

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 radiobiology. The technologies that will be demonstrated in LhARA have the potential to allow particle-beam therapy to be delivered in a completely new regime, combining a variety of ion species in a single treatment fraction and exploiting ultra-high dose rates. LhARA will be a hybrid accelerator system in which laser interactions drive the creation of a large flux of protons or light ions that are captured using a plasma (Gabor) lens and formed into a beam. The laser-hybrid approach will allow radiobiological studies using a variety of ion species in completely new regimes.

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, the beam will be accelerated using a fixed-field accelerator (FFA). This will allow experiments to be carried out in vitro, and particularly in vivo (e.g. using tumour-specific xenograft mouse models), with proton beam energies of up to 125 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 R&D programme by which the LhARA consortium seeks to establish the facility.