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A compact neutron spectrometer for neutrons produced by cosmic rays

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Cosmic rays are comprised largely of high energy protons and alpha particles which create large amounts of secondary particles through spallation when they interact with our atmosphere. At aviation altitudes the radiation field is made up predominantly of neutrons in the energy range 1 - 100 MeV [1]. During space weather events, such as solar flares, the number of energetic particles entering the atmosphere can increase drastically resulting in higher radiation doses to aircrew, and an increased risk of electronics malfunction on board aircraft [2]. As these events are unpredictable and short-lived, very little observational data exist.

The development and characterisation of a compact detector to measure cosmic ray induced neutrons with energies up to 100 MeV on board aircraft is presented. Building upon previous research at UCT [3,4,5], the prototype detector comprised of a 6 mm x 6 mm x 50 mm slab of EJ-276 plastic scintillator, a SensL C-series silicon photomultiplier, and digital data acquisition. Results from the first measurement campaign at n-lab (UCT) utilising mixed gamma ray and neutron fields with energies up to 4.4 MeV and 14.1 MeV respectively are presented. Overall, the detector system performed well and showed promise of being suitable for the measurement of neutrons with energies up to 100 MeV. Further development of the device is ongoing in collaboration with SANSA and iThemba LABS, and a design which optimises neutron detection and light collection has been identified using Geant4 simulations. Future work aims characterise the response of the detector up to 100 MeV and perform measurements in an in-flight scenario.

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