Neutron-Gamma Discrimination Using ^{252}Cf Source With Four AGATA Triple Clusters

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L. Pellegri, F. Recchia, S. Riboldi, P.A. Söderström, E, Şahin, and the AGATA collaboration

Aim of the Study :

Discrimination of gamma rays and neutrons in the AGATA detectors.

➢ TOF method
➢Discrimination of gamma rays due to inelastic neutron scattering by tracking (AU)

➢ PSA- Investigate the differences in pulse shapes of neutron and gamma-ray interactions in the AGATA detectors (UU)

Overview of Presentation:

➢ ^{252}Cf experiment

➢Discrimination methods
       TOF
       Tracking
       PSA (UU)

➢Conclusions

^{252}Cf Experiment

16 HELENA detectors
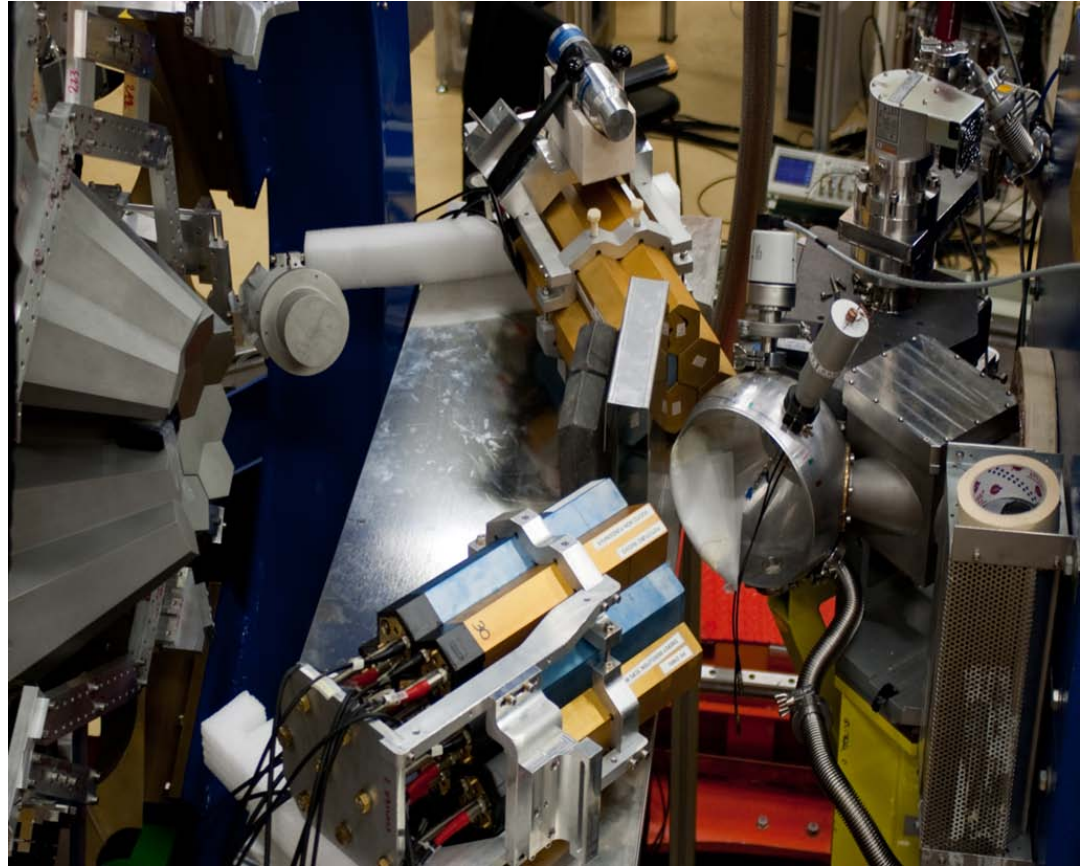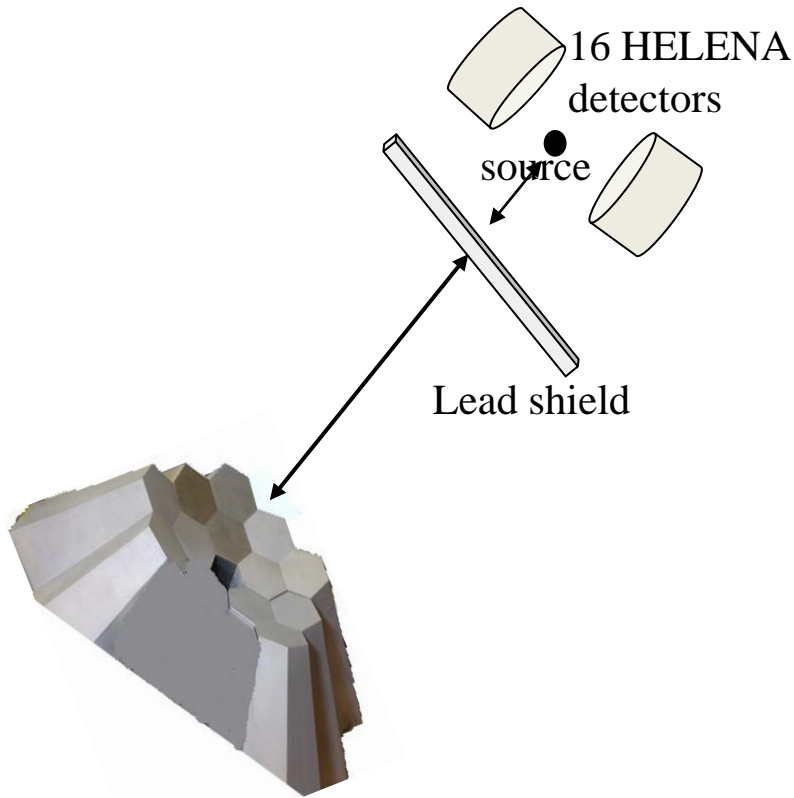
source

Lead shield

Four AGATA Triple Cluster (ATC:s)

