

WP5: Novel end station development

Report from 1st peer-group consultation meeting – 14 Dec 2022

Dr Ruth McLauchlan Imperial College Healthcare NHS Trust

Dr Tony Price University of Birmingham

Dr Carsten Welsch University of Liverpool


WP5: Objectives

Through peer-group consultation, produce detailed specifications and designs for the in-vitro and in-vivo end stations, the associated dosimetry and the beam diagnostics necessary to characterise the beam delivered to the end stations.

WP5: Tasks and Milestones

- Design LhARA automated cell dish handling and environmental system via user-community consultation
 - De-risk key end station components through experimental measurements at Birmingham
- Assessment of current beam monitoring technology and identification of the R&D required to deliver the diagnostic systems for LhARA
- Development of the design of a test facility at Birmingham capable of delivering kGy/s for use to prove instrumentation and diagnostics developed for LhARA in the Preconstruction Phase
- **M5.1** Initial report on the user requirements for the in-vitro and in-vivo end stations
 - An initial parameter list and end-station specification will be given
- **M5.2** Report on the beam-monitoring technology for LhARA.
 - Will include an options analysis and discussion of cost and R&D requirements
- **M5.3** Report on the user requirements for the in-vitro and in-vivo end stations.
 - Will contain detailed specifications, analysis of layout options, and initial designs for key components

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May 12, 2023 LhARA-Gov-PMB-2023-04 Draft 0.0 

First peer-group consultation meeting

14th December 2022

The LhARA collaboration

N. Kumar, K. Long, R. McLauchlan, T. Price, C. Whyte for the
The LhARA Project Management Board

1 Introduction

The first of the series of peer group consultations to solicit input on the specification and design of the end stations for LhARA [1, 2], the Laser-hybrid Accelerator for Radiobiological Applications, was held on the 14th December 2022. The consultation meeting was held fully online owing to the national train strikes that took place that day. The programme for the meeting (<https://indico.stfc.ac.uk/event/668/>) was split into two sessions. The morning session received presentations on:


- The mission of the LhARA collaboration and the status of, and plans for, the LhARA project;
- The development of the LhARA initiative in the context of the Ion Therapy Research Facility; and
- The status of the consideration of the conventional, synchrotron-based, fall-back option.

These contributions were followed by presentations on beam instrumentation and the development of culture dishes with thin entrance windows suitable for use with low-energy proton and ion beams. Building on the morning's introductory session, the afternoon comprised of two forums in which the specifications for the *in-vitro* and the *in-vivo* end stations were discussed. This document summarises the discussions that took place and the conclusions and recommendations that were agreed. 51 people from across Europe and beyond registered for the meeting. The conclusions are numbered "Cn" and the recommendations are numbered "Rn" in the text as they appear. Appendix A summarise the conclusions and recommendations. The maximum attendance on the ZOOM call during the morning session, was 37.

The baseline design [3] for the LhARA facility serves two end-stations for *in-vitro* radiobiology (Stage 1 and Stage 2) and one end-station for *in-vivo* studies (Stage 2). An end-station requirements document [4] was sent to all registered attendees prior to the meeting. Table 1 (overleaf) presents a summary of the specification for the beam parameters that the LhARA facility will provide.

ccap.hep.ph.ic.ac.uk/trac/wiki/Research/LhARA/EndStation

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wiki: Research / LhARA / EndStation

End station R&D and vertical beam line development

- 19Jun23: [LhARA second peer-group consultation meeting](#)

Meetings

Meeting history can be found by clicking on the meetings section header in the line above.

Note that we hold our work package meetings every 2 weeks on Thursday mornings at 1000-1100h (London, UK):

Zoom link: <https://bham-ac-uk.zoom.us/j/86078899579?pwd=dmVieXpzOFVlZVRHV2c2Vjk2RklZz09>

Upcoming dates 2023:

Jun 22, Jul 6, Jul 20, Aug 3, Aug 17, Aug 31, Sep 14, Sep 28

NOTE CHANGE TO MEETING CYCLE FROM TUESDAY MORNINGS

Consultation meeting reports

1. Report from first peer-group consultation meeting held on 14 December 2022
 - [Consultation1 14 Dec 2022](#)

Communication

[Mailing list hosted on JISMAIL: CCAP-LhARA-ENDSTATION](#) <at> jiscmail.ac.uk

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Conclusions

1. Baseline to be retained
2. Upper limit on accuracy and repeatability of dosimetry = 5%

Table 1: Summary of the LhARA beam parameter specifications [3]. These estimates are based on Monte Carlo simulations [1, 2]. The average dose rate is based on the 10 Hz repetition rate of the laser source that is specified in the LhARA baseline.

	Stage 1		Stage 2	
	Proton		Carbon	
Kinetic energy	12 MeV	15 MeV	127 MeV	33.4 MeV/u
Beam diameter	35 mm	35 mm	Spot: 1 mm; Uniform: 10–30 mm	
Bunch length	7 ns	7 ns	41.5 ns	75.2 ns
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

Recommendations

1. Investigate radiobiological opportunities arising from unique time-structure offered by LhARA
2. Consider experimental complications arising from low-energy proton beam (Stage 1)
3. Carefully plan workflow and cell-culturing facilities to support multi-user, quasi-continuous irradiation facility
4. Evaluate impact of scattered radiation on neighbouring samples
5. Consider required ranges and stability of temperature and oxygen-levels
6. Careful consideration required for in-vitro end-station regarding all aspects of animal-handling (Stage 2)
7. Consideration of location of LhARA relative to animal house

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