

CDR & Simulation Update

William Shields
(william.shields@rhul.ac.uk)

WP6 Meeting

10th September 2024



ROYAL
HOLLOWAY
UNIVERSITY
OF LONDON



- 1) Overview
 - a. Layout & Key parameters
- 2) Stage 1 Design & Performance
 - a. Lattice description
 - b. Optics Tracking and Performance
 - i. Parameterized Beam
 - Spectrum *
 - Angular Distribution *
 - Transverse Spatial Distribution
 - i. Start-to-end tracking
 - Nozzle Region
 - Reduced Angular Divergence
 - Stage 1 Nominal Design Performance
 - Space Charge Impact and Mitigation
 - Stage 2 Operation
 - Gabor Lens Tracking
 - i. End station Dose Estimation
 - Model
 - Maximum theoretical dose calculations
- 3) Stage 2 Design & Performance
 - a. Injection Line
 - i. Lattice description
 - ii. Optical Performance
 - b. FFA
 - i. Lattice Description
 - ii. Optical Performance
 - c. Extraction Line
 - i. Lattice Description
 - ii. Optical Performance
- 4) LhARA Technical Systems
 - a. Magnet Design
 - b. RF Cavities
 - c. Diagnostic System
 - d. Control & Feedback Systems
 - e. Vacuum Concepts
- 5) Engineering & Infrastructure
 - a. ITRF/LhARA Building Concept Design
 - b. Bulk Shielding Assessment
 - c. Mechanical Systems Integration Support Concepts
 - d. Power Consumption & Cooling Requirements
- 6) Conclusions

Facility Design Chapter
Material Not Started
Material Ongoing
Material Complete

- Discrepancy between LhARALinearoptics laser parameters and those in pre-CDR

LhARALinearoptics

Parameter	Value/Range	Unit
Laser Parameters		
Power	1	TW
Energy	2.5	J
Pulse length	25	fs
Rep. rate	10	Hz
Proton Energy	15	MeV
Ion Energy	4	MeV/u

- Laser parameter changes shouldn't impact tracking of LhARA beam at 15 MeV \pm 2%
 - Slope across the energy band may change

pre-CDR

Parameter	Value	Unit
σ_x	4	μm
σ_y	4	μm
$\cos \theta_S _{\min}$	0.998	
E_{\min}	1.0	MeV
E_{\max}	25.0	MeV
nPnts	1000	
Laser power	2.5e-15	W
Laser energy	70.0	J
Laser wavelength	0.8	μm
Laser pulse duration	2.8e-14	s
Laser spot size	40	μm
Laser intensity	4e+20	J/m^2
Electron divergence angle	25.0	degrees
RMS θ_S at $K = 0$ MeV	20	degrees
Scaled slope of RMS θ_S versus K	15	degrees

