

Laser driven ion source session:

12:00~12:15 - Nick Dover (Imperial):

Update on WP2 progress

12:15~12:30 - Ross Gray (Strathclyde):

Update on SCAPA commissioning for high repetition rate operations

12:30~12:40 - Brendan Loughran (QUB):

Summary of developments in automation and optimisation of laser-driven ion acceleration

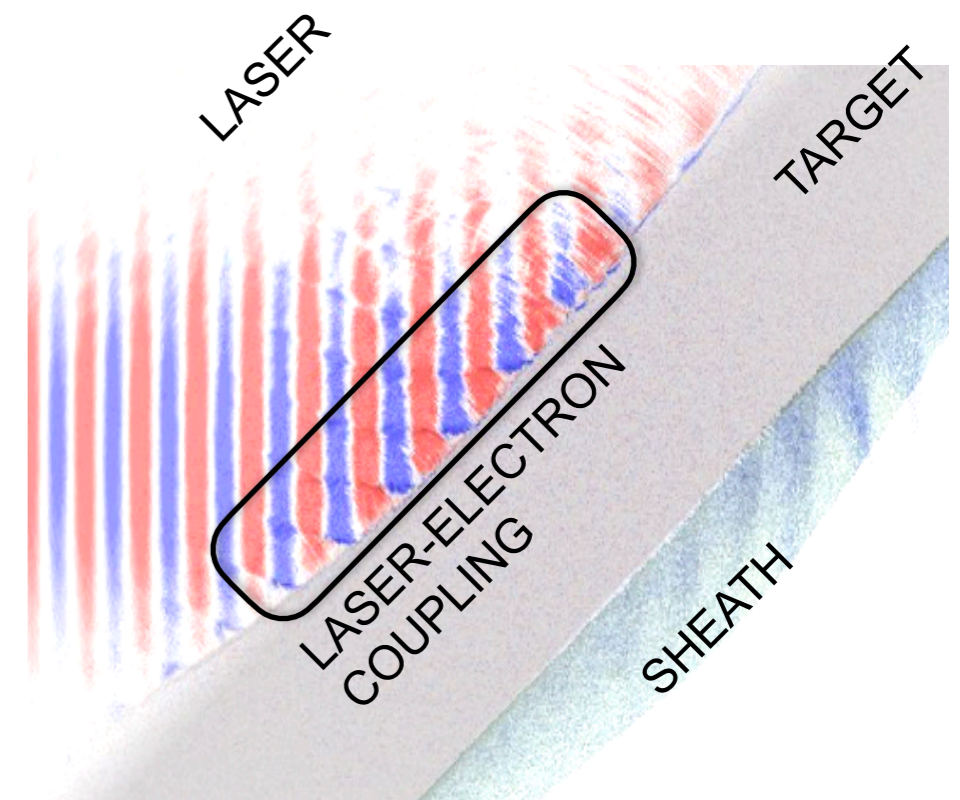
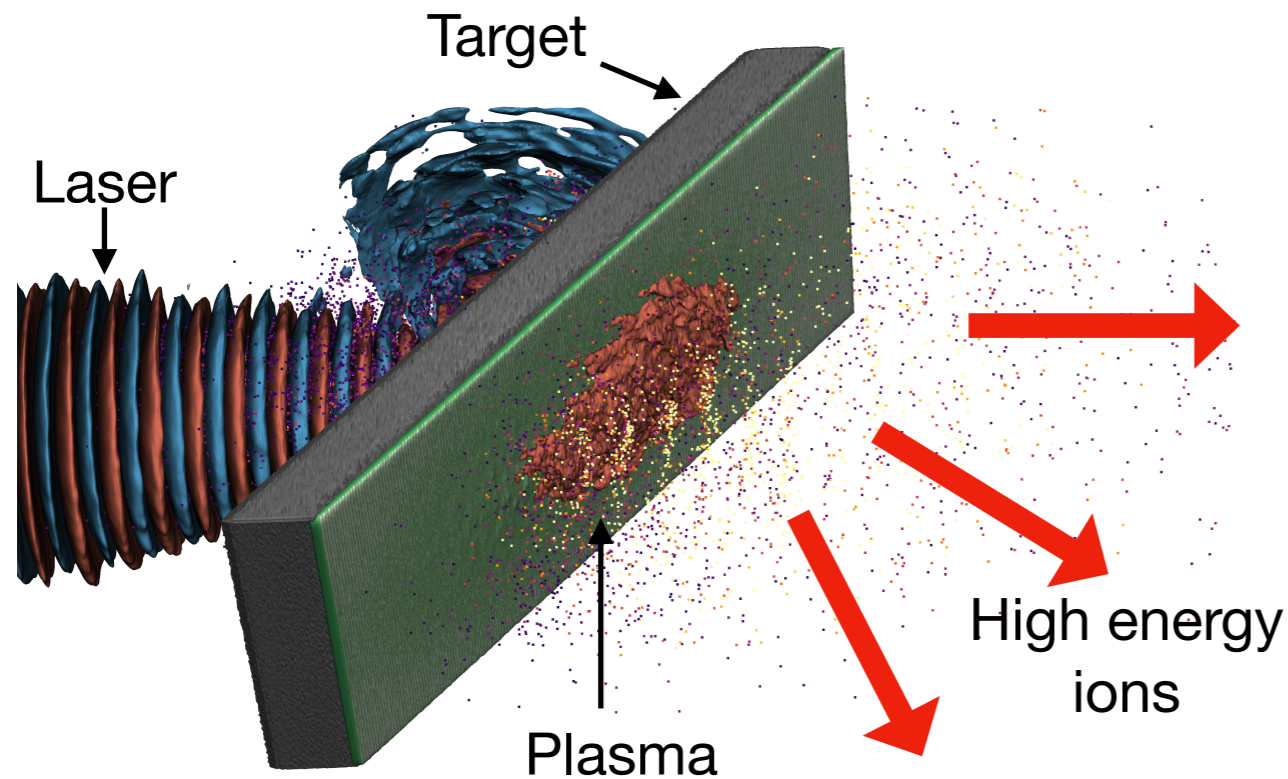
12:40~12:50 - Charlotte Palmer (QUB):

