



The ELI-ALPS project

ELI: Extreme Light Infrastructure
ALPS: Attosecond Light Pulse Source

Zsolt Fülöp



A graphic showing a bright laser beam originating from a point on the Earth's surface and extending vertically into space. The beam is flanked by two other beams that originate from different points on the Earth's surface and converge towards the central beam. The background shows the Earth's horizon and a crescent moon in the dark sky.

ESFRI

Landmark

World's most advanced
**international laser research
infrastructure**

Selected by **ESFRI in 2006**

Funded between **ESIF, National
and Framework** funds, after
international site selection, and
EU approval

First **multi-site research
infrastructure** built
completely in **Central Europe.**

...In time and within budget!

ELI-DC Brussels

The consortium that is responsible for the coordination of the three research centres during implementation

ELI-ALPS Szeged Hungary

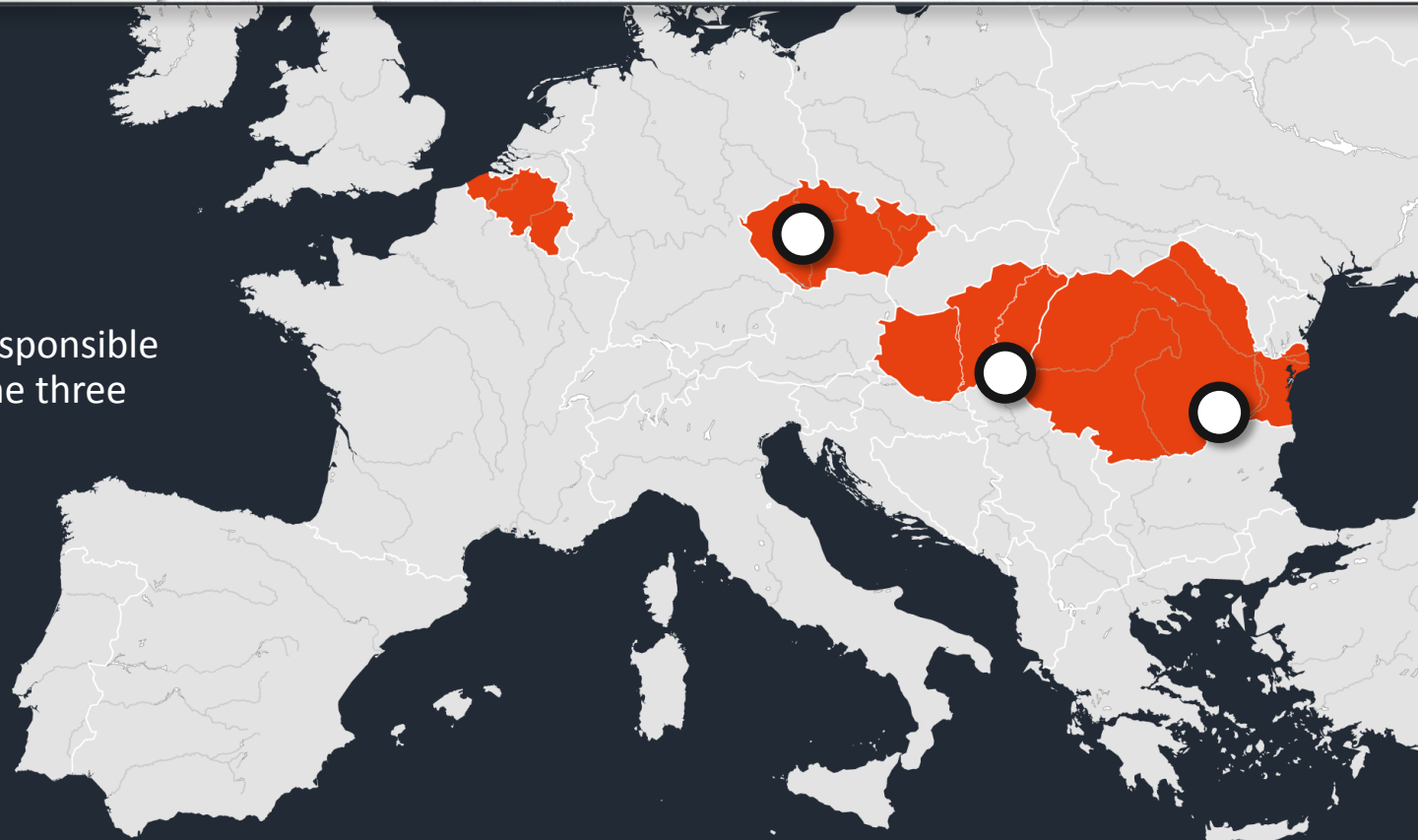
ultrashort laser pulses at high repetition rate

