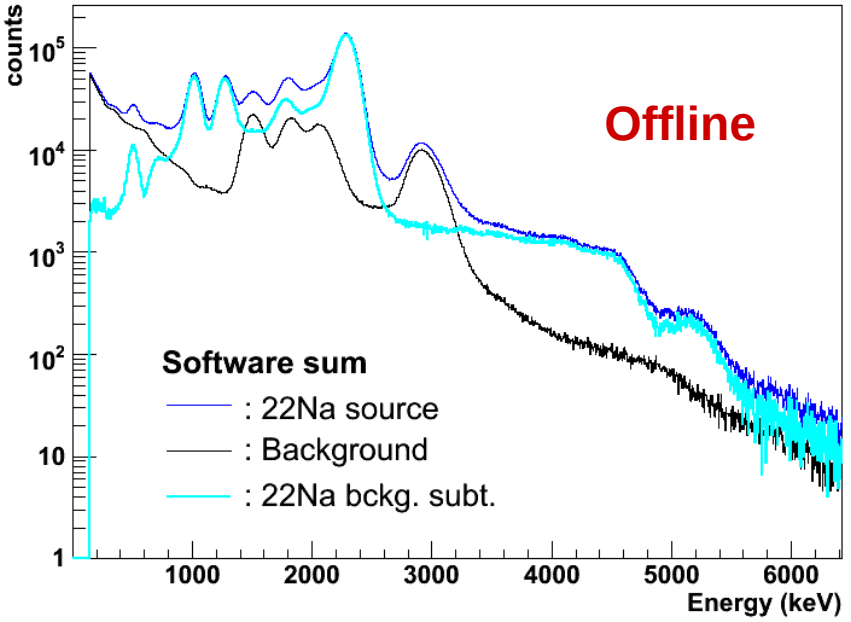
Gain stabilization/matching:

Fast versus slow gated QDC signals to select contaminant α-peaks used as reference

