Performance of scintillator tiles with different doping concentrations after irradiation

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Abstract

The performance of plastic scintillator degrades when exposed to radiation. We present results on degradation of the light output of scintillator tiles when irradiated by a ^{60}Co source for a variety of concentrations of the primary and secondary dopant. Tiles made from a blue scintillator with blue-to-green wavelength shifting fiber and for green scintillator with green-to-orange wavelength shifting fiber are presented.

Keywords: organic scintillator, radiation hardness, calorimetry

1. Introduction

Sampling calorimeters using plastic scintillator tiles with wavelength-shifting (WLS) fibers as the active element have been part of hadron collider experiments since the mid 1990's, when the CDF plug calorimeter was constructed[1]. Both the CMS Barrel[2] and Endcap[3] calorimeters use a similar design. Prolonged exposure of plastic scintillator to ionizing radiation, however, can result in damage: light self-absorption (yellowing) increases and the transfer efficiency of the initial excitation of the polymer to the dopants combined with the probability of radiative decays for the dopants ("initial light output") can lessen. During

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running of the LHC from its commissioning through 2012, the CMS detector was exposed to an integrated luminosity of 25 fb^{-1}. Parts of the CMS endcap calorimeter are estimated to have received doses of 0.1 to 0.2 Mrad[4]. Exposures prior to installation using an electron linac and ^{60}Co sources indicated radiation causes a expoential reduction in light light output with accumulated dose, with a expoential constant of around 7 Mrad [5]. However, although the dose received was small compared to this number, significant light loss was observed [6].

The effect of radiation on plastic scintillator is known to depend both on dose and dose rate.

[7],[8],[9],[10],[11],[12],[13]

Radiation

2. Conclusions

3. Acknowledgements

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