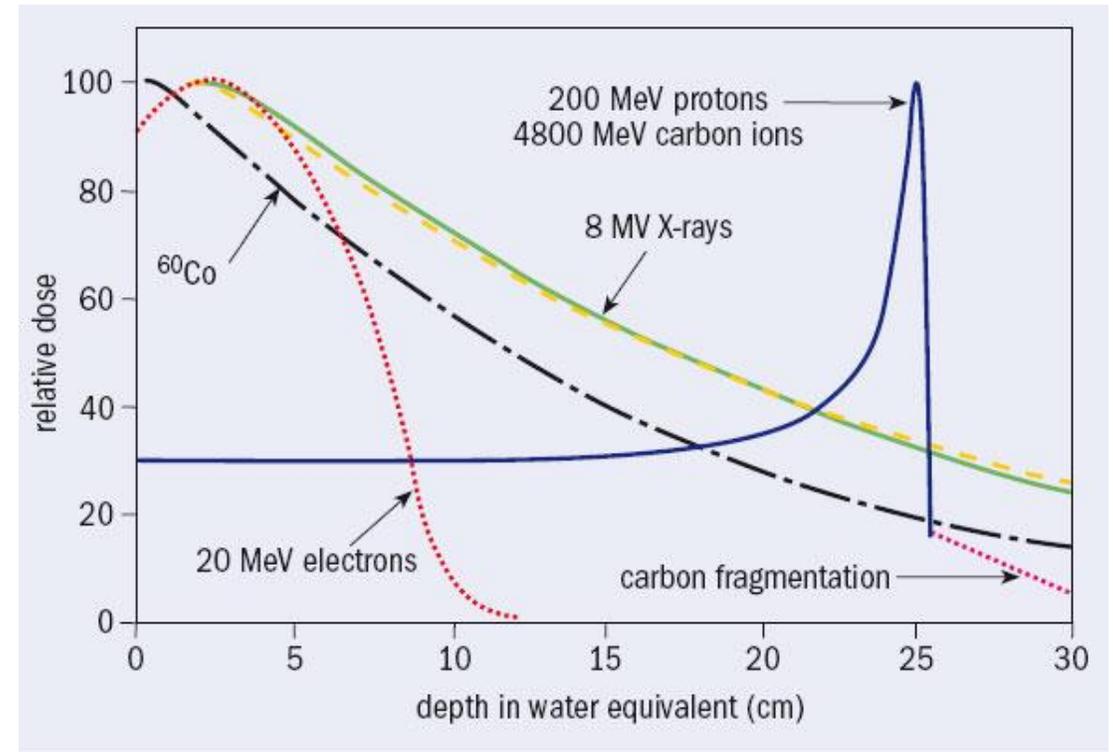
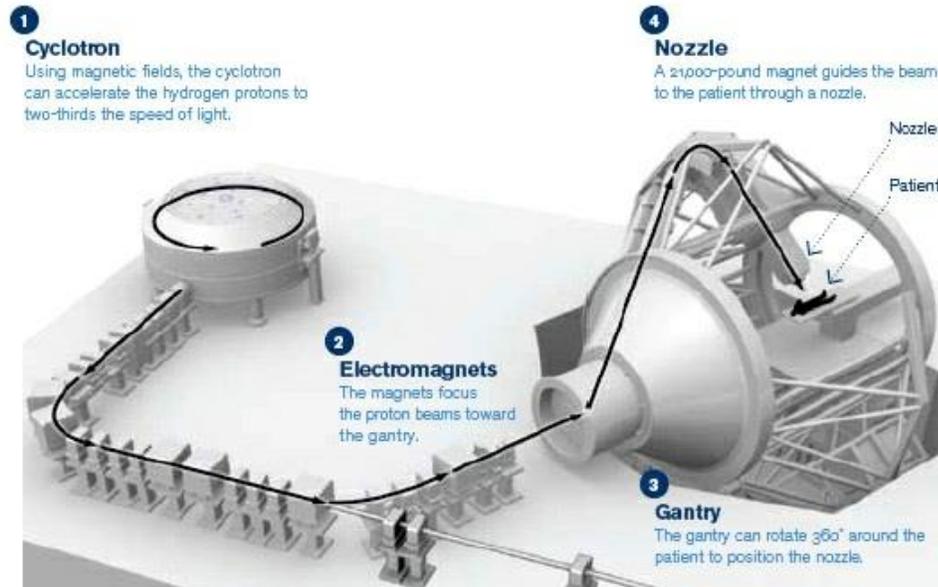