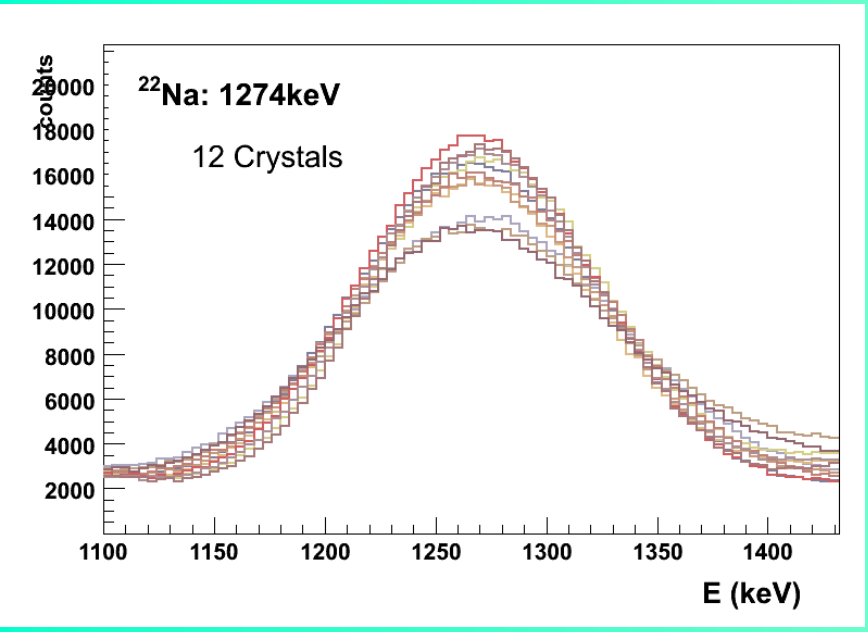




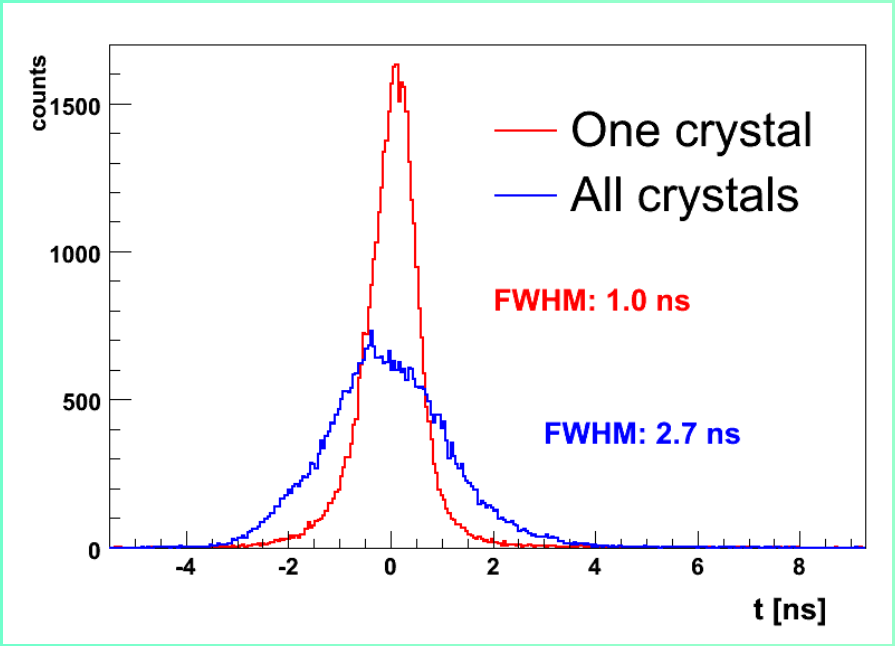




Energy resolution:



Time resolution:



Single Crystal Resolution:
13.1% - 16.4% @662keV

Software Sum Resolution:
15% @ 662keV
10%@1332keV

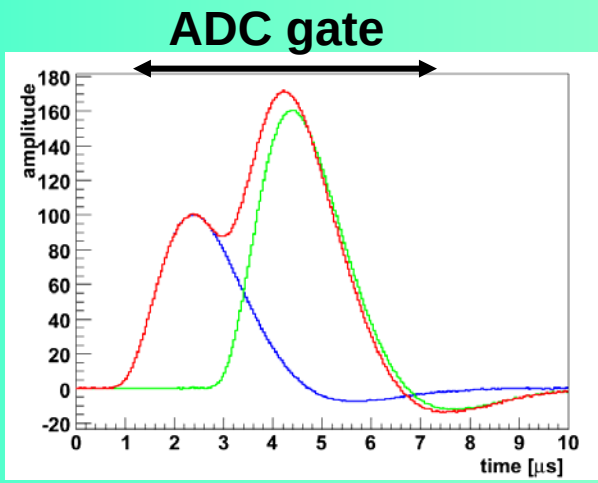
LBL@GSI TAS:
7.3% @662keV
5.8% @1332keV

^{60}Co source
Threshold = 150keV
(Thin BC400 scintillator)

