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Hz-Rate Laser-Solid Ion Source Platform at SCAPA

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Mini-workshop on high repetition rate laser-driven ion acceleration at
AAC2026

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SCAPA: Scottish Centre for the Application of Plasma-based Accelerators

www.scapa.ac.uk

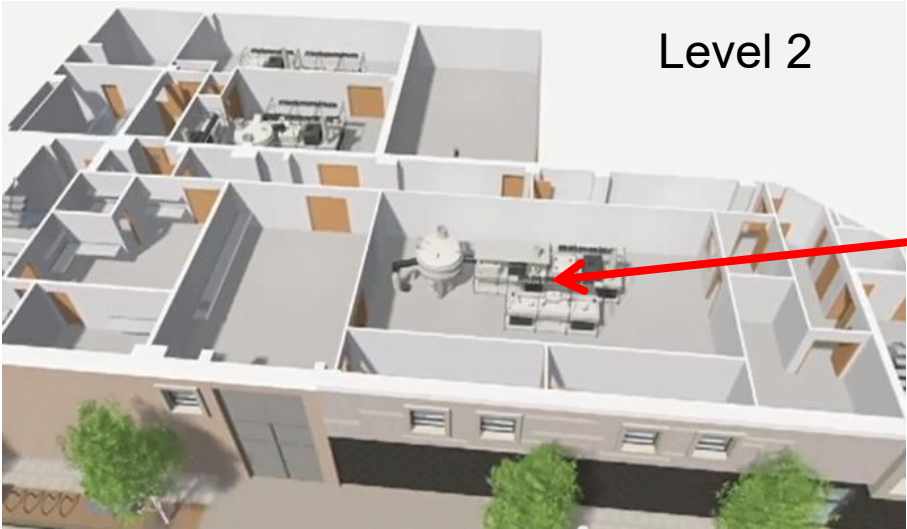


High-intensity fs laser systems:

- a) 350 TW at 5 Hz,
- b) 40 TW at 10 Hz,
- c) sub-TW at kHz.

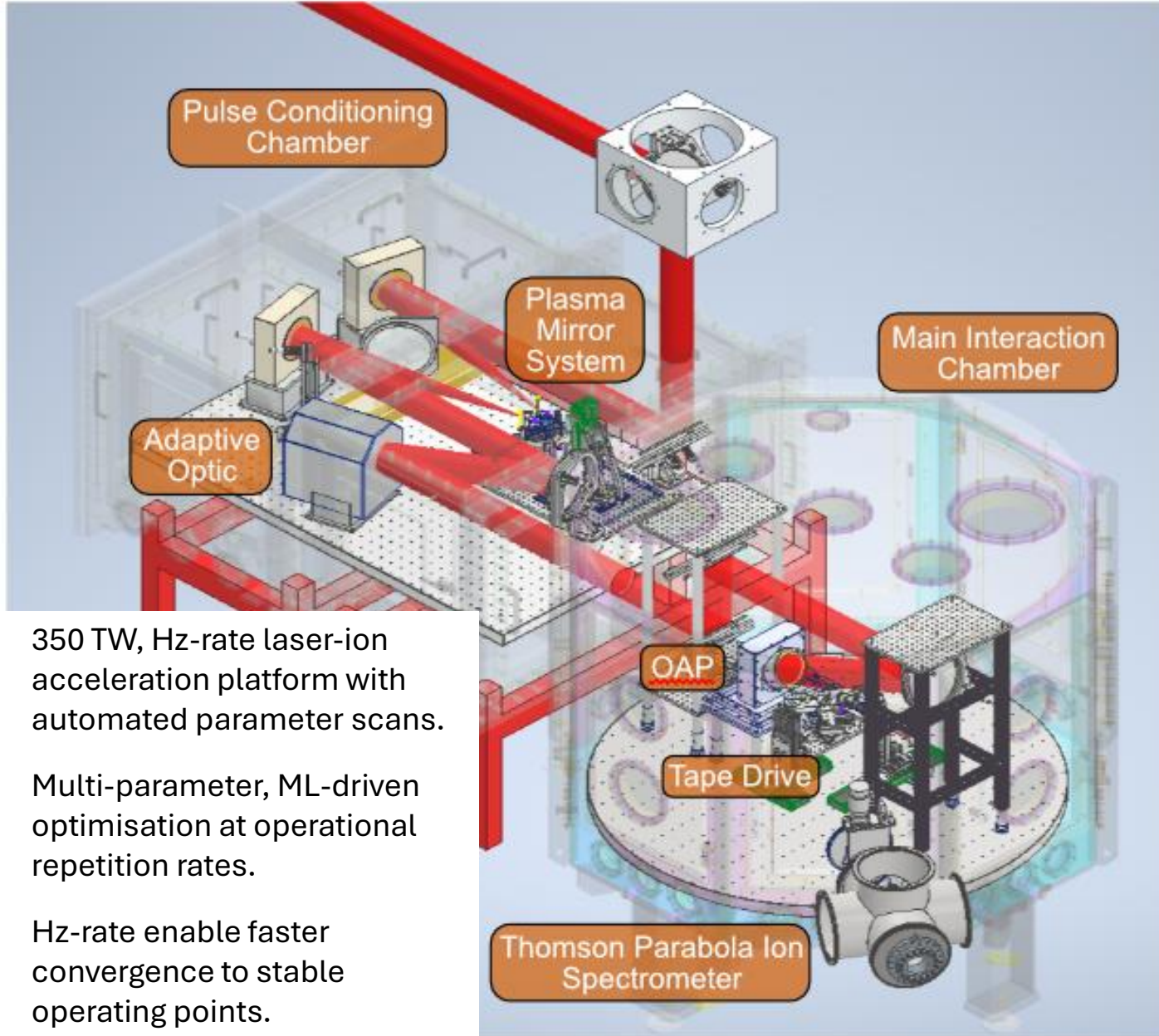
3 shielded areas with multiple beam lines.

