

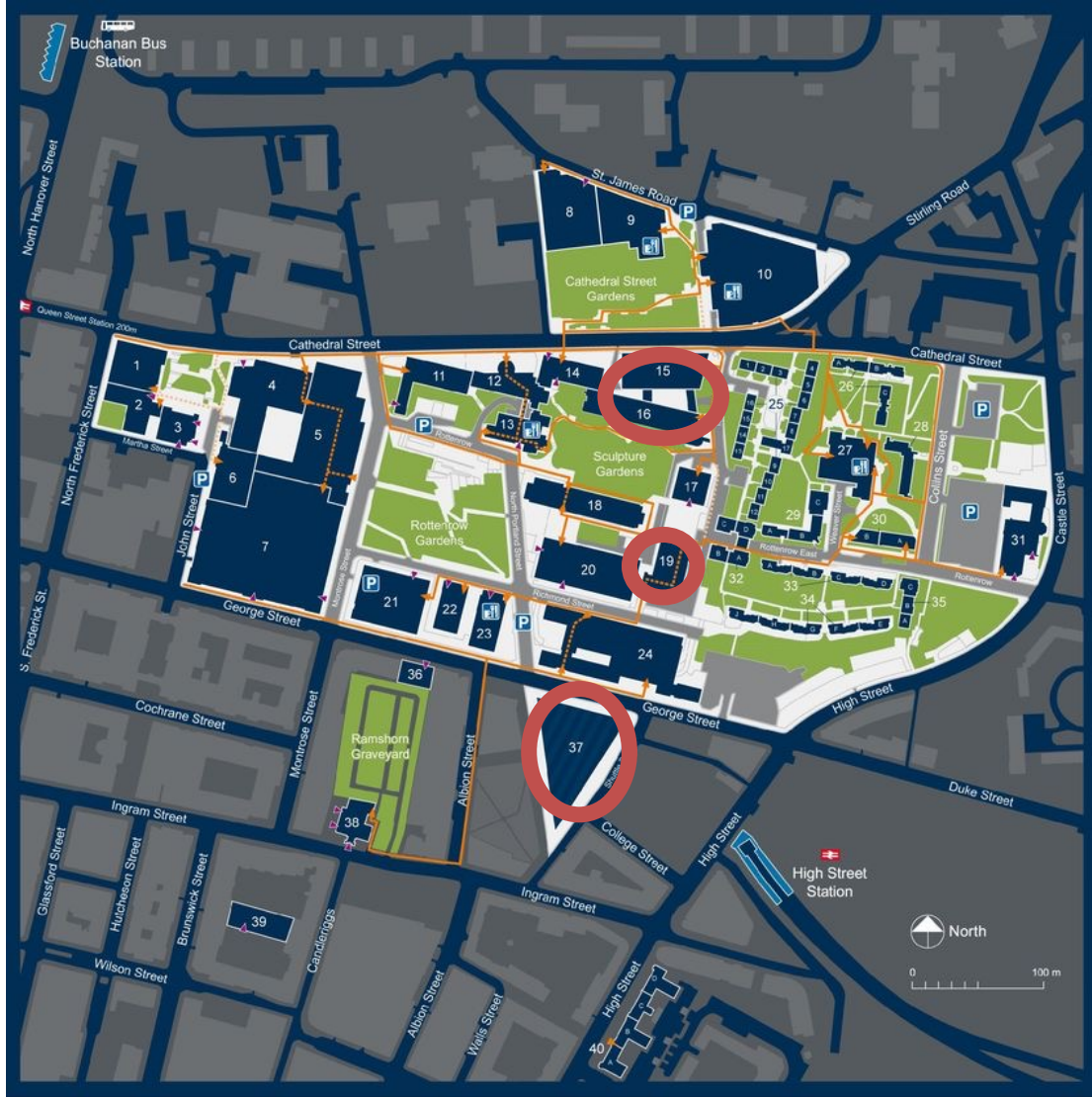


LhARA-relevant capability at Strathclyde

Colin Whyte

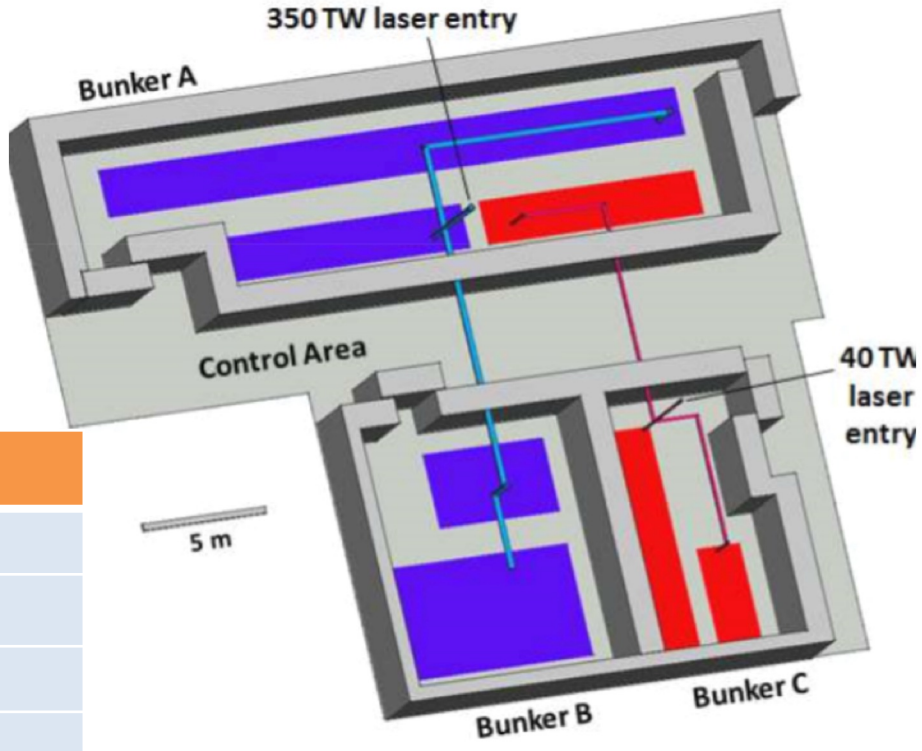


University of Strathclyde

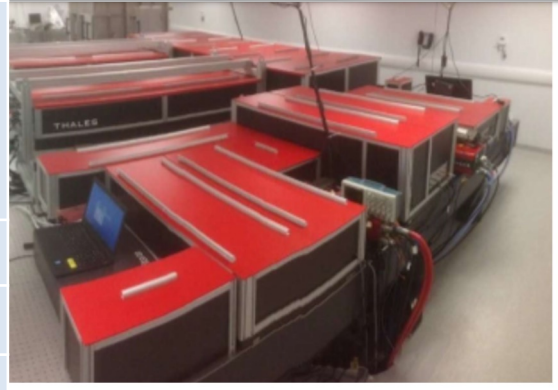




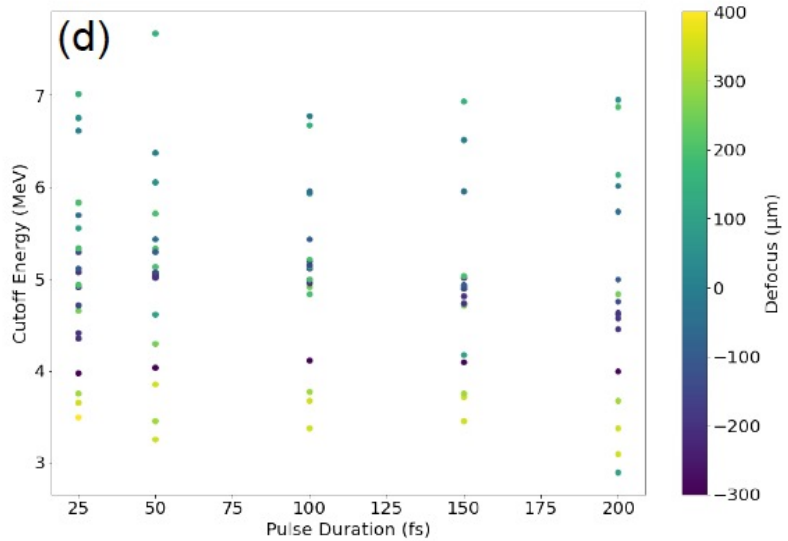
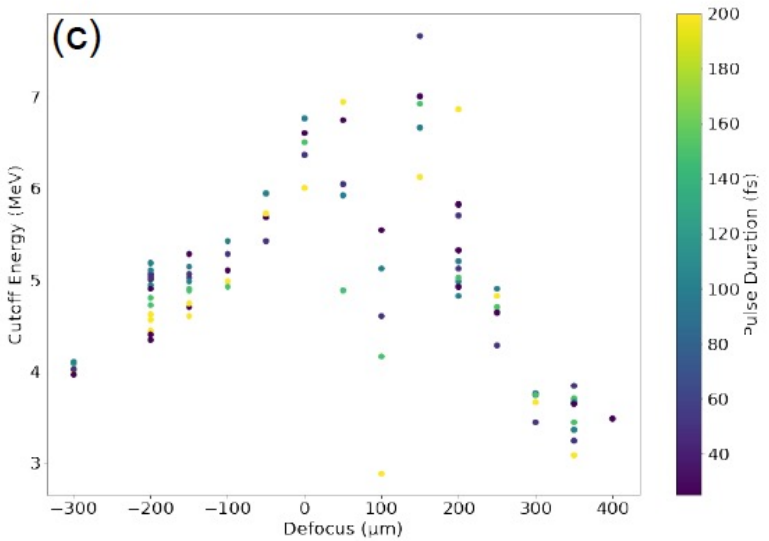
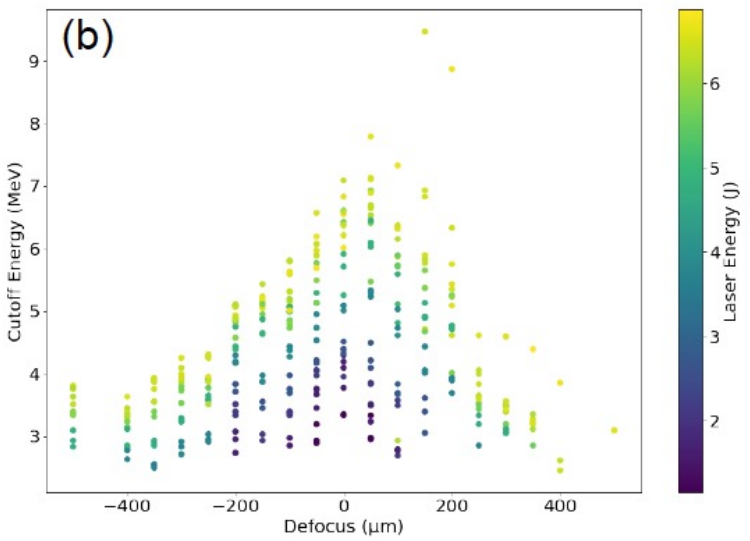
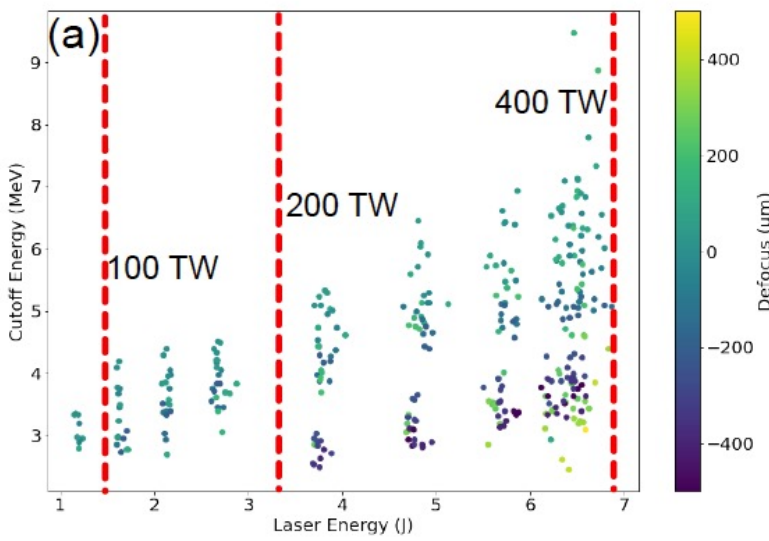
SCAPA: Scottish Centre for Application of Plasma based Accelerators



Parameters	
Peak Power	$\geq 350 \text{ TW}$
