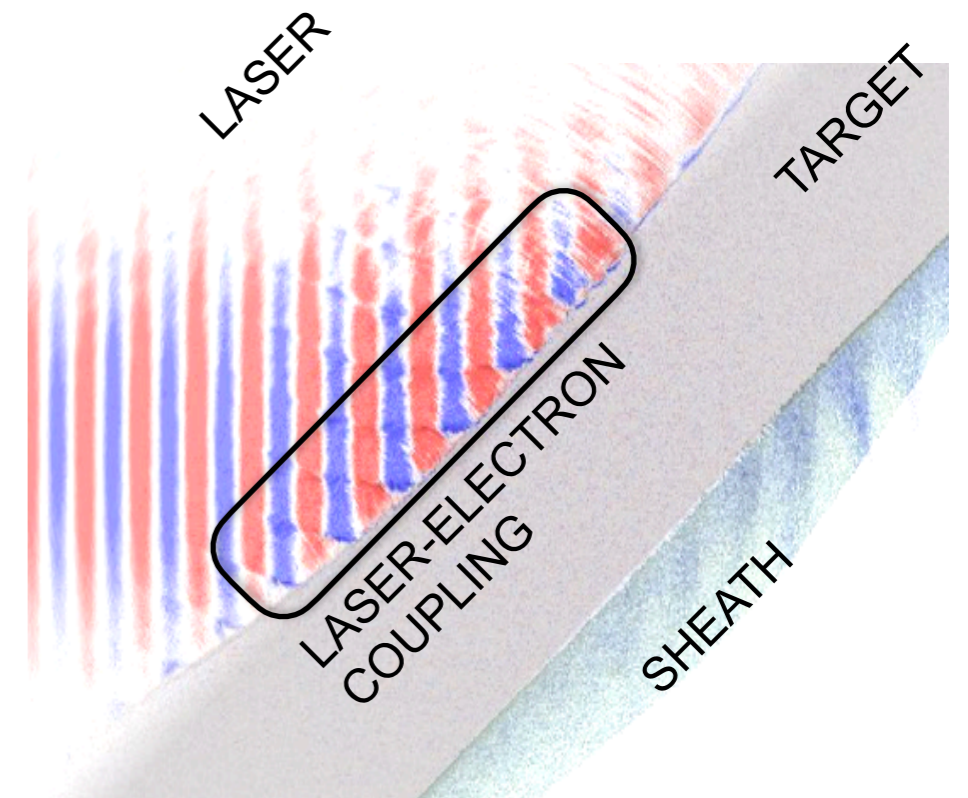
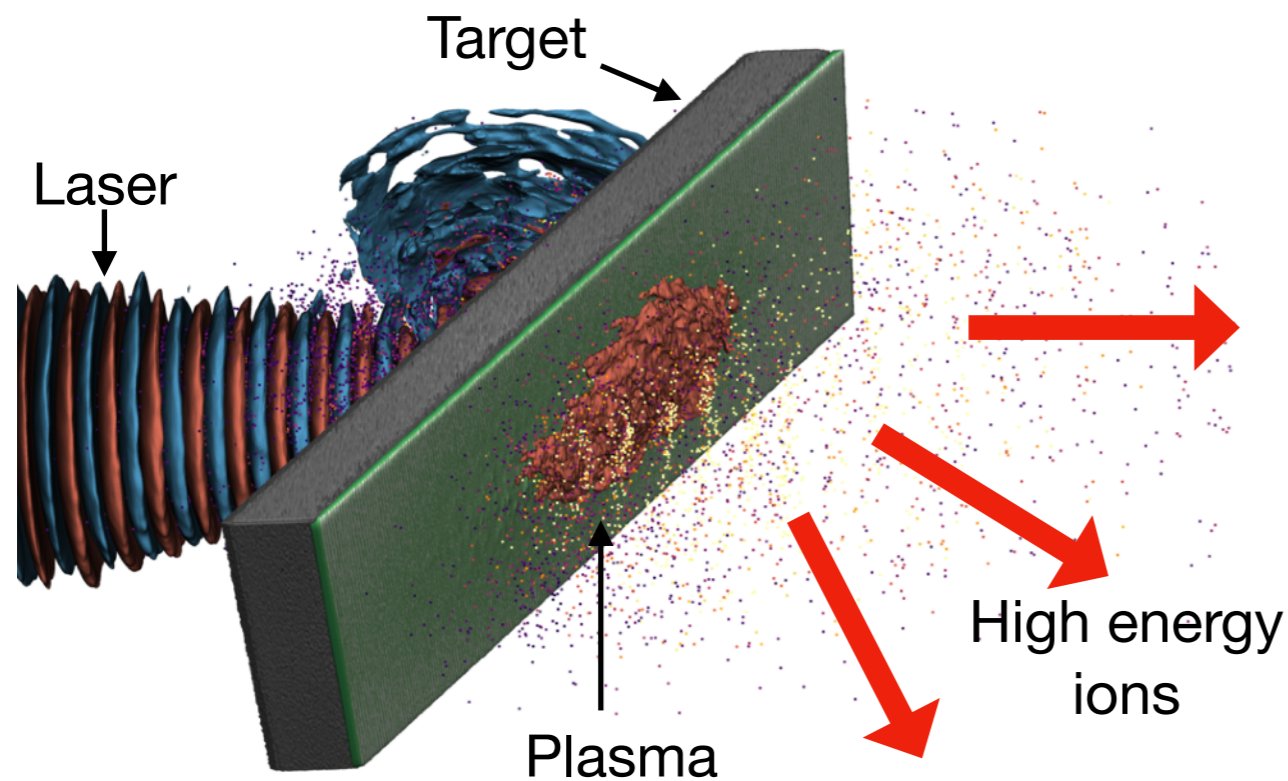


