**1) Title and spokesperson**

**AGATA Demonstrator Test with a 252Cf Source: Neutron-Gamma Discrimination**

**M. Şenyiğit, A. Ataç, J. Nyberg**

**2)     Main objectives**

The main objectivity of this work is to investigate three possible techniques, namely the t ime-of-flight (TOF), the forward tracking and the pulse-shape analysis techniques in order to study neutron gamma-ray discrimination in AGATA. Due to the high segmentation , the last two methods are expected to work better for AGATA detectors as compared to the normal HPGe detectors. On the other hand, the well known TOF technique is expected to be of limited use at the nominal AGATA distance of 23.5 cm with the time resolution of the AGATA detectors. The TOF technique may be a complementary procedure that can be used together with the tracking based methods investigated in this work. Discrimination of neutrons from gamma-rays is expected to become a large problem in future studies where neutron-rich radioactive beams will be used e.g. at GSI/FAIR and at GANIL/SPIRAL2. The investigation of the neutron interaction points in this work are also seen as a first step for a possibility to use AGATA for neutron measurements.   
 **3)     Short statement on the run itself and how AGATA operated.**

AGATA operated perfectly well during our source run. Great help from the local people was recieved.   
 **4)     Status of the analysis**

The work on the discrimination of neutron induced background in the gamma spectra based on the tracking algorithms is finalised. We are currently preparing a NIM article on this part. The analysis of the pulse-shape differences between neutron and gamma-ray interactions is ongoing.   
 **5)     Any results**

In an earlier work, based on Geant4 simulations, discrimination of gamma rays due to inelastic neutron scattering in the AGATA detectors was investigated by using the forward tracking algorithm. The mgt tracking code was used to identify the neutron interaction points and methods for eliminating gamma rays due to inelastic neutron scattering reactions were developed with a special emphasis on not to reduce the photopeak (= full-energy peak) efficiency of the gamma rays of interest. In the present work, these methods were checked in an experiment using a 252Cf source.

The results reveal that in the gamma-ray spectra an overall background reduction of about 40% is achieved when the neutron-gamma discrimination methods are applied. The results also show that the gamma-ray peak at 1040 keV (70Ge) and the related bump, caused by the recoiling Ge nuclei, are reduced by 49%. This neutron rejection method causes a loss of 19% of the counts in the 1332 keV full-energy peak measured with a 60Co source. Simulation results show that among the three discriminations methods, the rejection based on the low energy of the first interaction point is the most successful one, since it does not decrease the 60Co full-energy peaks as much as the other methods. By using only this requirement, the gamma-ray peak at 1040 keV together with its bump is reduced by 24%, with a loss of only 5 % of the counts in the 1332 keV peak. This method can be improved if the low-energy threshold on the segment signals, which was 10 keV during the experiment, is reduced even further, e.g. to 5 keV. The overall agreement between the experimental results and the simulations results are good.

**6)     Publications or talks (or an indication if there will be any)**

Talk: M. Şenyiğit, [The neutron-gamma discrimination using](http://agenda.infn.it/contributionDisplay.py?contribId=10&sessionId=21&confId=3224) 252Cf source with four AGATA triple clusters,  EGAN Workshop, 27-30 June 2011, Padova, Italy .

LNL Report: M. Şenyiğit et al, AGATA Demonstrator Test with a 252Cf Source: Neutron-Gamma Discrimination. LNL Annual Report 2010.

LNL Report: M. Şenyiğit et al, Discrimination of Neutrons and Gamma Rays in AGATA. LNL Annual Report 2011.

Thesis: M. Şenyiğit, PhD Thesis, 9 Sept. 2011

Publication: Manuscript for a NIM paper is being prepared.  
   
 **7)     Any problems:**

We had difficulties during the replay of the raw data due to lack of experience to analyse AGATA data.