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Upstream Dosimetry using a Monolithic Active Pixel Sensor (MAPS)

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Intensity Modulated Radiotherapy (IMRT) is a treatment for cancerous tumours. These treatments are complex, with the radiation shaped using dynamic Multileaf Collimators (MLC). This increases dose to the tumour, whilst sparing healthy issue and sensitive organs. Due to the complex nature of these treatments safety is critical. Currently monitoring is from the linac itself and verification is carried out prior to the treatment. New independent dosimeters are emerging, including upstream detectors. In the upstream detector under investigation the aim is to do both real-time monitoring and verification simultaneously. The problems caused by placing a detector upstream are: attenuation from the device and generation of secondary radiation. To overcome these issues the detector must be thin and radiation hard. These criterion match that of sensors for the vertex detector of the International Linear Collider, where one of the technologies is Monolithic Active Pixel Sensors (MAPS). In this project the Achilles MAPS was used. Its suitability for upstream monitoring and verification was tested using a variety of IMRT beams. Using image reconstruction techniques an unprecedented MLC position precision of $52\pm4\mu$m was achieved using a single image. This allows the beam shape to be monitored precisely and forms the building block of a real-time monitoring device. The treatment verification was tested using the Matixx dosimeter as a reference. Comparing the dose distributions using the Gamma metric showed a 97% pass rate for 3% and 3mm, which is good enough for verification. These results will be presented, along with future prospects.

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