LhARA Laser-Driven Proton & Ion Source WP1.2

N. Dover (Imperial), E. Boella (Lancaster), R. Gray (Strathclyde)

LhARA 6 month review, 21st February 2023

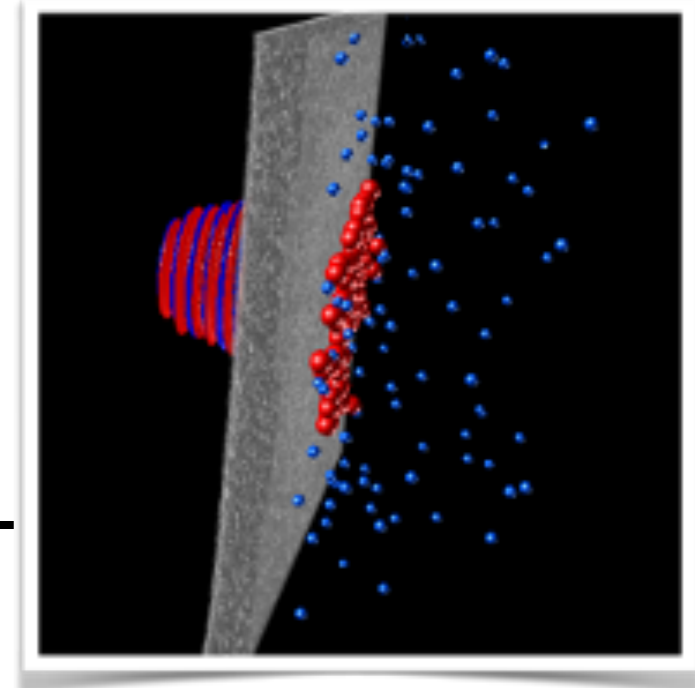
Laser driven ion sources



- **High intensity laser driven ion sources have unique features:**
 - Naturally extremely high peak current (< ps generation time)
 - Triggerable and on-demand
 - High energy from source (up to ~100 MeV)
- **Attractive for delivering ions at high instantaneous dose rate**