Update on development of liquid jet targets

Update of WP2 progress

N. Dover, on behalf of WP2: E. Boella (**Lancaster**), R. Gray, P. McKenna, R. Wilson (**Strathclyde**), N. Xu, O. Ettliger, Z. Najmudin (**Imperial**), B. Loughran, C. Palmer (**QUB**), J. Green, C. Armstrong (**CLF**) and many others...

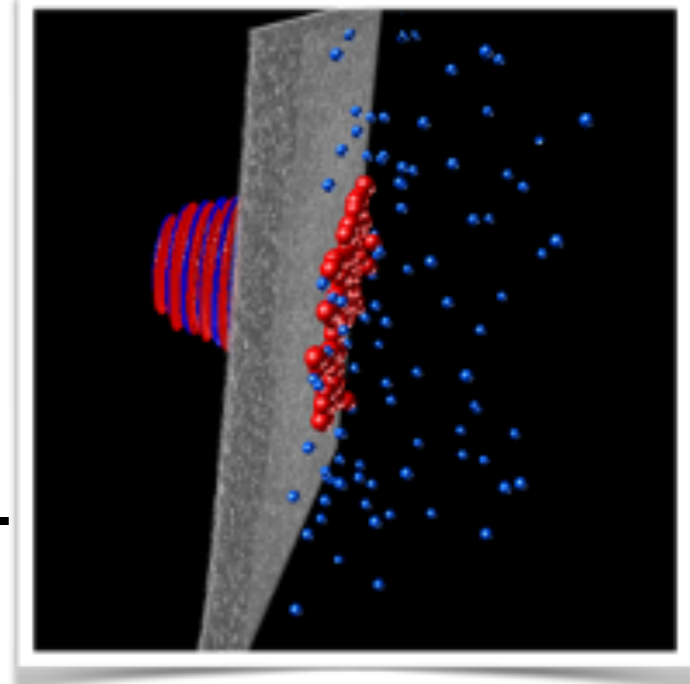
Laser driven ion sources



- **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
 - See next talk by R. Gray (Strathclyde)



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
 - Experimental chamber commissioned, experiments to start next month
- **Other LhARA relevant experiments**
 - Strathclyde experiments at the Central Laser Facility investigating parametric optimisation of laser plasma interaction
- **Ongoing discussions with WP3/WP6 on interface with beamline**
 - Producing accurate source parameters for downstream beamline optimisation