^{252}Cf source placed at a distance of about 50cm from the ATC:s.
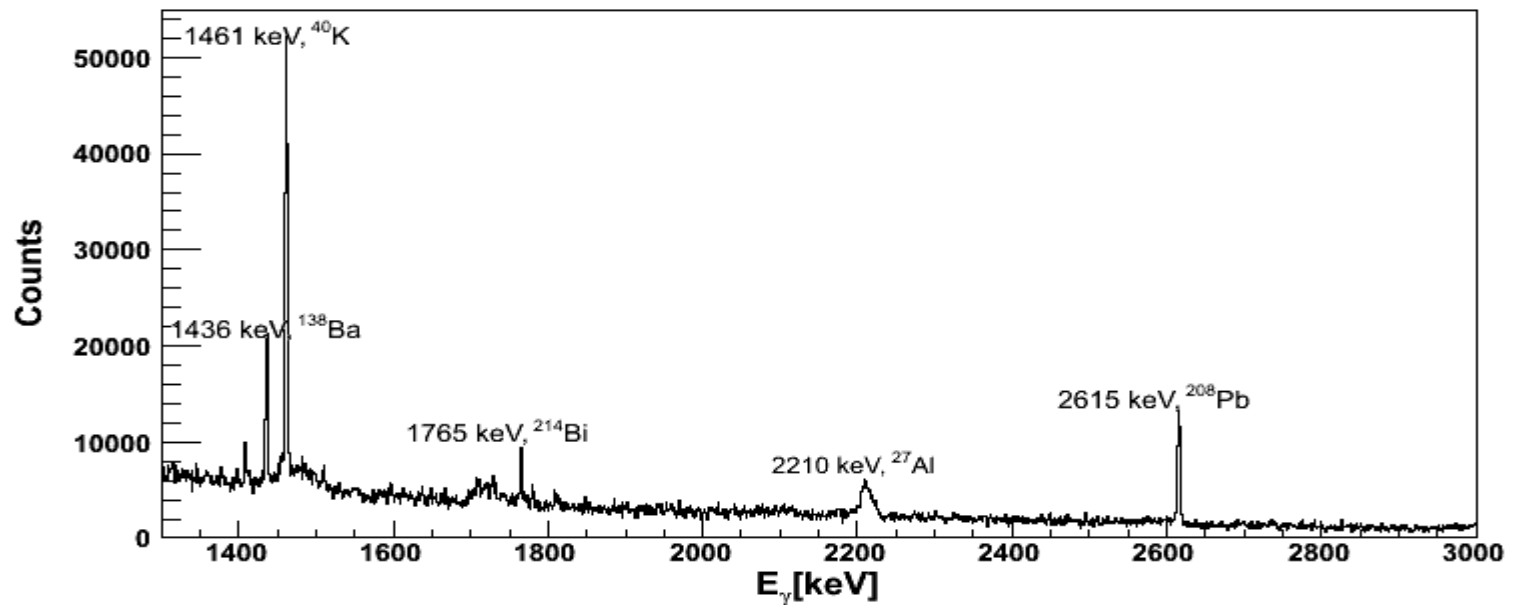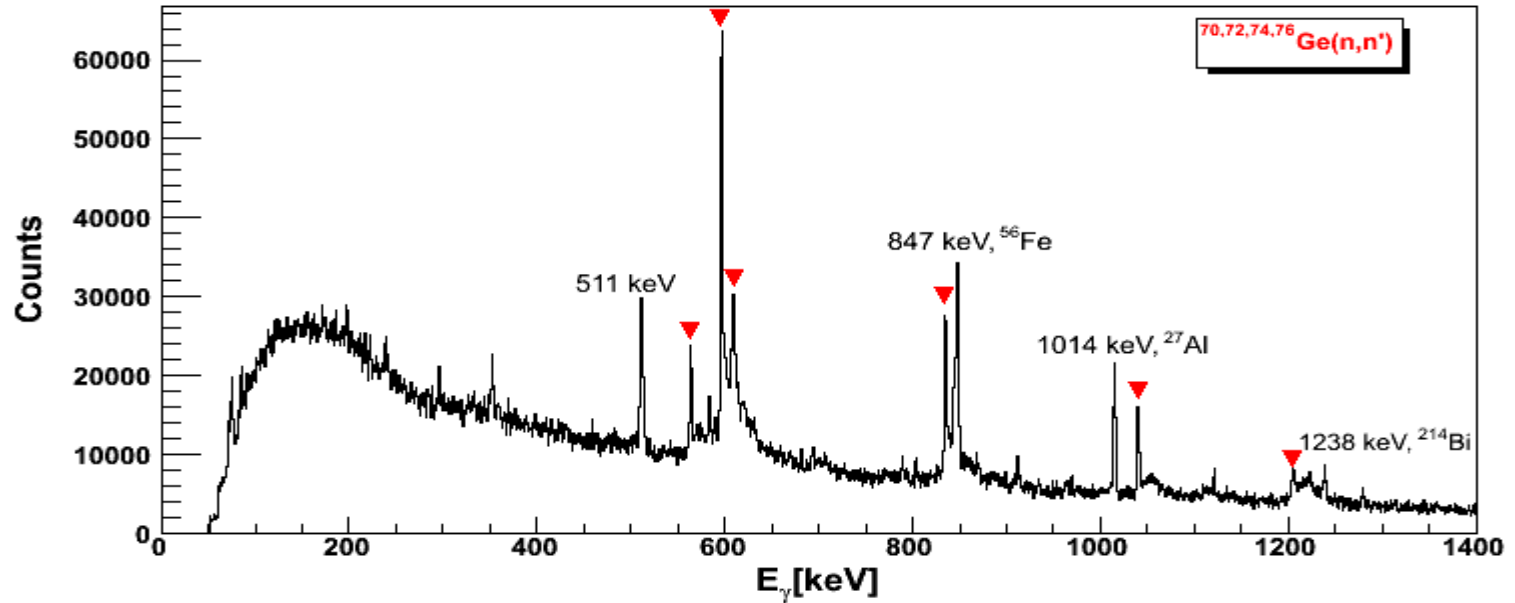BaF2 