

EUROPEAN  
PLASMA RESEARCH  
ACCELERATOR WITH  
EXCELLENCE IN  
APPLICATIONS



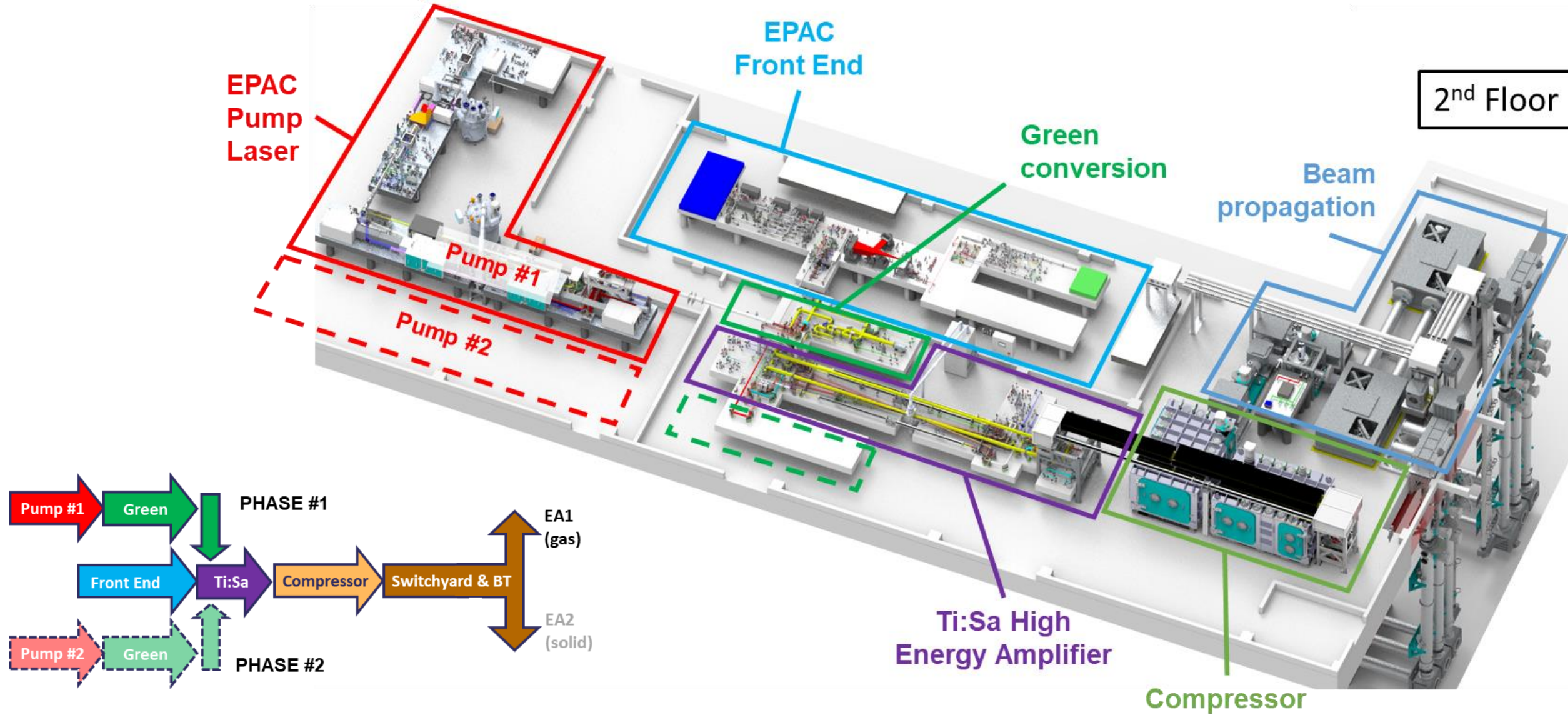
# WP12 – STFC Update

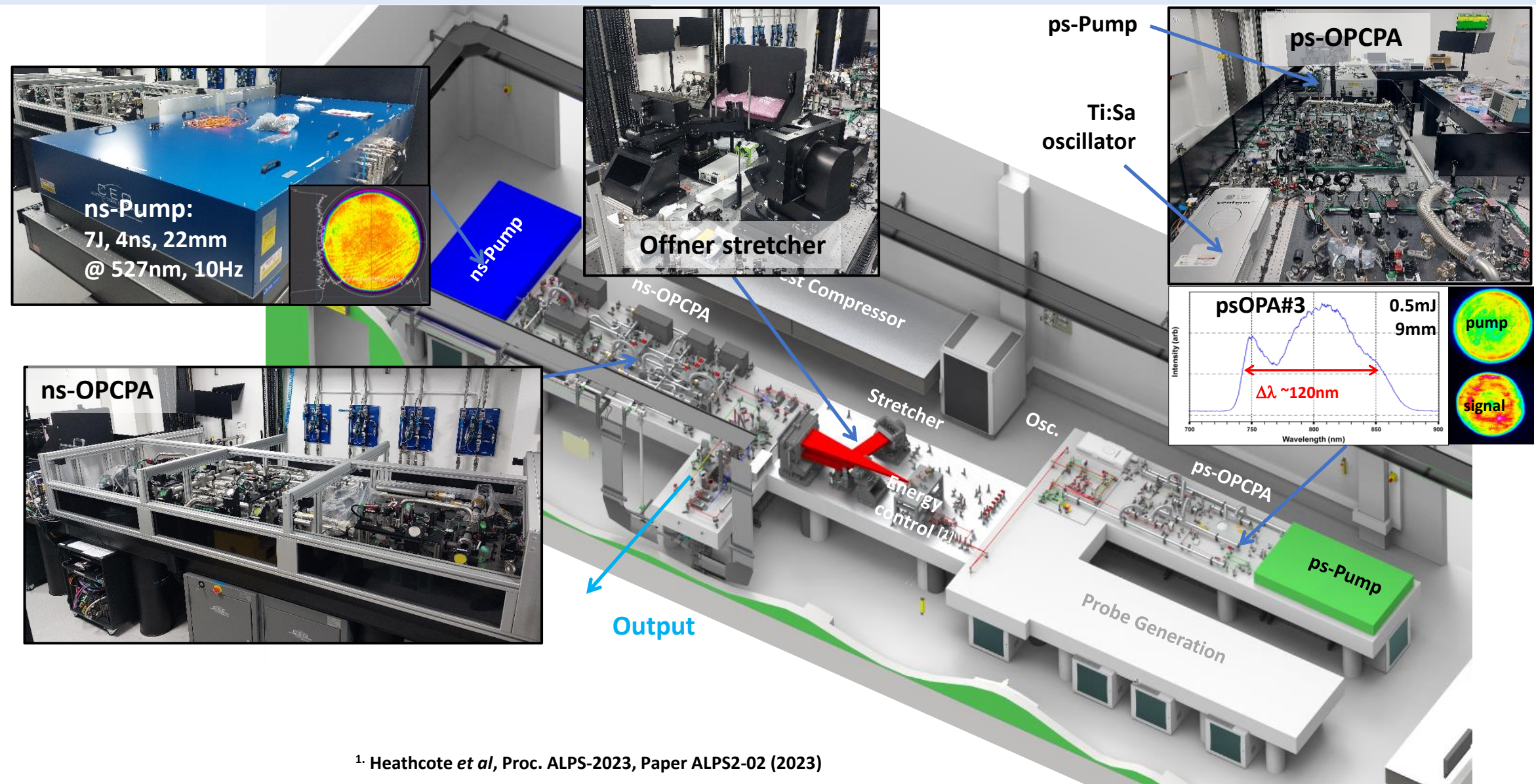
Mariastefania De Vido, UKRI – STFC – Central Laser Facility (UK)  
EuPRAXIA\_PP Annual Meeting, Elba  
24<sup>th</sup> September 2024



This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101079773

- EPAC 1 PW, 10 Hz – installation & commissioning update
- DiPOLE-100Hz nanosecond pump laser – result updates & next steps