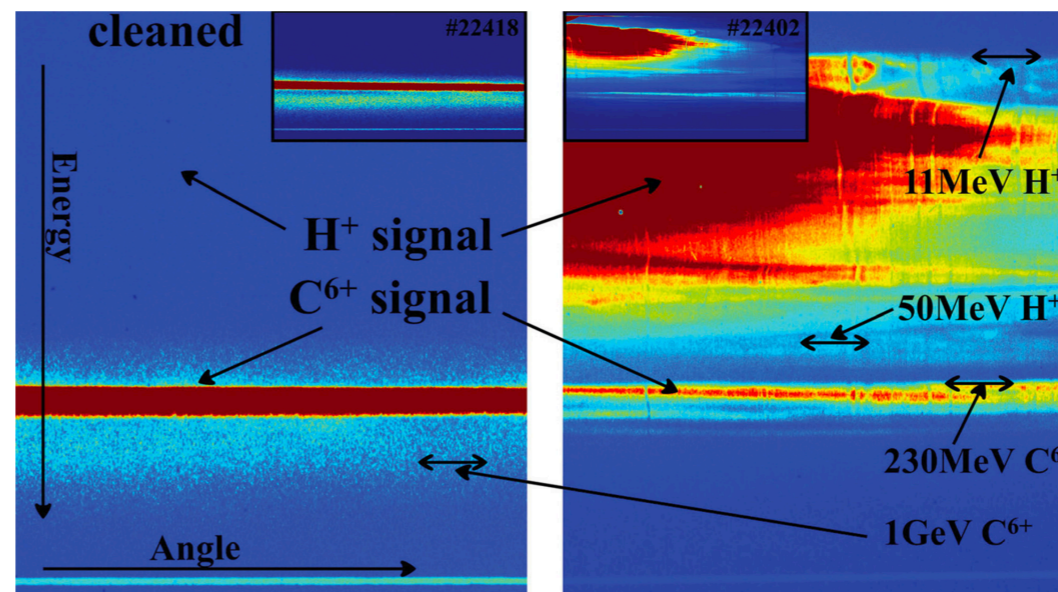
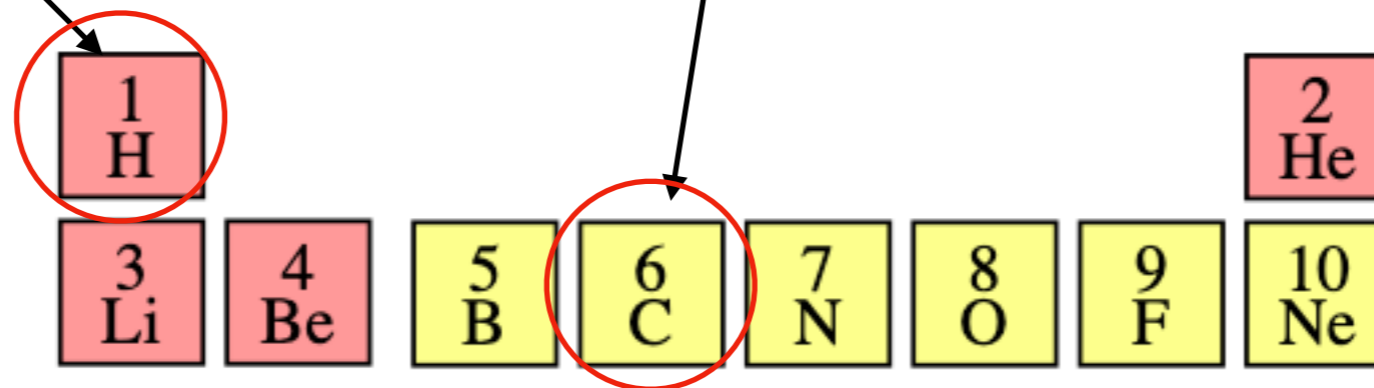
Current scope of funded research

- **For ITRF preliminary activity, limited funds leads to focused scope:**
 - Generation of proton (15 MeV) and carbon (4 MeV/u) beams using existing “tape” targets
 - Specifying required laser for LhARA facility
 - Investigating risks to the project related to high repetition, sustainable operation
- **Other important activities currently not funded**
 - Development of bespoke diagnostics
 - Advanced targetry (e.g. liquid sheet) for higher quality beam generation and risk mitigation - see later talk by C. Palmer
 - Generating ion species other than carbon/protons

Producing different ion species

Easy to produce from contaminants on any solid material, or liquids/ cryogenic targets

