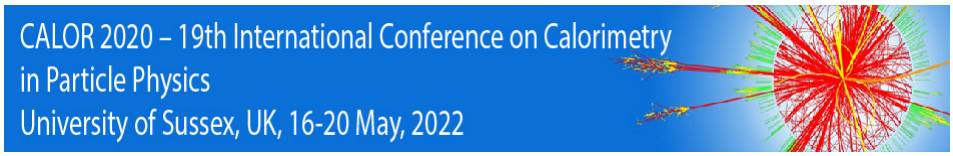


Contribution ID: **127** Type: **not specified**

# Radiation damage studies for phenyl-based plastic scintillators

Plastic scintillators are one of the most versatile and inexpensive particle detection options available which is why the largest particle physics experiments, CMS and ATLAS, are using them. A challenging aspect of scintillators is their relatively low radiation hardness which might be inadequate for the HL-LHC program. In this study, results on the effects of ionizing radiation on the signal produced by plastic scintillating rods manufactured by Eljen Technology company are presented for various matrix materials, dopant concentrations, fluors (EJ-200 and EJ-260), anti-oxidant concentrations, scintillator thickness, doses, and dose rates. The light output before and after irradiation is measured using an alpha source and a photomultiplier tube, and the light transmission by a spectrophotometer. Assuming an exponential decrease in the light output with dose, the change in light output is quantified using the exponential dose constant $D$. The $D$ values are similar for primary and secondary doping concentrations of 1 and 2 times, and for antioxidant concentrations of 0, 1, and 2 times, the default manufacturer's concentration. The $D$ value depends approximately linearly on the logarithm of the dose rate for dose rates between 2.2 Gy/hr and 70 Gy/hr for all materials. For EJ-200 polyvinyltoluene-based (PVT) scintillator, the dose constant is approximately linear in the logarithm of the dose rate up to 3400 Gy/hr, while for polystyrene-based (PS) scintillator or for both materials with EJ-260 fluors, it remains constant or decreases (depending on doping concentration) above about 100 Gy/hr. The results from rods of varying thickness and from the different fluors suggest damage to the initial light output is a larger effect than color center formation for scintillator thickness $\leq$1 cm. For the blue scintillator (EJ-200), the transmission measurements indicate damage to the fluors. We also find that while PVT is more resistant to radiation damage than PS at dose rates higher than about 100 Gy/hr for EJ-200 fluors, they show similar damage at lower dose rates and for EJ-260 fluors. Finally, the oxygen penetration depth is measured using the color change of the irradiated rods. The results show that the oxygen permeation coefficient is different for PS and PVT, and for irradiations at $-30^\circ$ C and room temperature.

**Authors:** PAPAGEORGAKIS, Christos (University of Maryland (US)); BELLONI, Alberto (University of Maryland (US)); EDBERG, Timothy (University of Maryland (US)); ENO, Sarah (University of Maryland (US))

**Presenter:** PAPAGEORGAKIS, Christos (University of Maryland (US))