# The ITRF Project

Hywel Owen (on behalf of the ITRF team)  
STFC Daresbury Laboratory  
Accelerator Science and Technology Centre

14<sup>th</sup> December 2022  
Novel End-Station Development: Consultation 1

# Why protons? Why ions?



UK position and clinical justification:

<https://www.birpublications.org/doi/10.1259/bjr.20200247>

$$-\frac{dE}{dx} = \frac{4\pi}{m_e c^2} \cdot \frac{nz^2}{\beta^2} \cdot \left(\frac{e^2}{4\pi\epsilon_0}\right)^2 \cdot \left[ \ln\left(\frac{2m_e c^2 \beta^2}{I \cdot (1 - \beta^2)}\right) - \beta^2 \right]$$

# ITRF: Ion Therapy Research Facility

## Beyond protons, for cancer treatment

### WHY

- one in two people will develop cancer in their lifetime in the UK
- conventional radiotherapy used in around 50% patients
- ion therapy may offer benefits for certain patients, but the basic radiobiology needs exploring

### WHAT

- a world-first infrastructure for proton/ion beams towards cancer treatment
- a flagship project for the region, building on the UK's research community strengths and the science and innovation heritage of the national laboratories



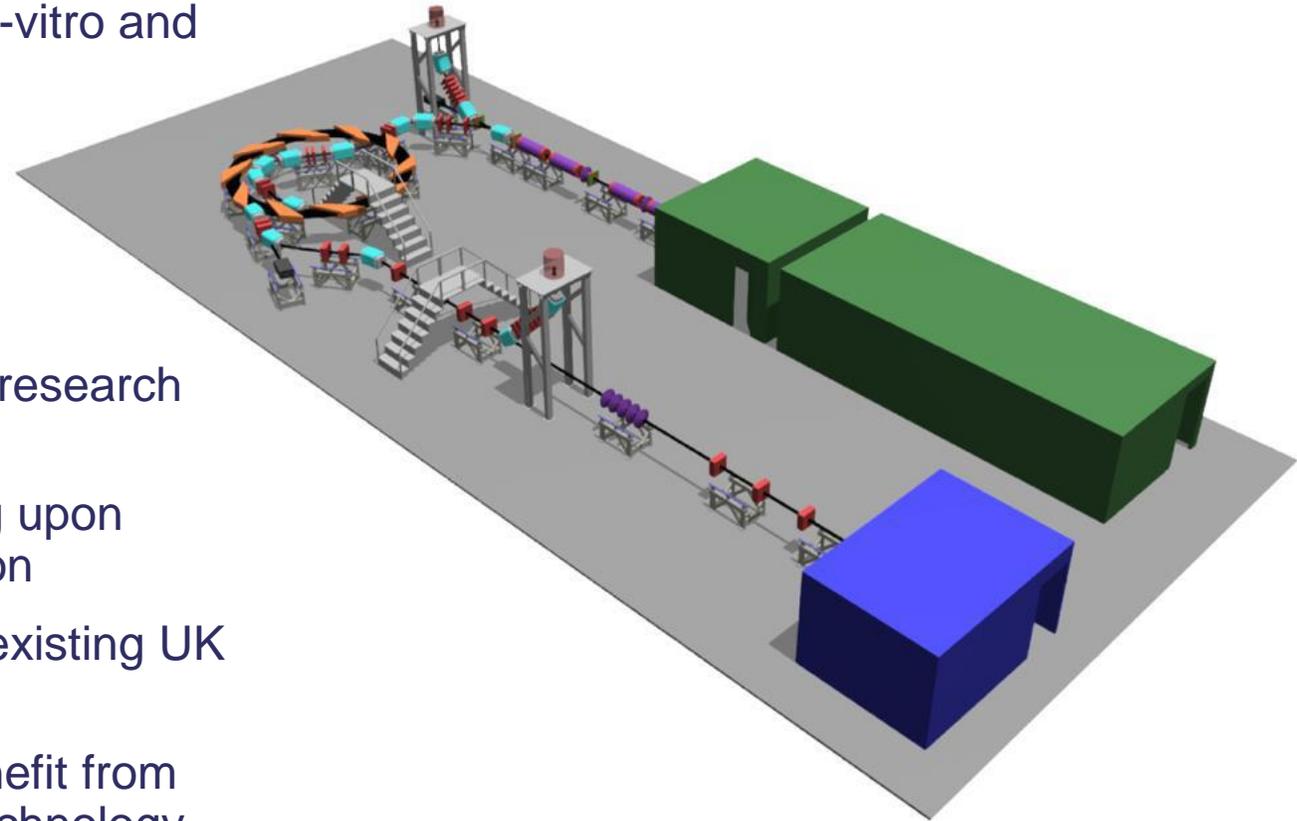
# Ion Therapy Research Facility – the ambition

