LhARA WP 0
Project Management

Daresbury 21st March 2023

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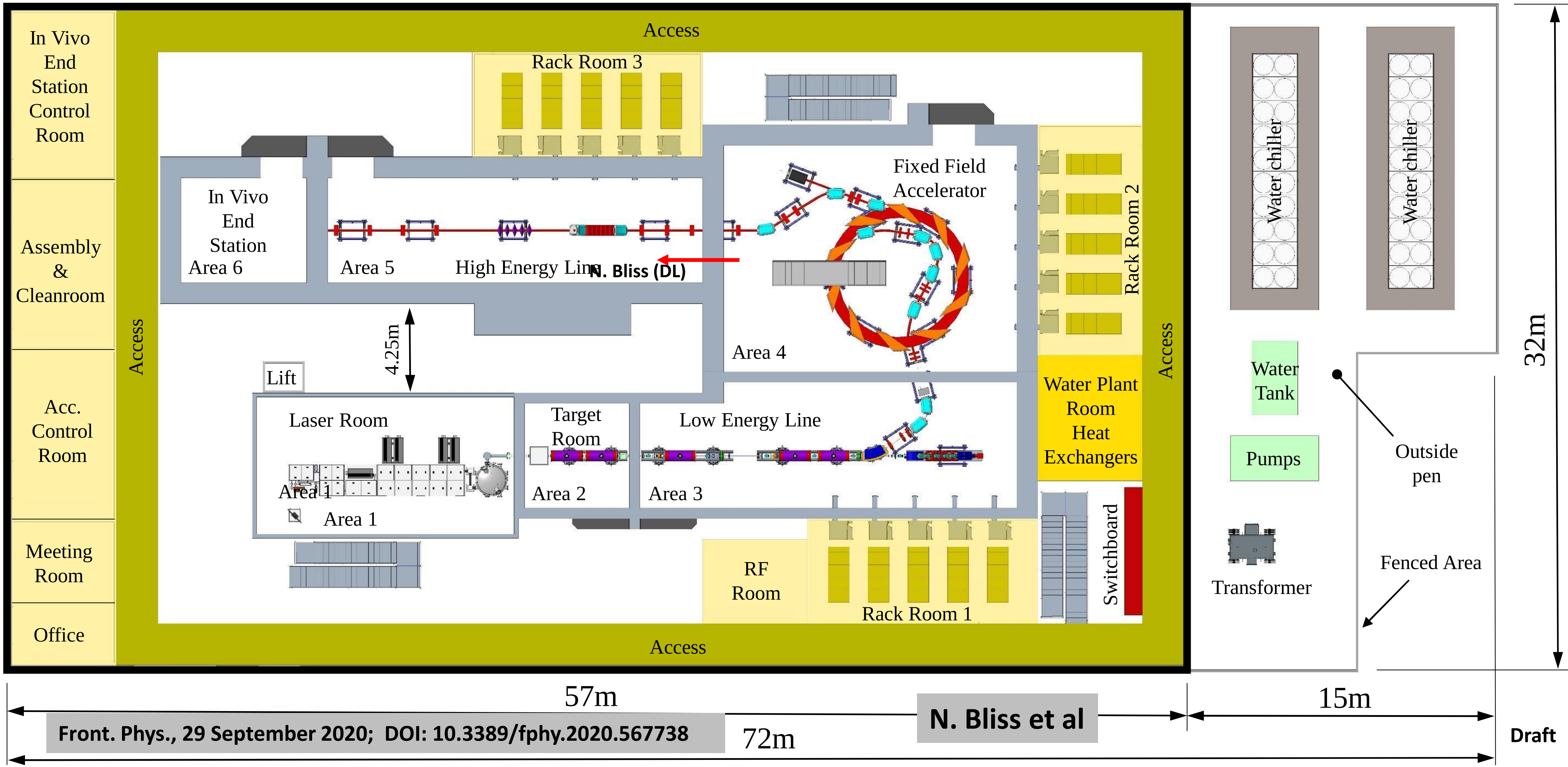
Progress – PM’s 6 month report

- LhARA review complete
  - Response recorded on Wiki
  - next….radiobiology aspects.. Expand LhARA baseline document
- 6 month review
  - Substantial ‘progress to date’ report
  - Review ‘ongoing’?
- Lessons
  - Don’t schedule major events to project calendar, schedule them to the University teaching calendar.

