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Report on the R&D project of the LabEx P2IO
“Development of a small prototype of Compton gamma-ray telescope”
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The project aims at the construction of a small gamma-ray telescope utilizing recent advances in detector technologies and integrated readout electronics. The eventual goal is to prepare a new space mission for gamma-ray astronomy in the MeV range to replace the ESA's INTEGRAL observatory. The prototype instrument will be realized by combining several thin layers of double-sided silicon strip detectors (DSSSD) with a cerium-doped lanthanum bromide (LaBr₃:Ce) scintillator coupled to a multi-anode photomultiplier tube (MAPMT). The DSSSD technology is studied at IPNO, the LaBr₃:Ce module is developed at CSNSM, and LAL takes part in the realization of the readout electronics together with the two other P2IO laboratories.

A “kickoff” meeting took place at CSNSM on the 10th of February 2012 with most of the team members (there were 16 participants to this meeting). After a presentation of the project, we discussed the allocation of the budget (40 k€ attributed by P2IO against 80 k€ initially requested) and the planning of the activities in each laboratory. Several more informal meetings between physicists and engineers of LAL, IPNO and CSNSM have occurred since then.

The experimental work at CSNSM focuses at present on three aspects: (1) characterization of the electronic board designed at LAL around the ASIC MAROC to readout MAPMT signals, (2) characterization of a LaBr₃:Ce detection module recently bought to Saint Gobain Crystals, and (3) development of GEANT4 simulations to reproduce the spatial distribution of scintillations signals within the sensor plane. The first task is now almost completed, the second one needs further measurements with the dedicated test bench, and the third one is in progress. At present, the numerical simulations reproduce quite well the shape of the measured charge distributions, although they overestimate the total number of detected photoelectrons by about 40%.

Concerning the DSSSD characterization work made at IPNO, several tasks are currently undertaken. The first one concern the test and fine-tuning of the PACI charge pre-amplifier developed at IPNO in order to detect low energy deposits (~ 60 keV). For this purpose a 1.5 mm thick DSSSD (BB7 model from Micron Semiconductor Ltd) as well as a silicon junction are used. The second task is to identify a low-noise ASIC which would be suited for the readout of the DSSSD. First tests have been done with the ASIC ATHED, which equips the COFEE electronics board. In parallel, discussions have started with the company Gamma Medica-Ideas, which develops dedicated ASICs for gamma-ray space instruments.