detectors located 10cm from the 60 kBq 252Cf source.
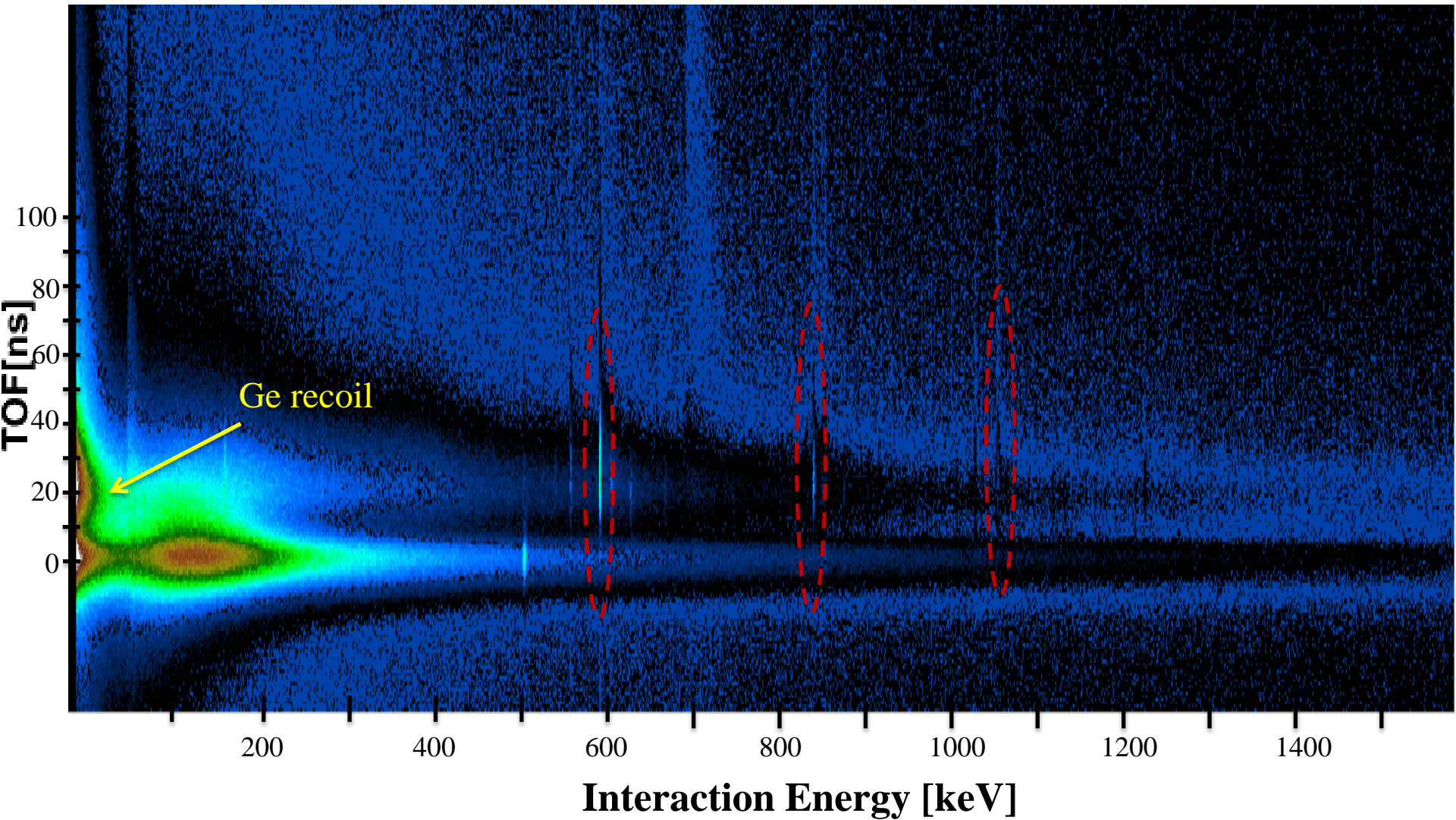5 cm thick lead shield was placed between the ^{252}Cf source and the ATC:s.
Trigger condition was 1 BaF2 detector in coincidence with at least one HPGe core signal