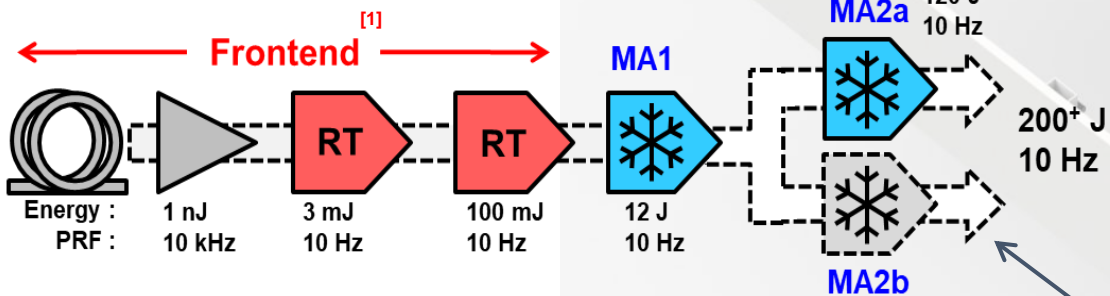
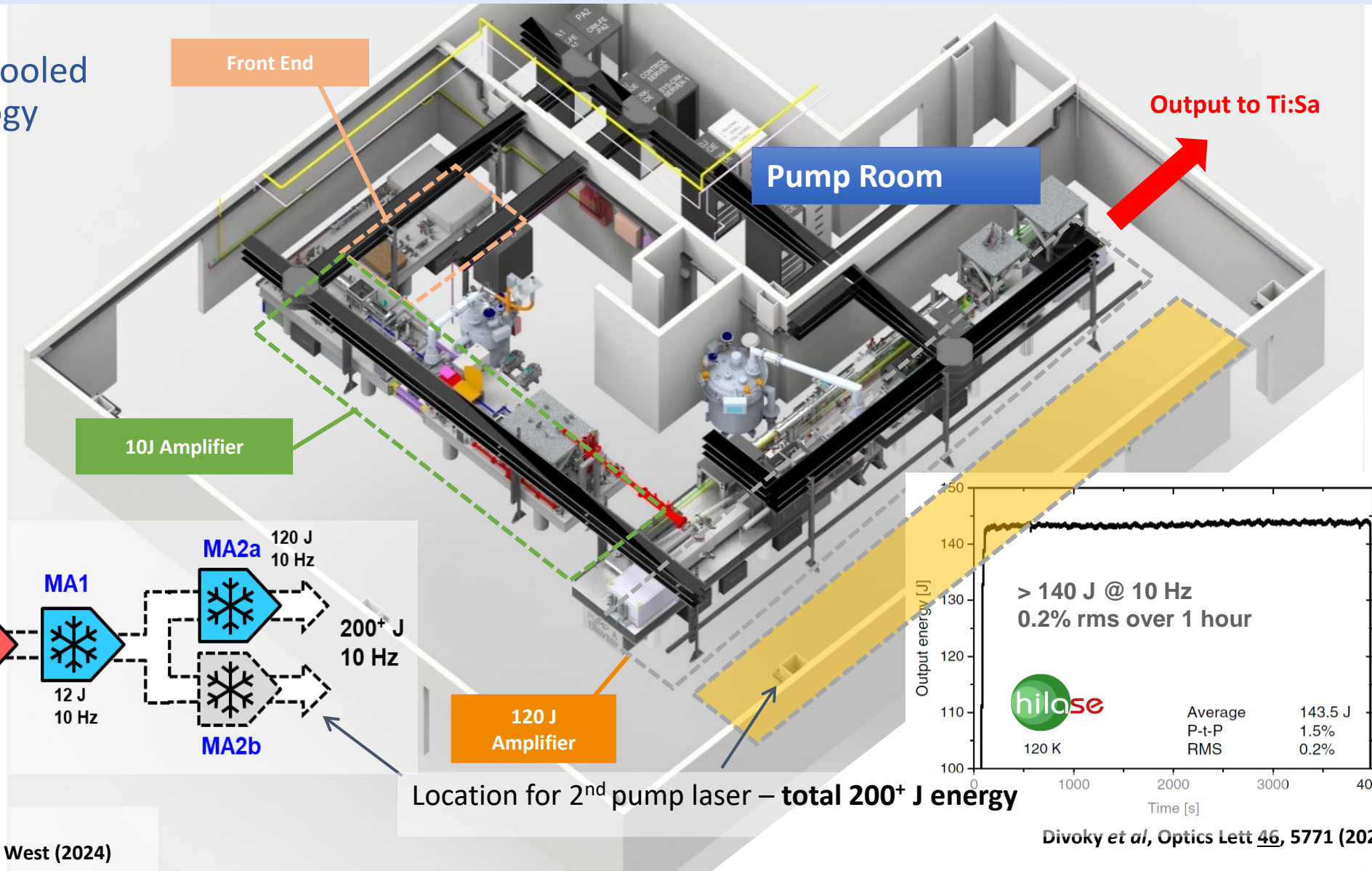




<sup>1</sup> Heathcote *et al*, Proc. ALPS-2023, Paper ALPS2-02 (2023)

## Multi-slab cryogenic gas-cooled Yb:YAG amplifier technology

- **1030 nm** wavelength
- 1 or 10 Hz operation
- 75 mm square beam
- 15 ns pulse duration
- Pulse shaping capability
- **Phase 1 = 120 J output<sup>[2]</sup>**
- **Phase 2 = 200<sup>+</sup> J output**