ELI-BL Dolny Brezany Czech Republic

ultrashort x-ray generation, particle acceleration

ELI-NP Magurele Romania

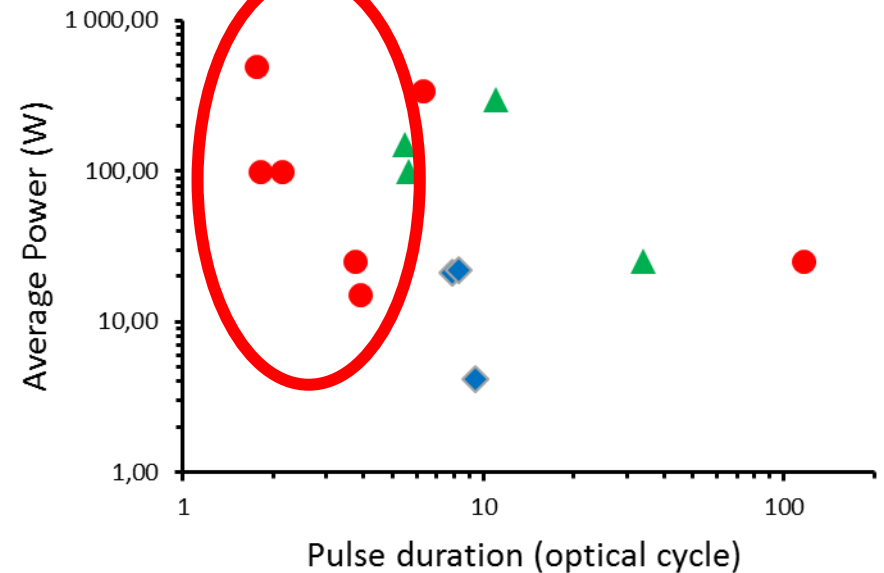
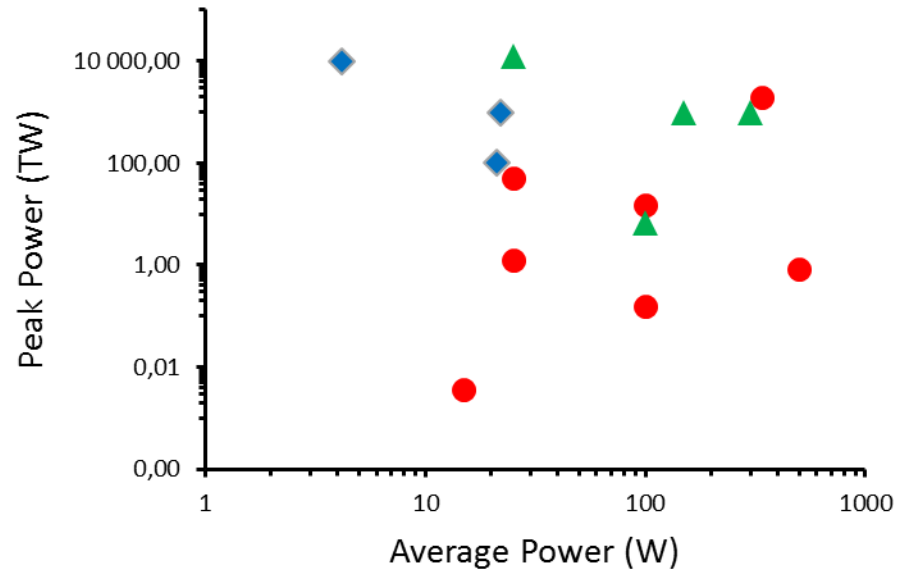
ultra-intense optical and gamma ray pulses



