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Multifunctional scintillation materials of the garnet structure for nonhomogeneous detecting cells of electromagnetic calorimeters to operate in a harsh irradiation environment

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Irradiation environment of experiments to be considered at novel colliders will be harsh enough to limit the long term maintenance of homogeneous detector calorimeters. This will occur due to accumulation of the damage caused by various effects, particularly due to hadron component of irradiation environment. Non-homogeneous calorimetric detecting cells, consisting of absorber and low-volume scintillation elements in a form of plates or fibers become very promising in this view. Here we just mention the two most popular designs: "spaghetti"and "shaslik"type detecting cells, combining heavy metal absorber and plastic scintillator. However, plastic scintillation materials are heavily damaged under irradiation, as follows from observations at LHC experiments and, preferably, should be replaced by more radiation hard materials. Among them, scintillation materials of the garnet structure have few preferences. They can be produced in a single crystalline or ceramic form; their atomic composition can be varied to meet requirements of the application. Gadolinium-aluminum gallium garnet Gd3Al2Ga3O12, (GAGG), activated by cerium ions, can be used to detect γ-quanta and to absorb neutrons in a wide energy range. The capture of neutrons is accompanied by the emission of relatively soft γ-quanta which can be virtually ignored. On the contrary, yttrium-aluminum gallium garnet Y3Al2Ga3O12, (YAGG), activated by cerium ions, is sensitive to γ-quanta only. Here we compare scintillation properties and radiation hardness as well, of GAGG and YAGG scintillators in the single crystalline and ceramic form. Both single- and polycrystalline forms are founded to be prospective for detecting cells construction. The results for perspective new materials will be contrasted to the ongoing investigation of PWO (PbWO4) as today's choice of detector material for modern detector systems such as PANDA, for which a long-term study with the EMC barrel crystals is being performed.

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Secondary topics

Applications

Design concepts for future calorimeter at the intensity frontier

Primary topic

Scintillators

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