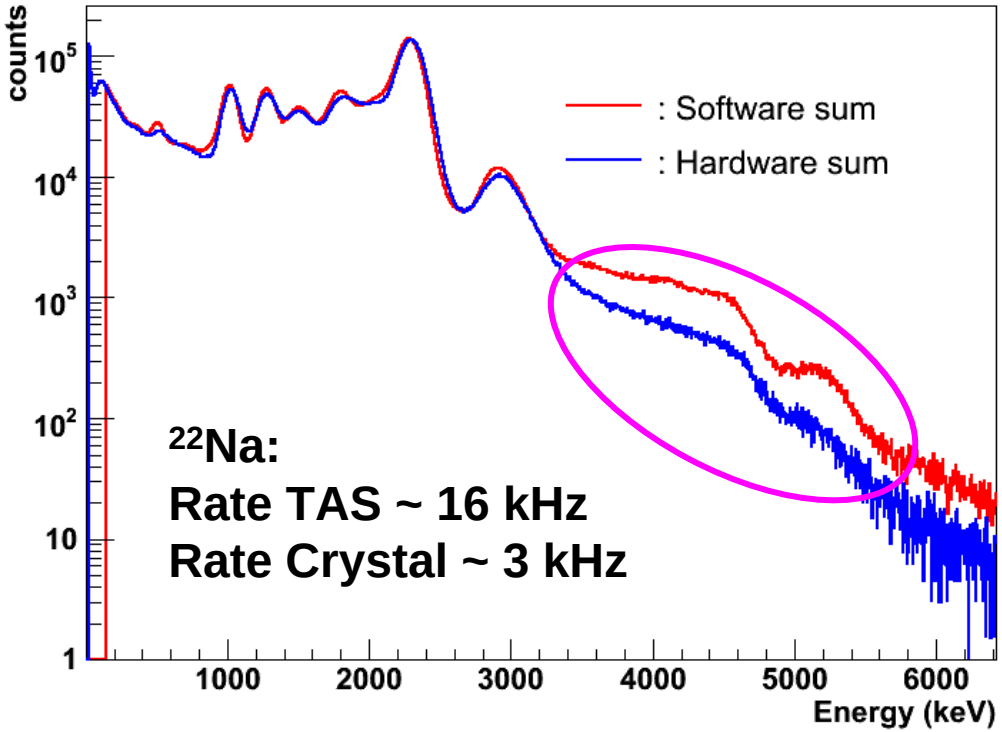
Timing resolution: <1ns

Pileup & summing corrections:

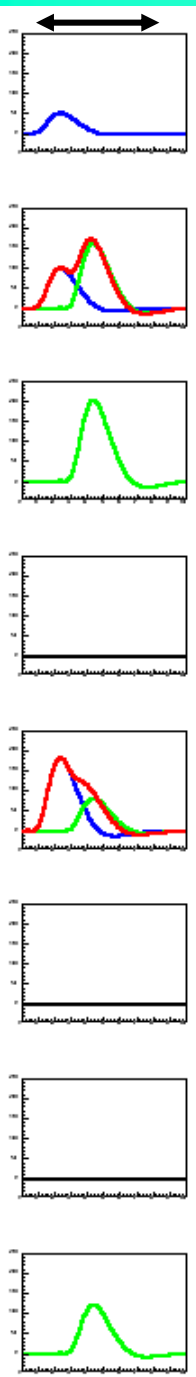
- **Due to random nature of decay, pulses can overlap.**
- **Effect is rate dependent.**
- **Single crystal: distortion (pileup) and count losses (dead-time)**



Previously we have developed a method to calculate spectral distortion based on the true pulse shape and the recorded spectrum: Cano-Ott et al. NIMA 430 (1999) 488

