

# ITRF and LhARA

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LhARA Collaboration Meeting,

<https://indico.stfc.ac.uk/event/517/>

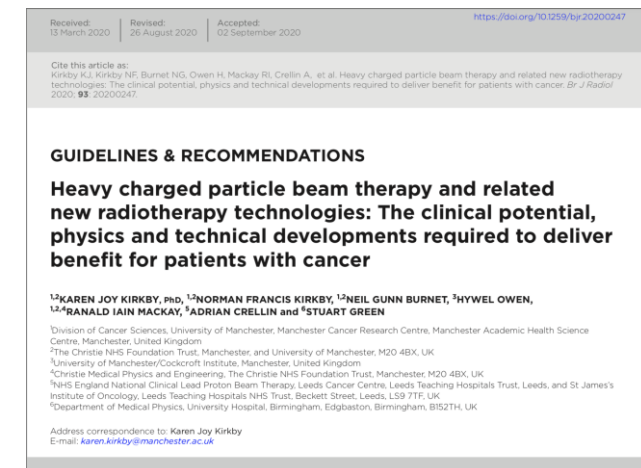
# ITRF and LhARA

- 1-Page Summary:
- ITRF and LhARA have differing origins but overlapping scope and aims
- ITRF (Ion Therapy Research Facility)
  - The stepping stone from today's proton therapy toward tomorrow's ion therapy; radiobiology needed
  - Technology background: EMMA, PAMELA; Networks: EUCARD2, EPSRC & STFC Networks EP/R023220/1 and ST/N002423/1, EU INSPIRE
  - Clinical background: Roadmap from overseas programme -> clinical protons -> ions
  - ITRF is 1<sup>st</sup> stage in establishing case for ion therapy for the UK
- LhARA
  - The most exciting technology direction for the production of multiple ion species
  - Enables paradigm-shifting radiobiology research and technology development for ion therapy
- LhARA is the preferred technology option for ITRF – but a CDR is needed to establish feasibility

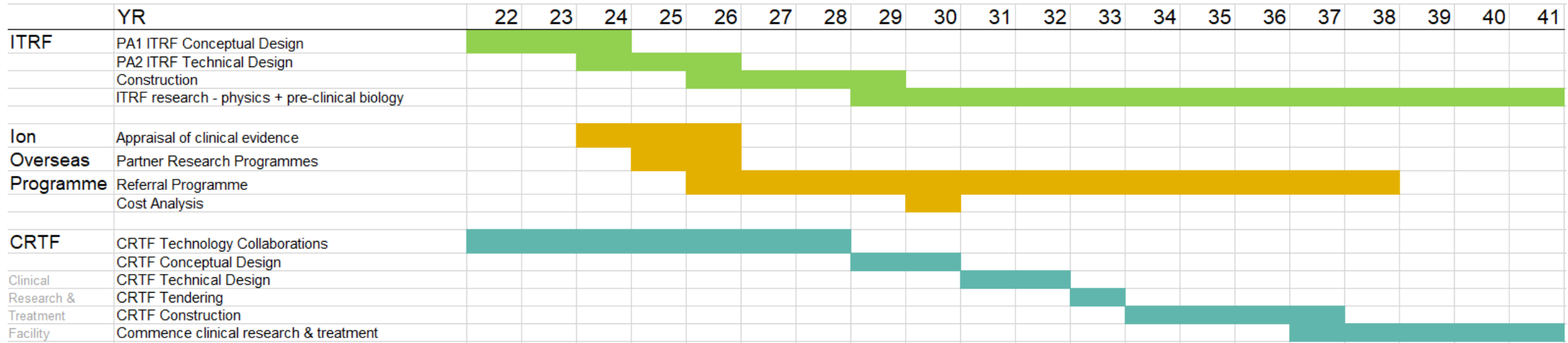
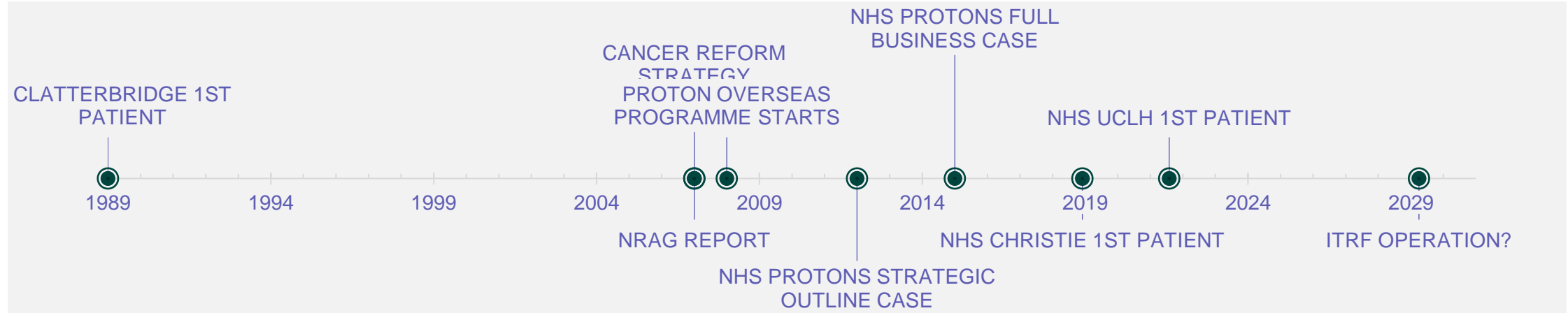
# ITRF Summary