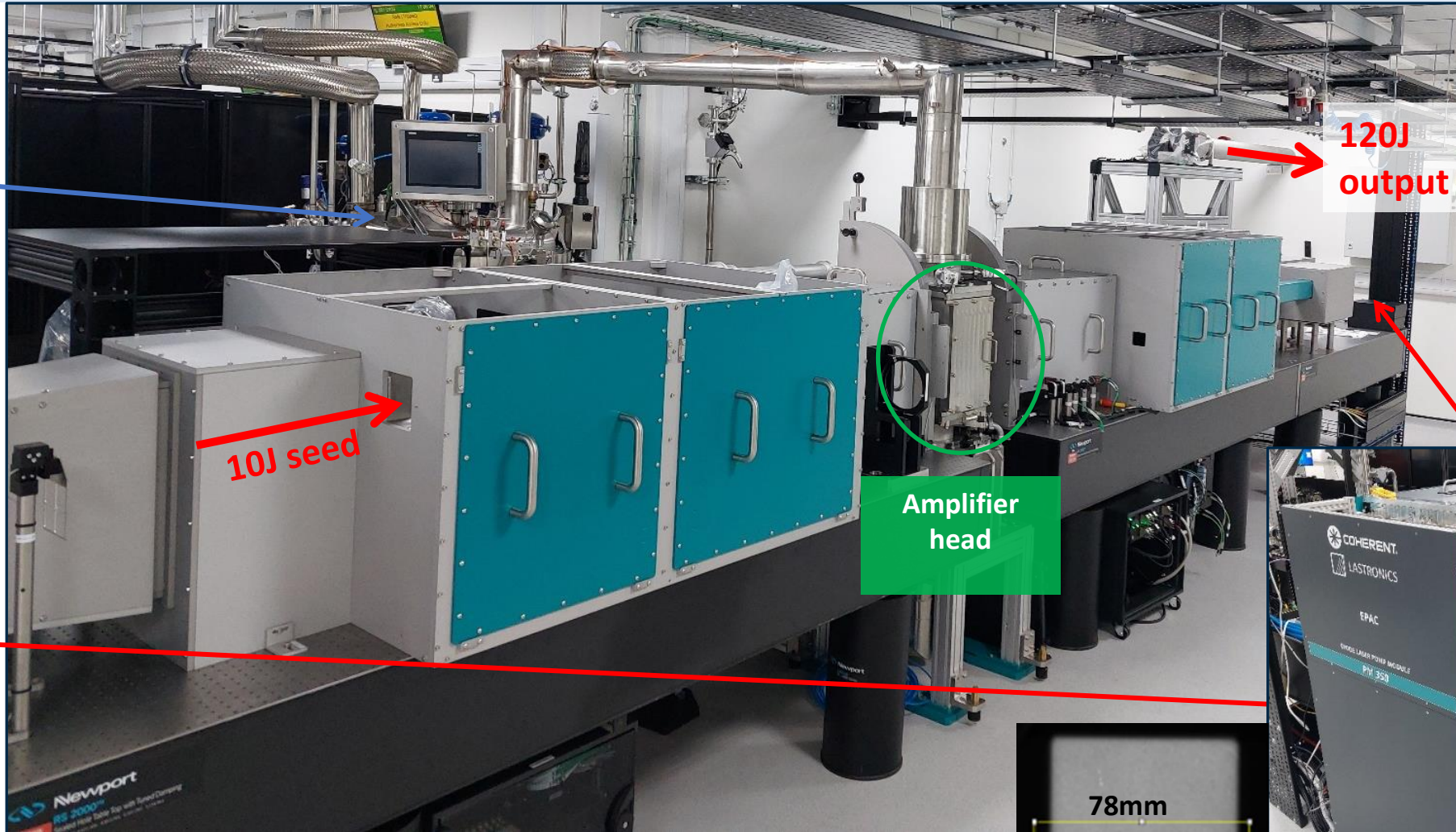


<sup>1</sup> Wojtusiak et al, ASSL, JTU1A.1 (2021)

<sup>2</sup> Wojtusiak et al, Proc. SPIE 12577-07, Photonics West (2024)



