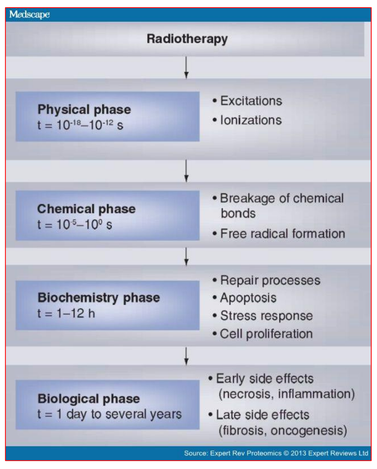
P152

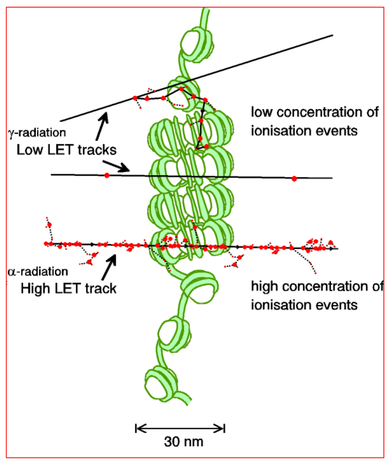
School of Physical & Chemical Sciences

The Laser-hybrid Accelerator for Radiobiological Applications (LhARA)

Peter R Hobson on behalf of the LhARA Collaboration

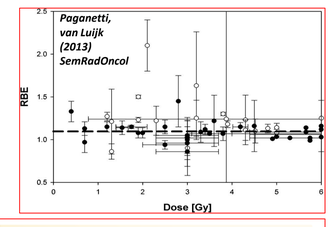
MOTIVATION

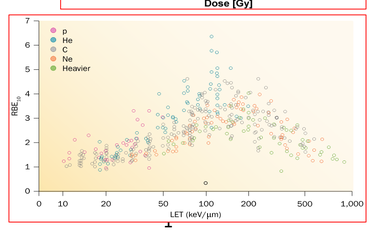


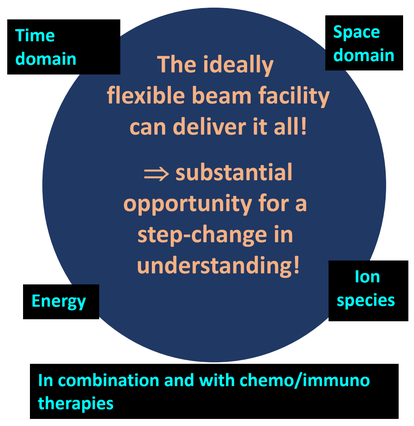


The case for fundamental radiobiology

- Relative biological effectiveness (RBE):
  - Known to depend on:
    - Energy, ion species
    - Dose & dose rate
    - Tissue type
    - Biological endpoint
- Yet:
  - *p*-treatment planning uses 1.1
  - Effective values are used for C^{6+}
- Develop a systematic programme of radiobiological measurements