- Context:
  - Radiobiology not sufficiently understood for UK clinical case
  - Recent spend on UK proton therapy means clinical funding unlikely now
  - Technology developments needed for high-intensity treatment, particularly FLASH
- ITRF is part of a roadmap:
  - Radiobiology with protons
  - ITRF technology and radiobiology programme
  - Clinical/cost case to UK Gov
  - Construction
- Multiple partners, including CI, JAI, Christie etc.
- Advisory Committee (Chair: Prof Neil Burnet) representing clinical and technological community; 3 meetings so far

- TIMELINE**
  - 2008 onwards – growing STFC discussions and involvement, various white papers on research and roadmaps
  - EUCARD2 workshop on ion therapy 2016  
<https://indico.cern.ch/event/456299/>
  - White papers to STFC 2015/2016 on ion therapy
  - SPF outline 2018
  - UK community workshop 2019; position paper  
<https://www.birpublications.org/doi/10.1259/bjr.20200247>
    - community consensus on need for ITRF
  - SPF outline 2020
  - IAC case: 2 year Prelim Activity (CDR) – costing and some technical design; under review
  - 2 year TDR
  - 3 year construction
- What we have bid for



# A tentative roadmap

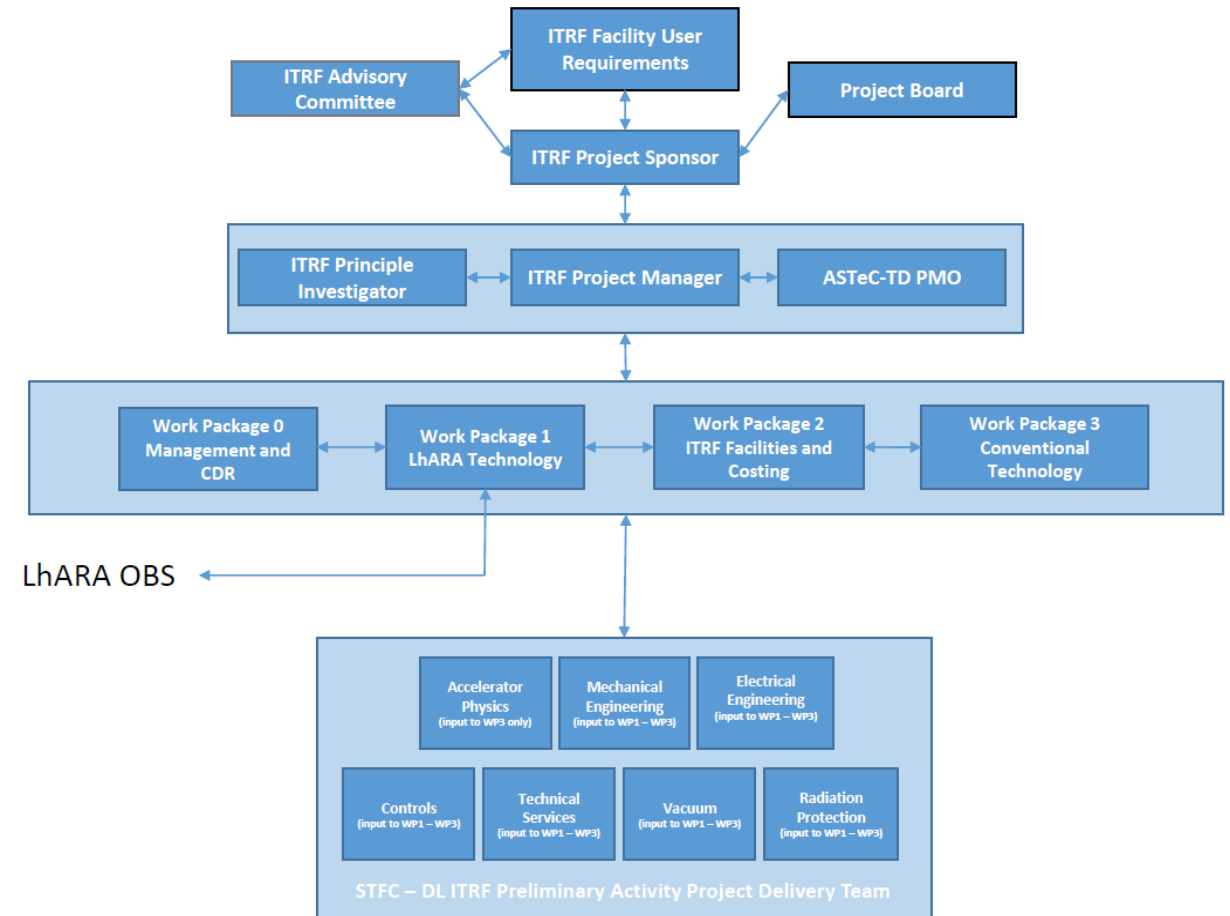


# The 2-Year Preliminary Activity

- STFC submission to UKRI Infrastructure fund
- Iteration on scope of study – recommend Preliminary Activity (2 years) to compare feasibility of differing options
- Bid commits to the following items:
  - CDR – design scope, usage model
  - Definition of end station and beam specification to support a biomedical research programme; staged in-vitro and in-vivo delivery
  - Technology choice and technical risk management; comparison of 3 technology options
- Current guidance:
  - Good chance of funding; assume start date 1<sup>st</sup> October 2022
  - Aim at Y1 0.7M and Y2 1.3M (but some flexibility)