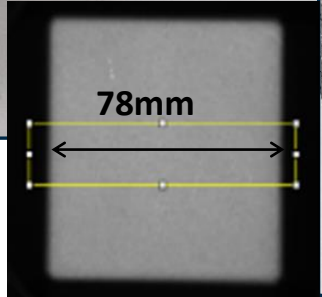
Cryo-cooler



10J seed

120J output

Amplifier head

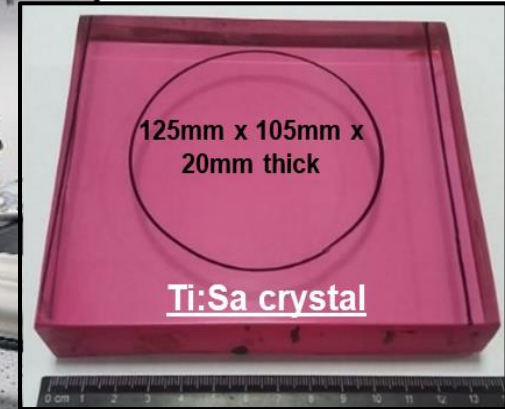
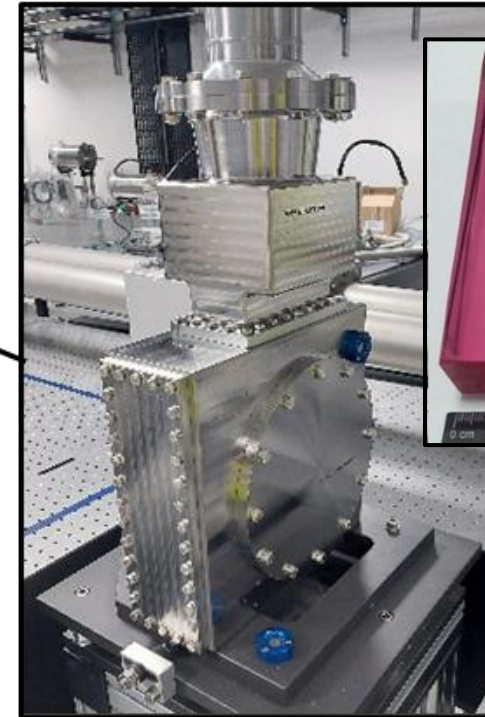
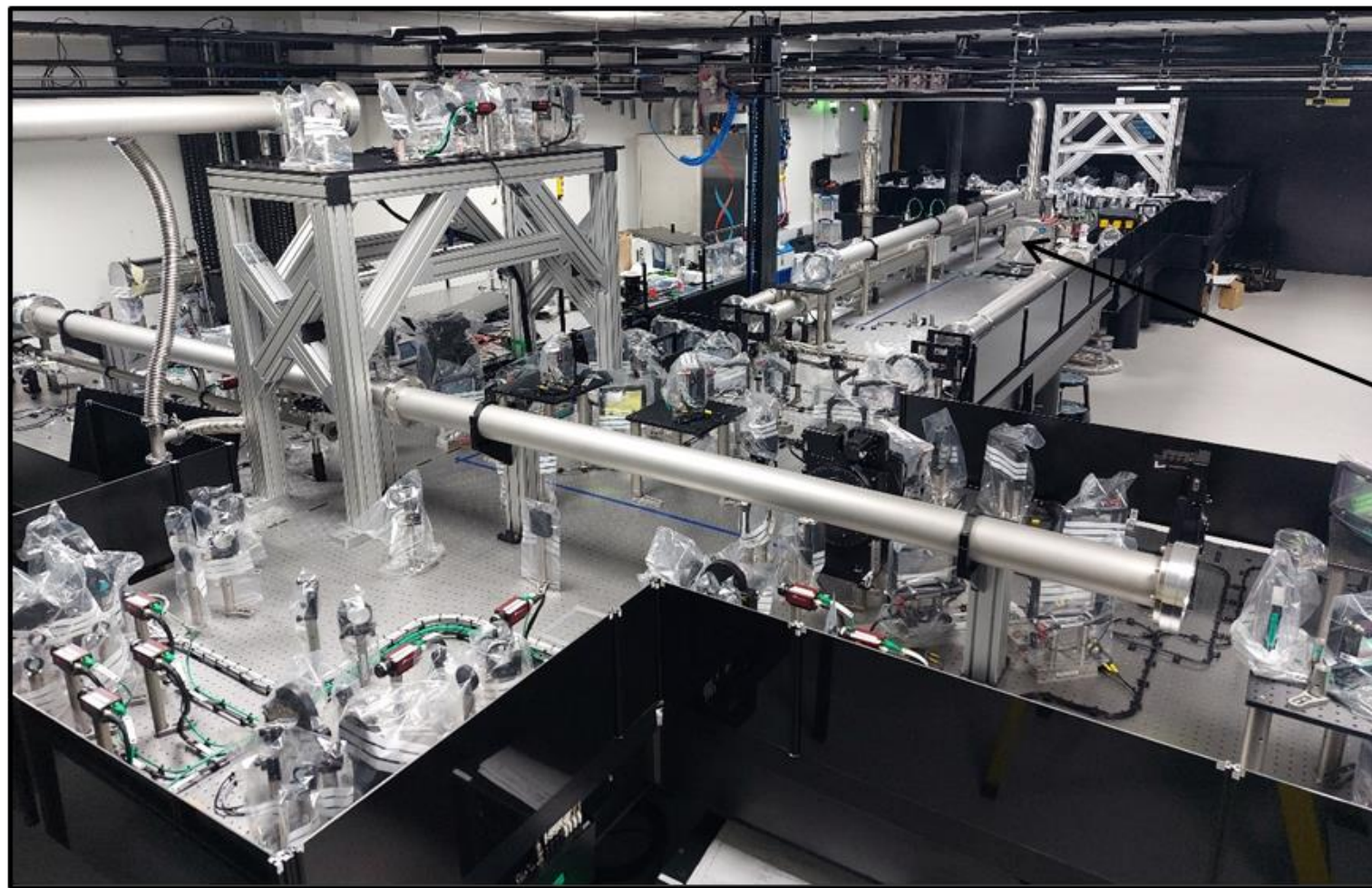


