LhARA: A Radiobiological Cancer Therapy

LhARA is a Laser hybrid Accelerator for Radiobiological Applications in which laser interactions drive the creation of a large flux of protons or light ions.

The flux of protons or light ions is generated at energy levels above those produced in conventional cyclotron facilities. This avoids the current space-charge limit on the instantaneous dose rate that can be delivered, opening new possibilities for improved cancer treatment and care. The flux of ions is focused into a beam to deliver Particle Beam Therapy and preclinically probe radio-biological interactions.

Problem Addressed:

Traditional X-ray therapy uses high-energy photons to treat tumours but can damage healthy tissue. New techniques are envisaged where proton beams (rather than photon beams) are directed at a tumour. This deposits energy more precisely within tumours, sparing healthy tissue. However, existing proton machines are large and expensive.

How LhARA Addresses It:

Proton beam machines are mainly cyclotron-based, often large and expensive to use and operate, so there exists a need to develop smaller, cheaper and more flexible machines. LhARA aims to develop smaller, more flexible proton machines for producing a range of particles at different energies using high-power lasers. These machines can deliver short, intense pulses and micro-beams, enhancing cancer cell killing while minimising harm to healthy tissue. LhARA aims to open PBT to the many and enable the investigation of radio-biological interactions to improve treatments and explore laser-hybrid accelerators.

LhARA will integrate cutting-edge technologies including:

- **Laser-driven proton & ion source**: This component generates short, intense pulses for “FLASH” radiation and tightly focused mini-beams. Unlike traditional methods, LhARA achieves this without collimation.
- **Electron Plasma (Gabor) Lens:** Laser-driven ion sources create highly divergent beams, with a large energy spread that can vary up to 25% pulse by pulse. A Gabor lens is a cost-effective alternative to conventional solenoids and provides strong focusing capabilities.
- **Post Acceleration using Fixed-Field Alternating (FFA) Gradient Accelerator:** Rapid acceleration will be performed using a Fixed-field alternating-gradient accelerator which allows flexibility in adjusting the time, energy, and spatial structure of the ion beam. Collaboration with major UK institute groups in ion-source lasers and accelerators ensures robust development.
- Intelligent automation for patient positioning.
- Novel instrumentation & diagnostics including Ion-acoustic imaging.

Benefits

- **Higher Beam Energy:** LhARA will provide proton and ion beams at much higher energies than traditional methods, allowing for new applications.
- **Breaching the Dose Rate Limit:** LhARA surpasses the current limit on how much radiation can be delivered at once, potentially improving treatment times.
- **Enhanced Precision:** LhARA offers a more precise way to deliver particle beam therapy (PBT) compared to conventional methods like X-rays.
- **Cost-Effective Technology:** The machinery needed for LhARA is expected to be smaller, cheaper, and more adaptable than existing facilities.
- **Advanced Radiobiological Research:** LhARA will enable a deeper understanding of the radiobiological interactions that occur during PBT.

A paper describing the technology can be found here: https://doi.org/10.3389/fphy.2020.567738

A website provides further information about the initiative:

LhARA is developing new laser technologies for medical applications – LhARA

This technology is open to Research funding bids for Joint Research with potential partners.

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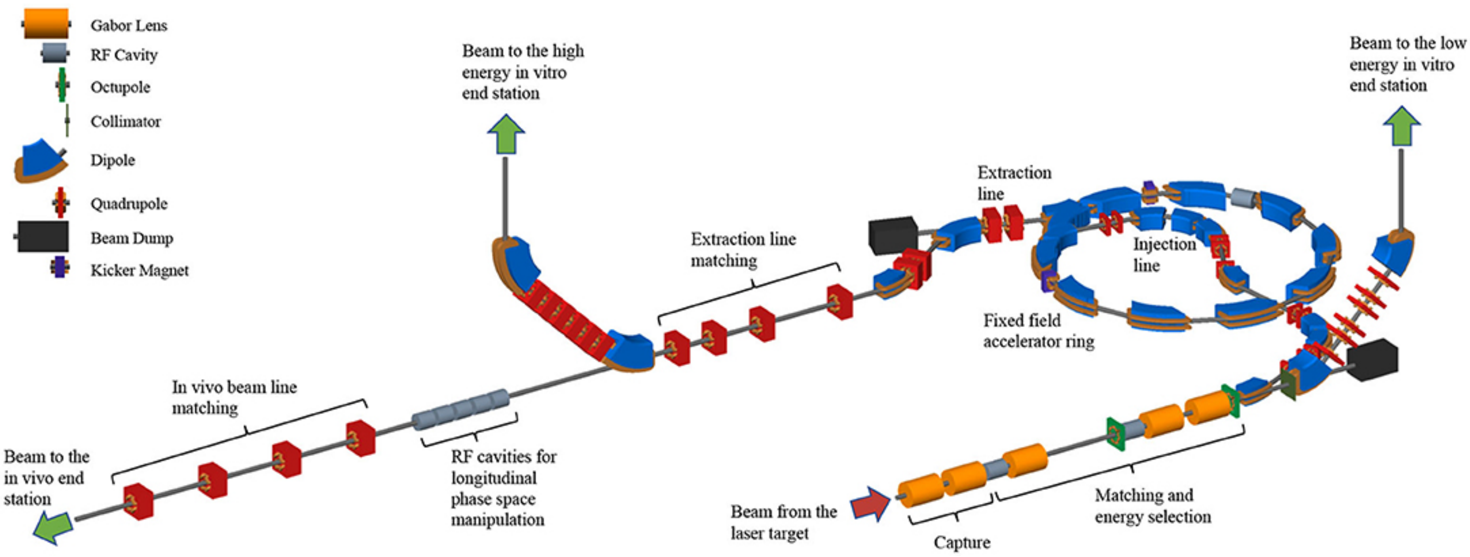
Technology Reference: **11979**

IMPERIAL

Technology overview:



Intellectual property information

The core technology comprises published scientific data, copyright protection, and proprietary know-how (trade secrets).

Internal IP Case: 11979

Published paper(s):

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