

Radiation resistance investigation of SCSN-81T, BC-408, UPS923A and UPS98RH plastic scintillators

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The novel plasticized polystyrene plastic scintillator (PS) UPS98RH (Amcrys-H, Ukraine) has been shown to exceed scintillators SCSN-81T (Kuraray, Japan), BC-408 (Bicron, USA), and UPS923A (Amcrys-H, Ukraine) in radiation resistance. A post-irradiation coloration in the bleach zone was observed after gamma-irradiation (dose rate 0.02 Mrad/h). In the irradiated plasticized PS, the absence of bleach zone and independence of radiation resistance of plasticized PS on dose rate have been found. It is shown that the results on PS radiation resistance communicated by many authors are unreasonably optimistic, since those were obtained at high dose rates and were not corrected for the dose rate effect.

Показано, что новый пластмассовый сцинтиллятор (ПС) на основе полистирола с пластификатором UPS98RH (Amcrys-H, Украина) по радиационной стойкости превосходит сцинтилляторы SCSN-81T (Kuraray, Япония), BC-408 (Bicron, США), UPS923A (Amcrys-H, Украина). Наблюдалось послерадиационное окрашивание в зоне просветления после гамма-облучения мощностью дозы 0,02 Мрад/час. Обнаружено отсутствие зоны просветления у облученного ПС с пластификатором и независимость радиационной стойкости ПС с пластификатором от мощности дозы. Показано, что полученные многими авторами результаты по радиационной стойкости ПС неоправданно оптимистичны, т.к. они получены при больших мощностях дозы и не скорректированы на эффект мощности дозы.

This investigation was carried out in connection with production of scintillation detecting plates (tiles) for Hadron Endcap (HE) calorimeter of CMS detector [1].

Individual tiles for HE calorimeter are manufactured of plastic scintillators SCSN-81T (Kuraray, Japan), BC-408 (Bicron, USA), and the plasticized scintillator UPS98RH (Amcrys-H, Ukraine). Some of them are situated near beam axis where particle intensity, and thus the radiation doses, are high. The total dose for those tiles is estimated to be of 10 Mrad during 10 years of service, thus, 1 Mrad/year or 0.0001 Mrad/h. This is a high radiation dose for plastic scintillators. Moreover, it is

known that radiation resistance reduces at dose rate reduction [3], and at tests carried out before exploitation, the PS radiation resistance is usually defined at dose rates (DR) that considerably exceed real ones. That is why to make a correct prognosis of CMS-detector service life, it is important to have as accurate and complete as possible information on radiation resistance of scintillators used in HE-calorimeter.

In this report, results of radiation resistance investigation depending on dose and dose rate are presented for scintillators SCSN-81T and UPS98RH. For comparison sake, the "standard" polystyrene scintillator UPS923A (Amcrys-H, Ukraine) that is not