78mm



Pump diodes

350J, 1ms (350kW) @ 940nm, 10Hz



**Ti:Sa amplifier head**

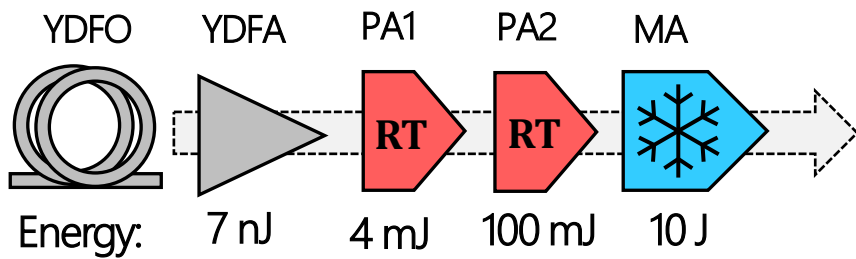
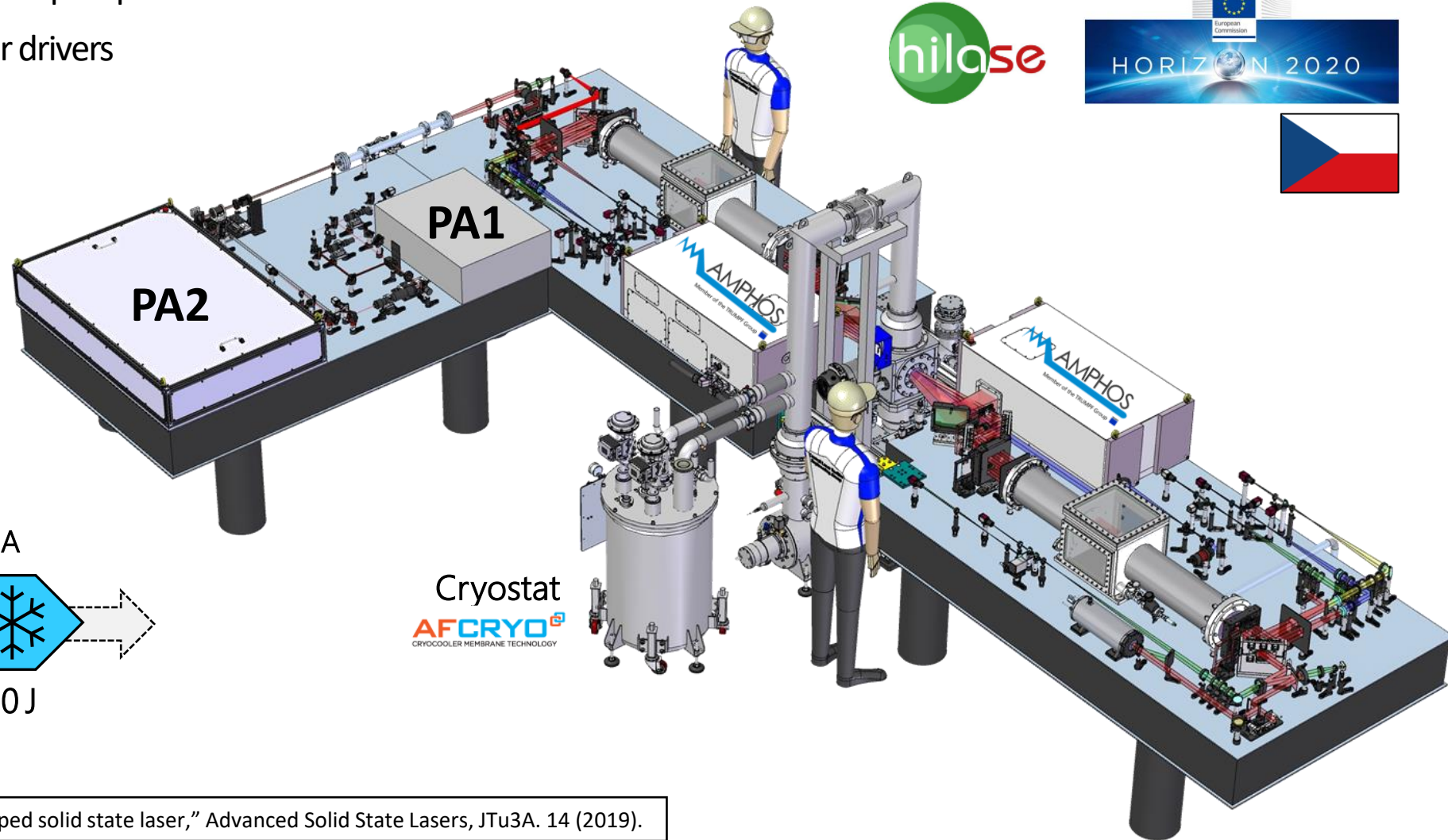
- Phase #1: **30 J @ 750-840 nm** (**70 J @ 515 nm**)
- Phase #2: **50 J @ 750-840 nm** (**130 J @ 515 nm**)



