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Fast technique based on transient optical absorption exploited to qualify LYSO:Ce crystals for CMS Barrel Timing Layer

The current upgrade of CMS Barrel Timing Layer puts forward a demand for a fast screening of materials to test the prospective scintillators, select the best crystal providers, and monitor the quality of the provided crystals in view of their timing properties. We report on a novel contactless method based on the transient optical absorption monitored in sub-picosecond domain in pump and probe configuration. The method is tested by comparing with the coincidence time resolution measurements, which are currently conventional but require sample mounting on silicon photodetectors and advanced readout electronics making the measurements time-consuming and difficult to compare. The method is based on the excitation of a scintillating material by a femtosecond laser pulse and probing the population of the emitting centers, Ce3+ ions in LYSO in our study, by a probe beam. The figure of merit to estimate the timing properties of LYSO:Ce is specified. The Pierson's coefficient of 0.95 for the correlation of the figure of merit with the CTR values in a set of high quality LYSO:Ce samples with the CTR values ranging from 80 to 100ps indicates the reliability of the method. The method has a great potential to become a routine procedure for scintillator characterization, as the time required to characterize a sample is less than 0.5 hour and repeatability is high.

Primary experiment

Compact Muon Solenoid (CMS)

Author: Dr NARGELAS, Saulius (Vilnius University (LT))

Co-authors: AUFFRAY HILLEMANNS, Etiennette (CERN); DAFINEI, Ioan (Sapienza Universita e INFN, Roma I (IT)); GUNDACKER, Stefan (Universita & INFN, Milano-Bicocca (IT)); KORJIK, Mikhail (Byelorussian State University (BY)); KRATOCHWIL, Nicolaus (CERN); LUCCHINI, Marco Toliman (Università & INFN, Milano-Bicocca (IT)); TAMULAITIS, Gintautas (Vilnius University (LT)); TALOCHKA, Yauheni (Byelorussian State University (BY)); PARAMATTI, Riccardo (Univ. Sapienza and INFN Roma); MECHINSKY, Vitaly (Byelorussian State University (BY)); VAITKEVIČIUS, Augustas (Vilnius University)

Presenter: Dr NARGELAS, Saulius (Vilnius University (LT))

Track Classification: Photon Detectors