

Present and future of the European laser research and on the role of large facilities

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Outline

Encouraging the growth of high energy density physics

Impact of lasers

Drivers for new infrastructures

Access to facilities

Laser-Lab Europe

Transnational access

ELI & HIPER

Relationships between university / intermediate / large scale facilities

Support infrastructure

User support

User forums

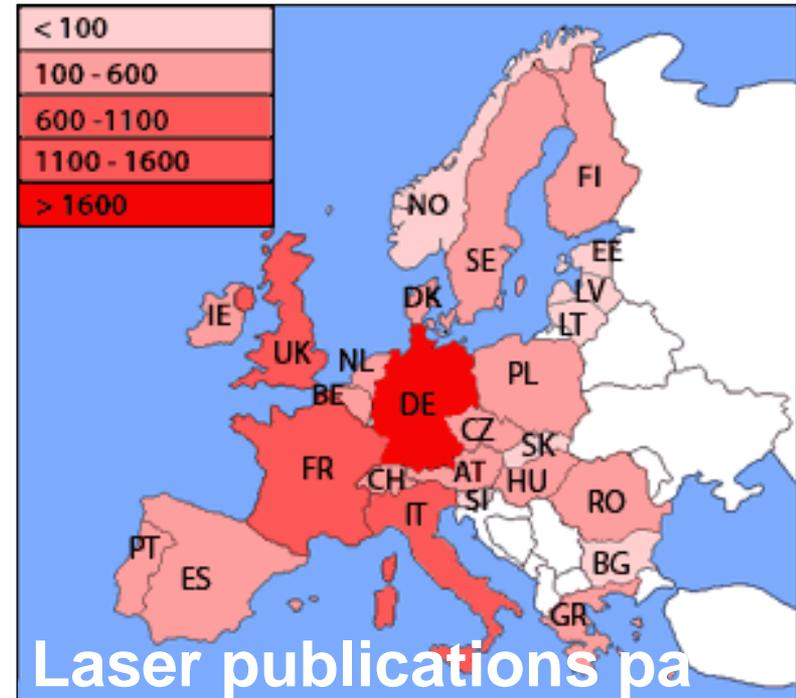
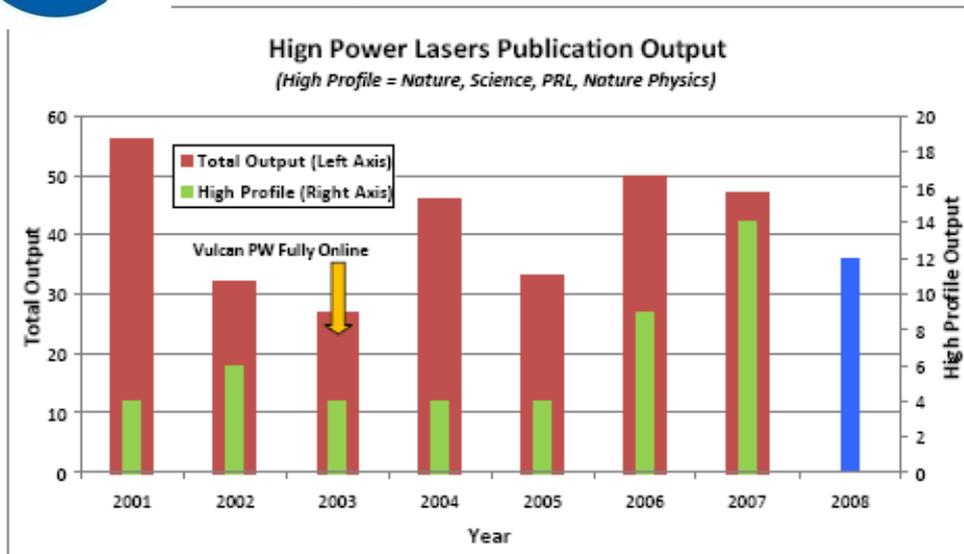
Community science meetings