FWHM pulse duration	$\leq 25 \text{ fs}$
Energy per pulse	$\geq 6.5 \text{ J}$
Pulse repetition rate	Up to 5 Hz
Temporal intensity contrast	$10^{10}:1$ @ 100 ps $10^8:1$ @ 30 ps $10^4:1$ @ 2 ps ASE contrast $10^{10}:1$
Central wavelength	800 nm
Beam quality Strehl ratio	≥ 0.85
Attenuator	10-100%



Summary of July 2023 Beamtime Results



Objectives for January 2024 beamtime

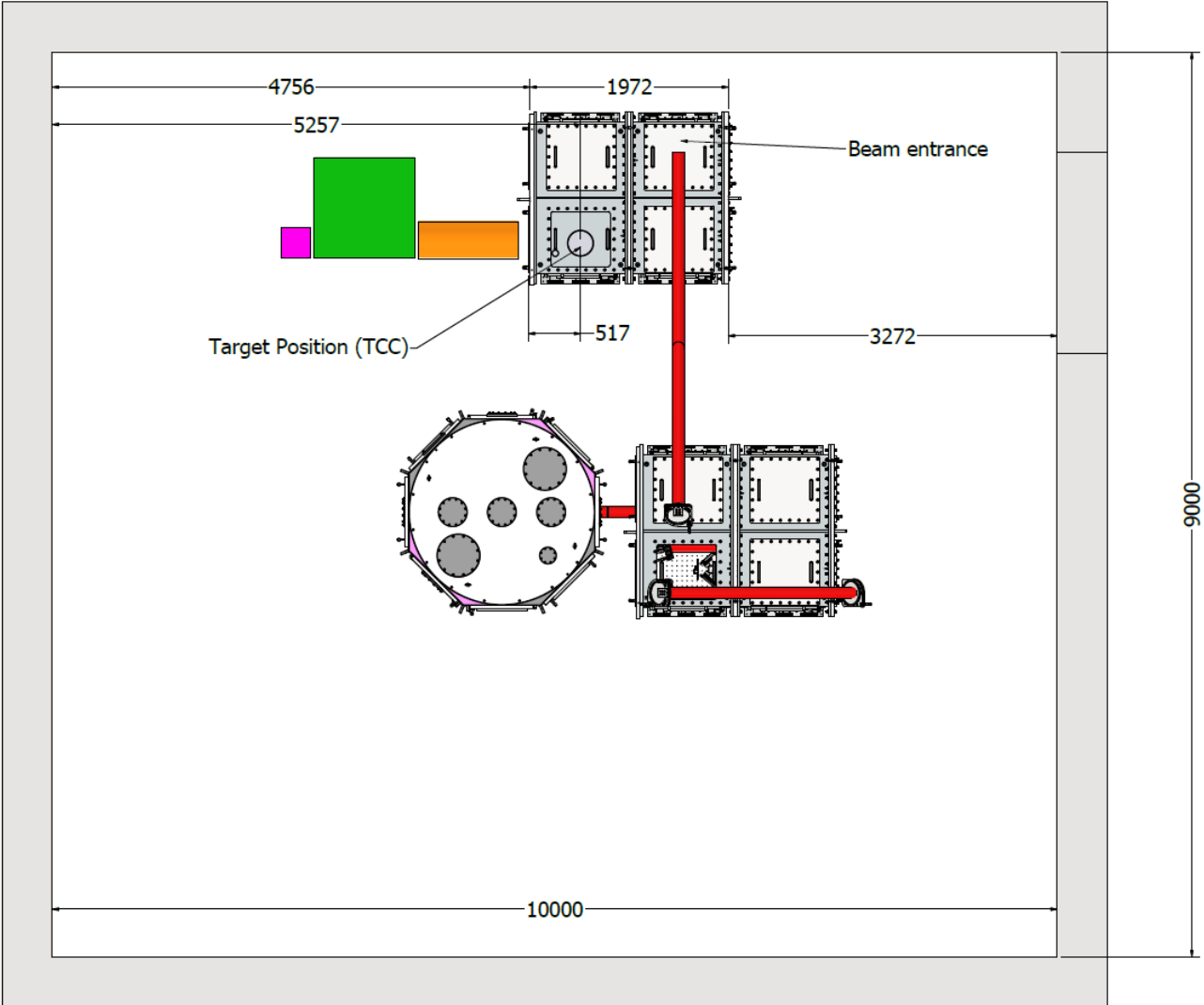
Objective 1: Ion acceleration characterisation @1 Hz (~1 Week)