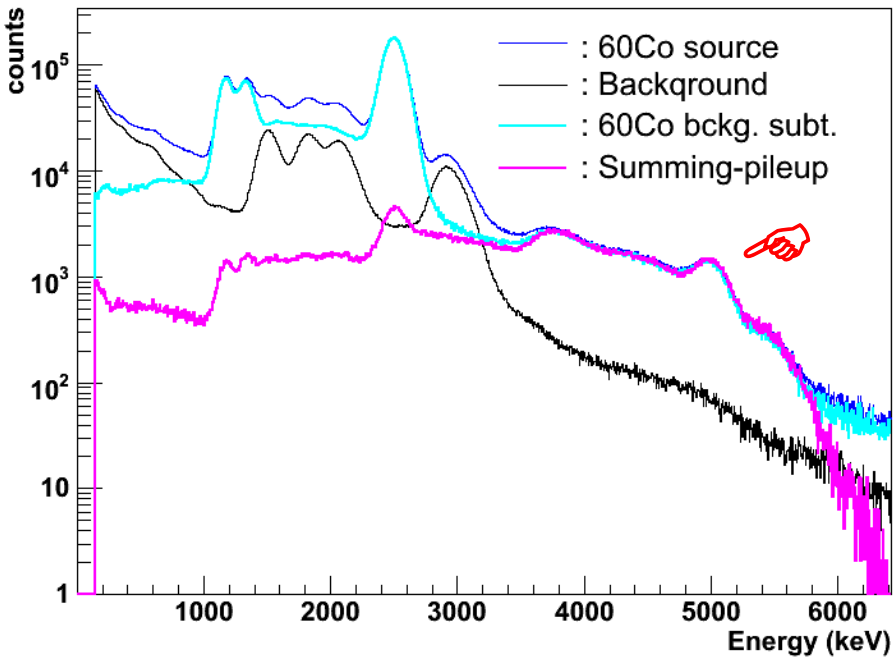


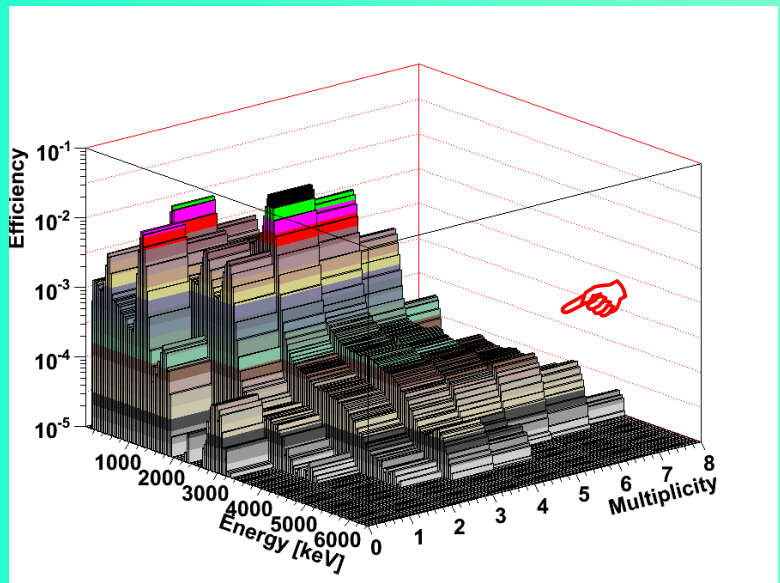
In a multi-crystal detector an additional effect appears: “summing”

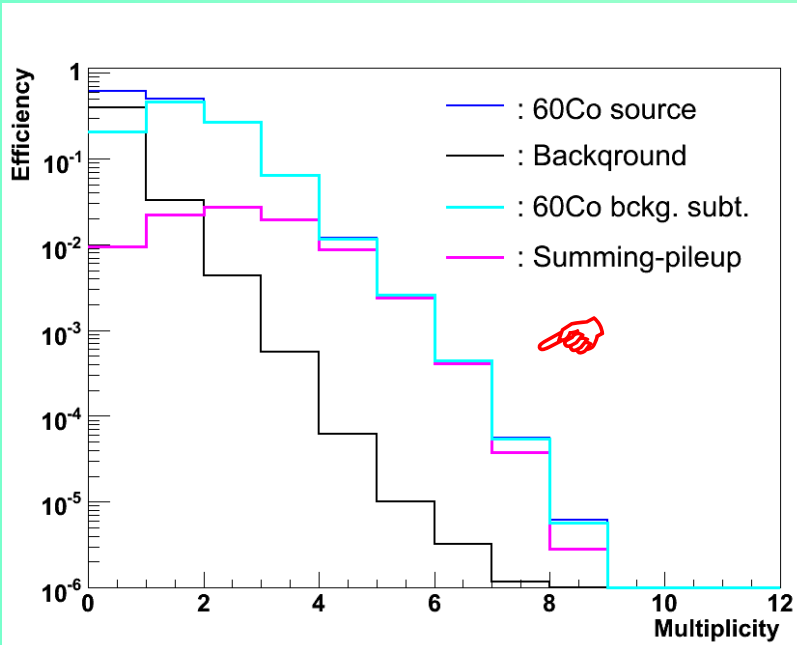


Summing effect is event multiplicity dependent!

