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Scanning facility to irradiate mechanical structures for the LHC upgrade programme

The existing luminosity of the LHC will be increased in stages to a factor of 10 above its current level (HL-LHC) by 2022. This planned increase in luminosity results in significantly higher levels of radiation inside the planned ATLAS Upgrade detector. This means existing detector technologies together with new components and materials need to be re-examined to evaluate their performance and durability within this enhanced radiation field. Of particular interest is the effect of radiation on the upgraded ATLAS tracker. To study these effects a new ATLAS irradiation scanning facility uses the Medical Physics Cyclotron at the University of Birmingham. The intense cyclotron beams allow irradiated samples to receive in minutes fluences corresponding to years of operation at the HL-LHC.
Since commissioning in early 2013 this facility has been used to irradiate silicon sensors, optical components and carbon fibre sandwiches for the ATLAS upgrade programme. Irradiations of silicon sensors and passive materials can be carried out in a temperature controlled cold box which moves continuously through the homogenous beamspot. This movement is provided by a pre-configured XY-axis cartesian robot system (scanning system). This paper reviews the design, development, commissioning, performance results and future plans of the irradiation facility, fully operational since 2013.

Summary

In 2022 the luminosity of the LHC will be increased in stages to a factor of 10 above its current level. This planned increase in luminosity results in significantly higher levels of radiation inside the planned ATLAS Upgrade detector with detrimental effects to existing detector technologies. To study these effects a new bespoke ATLAS high intensity proton irradiation scanning facility has been constructed using a Cyclotron at the University of Birmingham, enabling the evaluation of future detector technologies in several minutes as opposed to years of operation. This paper reviews the design, development, commissioning, performance results and future plans of the irradiation facility, fully operational since 2013.

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