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Study of Radiation Hardness of Plastic Scintillators for the Upgrade of the Tile Calorimeter of the ATLAS detector

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The influence of radiation on the light transmittance of plastic scintillators was studied experimentally. The high optical transmittance property of plastic scintillators makes them essential in the effective functioning of the tile calorimeter of the ATLAS detector at CERN. This significant role played by the scintillators makes this research imperative in the movement towards the upgrade of the tile calorimeter. The radiation damage of three polyvinyl toluene (PVT) based plastic scintillators was studied, namely, EJ-200, EJ-208 and EJ-260, all manufactured and provided to us by ELJEN technology. In addition, polystyrene (PS) based scintillators were also scrutinised in this study, namely, Dubna, Protvino and Bicron. All the samples were irradiated using a 6MeV proton beam at doses of 80MG, 25MG, 8MG and 0.8MG. The radiation process was planned and mimicked by doing simulations using a SRIM program. In addition, transmission spectra for the irradiated and unirradiated samples of each grade were obtained and observed. From observation and data analysis it was found that the PS based plastic scintillators experienced more radiation damage in comparison to the PVT based scintillators. Furthermore, among the PVT based scintillators, the experimental data showed that EJ 208 was the least affected by the radiation as it displayed the least transmission loss as well as showed the commendable annealing abilities over a short period of time. In addition, it was found that EJ 200 showed the second least transmission loss and the fastest annealing abilities over a short period of time. On the other hand, EJ 260 experienced the most amount of radiation damage.

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