We have developed a method to calculate the distortion based on summing of measured events (randomly time distributed) including the pileup distortion (with true pulse shapes)



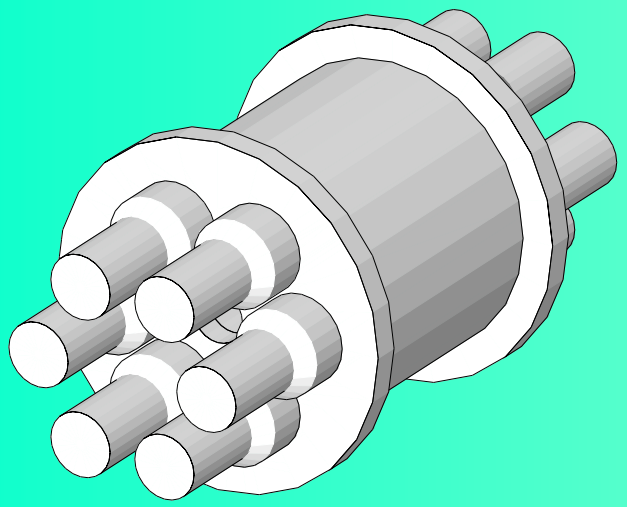


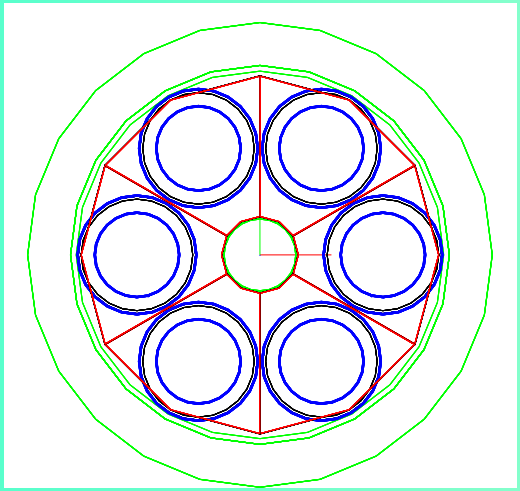


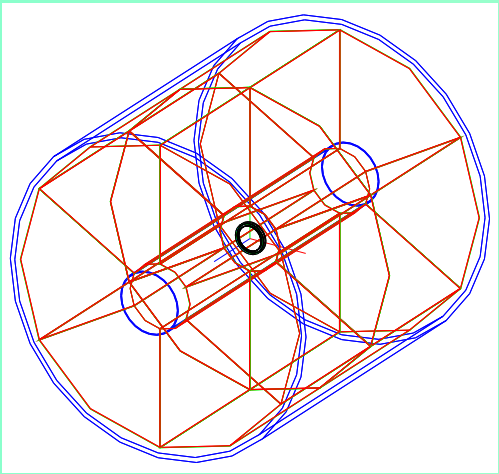
Geant4 Monte Carlo simulations of the spectrometer response

The accuracy of our analysis relies on the ability to reproduce the spectrometer response to γ-rays and β-particles (e-, e+) with MC simulations.