Gamma-ray spectrum after tracking (mgt)

^{70,72,74,76}Ge(n,n')

511 keV

847 keV, ^{56}Fe

1014 keV, ^{27}Al

1238 keV, ^{214}Bi

1461 keV, ^{40}K

1436 keV, ^{138}Ba

1765 keV, ^{214}Bi

2210 keV, ^{27}Al

2615 keV, ^{208}Pb

TOF versus interaction energy

Ge recoil

TOF[ns]

100
80
60
40
20
0

200   400   600   800   1000   1200   1400

Interaction Energy [keV]

Preliminary Results

TOF Histogram with Gate on Interaction Point Energies

Preliminary Results

gamma

neutron

100 keV<interaction energy<200 keV

500 keV<interaction energy<600 keV

1100 keV<interaction energy<1200 keV
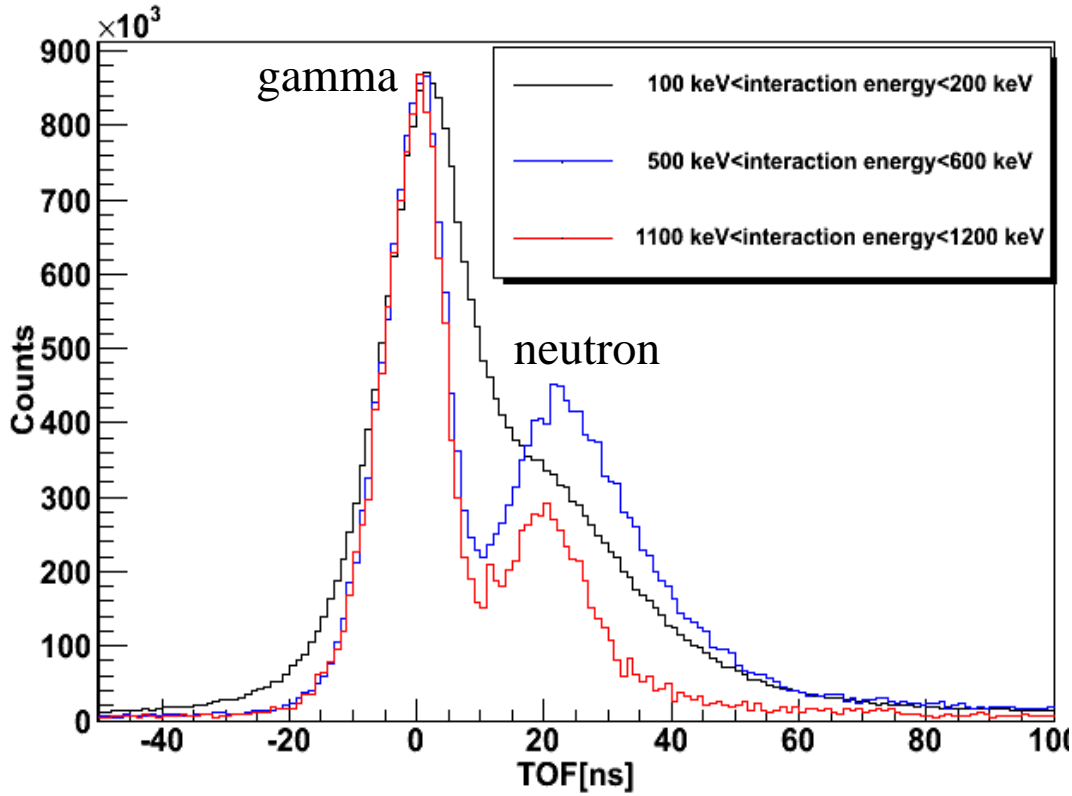
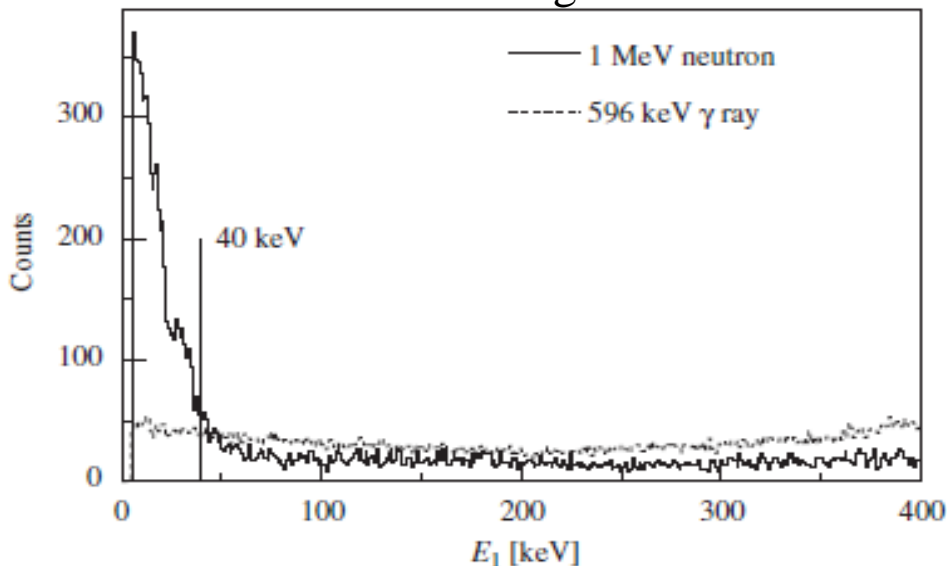HPGe Time (FWHM) from Core + Segment signals vs BaF2
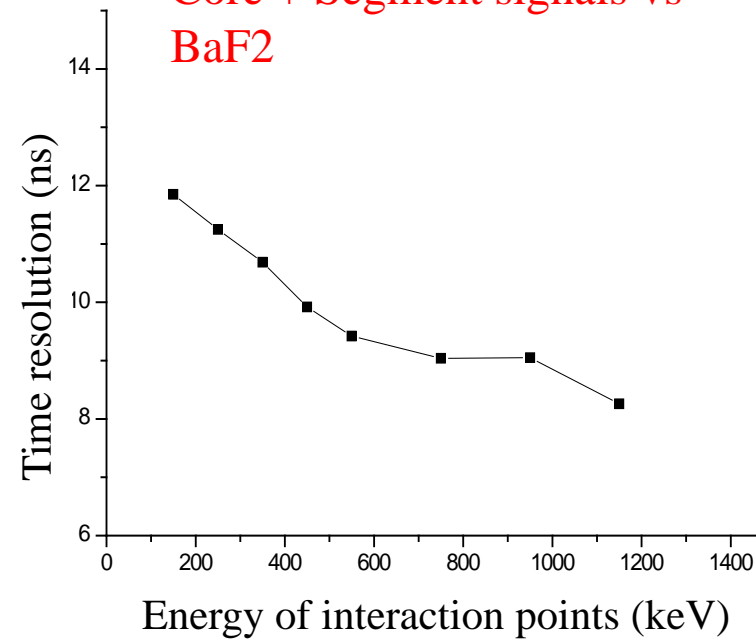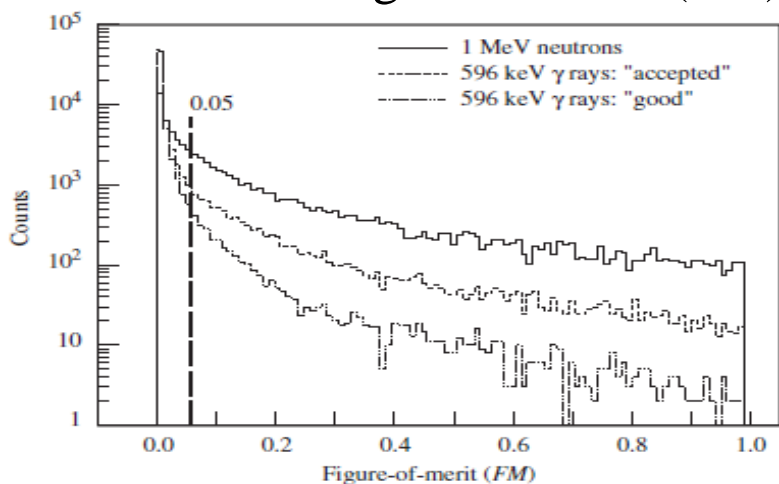
They are normalized to the top of the peak