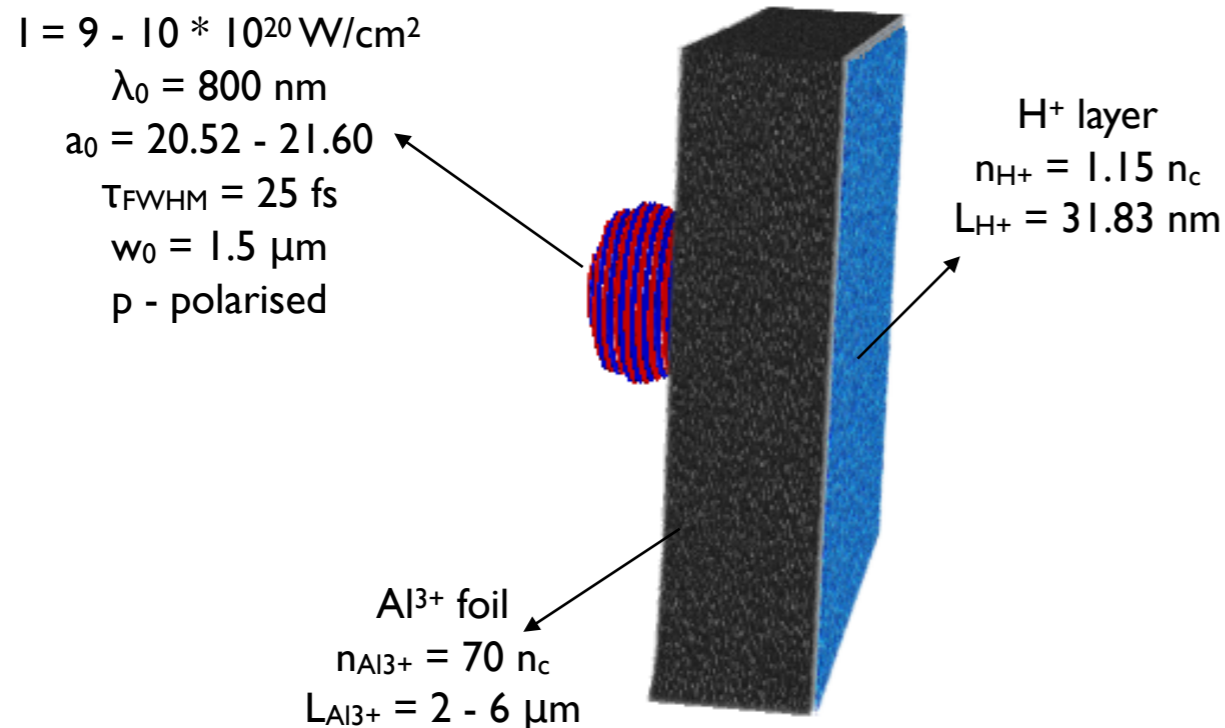
Progress towards ITRF milestones is on schedule

- **M2.1: Prediction of optimised proton source for 100+ TW laser systems based on hydrodynamic and kinetic simulations**
 - Due September 2023
 - Initial 3D simulations of LhARA-like source completed - E. Boella (Lancaster)
- **M2.2: First SCAPA ion source simulations and experiment completed**
 - Due March 2024
 - First experimental beam time booked - July 2023
 - Experimental area commissioning completed