## HOW

- A compact, single-site national research infrastructure delivering very high dose rates
- Protons and beyond, at energies sufficient for both in-vitro and in-vivo studies
- Consider technical options, with different risk profiles

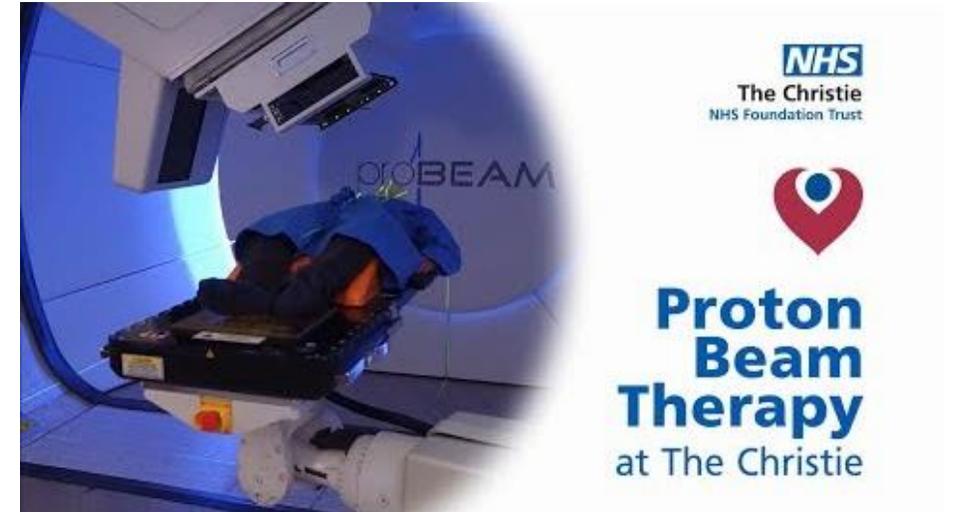
## PROPOSED PLAN

- Conceptual design of layout, cost and operation of a research facility
- Develop innovative laser-plasma technology, building upon world-leading expertise within the LhARA collaboration
- Develop innovative end-station designs, building on existing UK expertise in proton radiobiology research
- Collaborative agreement with CERN allows us to benefit from enormous experience and expertise in accelerator technology and successful projects



# Building on the NHS success: proton beam therapy

- The first ion in clinical use in the NHS is the **proton**
- The NHS approach with proton beam therapy is:
  - evidence-based with intention to cure
  - emphasis on children & young adults, under 25
- Intend to build on experience gained in proton therapy clinical and research activity



**NHS**  
The Clatterbridge  
Cancer Centre  
NHS Foundation Trust



# The Clinical Context

- 1989: Clatterbridge UK world's 1<sup>st</sup> hospital proton therapy centre (62 MeV, ocular); 100 patients/year
- 2007: NRAG report 'Radiotherapy: developing a world class service for England' recommends proton facilities
- 2007: Cancer Reform Strategy
- 2008: Proton Overseas Programme; 1102 patients (2008 – 2018)  
<https://doi.org/10.1016/j.ijrobp.2020.07.2456>  
<https://doi.org/10.1016/j.clon.2018.02.032>
- 2012 NHS Strategic Outline Case
- 2015: Full Business Case approved for 2 NHS centres
- 2018: NHS Christie 1<sup>st</sup> patients – **seen as a big success story**
- 2021: NHS UCLH 1<sup>st</sup> patients



Clatterbridge – 62 MeV Scanditronix cyclotron  
Basis for much UK technology and clinical-related research