Tracking (mgt):
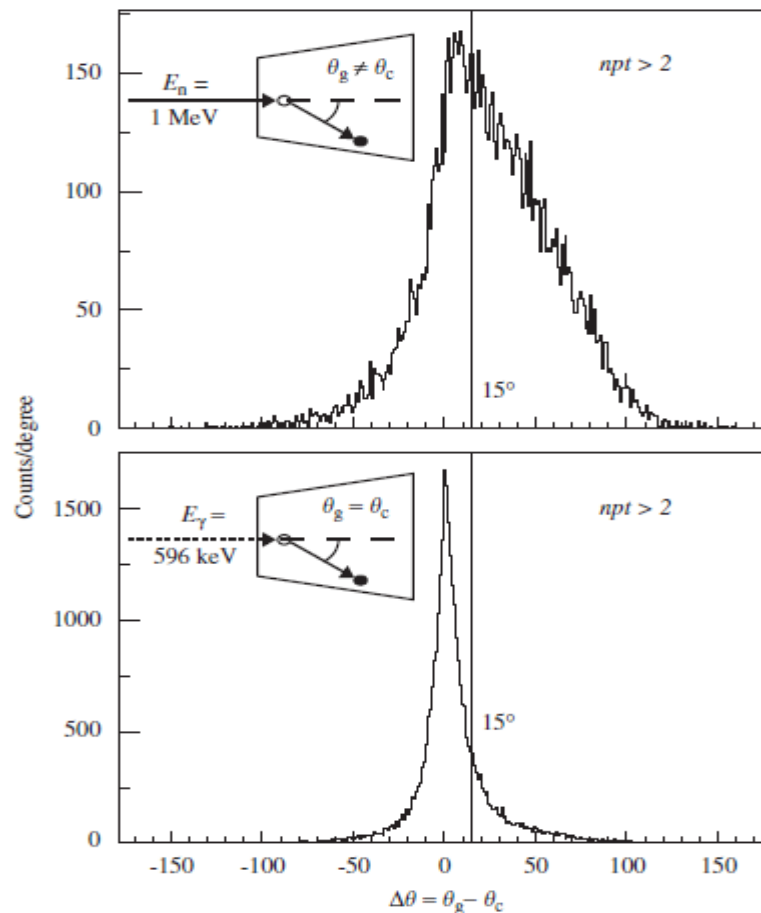# Simulation Results-Methods: (NIM A, 607 (2009)

Method 1: Energy of the first interaction points
Neutrons and gammas on 74Ge

Method 2: $\theta g - \theta c$
Direction of incoming gamma

Method 3: Figure of Merit (FM)

	1-5 MeV neutrons		1 MeV γ rays
834 keV peak	Bump	Total	Peak
54	39	76	14

Energy histograms of gammas with standard tracking, with TOF gate and with our tracking gates