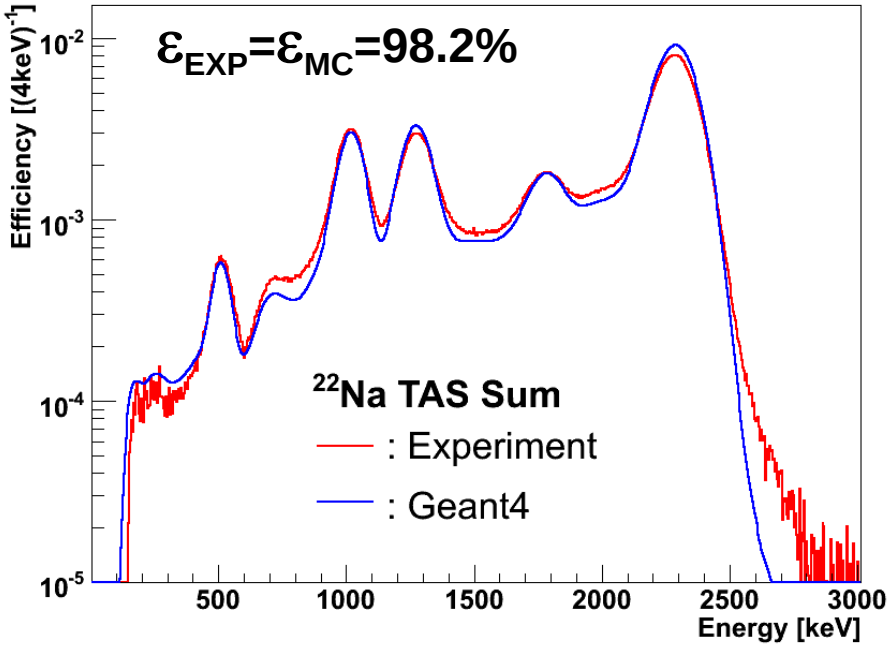
- **Geant4 (9.p02) simulation with very detailed geometry (including source geometry)**
- **Standard EM physics list (very similar to Low Energy Extension or Penelope physics list)**
- **No tracking parameters optimized yet**
- **Event generator includes the CE process**