In contaminants or organic liquids, but acceleration efficiency will be suppressed by protons. Pure carbon targets available, but not shown at high rep rate

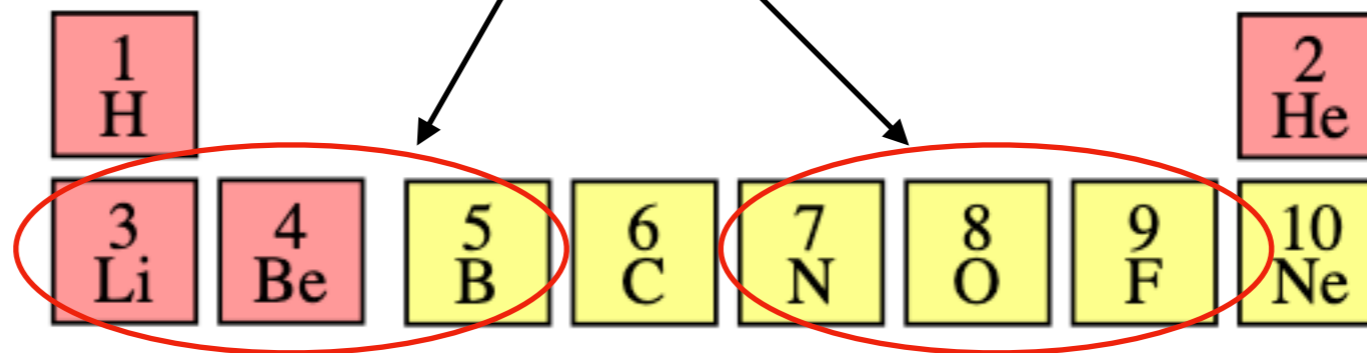
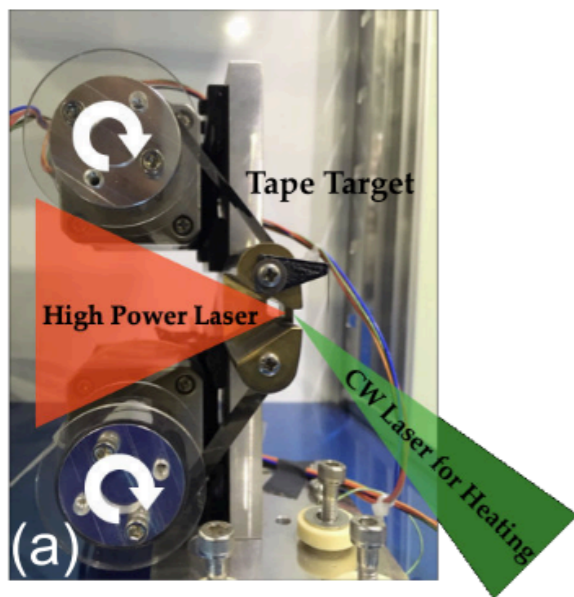


e.g. Safranov+ Phys. Plasmas 25, 103114 (2018)

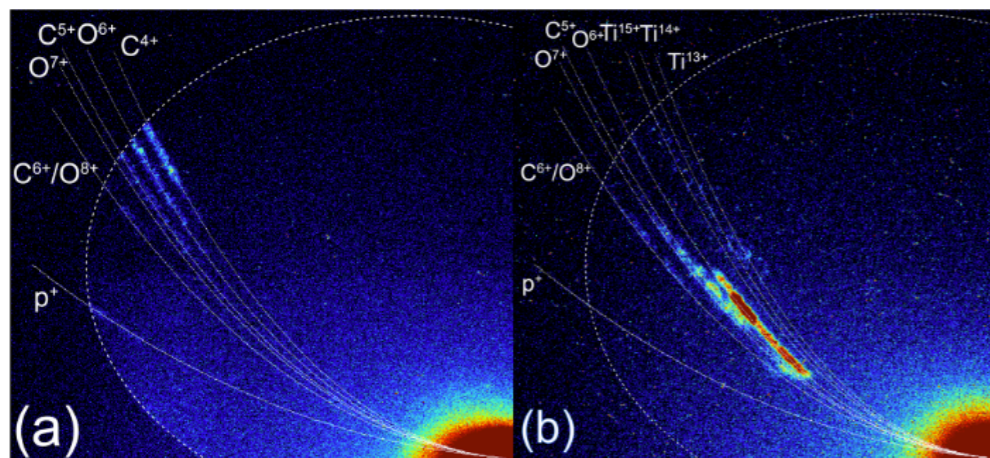
e.g. Jung+ Phys. Plasmas 20, 083103 (2013)