Training

Joint appointments

International exchange

Comments and outlook

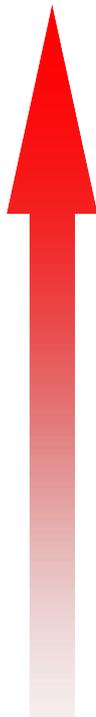
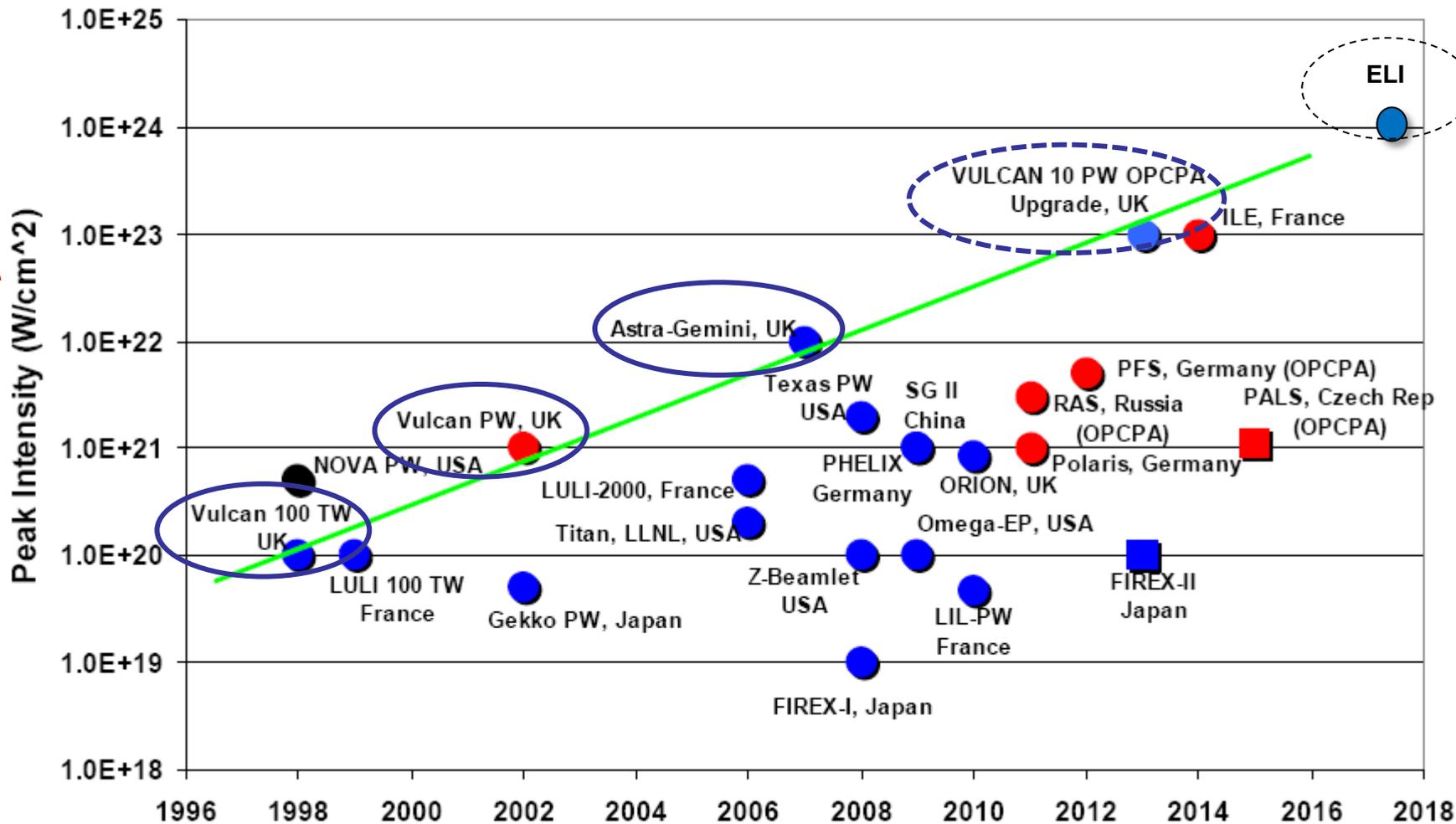


- Critical high technology sector
- Ubiquitous scientific presence
- multi-\$B direct market
- Enabling technology for life science, materials, comms, defence, industry, ...
- Pressing societal imperatives: carbon-free energy economy
- Pan-European HEDP facilities being prepared for the future
- Spark the imagination of younger scientists

