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

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Most radiotherapy treatments are currently undertaken using photons, although the use of particle and ion beams are becoming common 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' radiotherapy (> 40 Gy/min) 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 laser, directed at a thin target, generates a continuous stream of high intensity, ultra-short, particle bunches, at up to 15 MeV/u (and subsequent acceleration up to 127 MeV/u, as required) to be guided to one of several end-stations, whereby the effects can be studied via *in-vitro* or *in-vivo* experiments using newly developed detectors, existing phantoms, and test samples.

In order to capture and tailor a particle-beam generated by the laser source, lenses are required, and here were report upon the computational and experimental effort to use non-neutral electron plasmas for this purpose.

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