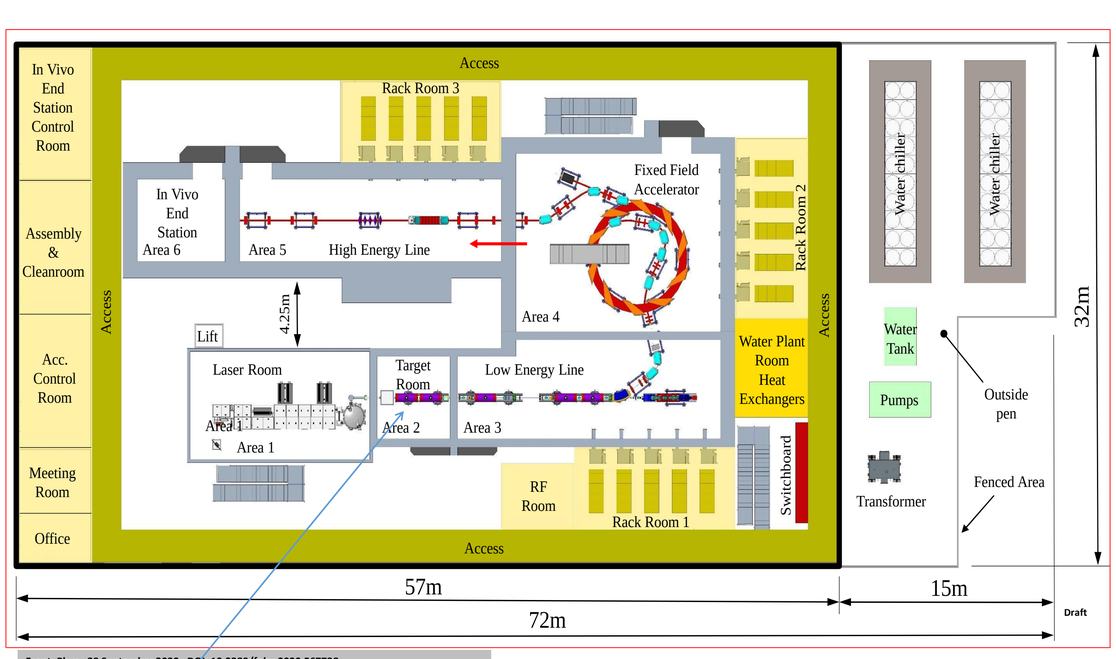
CONCEPT

LhARA performance summary arXiv:2006.00493

	12 MeV Protons	15 MeV Protons	127 MeV Protons	33.4 MeV/u Carbon
Dose per pulse	7.1 Gy	12.8 Gy	15.6 Gy	73.0 Gy
Instantaneous dose rate	1.0×10^9 Gy/s	1.8×10^9 Gy/s	3.8×10^8 Gy/s	9.7×10^8 Gy/s
Average dose rate	71 Gy/s	128 Gy/s	156 Gy/s	730 Gy/s

A novel hybrid, approach:

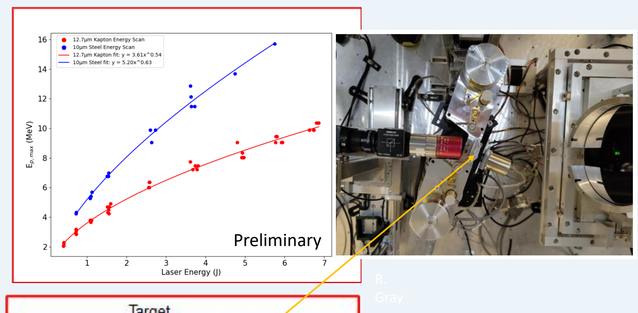
- **Laser-driven, high-flux proton/ion source**
  - –Overcome instantaneous dose-rate limitation (FLASH regime)
  - –Delivers protons or ions in very short pulses (10 to 40 ns duration)
  - –Triggerable; arbitrary pulse structure
- **Novel "electron-plasma-lens" capture & focusing**
  - –Strong focusing (short focal length) without the use of high-field solenoid
- **Fast, flexible, variable energy fixed-field post acceleration**

