Preliminary details and descriptions

Name of project (and acronym or short name if relevant)	Ion Therapy Research Facility (ITRF)
Type of infrastructure project	**Establishment of new capability**
Submitting Council(s)/UKRI team(s)	☐ **AHRC** ☐ **BBSRC** ☐ **EPSRC** ☐ **ESRC** ☐ **Innovate UK** ☐ **MRC** ☐ **NERC** ☐ **Research England** ☒ **STFC** ☐ **E-infrastructure Team** ☐ **Large multidisciplinary facilities (STFC managed)**
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One-line description of the preliminary activity for use in summary tables to IAC, ExCo etc. [22 words]

To develop the specification and costs for ITRF, a facility which will elucidate the **biological impact of proton/ion beams** for **clinical practice**.

Long description of the preliminary activity [800 words, **please continue to the next box when full** – for IAC]

Background:

Conventional X-ray therapy is effective in eliminating the tumour in 40-50% of all patients treated with the intent to cure. Newer Ion Beam Therapy (IBT) instead uses highly-accelerated atomic particles such as protons and carbon ions to kill tumour cells. The physics of IBT permits higher-energy ions to be distributed precisely over the tumour with greater biological effectiveness than X-rays and with minimal normal-tissue interactions. The patient will benefit from reduced toxicity and therapy which can be delivered in a much shorter period of time. Our wide community engagement assures us that **future cancer treatment** to 2050 and beyond **will require advanced radiotherapy**—delivered in such a way as to overcome the ability of tumour cells to repair themselves, whilst also being highly protective of healthy tissues (reduce side effects), stimulating a systematic immune response - an **"in-situ cancer vaccine"**.

Globally there is no facility that can explore these domains adequately, both to understand the fundamental processes and to optimise radiation delivery in time, space, ion species, and energy spectrum, alone and in combination with new drugs. The UK has the capability to deliver such a facility and to become a hub for the global fight against cancer.

Objectives:

The Ion Therapy Research Facility (ITRF) will be a **unique**, **compact, single-site national research infrastructure** delivering the world's first high-dose-rate ions from **protons through oxygen and beyond**, at energies sufficient for both **in-vitro** and **in-vivo** studies. Bespoke end stations will allow great flexibility in the spatial, temporal, and spectral characteristics of the ion beams, tailored to enable the study of biology relevant for future treatment regimens such as FLASH (high dose rate) and spatially-fractionated radiotherapy. Fundamentally new biological mechanisms in radiation treatment and immune response that **underpin the clinical efficacy of future proton- and ion-beam therapy** will be elucidated. Exploitation of the ITRF will promote the disruptive accelerator, diagnostic, imaging, and computing technologies required to radically transform clinical practice.

The **ITRF will place the UK** at the **forefront of the science and technology of particle therapy internationally**, **establish UK industry as a key player** in the delivery of novel clinical equipment/prototypes, and enable significantly enhanced **access to state-of-the-art IBT across the UK**. The ITRF will enhance the UK as the destination of choice for cutting-edge research.