		WP Number	Name	Description	Likelihood	Impact	Score	Mitigation	Mitigated Likelihood	Mitigated Impact	Mitigated score	Comments
WP1	1	1.5	Resources	Insufficient resources secured to deliver the project aims, project scope, quality or specifications to the required timescale.	5	4	20	Request adequate resources based on experience of delivering similar multidicipline facilities with comparable technical complexity. Use pre - CDR outputs to inform work towards Conceptual Design Report (CDR).	4	4	16	Project would benefit from additonal resource, particularly directed to WP3.
WP1	2	1.3	Performance specification parameters	Inadequate ion beam parameters specification to meet the Physics and Biolology requirements for the facility.	3	5	15	The project consortium consists of all the multidiscipline experts to understand the required parameters.	2	5	10	
All	3	9	Key specialist staff	Availability of key specialist staff critical to delivering the project.	4	5	20	Identify potential single point failure risks, apply cover and succession planning where appropriate.	2	5	10	Coming into play with staff availability at critical times. Mitigate through careful scheduling.
WP2	4	2.7	Source output	Unable to deliver desired beam.	4	3	12	Investigate experimental techniques to increase yield	4	2	8	Experimentalist suggest increased laser power may be required for target spec.
WP2	5	2.1	Source design - activation	Unsustainable activation of materials surrounding interaction	2	4	8	Change design to minimise potential for activated materials around interaction point	2	2	4	
WP3	6	3.3	Plasma Density	A low density will result in too long a focal length (& beamline)	4	4	16	Careful design and study to ensure a suitable density can be reached:	4	3	12	
WP4	7	4.1	Low acoustic signal	Insufficient acoustic signal to noise ratio (SNR) (i.e., low amplitude acoustic emission)	3	5	15	Frequency optimisation, prefocused large array, averaging over multiple pulses, adaptive reconstruction with priors and optimisation of frequency with element location. Adaptively trade dose-map resolution for SNR	3	3	9	
WP6	8	6.6	Facility Integration	Delayed start/insufficient early resource to progress Integration work	3	5	15	Prioritise integration work package	1	4	4	1st use of design engineering applied to target/capture interface.
WP5	9	5.1	End Station Specification	End station specification does not clearly specify requirements.	5	5	25	Additional resource.	1	5	5	
WP3	11	3.11	Staff recruitment	Delay to project as a result of delay to PDRA recruitment	4	2	8	Exploit exisiting staff where possible	5	2	10	Effectively realised - staff expected in post no earlier than May '23 > 6 month impact

Highlights

- Full 3D simulation of ‘SCAPA like’ particle production
- Started discussion/argument/bunfight over target to capture interface
- New concepts in acoustically transparent water phantom instrumentation for ion/acoustic tests.
- First user consultation with over 40 participants
- Significant progress in design of the low energy transport line
- New concepts in acoustically transparent water phantom instrumentation for ion/acoustic tests.



⇒ *compact, uniquely flexible facility*

LhARA
Laser-hybrid Accelerator for Radiobiological Applications

- Laser-driven, high-flux proton/ion source
  - Overcome instantaneous dose-rate limitation
  - Can deliver protons or ions in 10-40 ns bunch
  - Triggerable; arbitrary pulse structure
- Novel "electron-plasma-lens" capture & focusing
  - Strong focusing without high power, high-field solenoid
- Fast, flexible, fixed-field post acceleration
  - Protons: 15—127 MeV Ions: 5—34 MeV/u