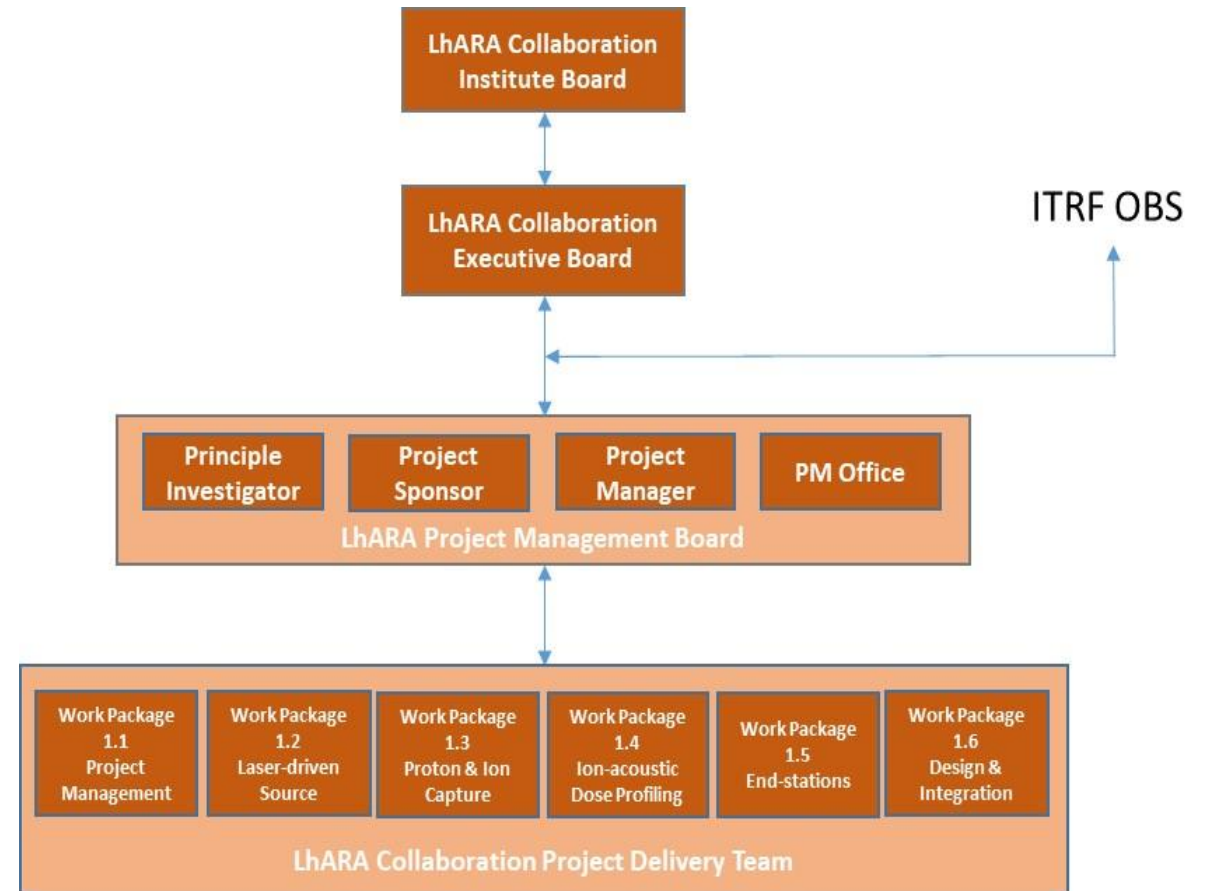
# OBS, WPs and PM

- STFC has an established project management methodology that we are required to follow
- Already had to meet STFC internal annual budget and effort definition (Feb/Mar)
- Project initiation is done via Bid Review; proposed 25<sup>th</sup> May
  - Budget
  - Deliverables/Milestones
  - WPs and responsible WP manager
  - Review and oversight (Monthly Progress, 6 monthly Reviews)
- As an STFC project, required to have STFC sponsor/PM/PI
  - Propose LhARA-focused WP to minimise overhead and allow LhARA collaboration oversight
- Costing activities carried out by STFC
- Funding disbursement via JeS (tbc)



# LhARA WP1.1 to WP1.6

- Each WP should have:
  - Single named manager
  - Final deliverables
  - (Interim deliverables)
  - Milestones (incl. for review)
- Proposal is that WP1.1 / LhARA PM provide single reporting line
  - Avoids WP overheads



- Additional slides....