- **Pre-plasma scale length, pulse 3rd order dispersion and pulse wavefront.**
- Characterisation of generated proton/ion beam,
 - Max. E_p , energy spectrum and beam divergence
- **with thinner target thickness wrt previous experiment.**
- Characterisation of generated proton beam parameter stability over a period of time @ 1Hz operation

Objective 2: Diagnostic and control system tests (~1 Week)

- Calibration of the Thomson Parabola employing slotted image plate to gain **real proton/ion numbers.**
- 1 Hz operation testing of new control system (**parameter selection automation and machine safety system**).

Proof of Principle Experiment Concept (31/10/2023)





SCAPA Experiment Team....



University of Strathclyde

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Imperial College

O. Ettliger, G. Casati and N.P. Dover



Queens University Belfast

P. Parsons and C. Palmer



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M. Wiggins, E. Brunetti, G. Manahan, W. Li

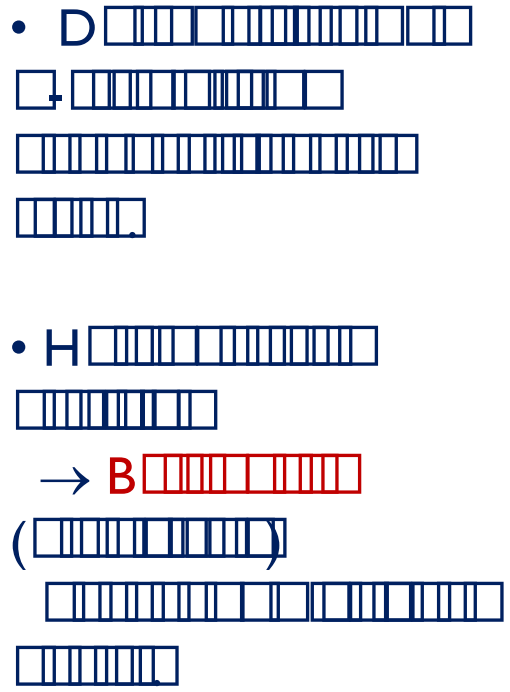
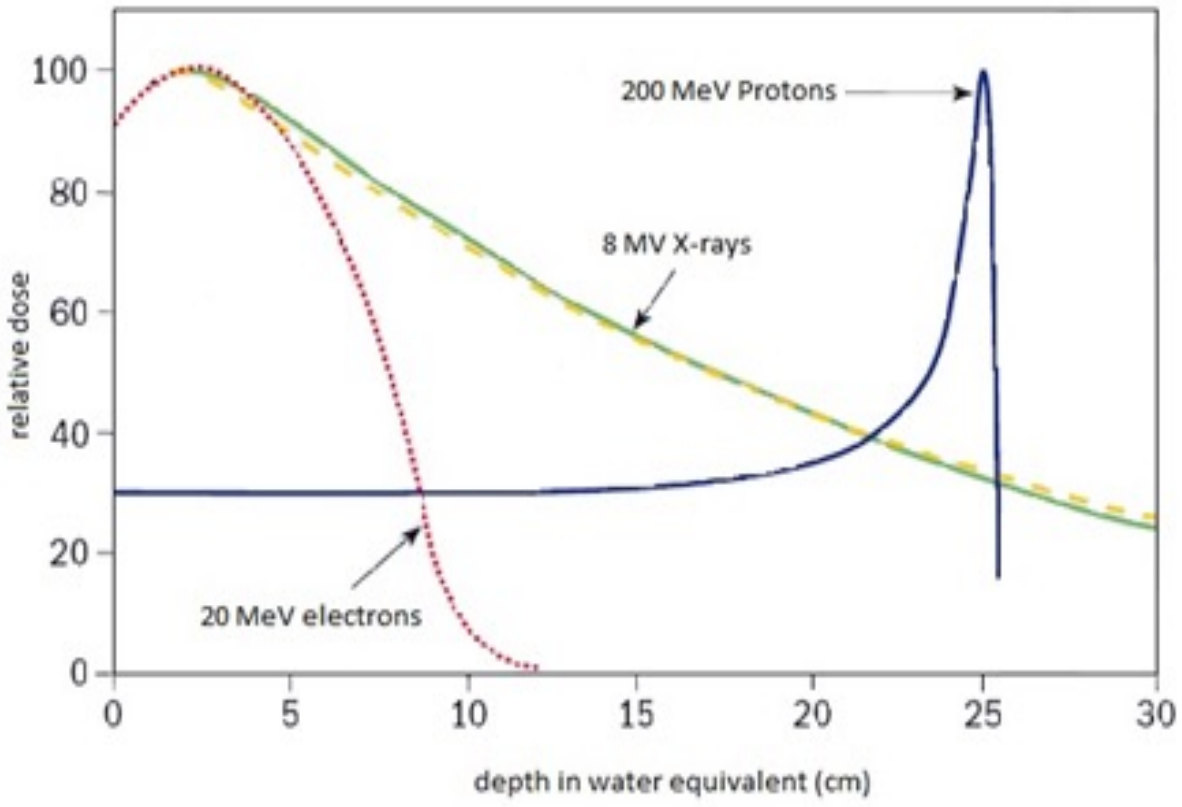


