

# Gabor lens for use within a Laser-hybrid Accelerator for Radiobiological Applications (LhARA)

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Most radiotherapy treatments are currently undertaken using X-rays, although the use of particle/ion beams are becoming more commonplace as they can more precisely target tumours. However, even though particle beams typically operate at low dose rates (<10 Gy/min) with tailored beam characteristics, damage to healthy tissue limits the deliverable dose and hence the clinical efficacy. Recently, the identification of the so-called ‘FLASH’ (> 40 Gy/s) radiotherapy regime presents an exciting development to overcome these limitations, although further understanding of the radiobiological effects is required.

Thus, the ‘Laser-hybrid Accelerator for Radiobiological Applications’, LhARA [1], facility is conceived to study the biological response to ionising radiation. A high repetition (10 Hz), high power laser, directed at a thin target, generates a continuous stream of high intensity, ultra-short, particle bunches, at up to ~20 MeV/u via the Target Normal Sheath Acceleration, TNSA, mechanism. These particles (with the option for subsequent acceleration to 127 MeV/u) are guided to one of several end-stations, whereby the biological effects can be studied via *in-vitro* or *in-vivo* experiments using newly developed detectors, existing phantoms, and test samples.

As the multiple ion species produced via the TNSA mechanism are highly divergent, they require capturing and tailoring for use. Here we report upon the current efforts to use non-traditional, non-neutral electron plasmas as the electrostatic lens elements within the beamline.

1. Aymar G. *et al.* LhARA: The Laser-hybrid Accelerator for Radiobiological Applications. *Front. Phys.* **8** (2020) 567738