SCAPA



SCAPA 350 TW Laser Parameters	
Peak Power	~350 TW
FWHM pulse duration	~25 fs
Energy (on target)	Up to 8 J
Pulse repetition rate	1 Hz (Up to 5 Hz)
Temporal intensity contrast	$10^{10}:1$ @ 100 ps $10^8:1$ @ 30 ps $10^4:1$ @ 2 ps
Central wavelength	800 nm
Strehl ratio	≥ 0.85

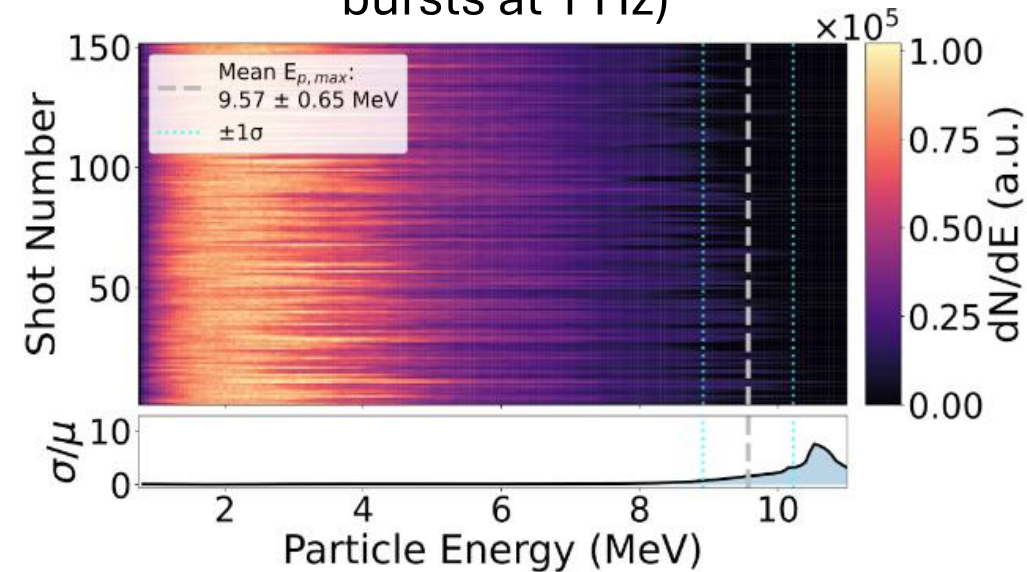
Ion Source Platform –Bunker B



- 350 TW, Hz-rate laser-ion acceleration platform with automated parameter scans.
- Multi-parameter, ML-driven optimisation at operational repetition rates.
- Hz-rate enable faster convergence to stable operating points.



- Current operation ≥ 0.1 Hz (some short bursts at 1 Hz)



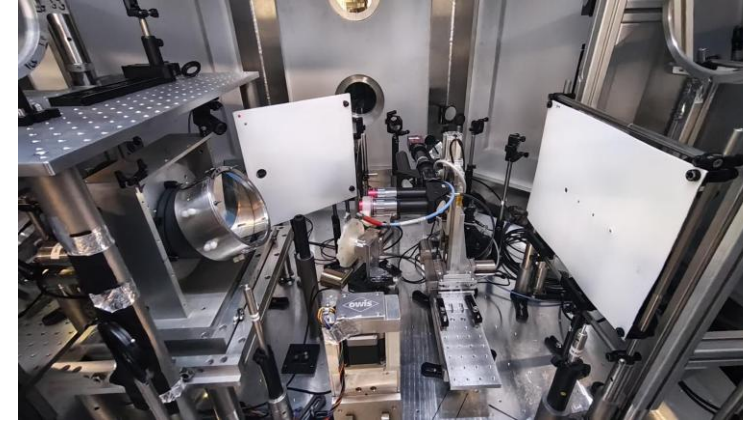
Challenges influencing stable Hz repetition rate operation

i) Pellicle

- Issue with beam spatial-intensity distribution damaging parts of the pellicle film protecting the OAP from debris.

ii) Debris

- Build up on debris on targetry system, optics and diagnostics.



iii) EMP

- EMP issue affecting electrical equipment when using metal tapes or relatively high laser energy.

iv) Data capture and near-real time analysis

- Large image files or a large quantity of diagnostics can slow data capture and analysis for feedback experiments.

v) Wavefront stability

- Transitioning from 0.5 to 1 Hz operation we experience a change in focus position.

