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Scintillator materials of garnets for a fast timing in a harsh radiation environment of collider experiments

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In the last 40 years, use of scintillation inorganic materials based calorimeters has played a crucial role in the discovery of matter properties and contributed to a continuous progress in this technique. Physicists had built a variety of detectors: small detectors based on NaI(Tl), CsI(Na), BaF2, PbF2, and Bi4Ge3O12 and large detectors such as the electromagnetic calorimeter of CMS, consisting of 11 m3 of PbWO4 scintillator crystals. The announcement of the LHC upgrade and FCC projects, in order to significantly increase luminosity at the experimental facilities, has renewed interest to the radiation tolerant inorganic scintillating crystals allowing suppression of pile-up by fast timing techniques.
Ce doped high light yield oxide scintillation materials have been recognised to be radiation tolerant to different kinds of ionising radiation, including gammas, high energy protons and neutrons [1]. Scintillation band of garnet crystals peaks in 520-560 nm spectral range, what pretty good matches SiPM spectral sensitivity. Moreover, time resolution in the measurements using multi-doped garnets was found substantially better. This behaviour was demonstrated for the first time at small energy release using 511 keV gamma-rays from 22Na source [2], when coincidence time resolution with full width at half maximum 233 ps was measured. At high energy deposit, when high energy charged particles have been used to excite the crystal, the samples yielded a better single device time resolution of 30.5 ps sigma [3]. Technology of the crystals under consideration is well developed, for different purposes, the different kinds of garnets are produced by tons.
Here we compare performance of three garnet crystals doped with Ce and co-doped with different ions: Y3Al5O12, Y3Al1.25Ga3.75O12 and Gd3Al2Ga3O12. Co-doping allows to control dynamics of the free carriers in the crystals and, at the certain conditions, to shift luminescence build up process in a sub-picosecond domain. A change of the scintillation properties in the operational temperature range from +20 to -40oC is discussed. Potential of the garnet type materials in different construction of calorimetric cells is debated.

References

1. P.Lecoq, A.Gektin, M.Korzhik, Inorganic Scintillators for detecting Systems, Springer, 2017, P.408.
2. M. Lucchini et al., NIM A 816 (2016) 176-183.
3. M.T. Lucchini, S. Gundacker, P. Lecoq, A. Benaglia, M. Nikl, K. Kamada, A. Yoshikawa and E. Auffray, NIM A 852 (2017) 1-9.

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