Central Laser Facility

J. Green, C. Armstrong, C. Spindloe, W. Robins,
S. Astbury

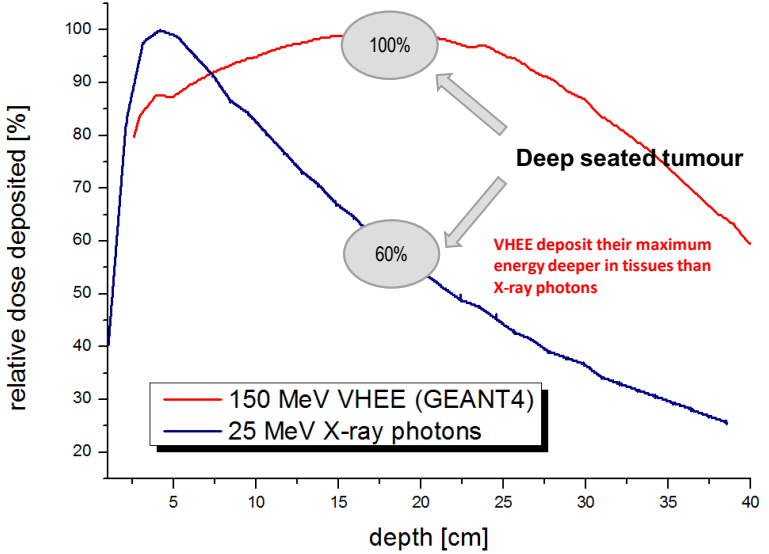


VHEE Radiotherapy



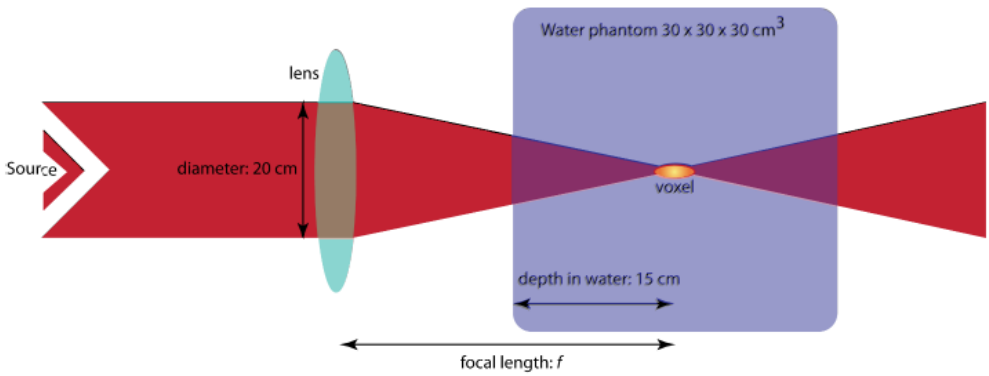
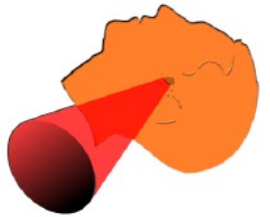
- **C**
- **E**
- **H**

Radiotherapy with very high energy electrons (VHEE)



- C... D... B... 45, 1781 (2000).
- HEE (>100 ...) B... 59, 5811 (2014).
9, 10837 (2019).
- D... B... 76, 345 (2020).

Focusing electron beam
→ further improved dose deposition



- D... CE... EA...
- ... D. A. ... C... 4, 33 (2021).



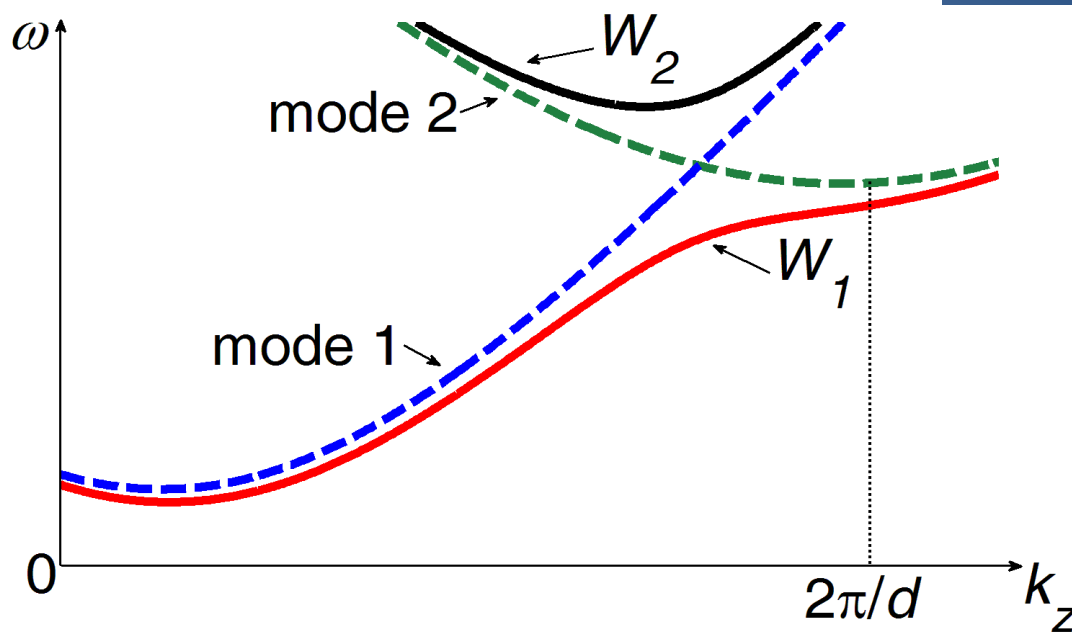
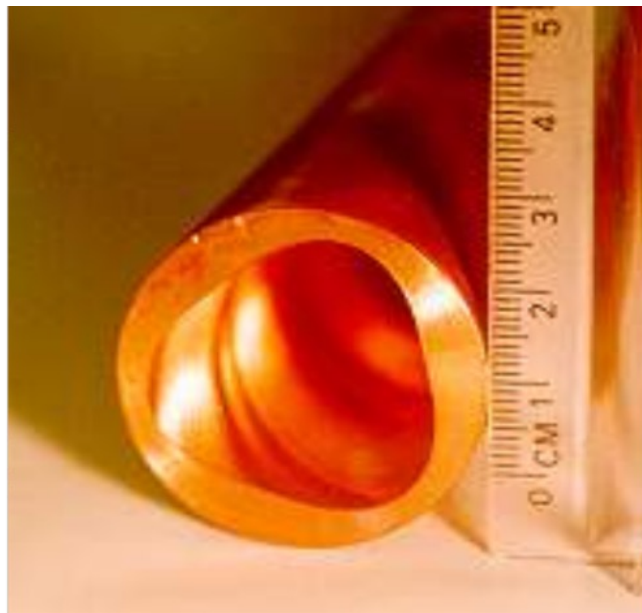
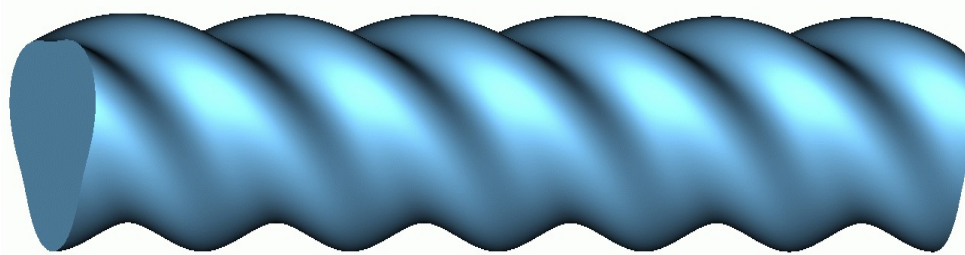
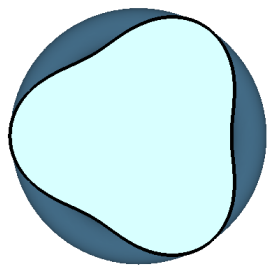
ABP Group - TIC Laboratories