High peak power, high average power lasers

ALPS, BL, NP

High average power
Few cycle lasers

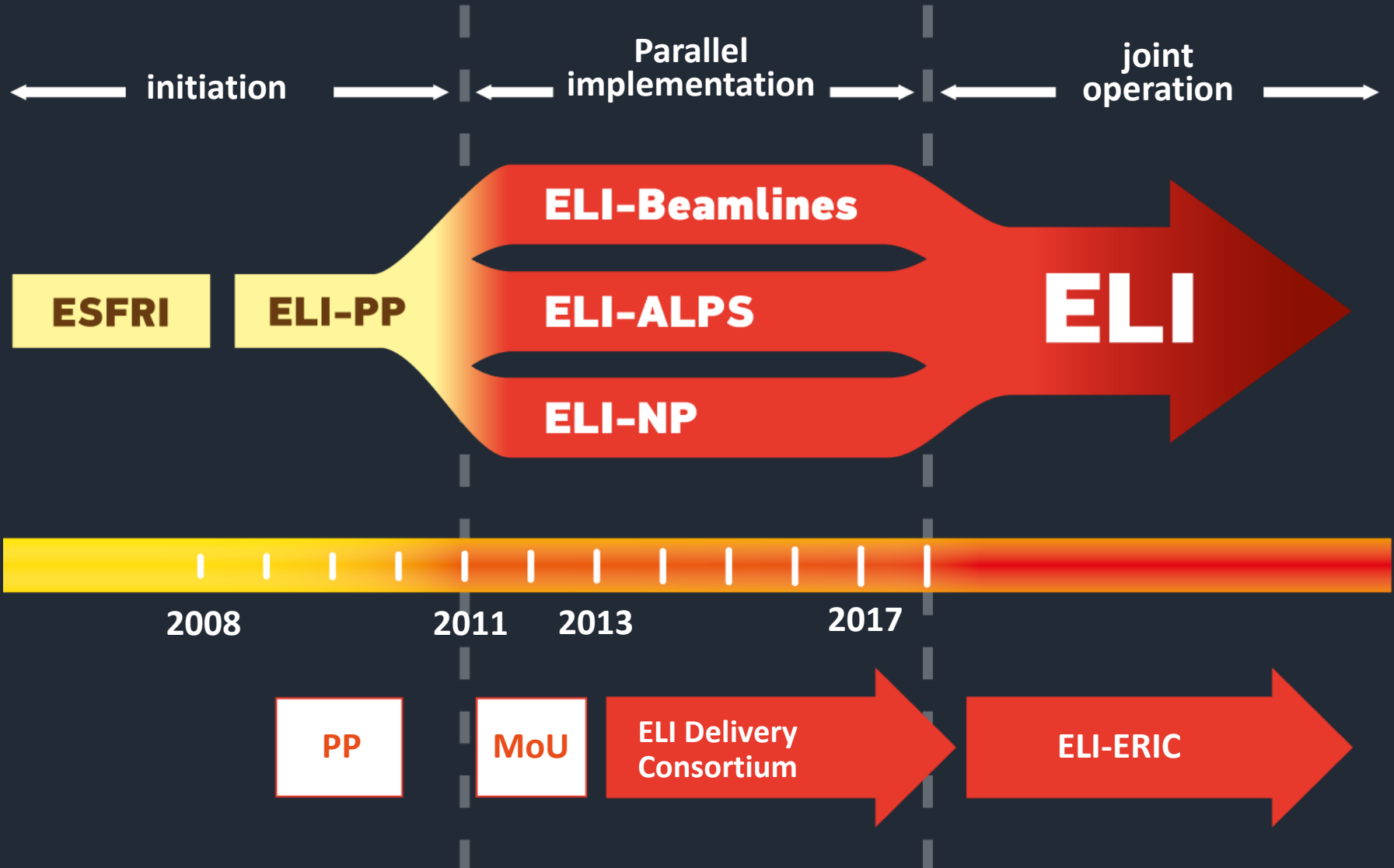




ELI will be

- the world's **first international laser user facility**, providing unique research opportunities for the future
“The CERN of laser research”
- a **distributed research infrastructure** based initially on 3 facilities in the Czech Republic, Hungary and Romania
- the first ESFRI project to be **implemented in the new EU Member States**
- **pioneering a novel funding model** combining structural funds (ERDF) for the implementation and contributions to an ERIC for the operation





