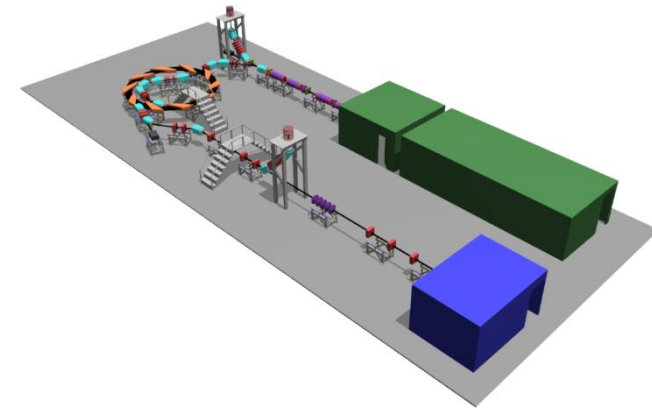


Overview of the LhARA programme

6th Plenary meeting of the CCAP



Ajit Kurup

24th June 2020



**Imperial College
London**

Introduction

- The pre-CDR.
 - Published as technical note CCAP-TN-01!
- Frontiers publication.
- R&D programme.

- Published as technical note CCAP-TN-01
 - Technical notes page on the wiki:
 - <https://ccap.hep.ph.ic.ac.uk/trac/wiki/Communication/Notes>
 - Link to the document:
 - <https://ccap.hep.ph.ic.ac.uk/trac/raw-attachment/wiki/Communication/Notes/CCAP-TN-01.pdf>
- Management annex
 - <https://ccap.hep.ph.ic.ac.uk/trac/raw-attachment/wiki/Communication/Notes/CCAP-TN-01-Management-annex.pdf>
- Summaries
 - <https://ccap.hep.ph.ic.ac.uk/trac/raw-attachment/wiki/Communication/Notes/CCAP-TN-01-Summaries.pdf>
- International review was a success.
 - <https://ccap.hep.ph.ic.ac.uk/trac/wiki/Research/DesignStudy/PreCDR/Review>
 - <https://ccap.hep.ph.ic.ac.uk/trac/raw-attachment/wiki/Research/DesignStudy/PreCDR/Review/2020-04-10-LhARA-review-summary-final.pdf>