New £1M facility in
flagship
Technology and
Innovation Centre

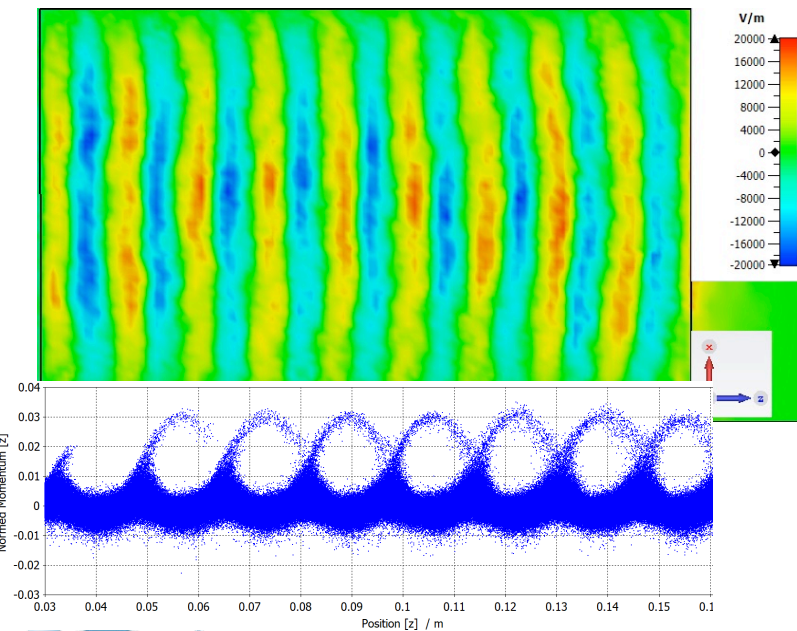




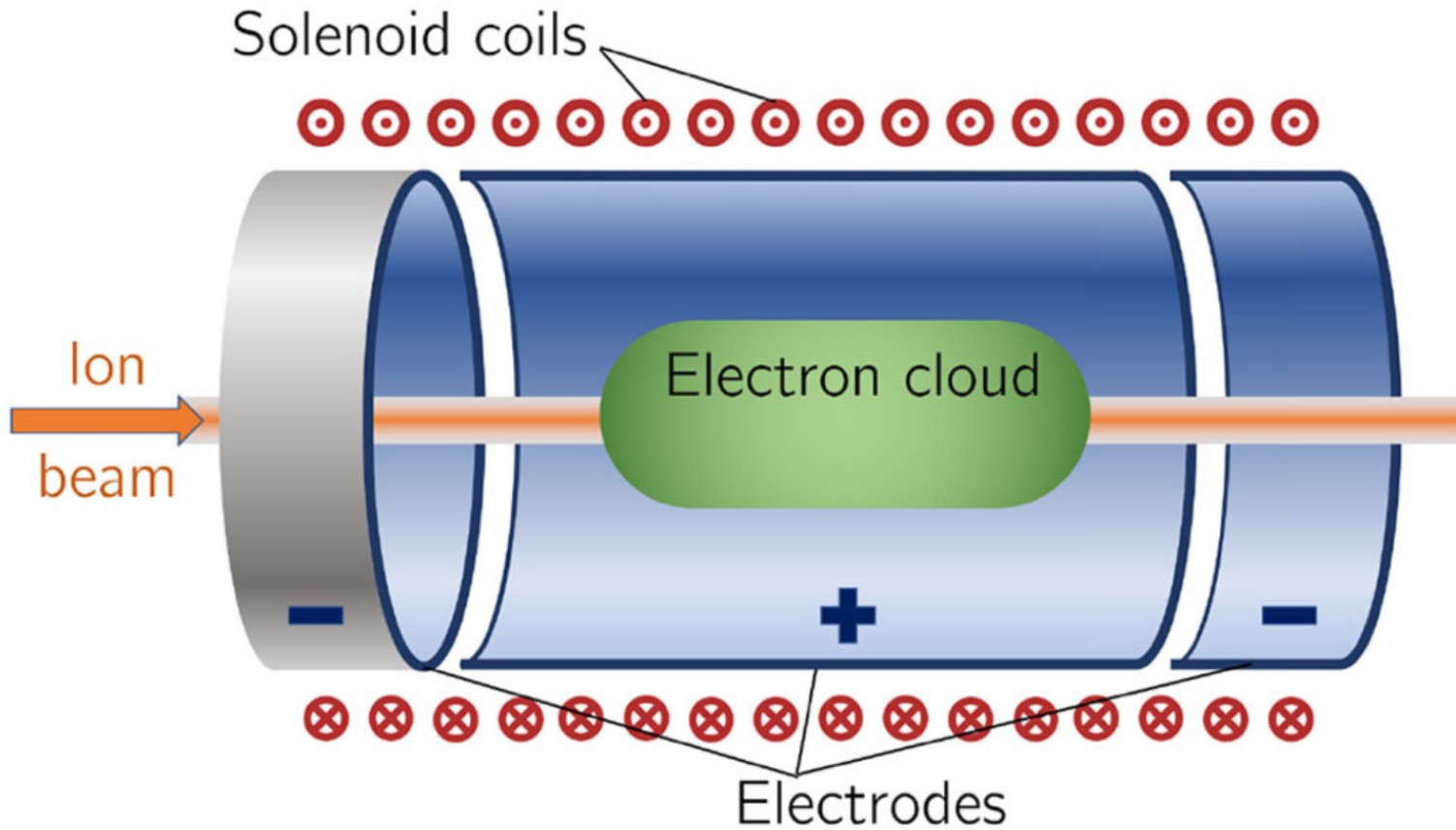
Strathclyde ABP group – electron beams & EM waves



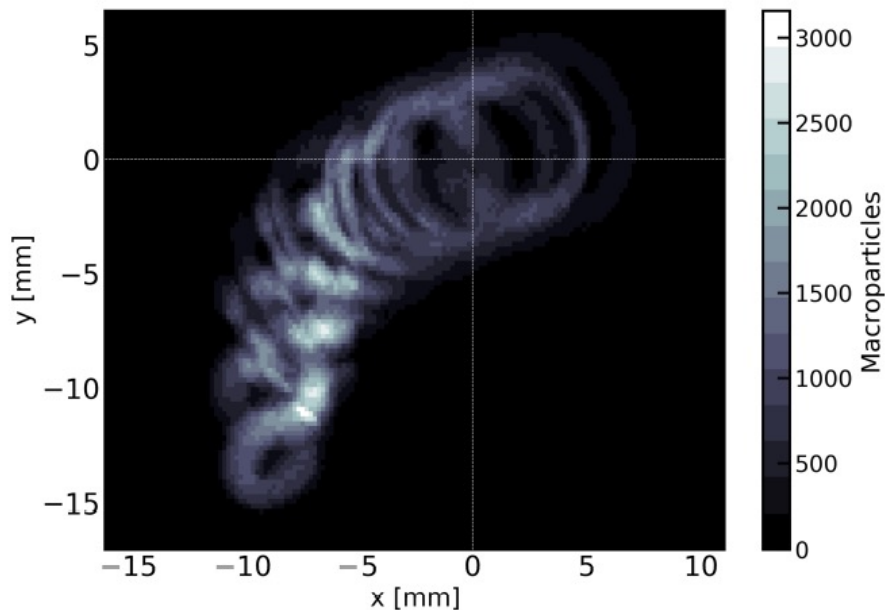
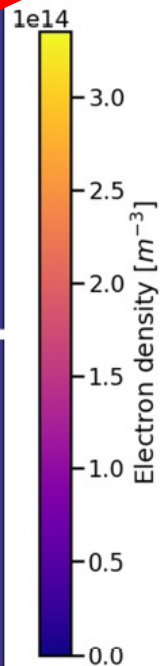
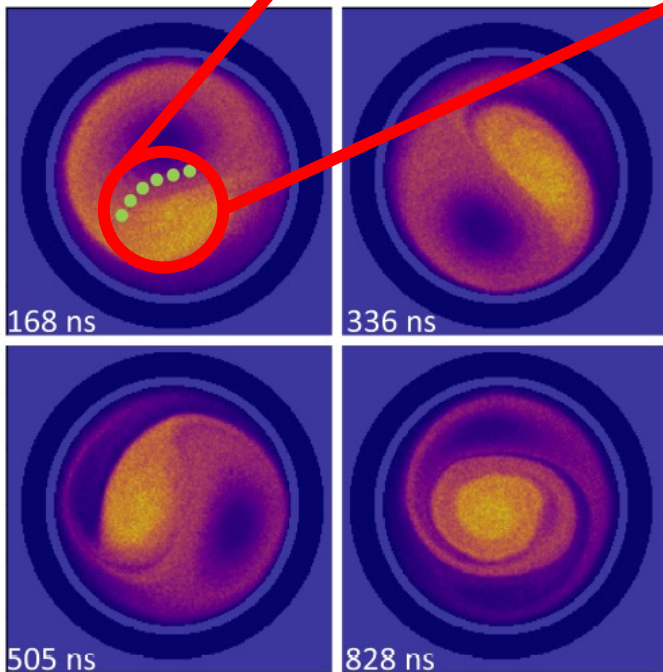
- Simulations of wave-plasma coupling
 - Upper hybrid/RAMAN excitation
 - Relevant to fusion applications
 - Fully kinetic PiC simulations