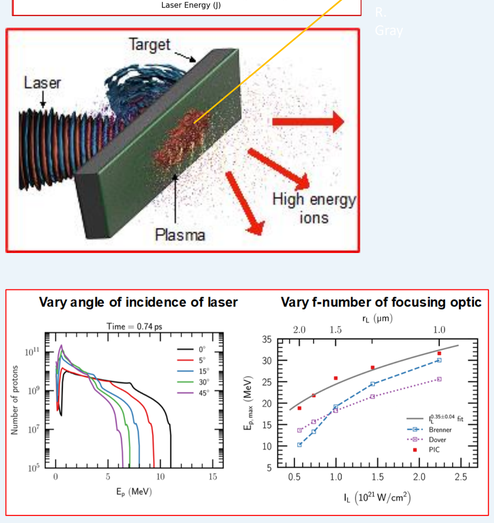


Front. Phys., 29 September 2020; DOI: 10.3389/fphy.2020.567738

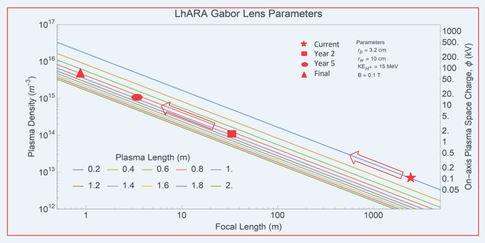
CURRENT STATUS

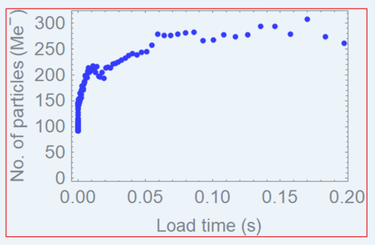
Laser source





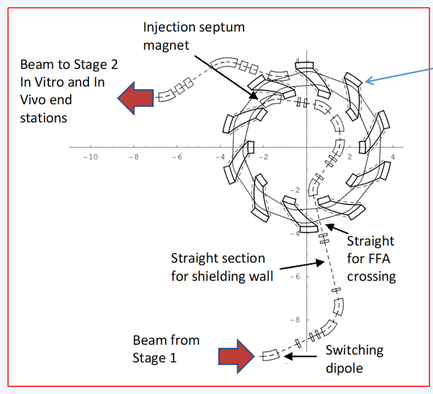
Gabor Lens

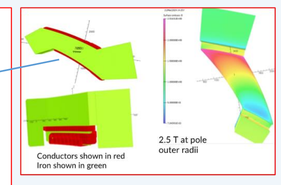


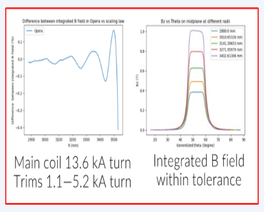


"Gabor" lens: an electron-plasma lens using a Penning-Malmberg Trap

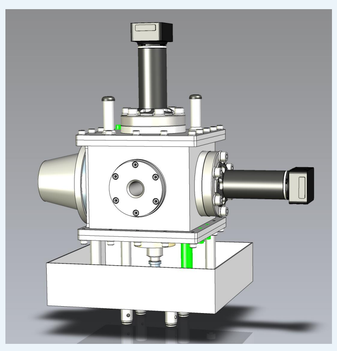
Accelerator







Smart Phantom



See Flash Talk F1 and poster in session A1 for more information.

Partners: Imperial College London; ICR The Institute of Cancer Research; Medical Research Council Oxford Institute for Radiation Oncology; University of Oxford; John Adams Institute for Accelerator Science; CCAP; Imperial College Academic Health Science Centre; Cancer Research UK Imperial Centre; Imperial College Healthcare NHS Trust; LhARA; The University of Manchester; University of Birmingham; University of Liverpool; University Hospitals Birmingham NHS Foundation Trust; The Clatterbridge Cancer Centre NHS Foundation Trust; The Christie NHS Foundation Trust; institut Curie; Queen's University Belfast; Swansea University Prifysgol Abertawe; UCL Medical Physics & Biomedical Engineering; Netherlands Cancer Institute; Hampton University Proton Therapy Institute; University of Strathclyde Glasgow Department of Physics; Royal Holloway University of London; Lancaster University; Queen Mary University of London; University Clinical Partners Accelerator Industry Laboratory; Science and Technology Facilities Council; ASTeC Daresbury Laboratory Particle Physics Department ISIS Neutron and Muon Source; Central Laser Facility; University of Birmingham Cyclotron Facility; Positron Imaging Centre; Coreraïn 鋰云科技; INFN Catania; The Cockcroft Institute of Accelerator Science and Technology; CERN; LEO Cancer Care; Maxeler Technologies; The Rosalind Franklin Institute; NPL National Physical Laboratory

Queen Mary University of London

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