# 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



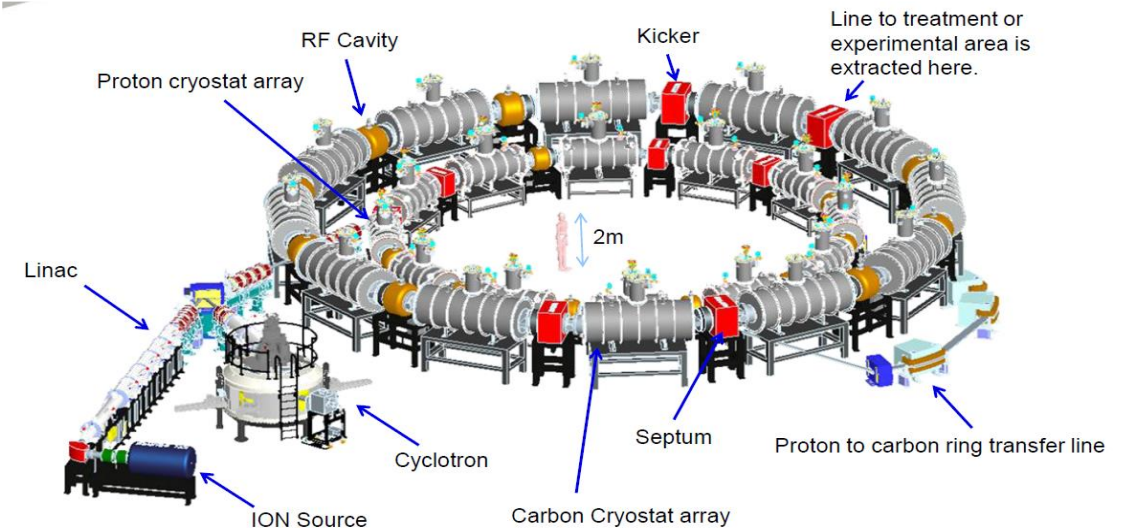
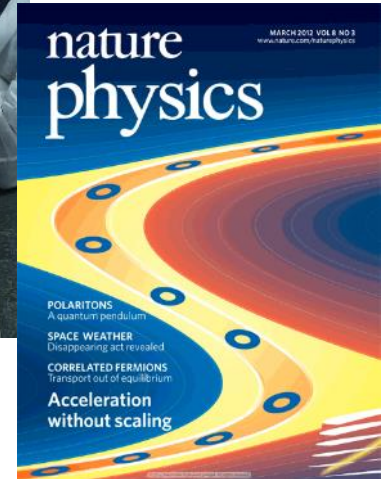
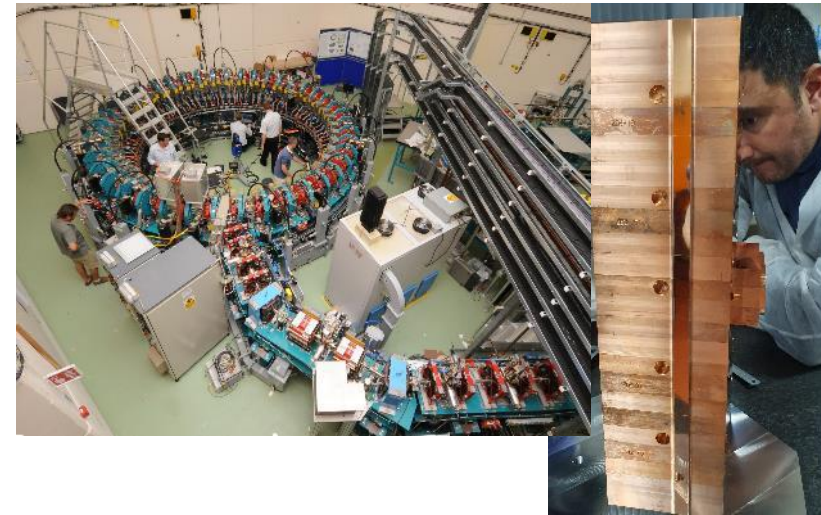
Christie – 250 MeV Varian cyclotron  
+ unique research beamline

## Protons in UK:

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