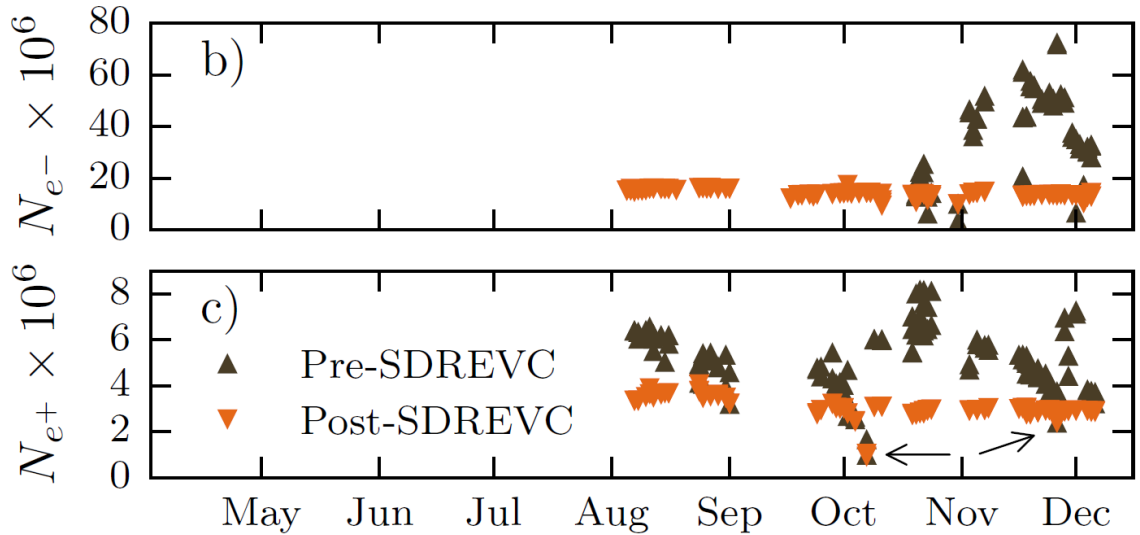
Basic Gabor Lens



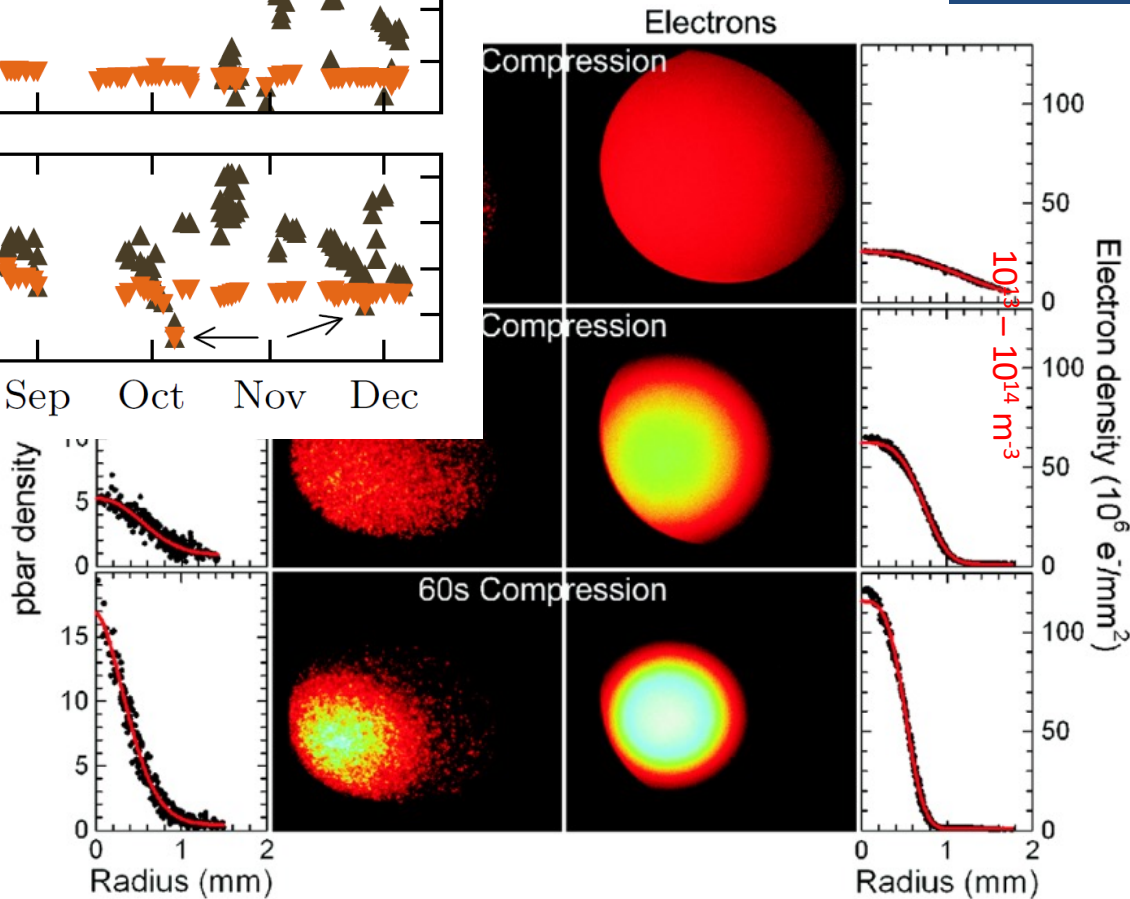
Plasma Instabilities



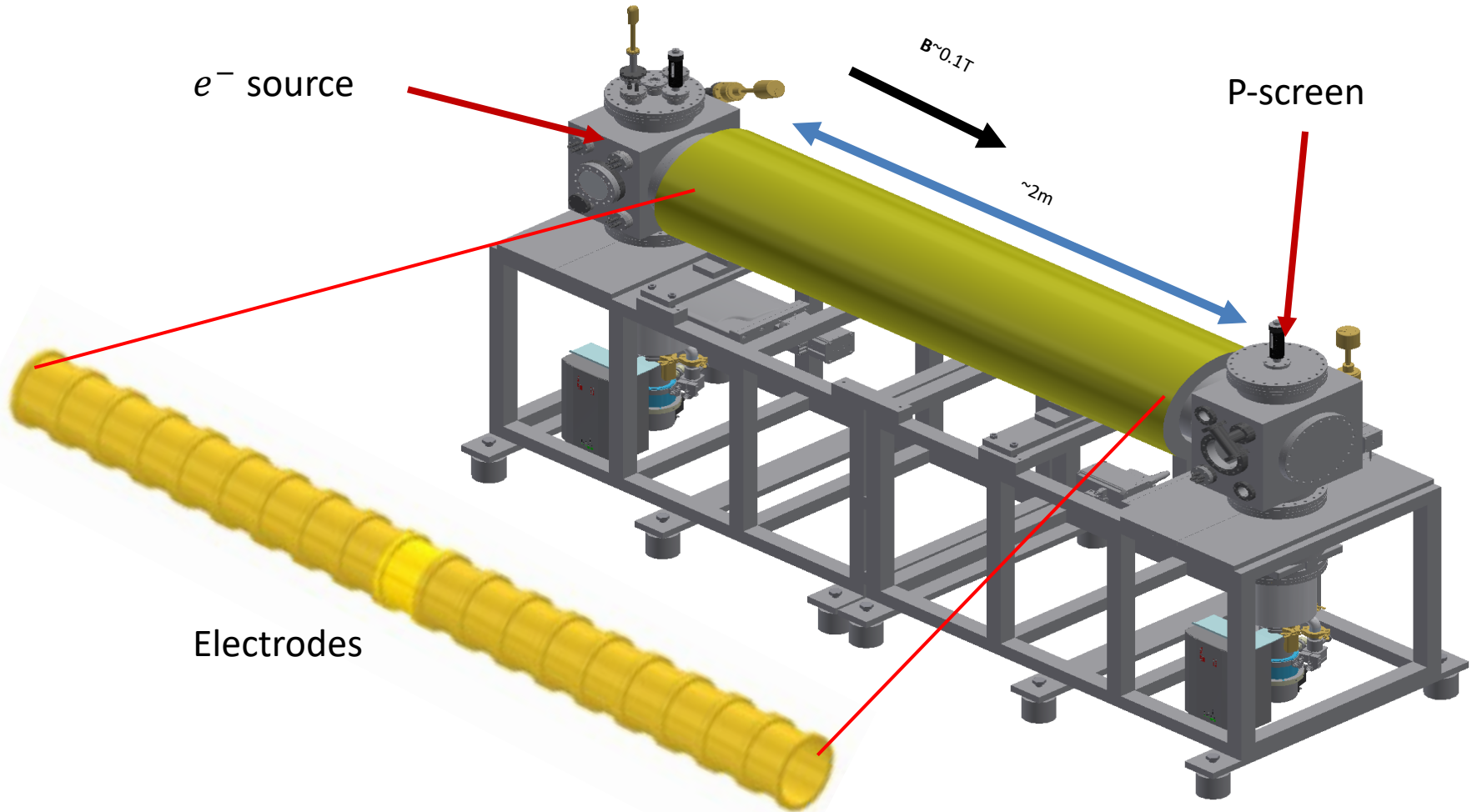
