# $LaBr_3$:Ce scintillation crystal for enhanced nuclear medicine imaging

Roberto Pani
INFN- Department of Experimental Medicine Sapienza University of Rome

In the field of molecular imaging, based on radioisotope labelling , there is an increasing demand for the development of a new class of compact gamma cameras with improved features in terms of spatial resolution, energy resolution and detection efficiency. Furthermore, the modular assembly of detectors could be crucial in order to obtain a suitable Field of View (FoV) for application either in small animal or dedicated human imaging tasks.

Over the last years, there has been a growing interest in the development of a new class of fast scintillators such as $LaCl_3$:Ce and $LaBr_3$:Ce. Their superior energy resolution is opening an easier way to improve spatial resolution , acquisition rate and concidence resolution time. Energy resolution is one of the most important feature for spectra quality analysis; infact, semi-conductor detectors (e.g. Ge or CdZnTe) are used instead of detectors based on inorganic scintillator. In semiconductor gamma imagers the best energy resolution does not influence spatial resolution that is only related to crystal pixillation size. In this paper, we address the question whether spatial resolution of continuous inorganic imagers can dramatically improve if energy resolution becomes comparable with semiconductor ones. The question is arising from the recent development of lanthanum trihalides scintillators cerium-doped, like $LaCl_3$:Ce and $LaBr_3$:Ce.

In this paper we present a review of results obtained at INFN- Sapienza University from a number of $LaBr_3$:Ce small gamma camera prototypes. They are based on continuous crystals, ranging from $50\times50$ $mm^2$and 100 x 100 mm2 coupled to position sensitive PMT (Hamamatsu H8500 Flat panel PMT). This detector configuration permits the narrowest light distribution with the highest light output in order to obtain the best spatial and energy resolution values, respectively. We deal with one of the most diffused application of gamma imaging as the detection of $^{99m}$Tc in nuclear medicine (single photon emission at 140 keV).Measurements are also compared with the analogous ones obtained from other scintillation crystals like LaCl3:Ce , NaI(Tl) and CsI(Tl) with continuous or pixellated configuration. Finally the data are also compared with ones obtained from a CdTe detector with 50 micron pixel size. The evaluation of their overall performance in basic imaging tasks is presented, through measurements of their detection efficiency, intrinsic spatial resolution, noise, image SNR and contrast recovery.