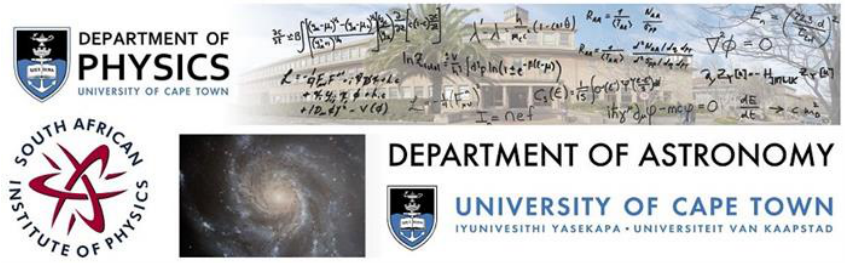

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Proton induced radiation damage to the fluorescence capability of plastic scintillators for the Tile Calorimeter of ATLAS

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Abstract content
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Plastic scintillators are organic materials which exhibit the effect of luminescence upon interaction with ionising particles. Their properties of high optical transmission, fast rise and decay times, low cost and ease of manufacture make them particularly useful for high energy physics detection systems. As such, the Tile Calorimeter of ATLAS employs tiles of plastic scintillators to detect hadronic jets and showers of quarks and gluons that result from the proton-proton collisions generated by the LHC.

The fluorescent light emitted by the plastic tiles is read out using wavelength shifting optical fibers coupled to photomultiplier tubes. As the plastics are exposed to harsh radiation environments, their subsequent radiation induced damage results in a degradation of the fluorescence light yield.

Presently, the LHC is undertaking several upgrades in order to broaden the scope of physics that can be studied. These upgrades will result in a much harsher radiation environment. In order to ensure that the ATLAS detector performance can be sustained for several years to come, scintillators from the GAP region of the TileCal will be replaced with more radiation tolerant plastics in 2018.

A series of investigations are currently being conducted into the radiation hardness of several PVT and PS based plastic scintillators which are candidates for the upgrade. In this study, we investigate the damage induced by 6 MeV protons to the light transmission and fluorescence capability of 350 μm thick scintillators. Presented here are the results of the damage for proton doses ranging between 800 kGy to 80 MGy conducted using the 6 MV tandem accelerator of iThemba LABS. A breakdown in the light transfer mechanism between base and fluor components, as well as damage to the primary scintillation mechanism is observed for increasing doses. The commercial plastics EJ208 or UPS923A are suggested for the upgrade.

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Bruce Mellado
Bruce.Mellado@wits.ac.za
University of the Witwatersrand

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Primary author: Ms JIVAN, Harshna (University of the Witwatersrand)

Co-authors: Prof. MELLADO, Bruce (University of the Witwatersrand); Prof. SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); MADHUKU, Morgan (iThemba LABS); Dr ERASMUS, Rudolph (University of the Witwatersrand); Ms LIAO, Shell-may (University of the Witwatersrand)

Presenter: Ms JIVAN, Harshna (University of the Witwatersrand)

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