Pre-CDR – Selected Highlights

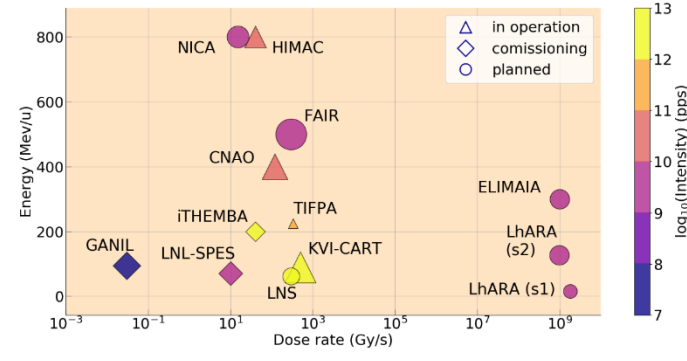
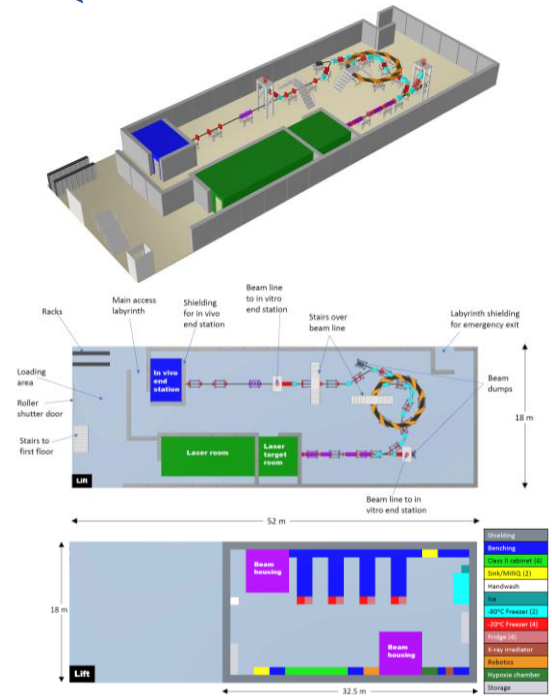
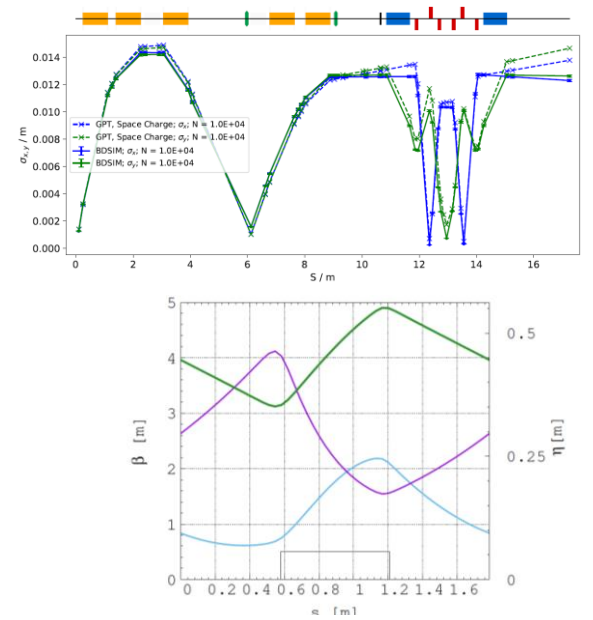
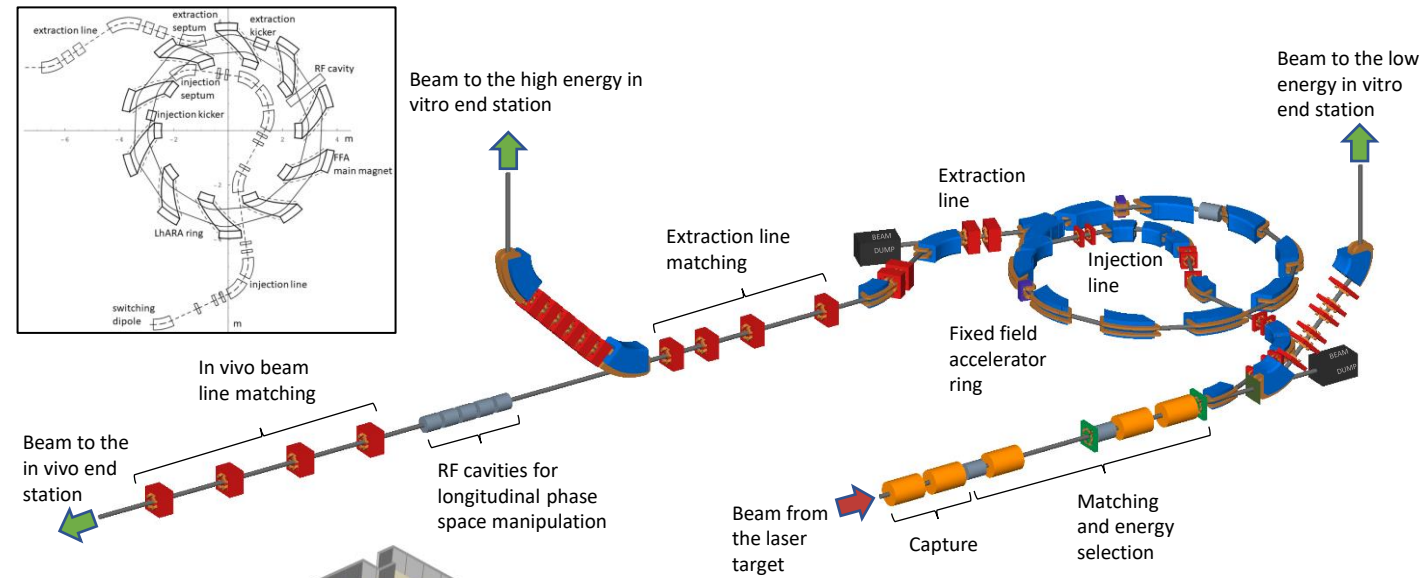
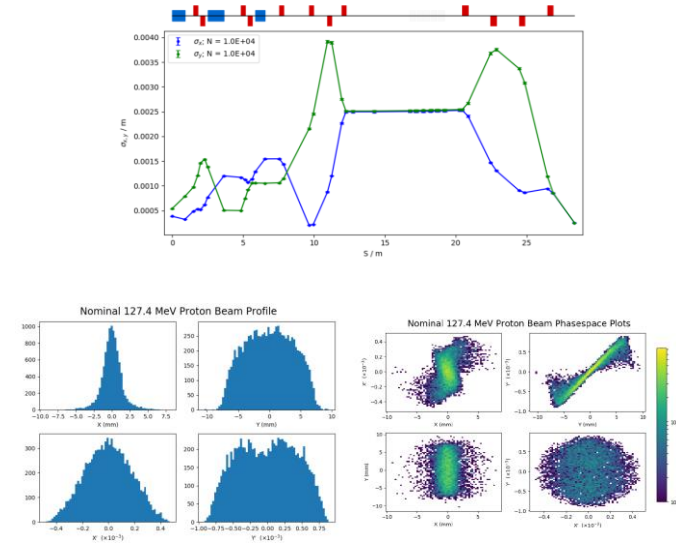


