Introduction

Since last time (27Sep21)

Update since last SG meeting

- **Proposal preparation has been the main activity**
- **Prioritisation of proposal has impacted preparation of:**
  - **White Paper & LhARA design revision paper**

Need to bring these forward in the near future

Early technology development and equipment for STFC grant holders

Creation of the capability to develop an ion-acoustic dose profile measurement system for ion-beam therapy as part of the LhARA initiative

Project overview

In the UK it is anticipated that 1 in 2 people will develop cancer. The present incidence of 17 million new cases per year globally is predicted to increase to 27.5 million new cases per year by 2040. Radiotherapy (RT) is recommended for ~50% of cancer patients and contributes to ~40% of curative treatments [1].

High energy X-rays are used most frequently in the delivery of radiotherapy. There is increasing emphasis on the exploitation of proton and ion beams in particle-beam therapy (PBT) for which the bulk of the beam energy is deposited in the Bragg peak with little energy deposited beyond. This allows dose to be conformed to the tumour while sparing healthy tissue and organs at risk to a greater extent than can be achieved with photons. The benefits of PBT are widely recognised. The NHS has invested £250M in PBT and the Particle Therapy Co-Operative Group (PTCOG) currently lists 90 proton therapy facilities and 12 carbon-ion-therapy facilities. These facilities are located predominantly in high-income countries. Nearly 70% of cancer patients in low-and-middle-income countries globally do not have access to RT. The laser-driven technology we propose has the potential to reduce the footprint, cost and complexity of PBT facilities. The unmet need and scale of market across high-, medium, and low-income countries drive our ambition to address the challenge of creating a compact, system capable of widespread deployment.

The international, and multi-disciplinary, Laser-hybrid Accelerator for Radiobiological Applications (LhARA) collaboration has been formed with the mission to transform the clinical practice of PBT by creating a fully automated, highly flexible system that harnesses the unique properties of laser-driven ion beams to [2]:

- Deliver particle-beam therapy in completely new regimens by delivering a variety of ion species from proton to carbon, exploiting ultra-high dose rates and novel spectral (energy/particle), spatial (microbeam) and temporal (FLASH) fractionation schemes; and
- Make “best in class” treatments available to the many by reducing the cost of PBT per patient. The system we propose integrates patient, soft-tissue, and dose-deposition imaging with real-time treatment planning in an automatic system that triggers the delivery of dose tailored in real time to the individual patient. Our system will reduce the cost per patient by removing the requirement for a large gantry, thereby reducing the size (and therefore the cost) of a clinical PBT facility and increasing patient throughput by reducing the time spent in treatment.

The multi-disciplinary collaboration includes the clinical oncologists, medical, particle, plasma, laser, ultrasound, and optical physicists, accelerator, computer, and instrumentation scientists, radiobiologists, industrialists, and patient representatives required to realise its ambition.

The LhARA system underpins the vision that motivated the proposal for an Ion Therapy Research Facility (ITRF) submitted by the STFC with the support of the MRC to the UKRI’s Infrastructure Advisory Committee. The research objectives of the ITRF are to:

- Create a fully automated, highly-flexible infrastructure to serve fundamental research into the biological and biochemical impact of proton and ion beams; and
- Demonstrate in a research facility the capability to deliver particle-beam therapy in the transformative new regimens outlined above.

To realise the vision that underpins the LhARA initiative and the development of the ITRF requires real time measurement the dose and its spatial distribution. We therefore **propose to purchase a “Vantage 256 – Research Ultrasound Platform” to establish the laboratory capability to develop the real-time dose-profile measurement system that is essential to the success of both the LhARA initiative and the ITRF**.

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Futures
PROPOSAL

Document Status: In Submitter Pool
STFC Reference:

STFC Horizons (Open) Call

Organisation where the Grant would be held (mandatory)

Organisation	Imperial College London	Research Organisation Reference:	PA1821
Division or Department	Physics		

Project Title (mandatory) [up to 150 chars]

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Start Date and Duration (mandatory)

a. Proposed start date	01 January 2022	b. Duration of the grant (months)	3

Request:

£112.72k for Vantage 256 - Research Ultrasound Platform