European laser facilities

Home to the world's most intense lasers

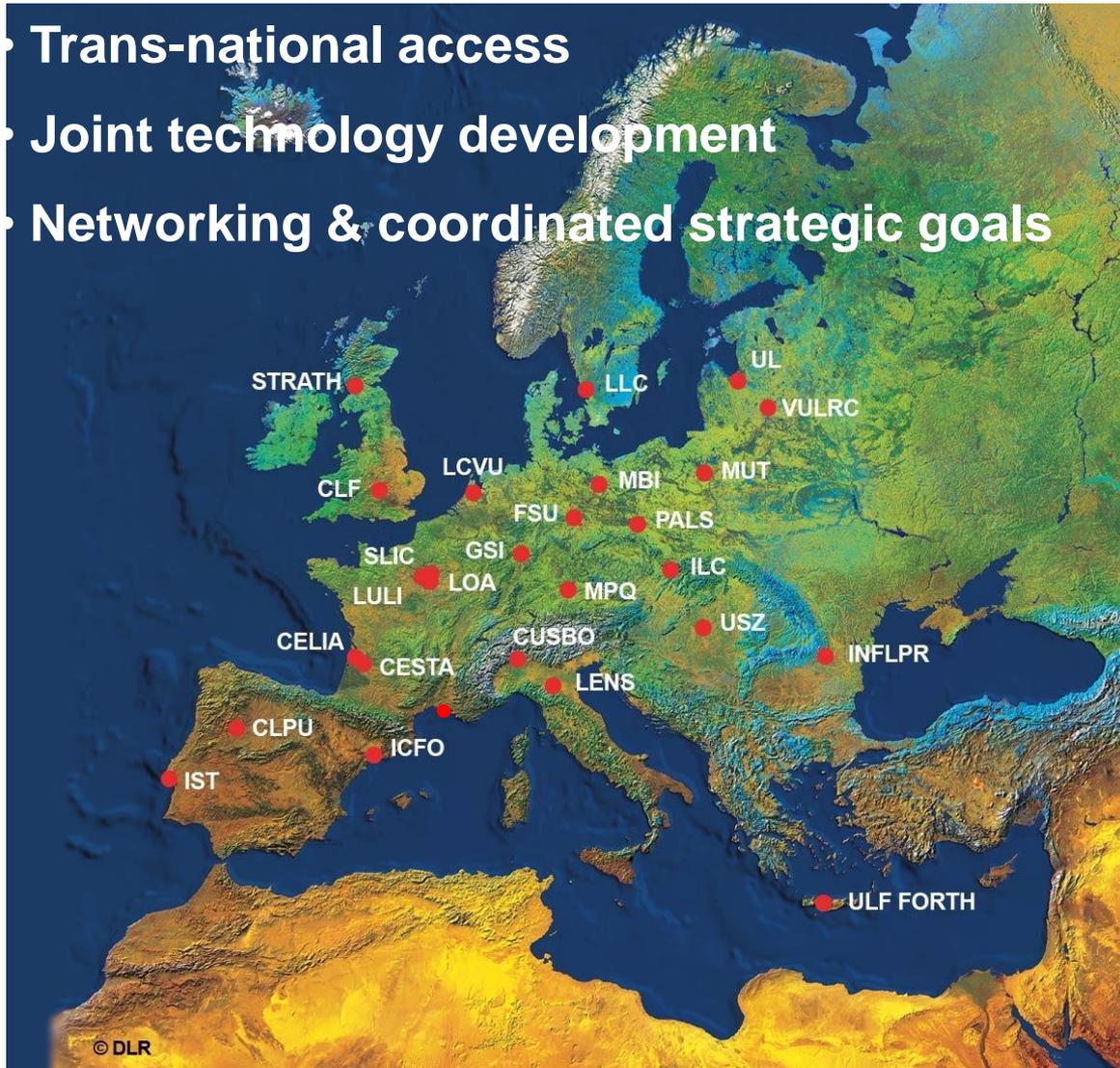
User Driven New Science

- Timely strategic investment has kept EU in the lead
- Sums are modest in comparison to many
- Huge increase in capability

Rapidly growing community: Laserlab-Europe

- Trans-national access
- Joint technology development
- Networking & coordinated strategic goals



Unique capability: HEDP facilities



Trans-national access

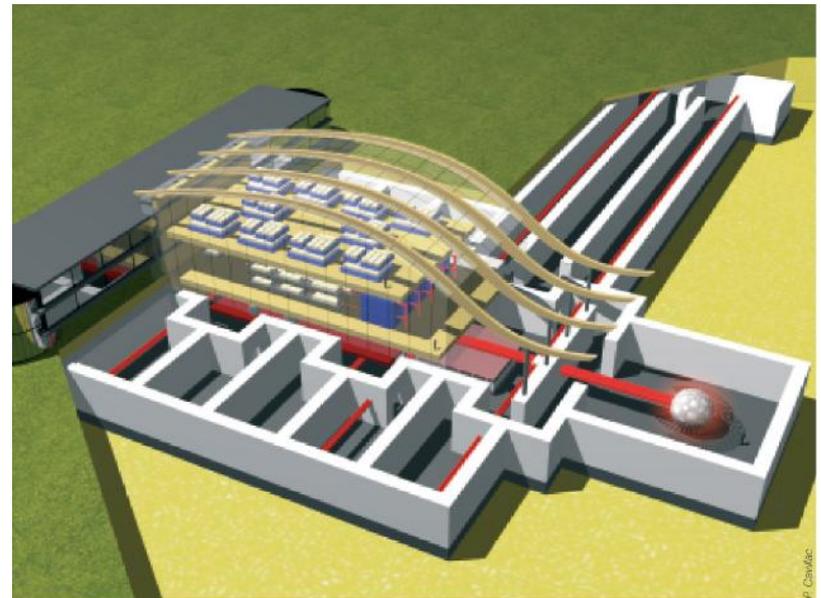
Laser-Lab Europe has funding from the EU to allow access across national boundaries to all established academics.