Existing plasma in ALPHA at CERN



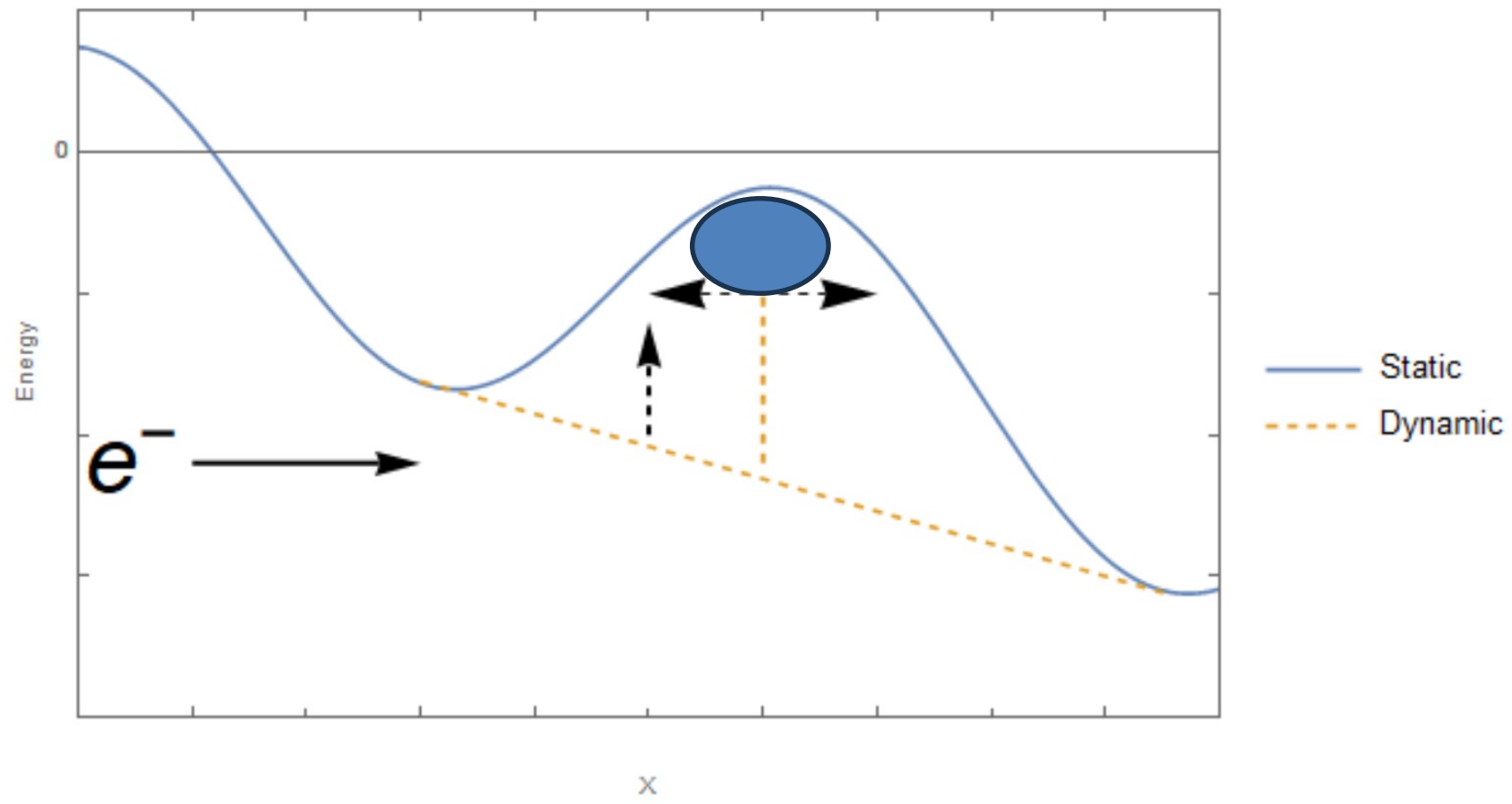
- Length ~ 10 cm
- Radius ~ 0.5 mm (at 1T)
- Density $10^{12} - 10^{14} \text{ m}^{-3}$