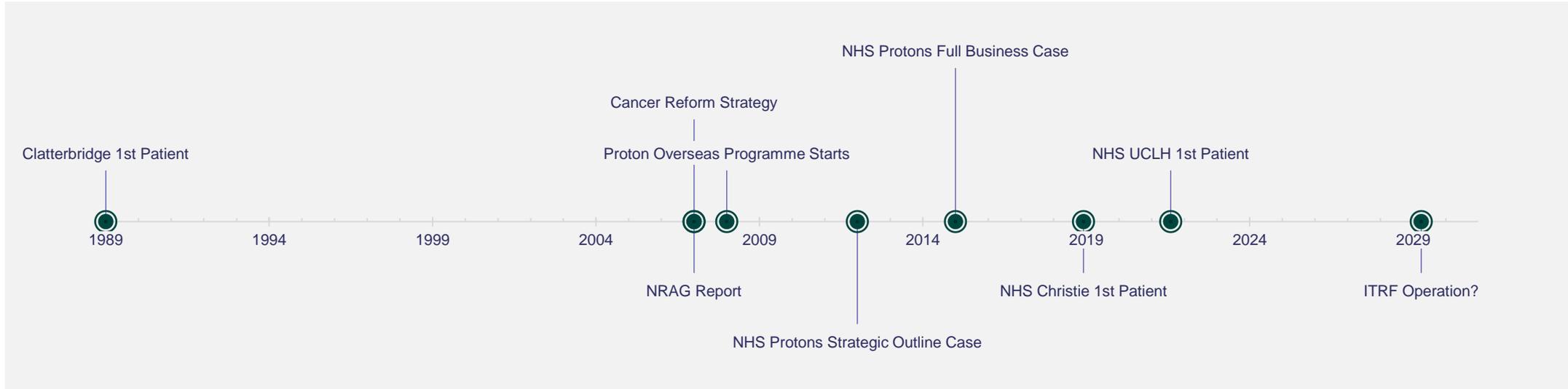


Christie – 250 MeV Varian cyclotron  
+ unique research beamline

## Protons in UK:

- Evidence-based
- Intention to cure
- Emphasis on children, young adults (<25), adults with rare tumours

# ITRF Timeline – Where Do We Want to Get To?



	YR	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41		
ITRF	PA1 ITRF Conceptual Design	█																					
	PA2 ITRF Technical Design		█		█																		
	Construction				█		█		█														
	ITRF research - physics + pre-clinical biology				█		█		█		█		█		█		█		█		█		
Ion Overseas Programme	Appraisal of clinical evidence		█		█																		
	Partner Research Programmes		█		█																		
	Referral Programme				█		█		█		█		█		█		█		█		█		
	Cost Analysis							█															
CRTF	CRTF Technology Collaborations	█																					
	CRTF Conceptual Design							█															
	CRTF Technical Design								█														
	CRTF Tendering										█												
	CRTF Construction												█		█		█		█		█		
Clinical Research & Treatment Facility	Commence clinical research & treatment																	█		█		█	

# Partner/Collaborating Institutions







Department of Physics  
 Faculty of Medicine






































# ITRF Status & Plan

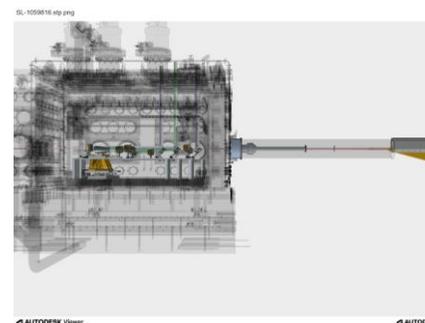
- ITRF funded through UKRI Infrastructure Fund
- 2-year Preliminary Activity will deliver a CDR to address:
  - What research programme ?
  - What design ?
  - What cost basis ?
  - What operating model ?
- During the Preliminary Activity:
  - Working groups to produce Conceptual Design Report, outline design and costing
  - Review designs with community
  - Establish funding roadmap
  - Develop key technologies
  - Examine alternative ways to achieve research goals
- STFC – CERN have agreed an Umbrella Collaboration Agreement to provide a framework to enable free exchange of ideas and technologies that is very relevant to ITRF (NIMMS project)



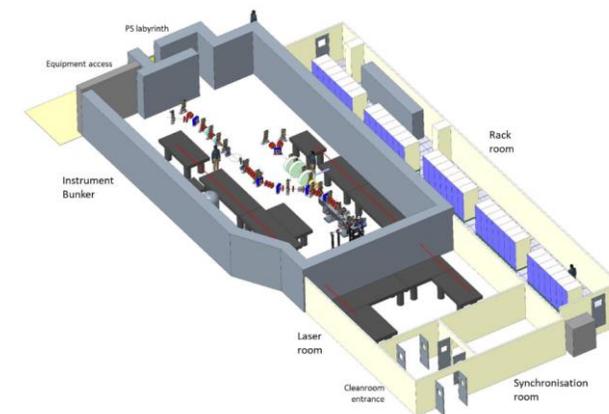
DIAMOND Light Source



CLARA high-brightness test facility



EPAC plasma facility



RUEDI diffraction/imaging facility



## UKRI-STFC

- Partner in numerous previous projects overlapping particle therapy and accelerator science
- 2 x National Laboratory (Daresbury and RAL) experienced in developing national infrastructures
- Technical partner in ITRF to assist in engineering integration and facility development

# Stage 1 / Stage 2 Facility Vision