Popular - it has leveraged more access to HEDP facilities. British, French and German lasers are now open to all accredited EU academics.

No distinction between small, intermediate and large scale facilities.
Single Web-based access portal – common to all facilities.

Why ELI?

- Large sums of regional structural funding has been made available to the Czech republic, Hungary and Romania from the EU.
- The UK, France and Germany will assist them in developing the required diode pumped solid state laser technologies. The aim is to stimulate the growth of the academic community through the development of new HEDP & applications
- ELI allows access to the science of extreme conditions by EU academics:
 - 1 -10 J / 1kHz pulses for attosecond pump/probe experiments
 - 10 J – 100 J / 10 Hz pulses for electron beams via wakefield acceleration and ion beams by sheath or radiation pressure acceleration



kJ /10 Hz 200 PW provides
unprecedented intensities 10^{25} Wcm⁻²



Why HiPER?

The development of fusion energy is needed for reasons of

Security of supply

Creation of a carbon-free economy

The energy sector is enormously important - \$Tn. IP associated with fusion energy is likely to be developed in the early stages of the technology.

DPSSL's developed for ELI will be scaled up for HiPER

IFE will revolutionise both HEDP and neutron scattering science

NIF
ignition
↓





**Science & Technology
Facilities Council**

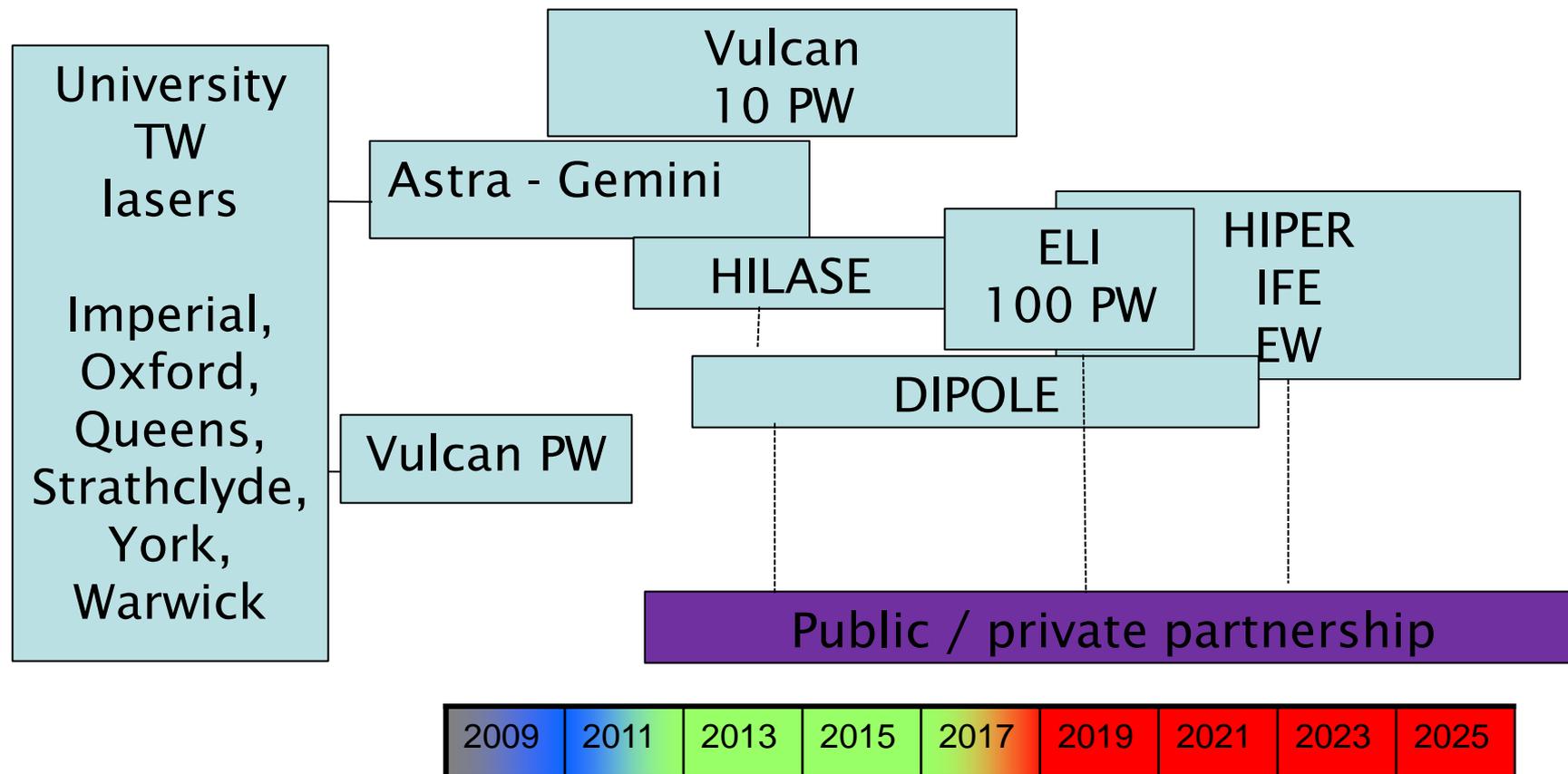
Facilities

**Synchrotrons
Neutron Scattering
Lasers, FELs
Computing
Telescopes**

**Accelerator Science
Particle Physics
Space Physics
Nuclear Physics, ...**

Public/private partnership

Expanded campus; major facilities; 20 year investment plan





Academic access and support (UK) Imperial College London

Academics apply for time on the facilities through a competitive dedicated call for access (usually every 6 months). There is no requirement on grant funding - only the commitment to use facility time if it is awarded.

Experimental access time is allocated free of charge to the universities – but the full costs of the experiment are credited to their departments in research quality assessments.

Support includes

- experiment design
- engineering procurement
- target fabrication
- full costs of travel and subsistence
- theory and modelling support (if needed)

The Council provides facility studentships to academics to allow them to train next generation scientists in the use of advanced facilities. We can also provide additional funding to students and universities to assist with student recruitment and retention.



Academic funding

Academics apply for students, post-doc's, conference travel, equipment, consumables through a different research council.

Issue of “double jeopardy” – the need to apply twice: once for grant funding and once for facility time.