Producing different ion species

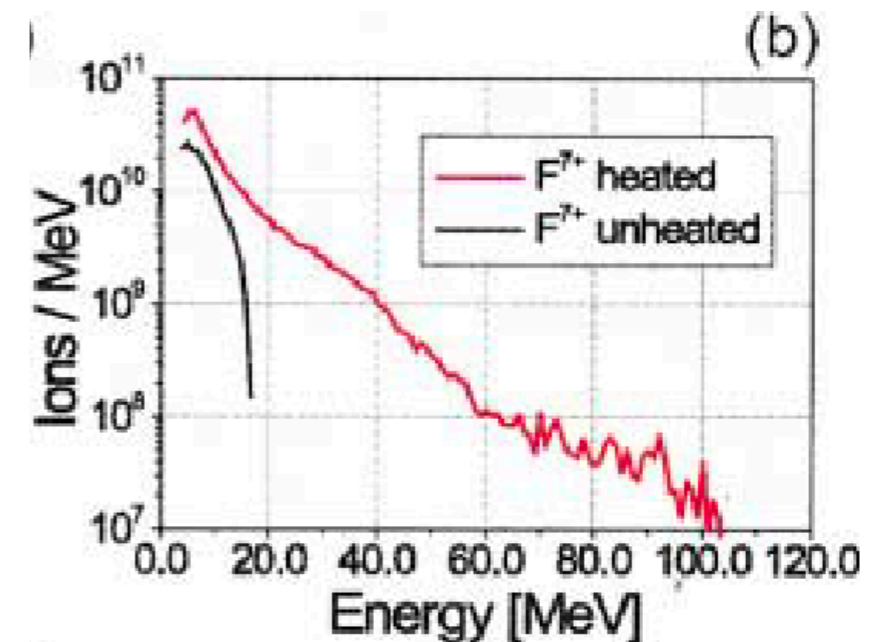
Can be found in pure foils, in compounds or e.g. oxide layers. R&D required to conceptualise and develop high repetition target delivery system



Kondo et al. Crystals 10, 837 (2020)

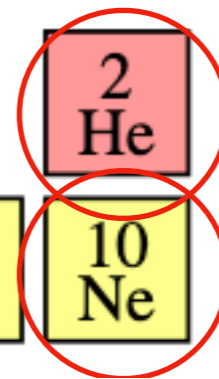


e.g. Hegelich+ PRL 89, 8 (2002)



Producing different ion species

Extremely challenging for LhARA-type laser systems, significant R&D needed!



Gas jets? No one has demonstrated high energies/flux using Ti:Sapph drive laser

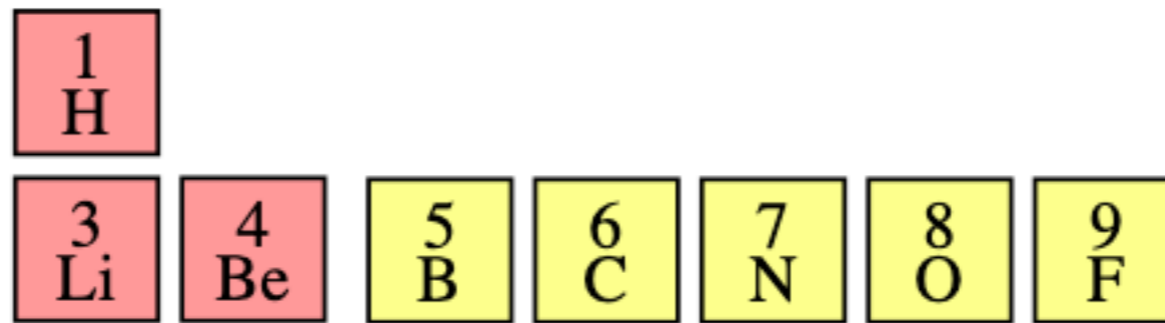
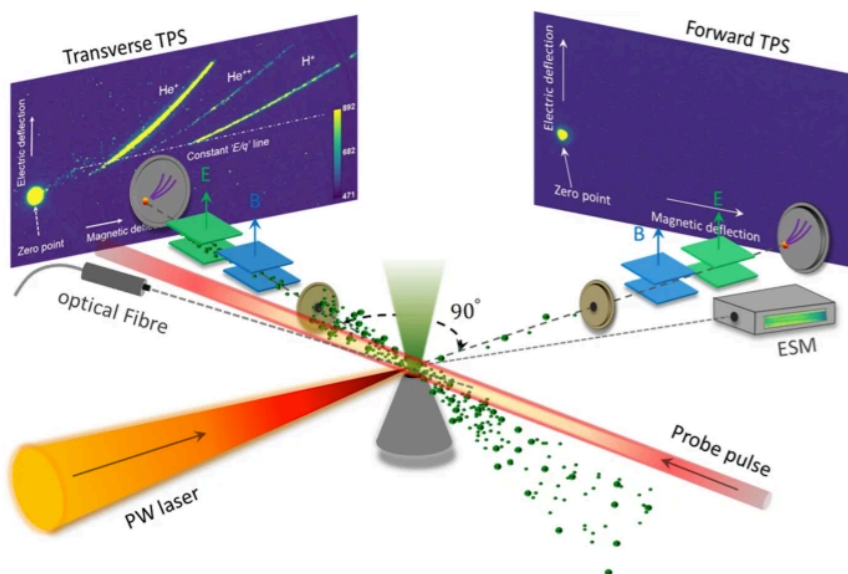