# The (Conventional) Accelerator Context: Protons

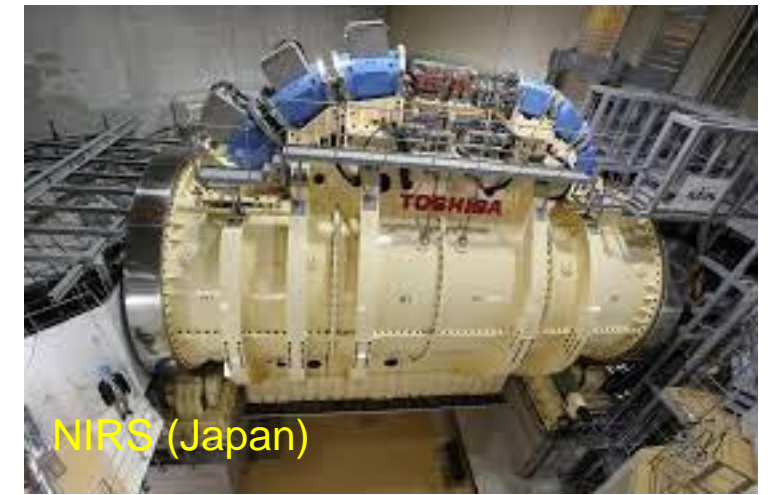
- 2007 – 2013 EMMA @ DL
- 2008 – 2013 PAMELA
- 2013 – 2015 NORMA
- 2015 – 2019 PROBE
- 2018 – 2021 TAAC70 Cyclotron
- Christie proton centre 2018 –
- Christie proton beamline 2019 -