LhARA performance summary arXiv:2006.00493

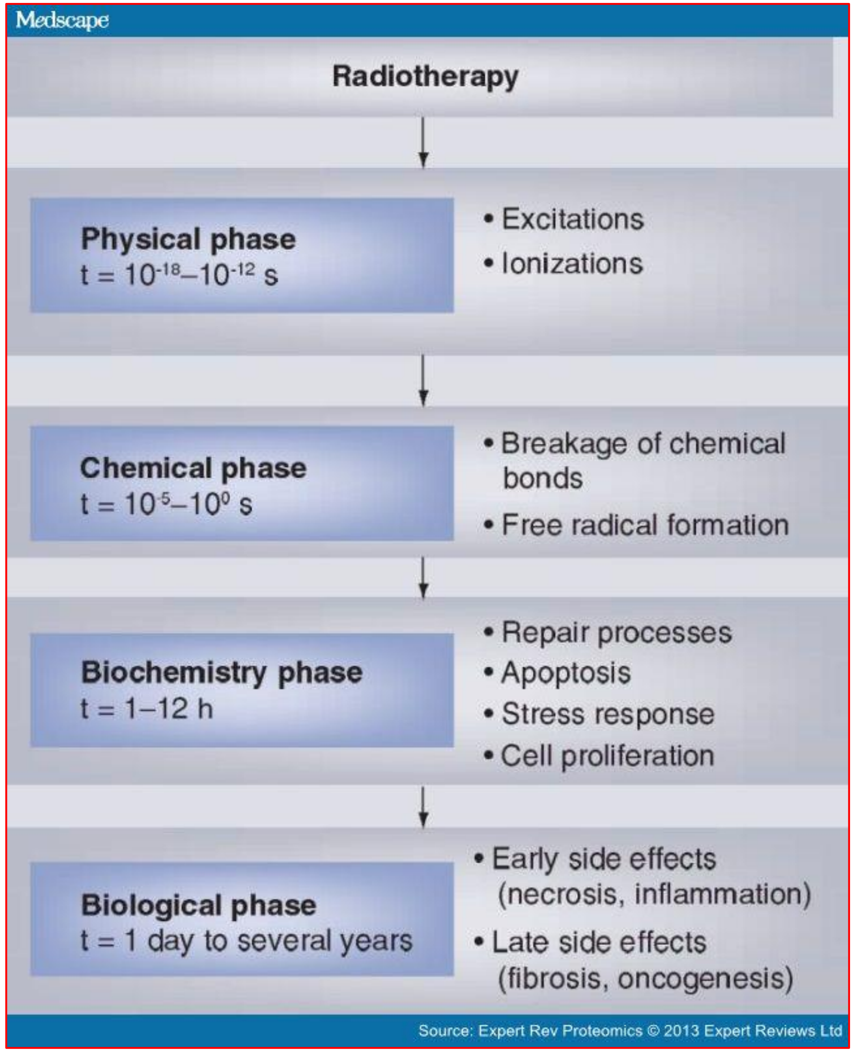
	12 MeV Protons	15 MeV Protons	127 MeV Protons	33.4 MeV/u Carbon
Dose per pulse	7.1 Gy	12.8 Gy	15.6 Gy	73.0 Gy
Instantaneous dose rate	1.0×10^9 Gy/s	1.8×10^9 Gy/s	3.8×10^8 Gy/s	9.7×10^8 Gy/s
Average dose rate	71 Gy/s	128 Gy/s	156 Gy/s	730 Gy/s

Our vision and our ambition

LhARA will be a uniquely-flexible, novel system that will:

- ***Deliver a systematic and definitive radiobiology programme***
- ***Prove the feasibility of the laser-driven hybrid-accelerator approach***
- ***Lay the technological foundations for the transformation of PBT***
    - **`automated, patient-specific: implies online imaging & fast feedback and control`**

Radiobiology in new regimens



Time domain

Space domain

The ideally flexible beam facility can deliver it all!

⇒ substantial opportunity for a step-change in understanding!

Energy

Ion species

In combination

and with chemo/immuno therapies