Figure 1

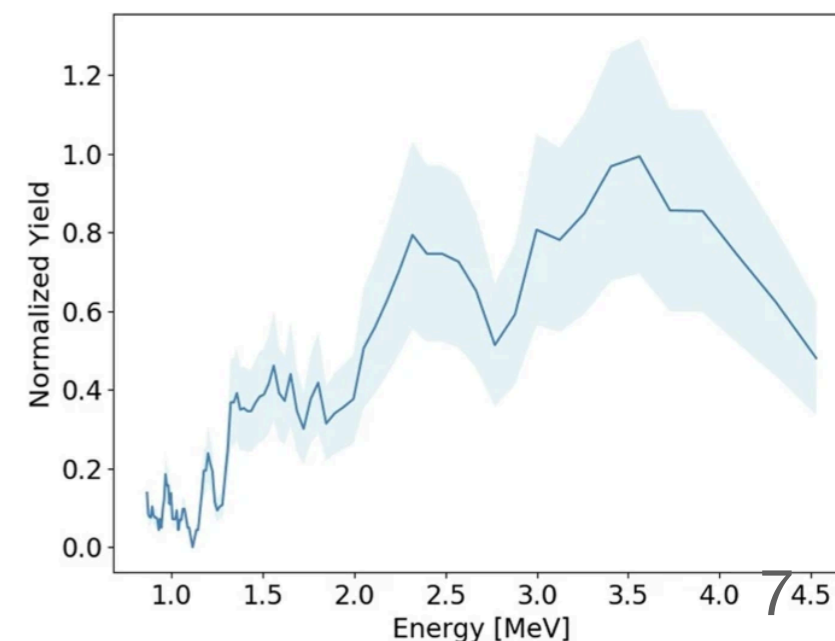


e.g. Singh+ Sci. Rep. 10, 18452 (2020)

For He, induced nuclear fusion reactions? Optimisation and potential flux not understood

e.g. Istokskaja+ Comm. Phys. 6, 27 (2023)

Fig. 3: Alpha particles energy distribution.



Producing different ion species

- **Each ion type will present its own unique set of challenges**, with some being more difficult than others!
- **We are currently focusing on delivery of H & C -**
 - Important to identify any other ions early (and recognise that significant resources required to deliver them!)

Summary

- WP2 team making excellent progress towards fulfilling the promised ITRF milestones
- Many complementary activities underway at Imperial, SCAPA, Lancaster, QUB and CLF
- Full exploitation of the ion source will require further R&D and investment at later stages of the project
- See more details in the next talks!

Laser driven ion source session:

12:00~12:15 - Nick Dover (Imperial):

Update on WP2 progress

12:15~12:30 - Ross Gray (Strathclyde):

Update on SCAPA commissioning for high repetition rate operations

12:30~12:40 - Brendan Loughran (QUB):

Summary of developments in automation and optimisation of laser-driven ion acceleration

12:40~12:50 - Charlotte Palmer (QUB):

Update on development of liquid jet targets