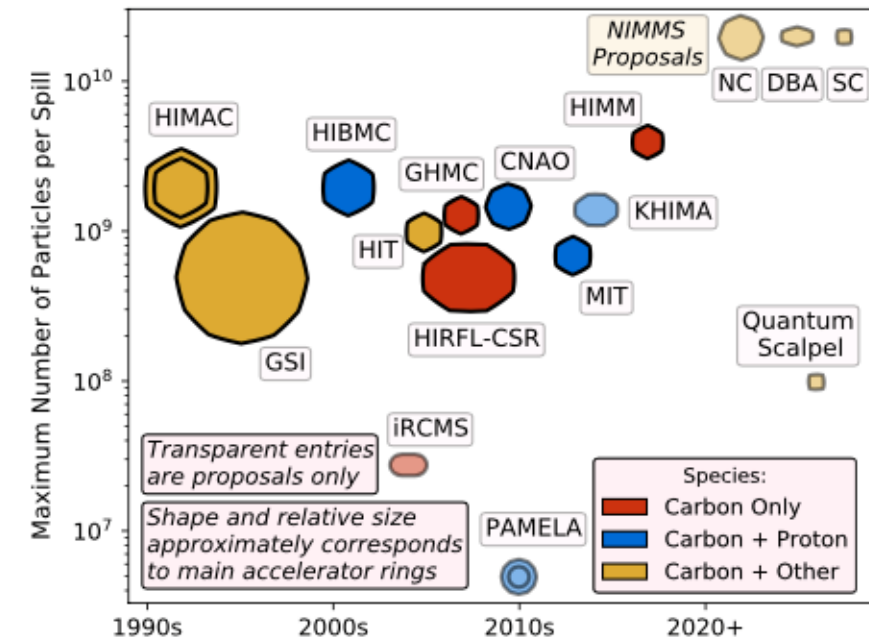


# Ion Therapy Context

- 1994 HIMAC (Japan)
- 1998 – 2008 GSI
- 1999 PIMMS study
- 2012 CNAO/HIT 1<sup>st</sup> patients
- 2019 MedAustron 1<sup>st</sup> patients
- 2019 NIMMS study begins

