Abstract submitted to
59^{th} Annual Conference of the Particle Therapy Co-operative Group
Online Meeting, 4-7 June 2021

Laser-hybrid Accelerator for Radiobiological Applications (LhARA)

The LhARA collaboration

The 'Laser-hybrid Accelerator for Radiobiological Applications', LhARA, is conceived as a novel, uniquely flexible facility dedicated to the study of the biological response to ionising radiation. With the potential to deliver multiple ion species in beams with a wide range of temporal and spatial profiles, and at ultra-high dose rates, LhARA will enable the exploration of a completely new regime of particle-beam therapy. The high flux, short bunch duration, and high repetition rate are well-suited to study the radiobiological mechanisms by which the therapeutic benefit is generated. The new approach is based on a high-power laser which creates a large flux of protons or light ions from a foil target. The particles are captured and focused using electron plasma lenses, thus evading the current limits on the maximum instantaneous dose rate.

LhARA will be developed in two stages. In the first stage, a programme of *in vitro* experiments will be served with proton beams with energies between 10 MeV and 15 MeV. In stage two, rapid acceleration will be performed using a fixed-field alternating-gradient (FFA) accelerator. A high-energy *in vitro* end station and an *in vivio* end station will be served by proton beams with energy up to 127 MeV. In addition, ion beams, with energies up to 30 MeV per nucleon for carbon, will be available for *in vitro* and *in vivo* experiments. This paper presents the conceptual design for LhARA and the RD programme that is required to demonstrate the feasibility of critical LhARA components.