Orion: Target diagnostic

Radiochromic Film (RCF)

The Orion laser facility at AWE Aldermaston, one of the largest scientific capital investments in the UK, houses a large neodymium glass laser system and a target chamber in which the high energy density physics experiments are performed. This is necessary to support certification of performance and safety of the UK deterrent.

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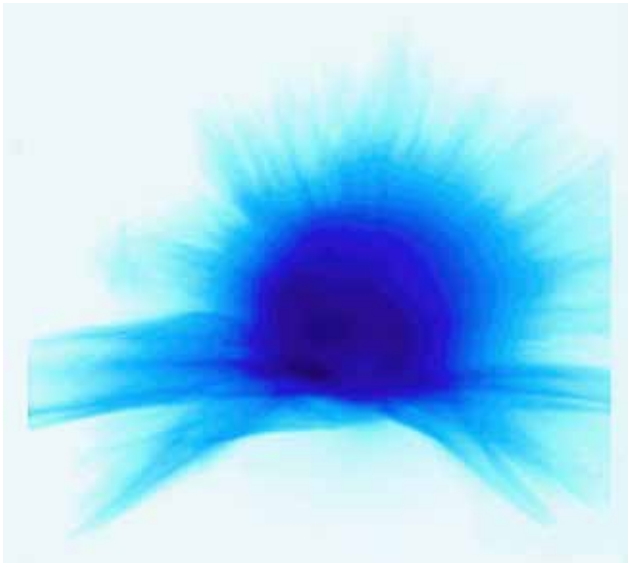
Radiochromic film (RCF) is deployed in an Orion TIM and is used to diagnose the protons and ions produced in ultra-high intensity laser-plasma interactions.

Radiochromic film is a light blue, clear, translucent plastic film that darkens on exposure to ionising radiation. It is only weakly sensitive to visible light. The major uses are medical applications such as measuring dose in radiotherapy – medical literature reports the colour change is largely independent of proton energy and has a near linear dependency to fluence.

RCF is typically deployed in `stacks' in combination with filters such as aluminium foil and can also be used in conjunction with CR-39 to diagnose the protons and ions produced in laser-plasma interactions. It is also used for radiographs and transient electromagnetic field detection. It has high spatial resolution (~1 μm) and can offer limited temporal resolution as higher energy protons will probe earlier times.



Raw Exposed Radiochromic film

Specification

TIM based

Detector material:	Radiochromic film
Dimensions of detector:	50 x 50 mm or 100 x 100 mm
Proton/ion energy range:	>0.5 MeV

A stack typically consists of an initial layer of aluminium to block out visible radiation and the majority of X-rays. Multiple layers of RCF are then used - the higher the proton energy, the greater its range in the stack. Hence, the whole energy spectrum can be unfolded into energy bins. Often a stack will have 'spacers' with a higher stopping power such as copper (also used for activation measurements) or CR-39 to reduce the number of layers of RCF required to observe the highest energy protons. By attributing a specific layer a given energy, the fluence can be calculated from the measured dose.

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