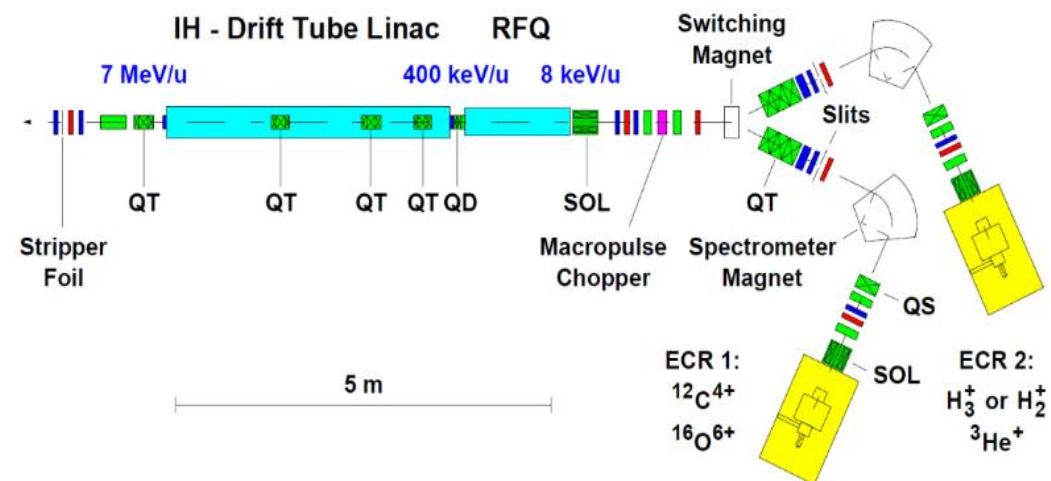
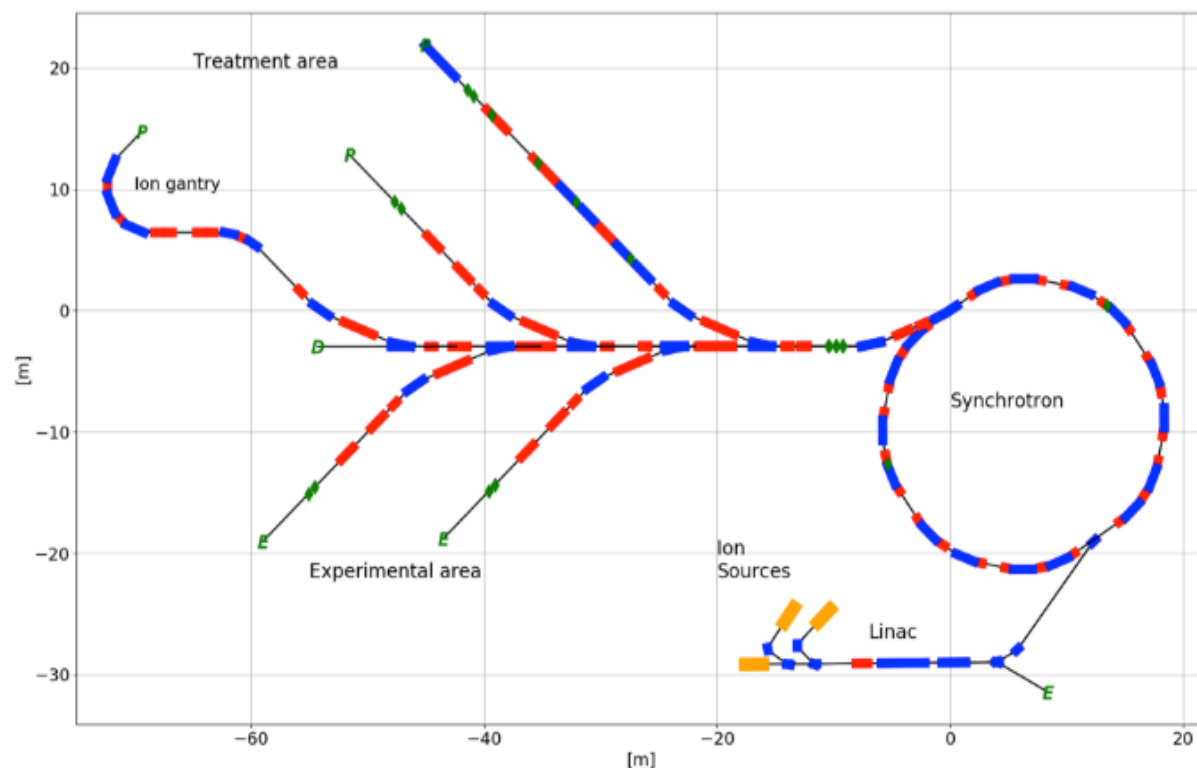


