Work package 1. New Materials

The main objectives of this work package are the study of the detection properties of new advanced scintillator materials and to assess the performances for their use in gamma spectroscopy for nuclear physics.

It is furthermore our interest to create a network with expert laboratories and companies that produces these new promising scintillator materials.

Detector's procurements

IPNO received for the GANAS project 39000 € over the first two years. This money has been asked to procure new advanced scintillator crystals and photomultipliers tubes to test them.

Crystal	Geometry	Manufacture	Price	Delivery
CeBr3	Ø 25 mm x 25 mm	Scionix	1,475€	In 2011
CeBr3	Ø 51 mm x 76 mm	Scionix	15,200€	November 2012
SrI2:Eu	Ø 25 mm x 25 mm	RMD	12,600$(9420€)	Expected March 2013
CLYC	Ø 25 mm x 25 mm	RMD	7,000$ (5701€)	Expected March 2013

PMT	Features	Manufacture	Price	Delivery
5 R7723-100	Ø 51 mm – SBA photocathode 8 dynodes	Hamamatsu	478.80€ (2,394€ total)	January 2013

Milano has bought a 1"x1" CLYC crystal from RMD manufacturer. The detector arrived in December 2012. Milano has also several LaBr3:Ce detector of different sizes, from 1"x1" up to 3.5" x 8". All these detectors were NOT bought with GANAS funds.

Scintillator characterizations

The two CeBr3 crystals have been fully characterized with gamma ray emitting sources in the energy range between 60 to 1408 keV. In particular we measured the light yield, the energy resolution, the gamma ray proportionality and, for the 76 mm thick CeBr3, the light yield uniformity.

The tests have been performed coupling the crystals to a PMT Hamamatsu R7723-100, equipped with a Ø 51 mm entrance window and a super-bialkali photocathode. The gamma ray spectra have been acquired with a standard spectroscopic chain: the anode signal from the phototube was sent to a cremat 113 preamplifier, then shaped with an ORTEC spectroscopy amplifier and finally collected with an ADC. For the two CeBr3 crystals we

measured an energy resolution at 662 keV of 4.8% and 4.7% for the small and the big volume crystal respectively.

In Milano the large volume LaBr3:Ce detectors have been fully characterized. We tested the detectors using monochromatic gamma-ray sources and in-beam reactions producing gamma-rays up to 22.6 MeV. We acquired PMT signal pulses and calculated detector energy resolution and linearity of response as a function of gamma-ray energy. Two different voltage dividers were coupled to the PMT: the Hamamatsu E1198-26, based on straightforward resistive network design and the "LABRVD", specifically designed for our large volume LaBr3:Ce scintillation detectors, which also includes active semiconductor devices. We also estimated the time resolution of different sized detectors (from 1"x1" up to 3.5"x8"), correlating the results with the intrinsic properties of PMTs and the GEANT simulations of the scintillation light collection process. A NIM paper is going to be submitted.

Concerning the measurements with the 1"x1" CLYC scintillator in Milano, the measurements are still in progress. We plan to compare the scintillator response using different PMTs, voltage dividers, and values of HV. We will measure energy resolution with different shaping times, preamplifiers and for different gamma rays energies. In addition, we plan to measure the neutron response using PSA digital technique and the specific modules we have designed for BaF2 and LaBr3:Ce.

In beam test at ALTO (May 2013)

The five scintillators procured within the frame of the GANAS collaboration will be tested in May 2013 during an in beam testing of clusters for the PARIS demonstrator. This campaign will lead us to test the scintillators at gamma ray energies not available with standard radioactive sources. Each scintillator will be coupled to a R7723-100 photomultiplier tube from Hamamatsu, as used for the phoswich light readout by the PARIS collaboration, and the signals will be collected by a 1 GS digitizer for offline analysis.