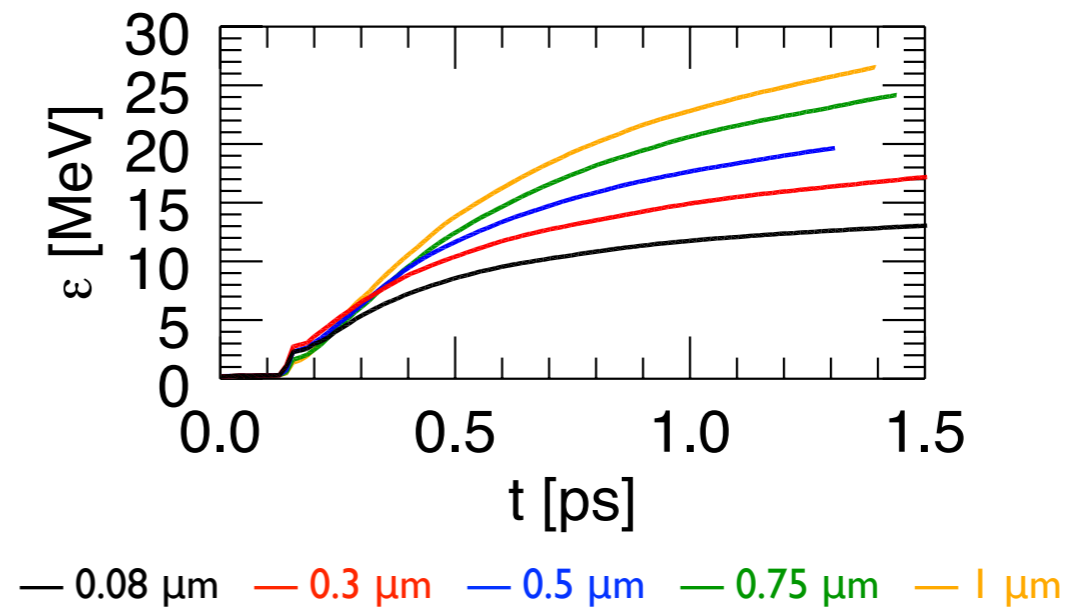


Progress on full 3D PIC simulations

Simulations and analysis performed by E. Boella (Lancaster)

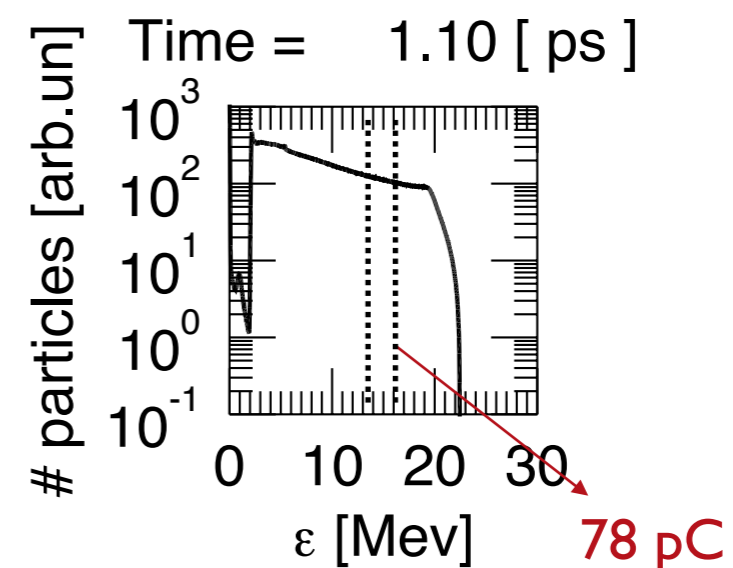


Proton cutoff energy vs time for different pre-plasma scale-lengths



- 3D simulations predict generation of ion beam parameters similar to LhARA baseline
- Optimal density profile will boost ion energies
- Currently developing workflow for modelling of effect of laser temporal pulse structure