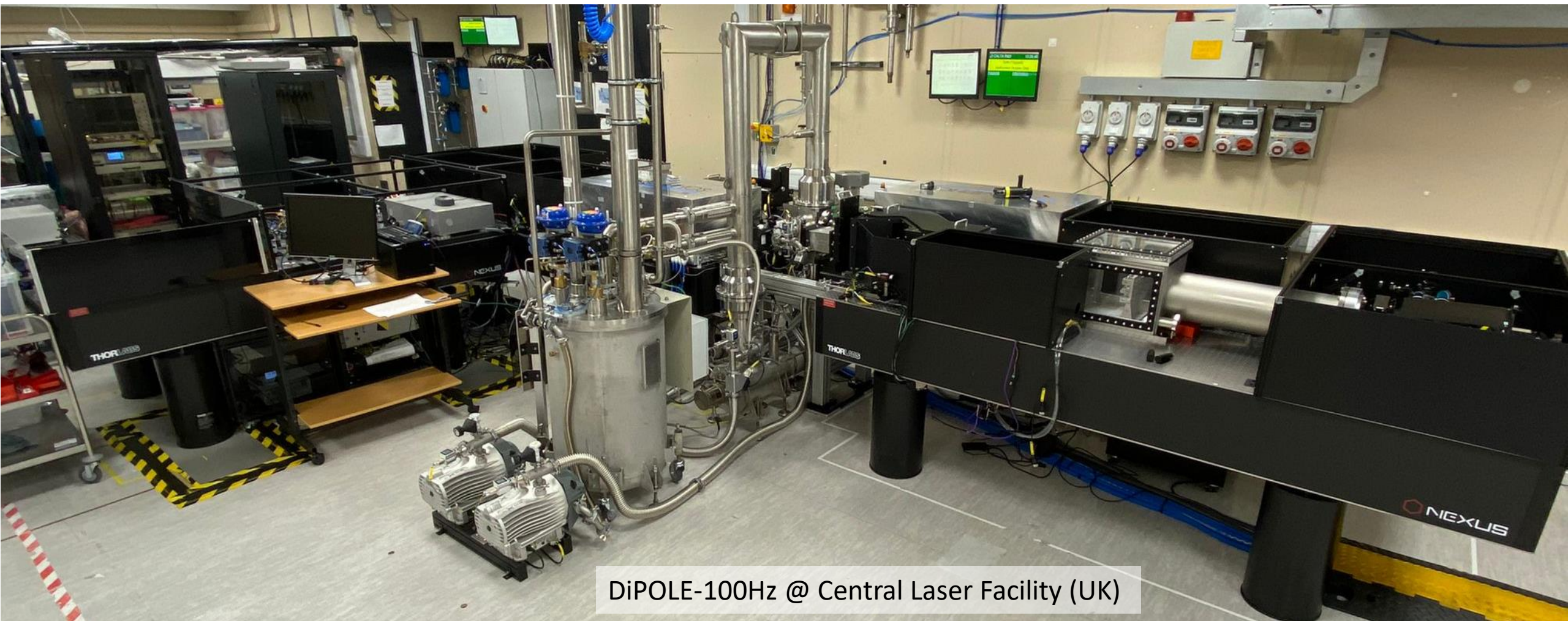
**Compressor chamber installed May 2024  
Gold grating install Spring 2025**