Table 1: Summary of expected dose per pulse and dose rates that LhARA can deliver. These estimates are based on Monte Carlo simulations using a bunch length calculated for the energy and particle species for the instantaneous dose rate and the average dose rate is based on the 10 Hz repetition rate of the laser source.

	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



Frontiers Publication

- Paper submitted to Frontiers in Physics – Medical Physics and Imaging
(<https://www.frontiersin.org/journals/physics/sections/medical-physics-and-imaging>).
 - Added to the wiki, see <https://ccap.hep.ph.ic.ac.uk/trac/wiki/Communication>
- Added to arXiv <https://arxiv.org/abs/2006.00493>
 - and on the wiki <https://ccap.hep.ph.ic.ac.uk/trac/attachment/wiki/Communication/Publications/2020/LhARA-preCDR-arXiv.pdf>

Five year R&D plan

- Aims to address the technical challenges highlighted in the pre-CDR and deliver technical designs for the LhARA facility.
- Facility design.
 - Development of conceptual design.
 - Development of technical design.
 - Principle deliverables:
 - CDR (detailed for Stage 1).
 - TDR Stage 1.
 - TDR Stage 2.
- End stations.
 - Automation, sample handling, imaging.
 - Simulation of the end stations.

Five year R&D plan

- Gabor lens.
 - First generation prototype.
 - Second generation prototype.
 - Theoretical studies.
 - Electron density measurements.
 - Alpha source and detector tests.
- Laser-driven source.
- Laser-capture interface.
- Investigation of space charge algorithms.
- Stage 1 beam line performance evaluation.
- Vertical bend.
- Capture technology milestone.

Five year R&D plan

- FFA.
 - Design and simulation.
 - Detailed magnet design.
 - Magnet prototype.
 - RF cavity design and performance evaluation.
 - Injection and extraction design.
- Stage 2 performance evaluation.
- Longitudinal phase space manipulation design, simulation and prototyping.
- Final beam preparation for in vivo end station.
- Instrumentation.
 - Low-energy beam diagnostics.
 - Online dosimetry and dose profile.
 - Absolute dosimetry at ultra-high dose rates.
 - Fast feedback and control.
 - High-energy beam diagnostics.
- Software and Computing.
 - Development of a global data acquisition and processing system.
 - Development of the controls and monitoring system.

Funding

- ERC Advanced Grant proposal.
 - Demonstrate the Gabor lens for LhARA.
 - Scope of the proposal being discussed.
 - Option for a radiobiological experiment.
 - Draft will be developed by the end of June.

- EPSRC+MRC Transformative Healthcare Technologies proposal.
 - Preparing an Expression of Interest.
 - Key dates:
 - Call opening in September 2020.
 - Outline proposal deadline in November 2020.
 - Outline proposal decision in December 2020.
 - Full proposal deadline in March 2021.
 - Goal is to put together an outline proposal for September 2020 to discuss at the information meeting.

Summary

- Pre-CDR is now published as technical note CCAP-TN-01.
 - Major milestone achieved!
- Publication submitted to Frontiers in Physics.
 - arXiv version uploaded.
- Focus is now on developing the programme to address the technical challenges highlighted in the R&D plan.
 - Gabor lens.
 - Simulations.
 - Radiobiology (more from Jason, et al.).
- Seek funding to deliver LhARA.
 - ERC Advanced Grant.
 - EPSRC+MRC Transformative Healthcare Technologies.