Proton spectrum

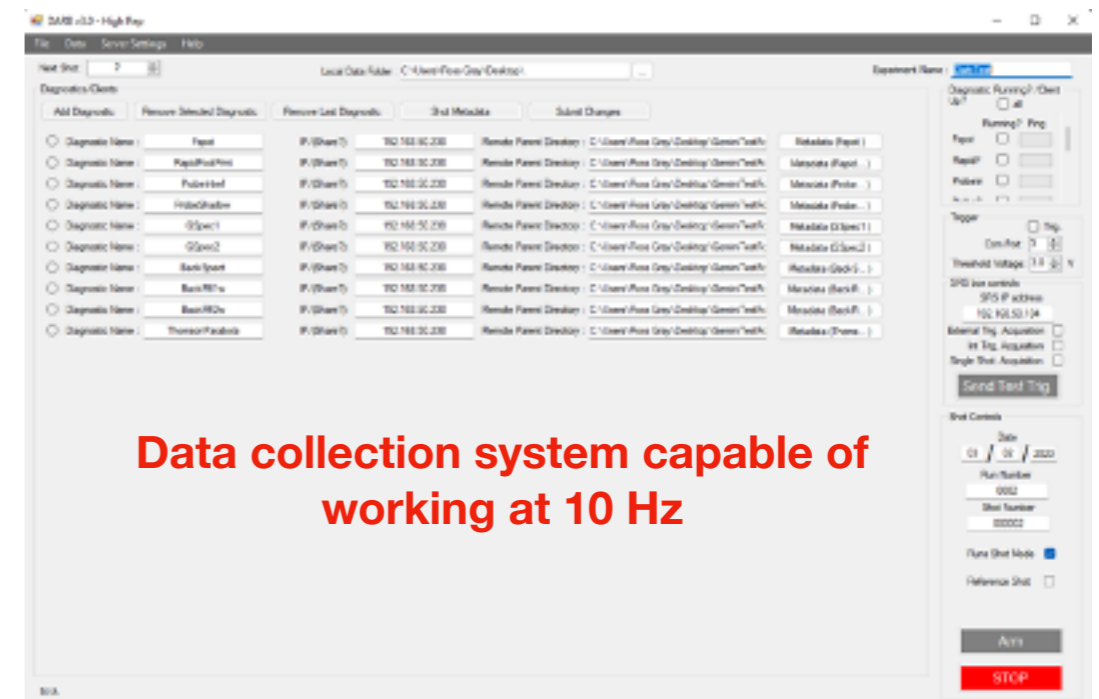
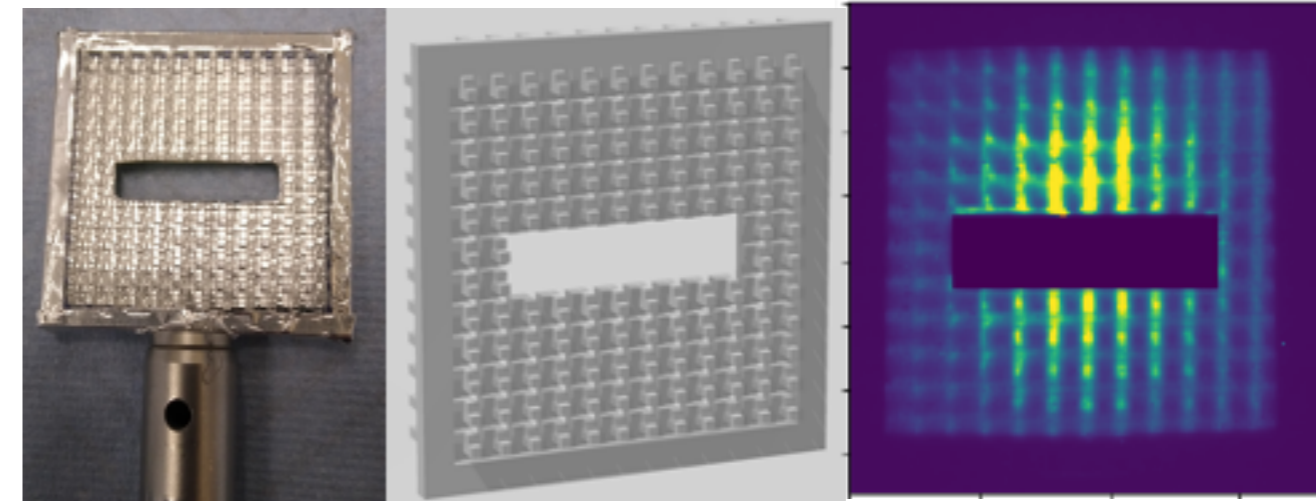


Progress towards SCAPA experiments

Led by R. Wilson & R. Gray (Strathclyde)

SCAPA: 8 J, 25 fs at 5 Hz repetition rate
up to $\sim 10^{20}$ W/cm²

Online beam spatial & spectral profile monitor



- Initial ion acceleration experiments performed at SCAPA using tape drive
- LhARA dedicated beamline planned for July 2023 for parametric source optimisation
- Diagnostic & hardware development ongoing

Other activities are also ongoing

- **Development of high repetition ion acceleration facility at ICL**
 - Driven by in-house 10-100 Hz ~100 mJ laser system, to address issues related to high repetition rate
 - High repetition ion source commissioning experiments have now begun
- **Other LhARA relevant experiments**
 - Strathclyde experiments at the Central Laser Facility investigating parametric optimisation of laser plasma interaction
- **Ongoing discussions with WP3/WP6 on beamline interface**
- **New collaboration on debris with CLF, overlap with development of STFC funded EPAC facility**
 - Sharing of diagnostics, equipment and experimental access for measurements

Summary

- WP2 team making excellent progress towards fulfilling the ITRF milestones to schedule
- Many complementary and collaborative activities underway at Imperial, SCAPA, Lancaster, QUB and CLF
- Provided funding has given much needed impetus to LhARA related R&D and collaborative activity
- Full exploitation of the ion source will require further R&D and investment at later stages of the project