Swansea - Proposed Apparatus

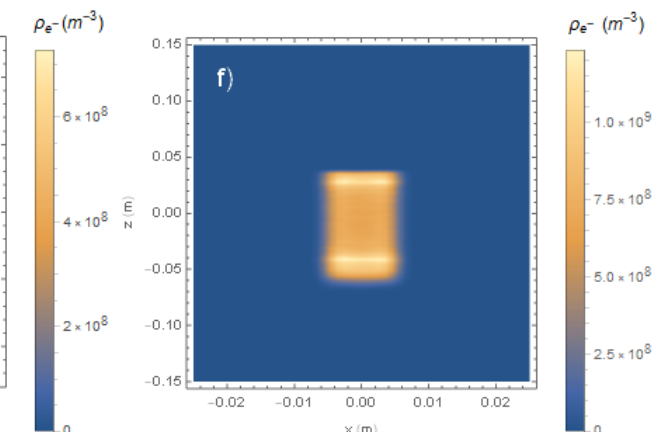
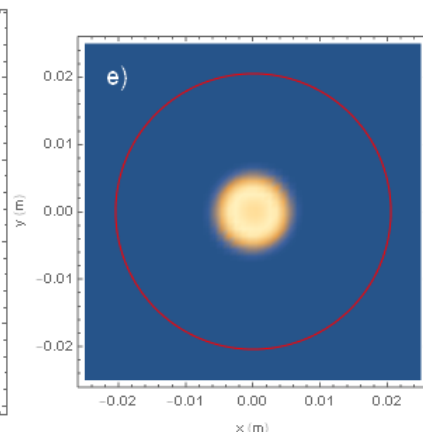
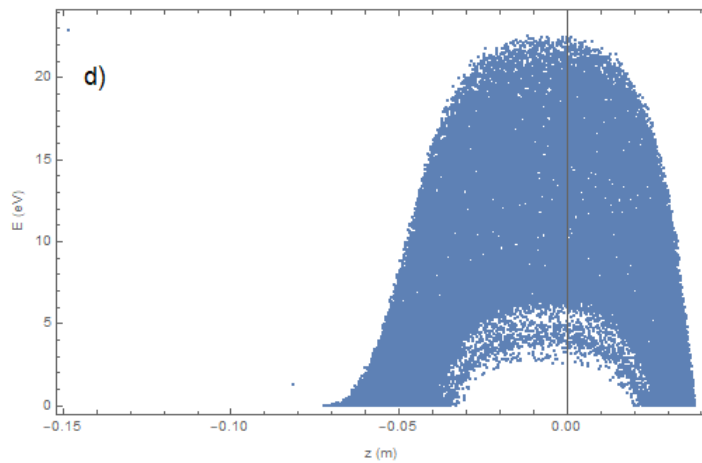
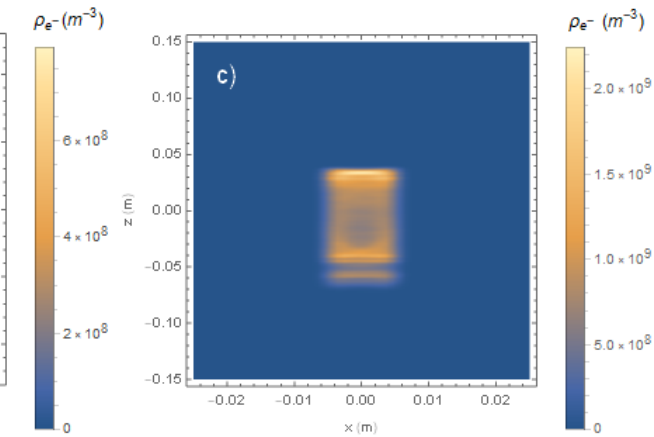
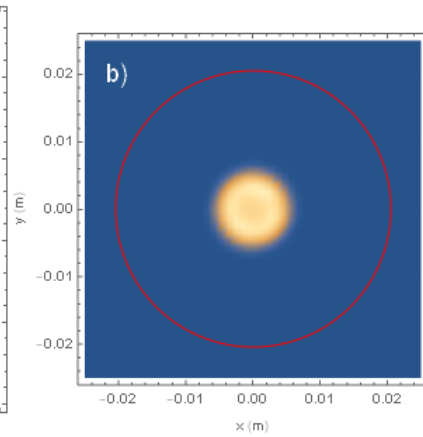
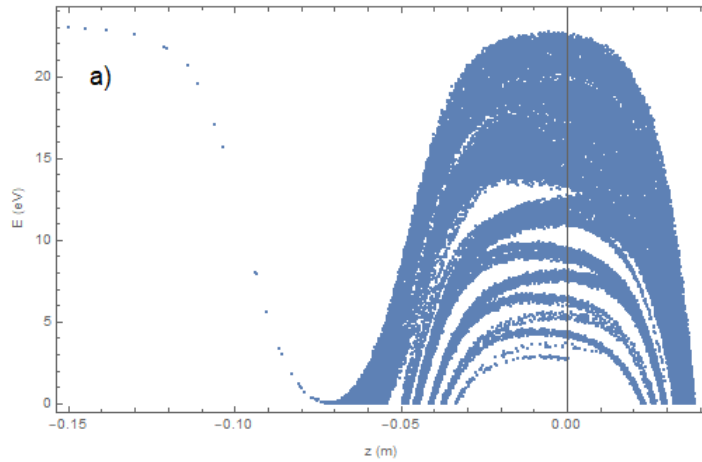


Gabor Lens - filling



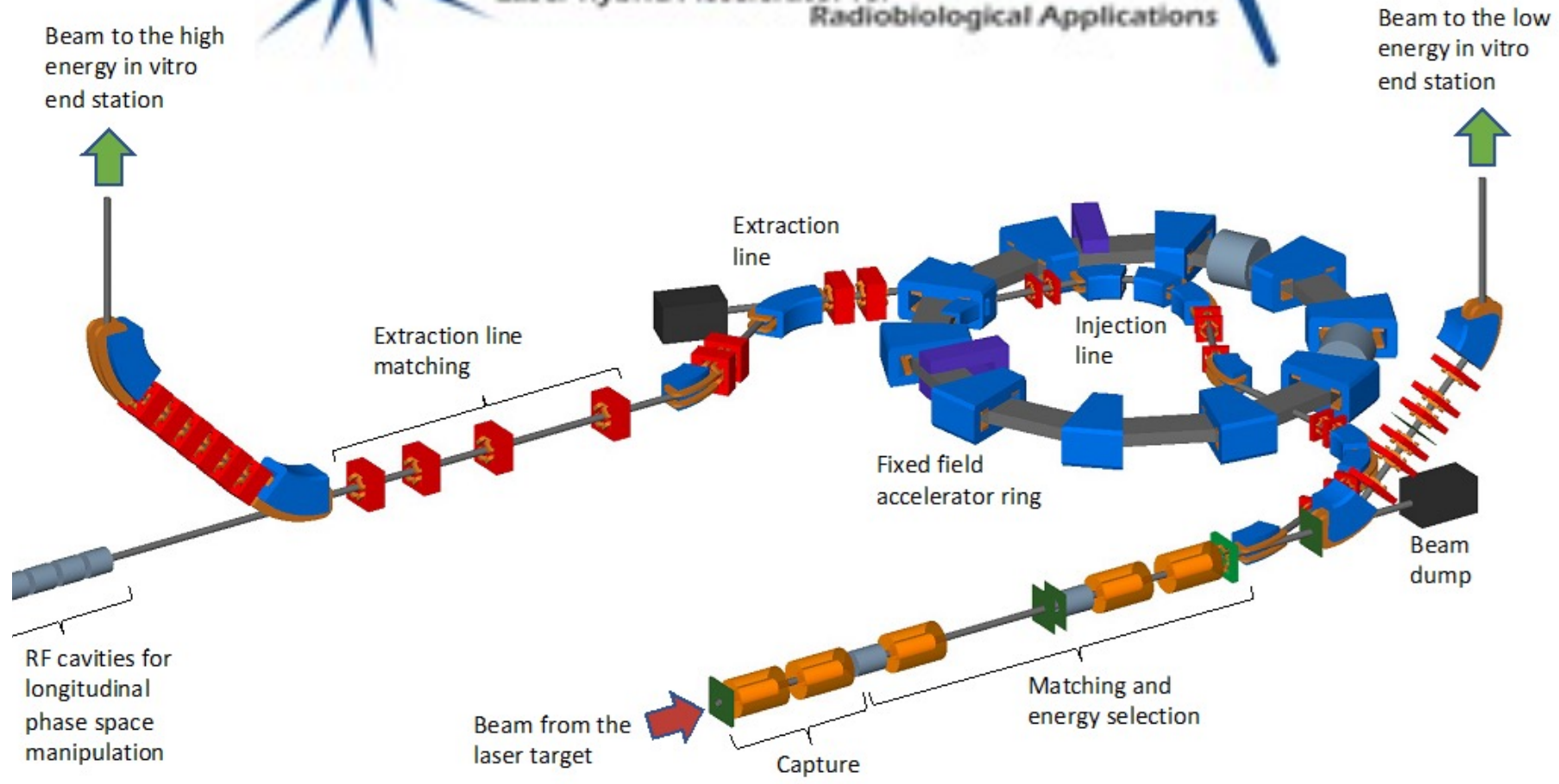
EMANA CM4 & TRF 12th. Review

Swansea - Gabor lens - Stability



LhARA

Laser-hybrid Accelerator for Radiobiological Applications





LhARA @ Strathclyde

- SCAPA
 - UK wide collaboration
 - Unique & available laser capability
 - Local biological capability plus backup
 - Experimental capability
- ABP plus Swansea – Gabor Lens
 - Power – sustainability
 - Stability expertise
 - High voltage engineering and safety
- Local to :
 - Beatson
 - Glasgow University