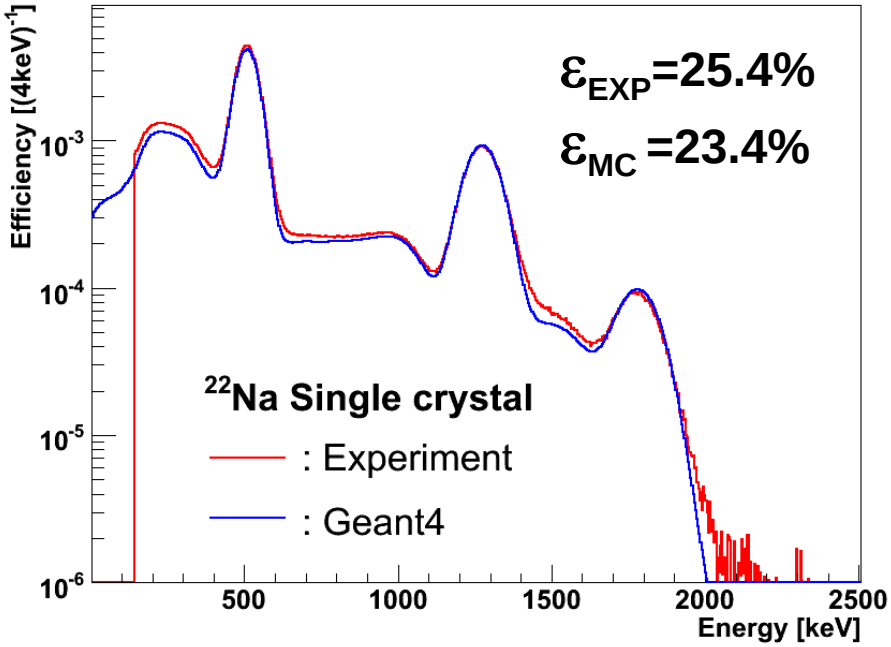


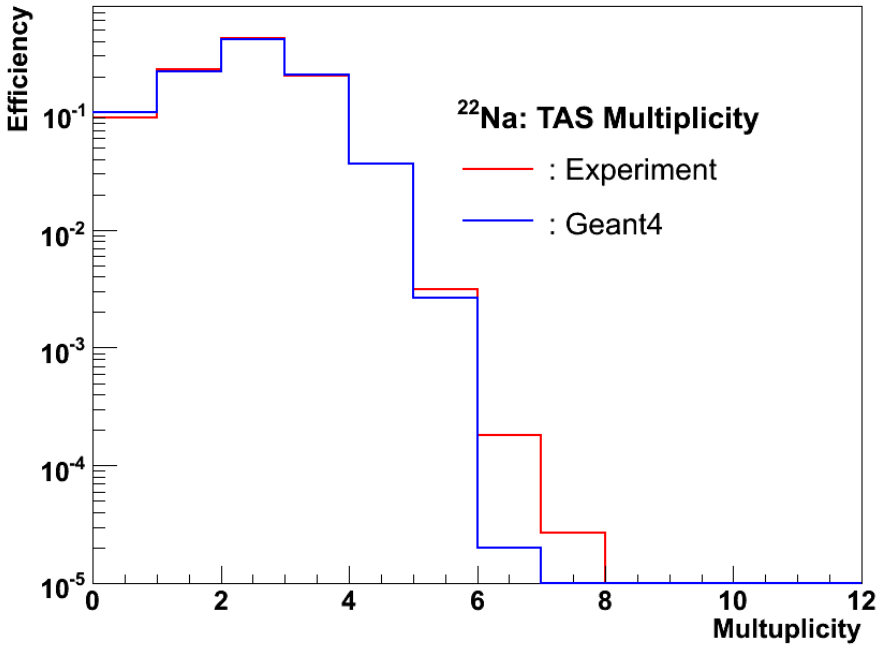


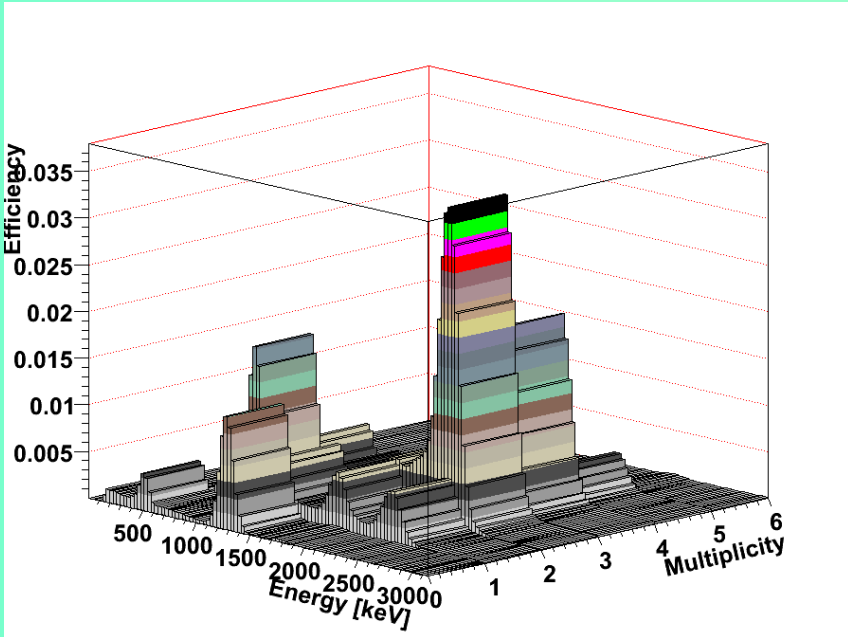


Background and summing-pileup subtracted source spectra are compared with simulations ☞


$\varepsilon_{EXP}=\varepsilon_{MC}=98.2\%$
^{22}Na TAS Sum
: Experiment
: Geant4
Efficiency [(4keV)$^{-1}$]
Energy [keV]


$\varepsilon_{EXP}=25.4\%$
$\varepsilon_{MC}=23.4\%$
^{22}Na Single crystal
: Experiment
: Geant4
Efficiency [(4keV)$^{-1}$]
Energy [keV]


^{22}Na: TAS Multiplicity
: Experiment
: Geant4
Efficiency
Multuplicity


Efficiency
Energy [keV]
Multiplicity