Management must strike a balance between cutting edge science and fulfilment of grant commitments.

There is also a tension between internal and external driven science. Facilities need leading experts to help deliver the cutting edge results. Those people need facility access to pursue their own interests.

Facility developments: potential conflict between current science delivery and upgrades / new projects.

User forums

Strategy briefing

- Alignment with stakeholder requirements
- New initiatives on the horizon

Performance briefing

- Availability of facilities
- Issues of concern to users
- Near term (≤ 1 year) upgrades to performance

Investigator grant applications

- News and directions from research councils and funding agencies

Presentation of longer-term upgrade options

- Performance improvements and implications to science programme
- Likely costs and timescales

Community Science Workshops

CLF High Power Laser Science Community Christmas meeting



First year PhD students receive 2-weeks hands-on experience of experiments on CLF lasers

They get to know staff and all aspects of facility life

instrumentation

target design and fabrication

mechanical engineering

electrical engineering

theory and modelling

2nd and 3rd year students must attend a week long dedicated training week

Health and safety - legislation & legal responsibilities

- risk assessment
- running experiments safely and minimising hazards

Management

- team building
- dealing with conflict
- project management

Joint Appointments

Optimum number of academics within one department
depends on a range of factors

- size of department

- seniority

- teaching load

- family commitments

- 2 - 4 experimentalists

- 2 - 4 theorists

Joint appointments between the facility and universities are helpful

- maintain optimum capability

- stimulate new research areas

- provide a career path for new researchers

International Exchange

International exchange are greatly enriching to the individual

- experience of different cultures
- broadening of horizons
- development of new ways of thinking
- cementing of life-long academic friendships

Younger scientists are strongly encouraged to work abroad for some period. Candidates for academic appointments and national laboratory status are viewed more favourably with overseas experience.

Comments and Outlook

- By the mid 2020's, small, intermediate and large scale facilities are likely to be brought closer by deployment of higher repetition rate drivers.
- Need to remove barriers & start preparing for these changes in scale.

Experiment and engineering design

Theory & modelling support

High rep-rate diagnostic acquisition, storage and manipulation

Target preparation and procurement

Travel & subsistence

Summer schools

User group workshops