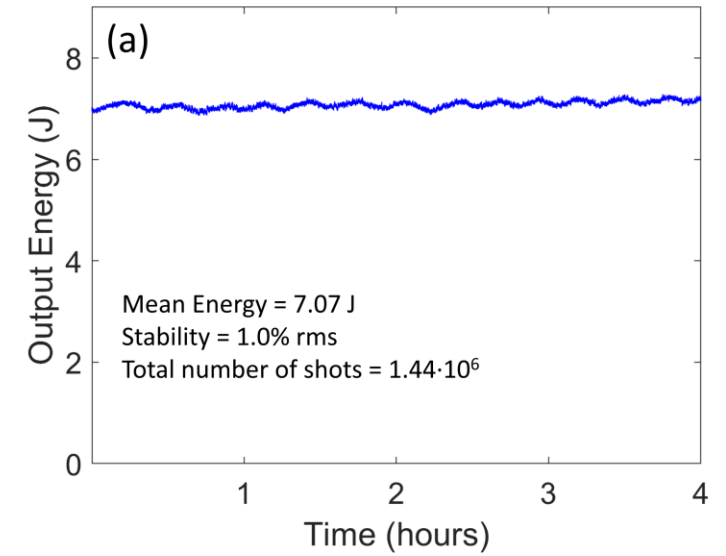
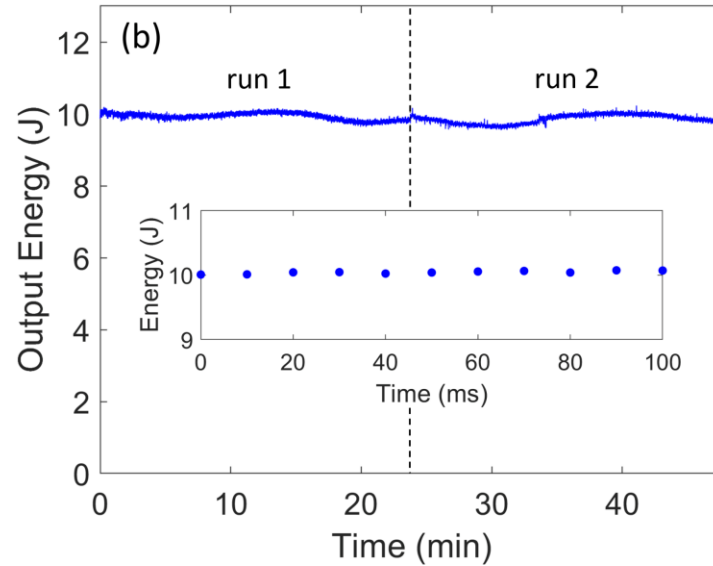
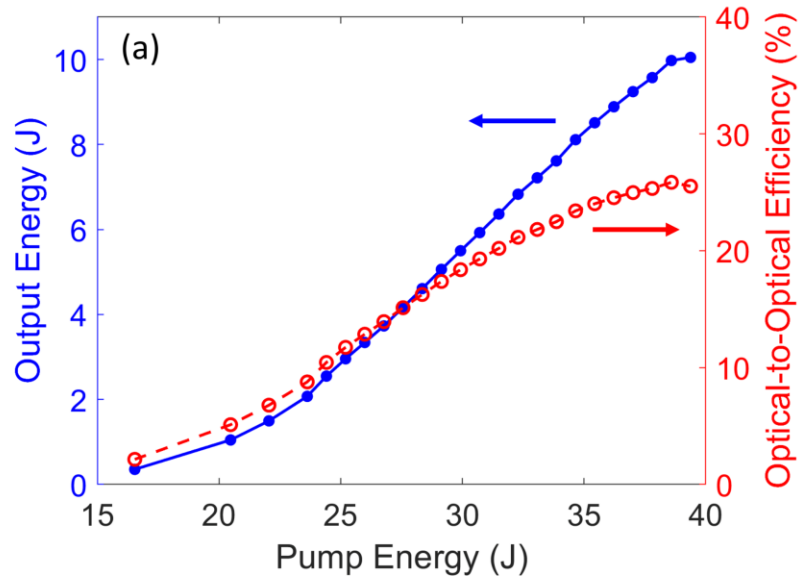
- DiPOLE-100Hz: nanosecond, diode-pumped Yb:YAG
- Prototype for future 100 Hz laser drivers



M. De Vido *et al.*, "Design of a 10 J, 100 Hz diode-pumped solid state laser," *Advanced Solid State Lasers*, JTU3A. 14 (2019).



DiPOLE-100Hz @ Central Laser Facility (UK)



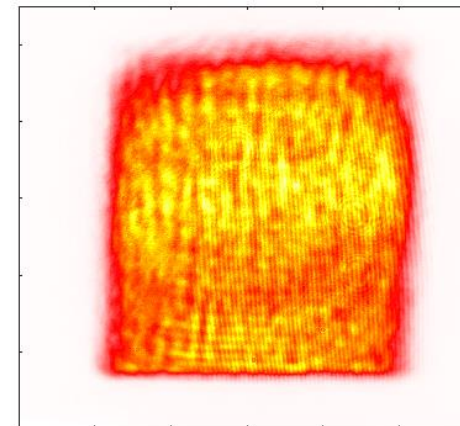
25.4% optical-to-optical efficiency

~300,000 shots @ 10 J, 100 Hz

~1.5M shots @ 7J, 100 Hz

1% rms energy stability

Near-field @ 10 J, 100 Hz



M. De Vido *et al.*, "Demonstration of stable, long-term operation of a kW-class nanosecond pulsed DPSSL operating at 10 J, 100 Hz," *Optics Express* 32(7), 11907-11915 (2024).

- DiPOLE-100Hz: delivered to ELI Beamlines, undergoing installation



- 2nd generation DiPOLE-100Hz laser @ CLF: pump for “EPAC 100 Hz” laser driver;
- “EPAC 100 Hz”: few-100 TW, 100 Hz, sub-50 fs (under review)
- Plasma Accelerator Systems for Compact Research Infrastructure (PACRI) project



- Beam expander

- Ti:Sa output beam expanded to **220 mm** dia. & relay-imaged into compressor
- Hybrid refractive/reflective achromatic telescope

- Compressor

- 4-grating design @ Littrow ( $10^\circ$  out-of-plane angle)
- $300 \times 300 \text{ mm}^2$  (G1&4),  $760 \times 300 \text{ mm}^2$  (G2&3)
- Peak fluence @ 1 PW =  $80 \text{ mJ/cm}^2$  (30 fs)
- Phase #1 use **gold gratings** @ 1480 line/mm for 1 Hz
- Phase #2 use **multi-layer dielectric gratings** for 10 Hz