2 ion gantries operating in the world today



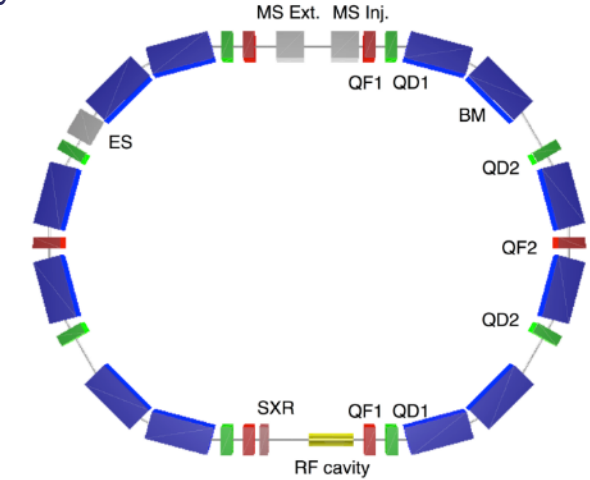
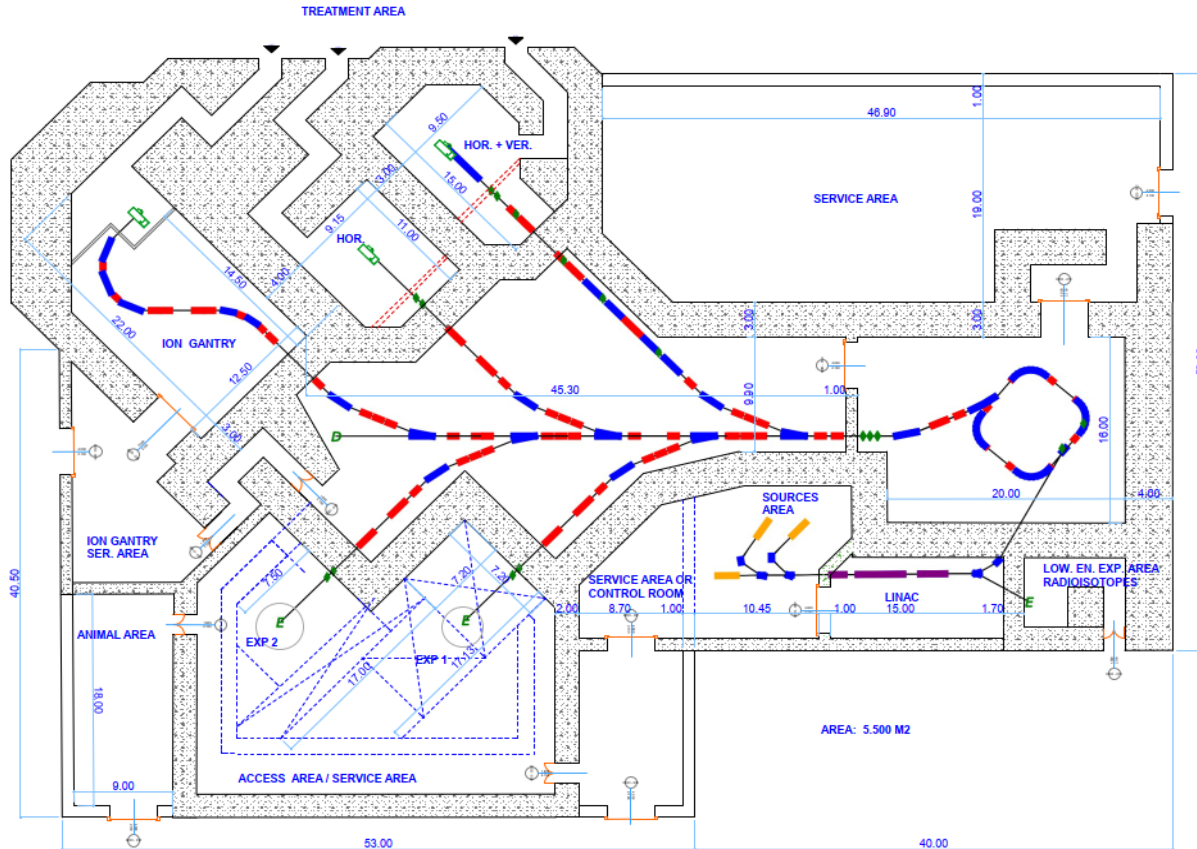
# NIMMS @ CERN

- PIMMS > NIMMS
- Linked to SEEIST
- 3 UK students working on NIMMS:
  - UOM CCT synchrotron/gantry (CI)
  - UOM FFA/Synchrotron (CI)
  - Imperial Synchrotron (JAI)
- STFC/CERN Framework Agreement (virtually) signed; access to design information and collaboration



# The Path to SC Ion Therapy

NIMMS compact synchrotron



**Table :** Detailed parameters of the proposed DBA lattice.

Circumference length	55 m
Max energy	430 MeV/u
Dipole length	2.31 m
Max dipole strength	1.5 T
Working point ( $Q_x, Q_y$ )	(1.67, 1.72)
Transition gamma $\gamma_t$	1.742
Natural chromaticities $\xi_x, \xi_y$	-1.1, -1.3
QF1 strength	1.05 m <sup>2</sup>
QF2 strength	0.8 m <sup>2</sup>
QD1 strength	-1.3 m <sup>2</sup>
QD2 strength	-0.65 m <sup>2</sup>