Preliminary Results
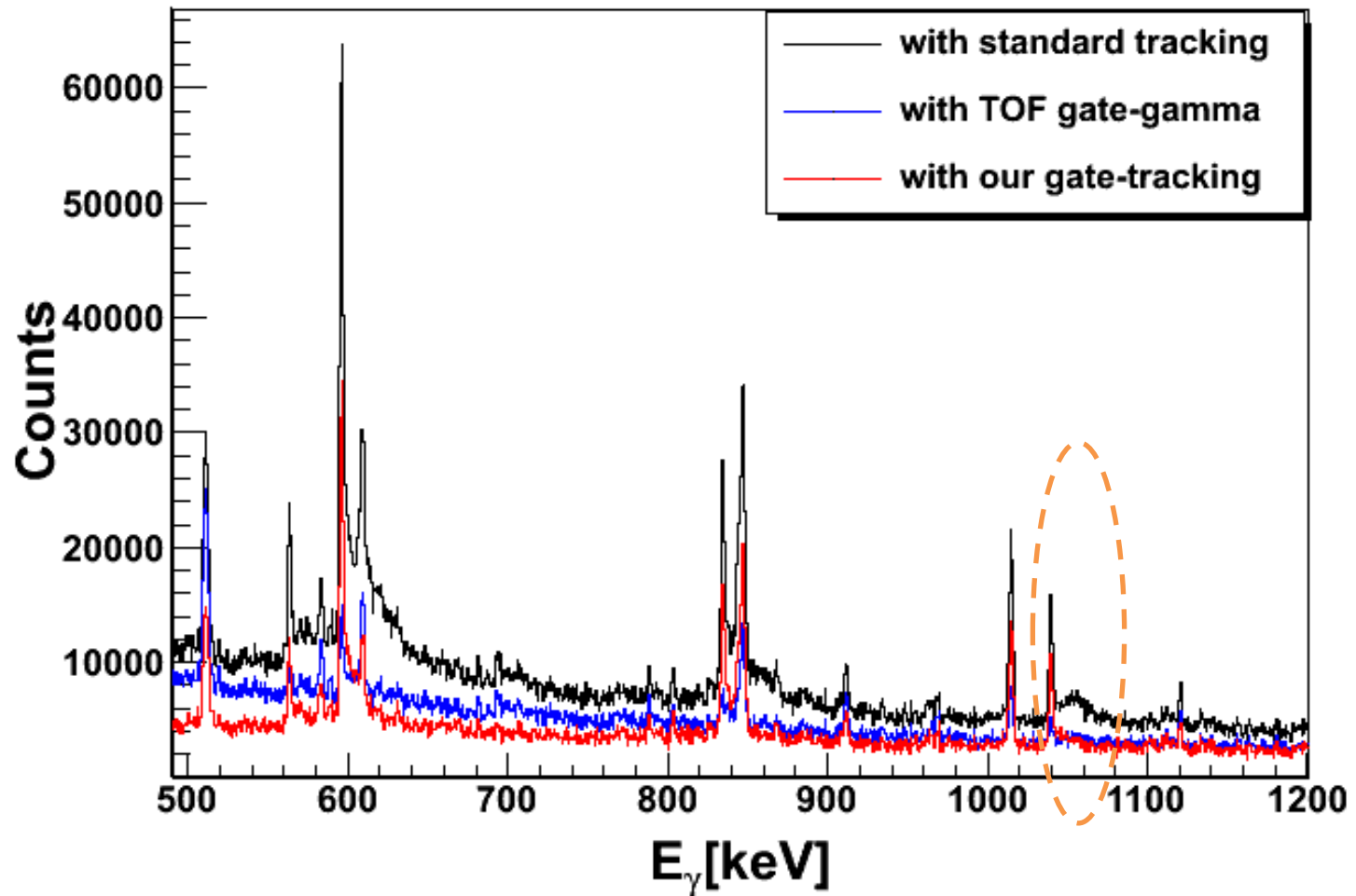
^{252}Cf Experiment:

Efirst < 35 keV, Esecond < 35 keV, FM> 0.1, θg - θc> 40°, Eth=5keV

	^{252}Cf source		^{60}Cf source (beginning of April 2010)	
	1040 keV peak (%)	1040 keV peak + bump (%)	1174 keV peak (%)	1333 keV peak (%)
Efirst, Esecond, FM, θg - θc	29.4	55.0	21.3	20.5

Work ongoing

CONCLUSIONS

➤ Time resolution of the Agata detectors were obtained from core + segment signals. It changes from 12ns at Eint of 150 keV to 8ns at Eint of 1150 keV.

➤ At this resolution and at a distance of 50cm, TOF method works very fine for neutron gamma discrimination. <u>Can we improve the time resolution so that TOF can be used at the nominal AGATA distance of 23 cms?</u>

➤ tracking → discrimination of gamma rays and neutrons
                          good reduction in background +
                          55% reduction in the 1040 keV peak and it's
                                      associated neutron bump were obtained.

➤ work ongoing at tracking method
   work ongoing at PSA (UU)