Extreme Light Infrastructure ELI Attosecond Light Pulse Source



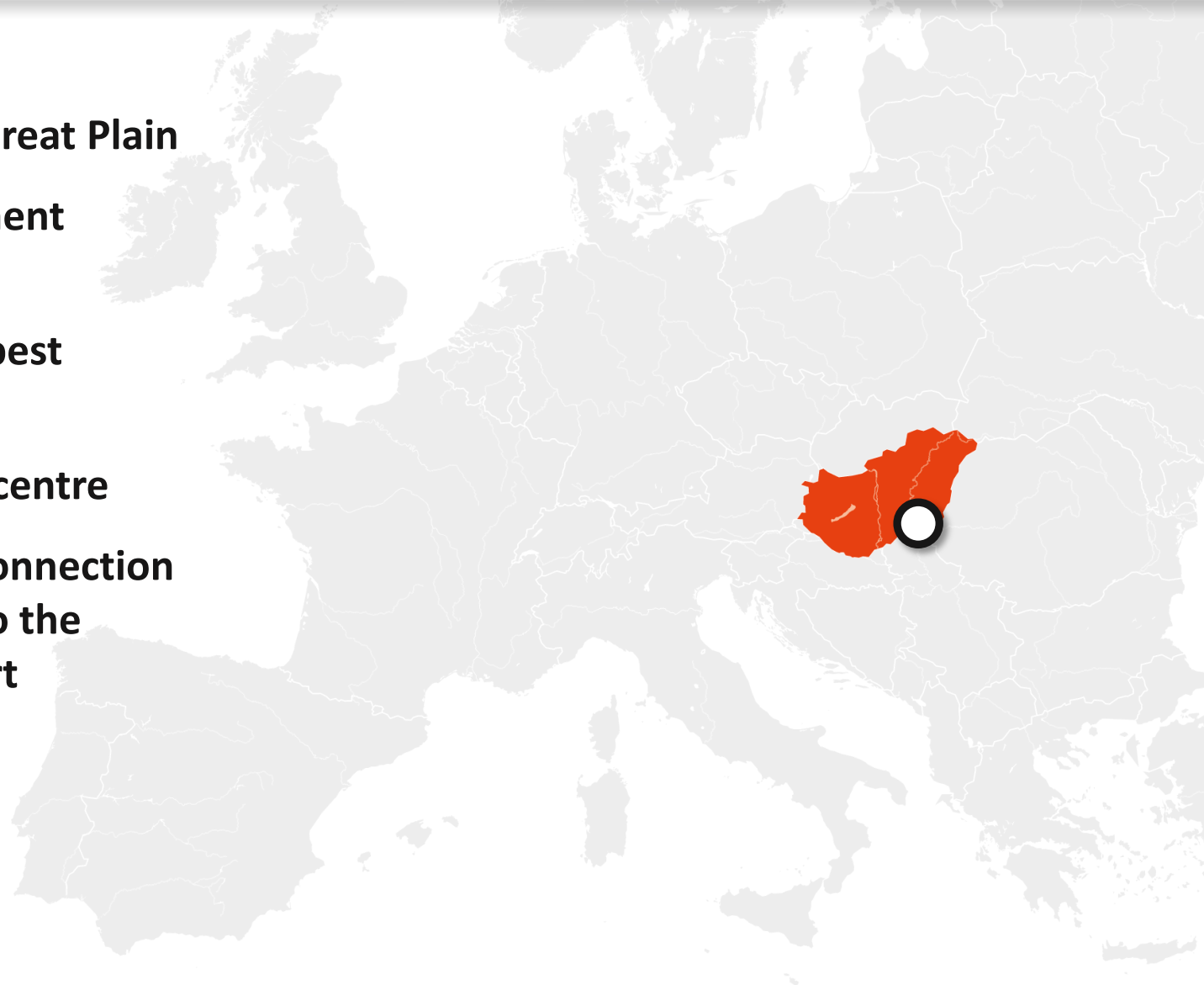
Ultrashort Pulse Pillar
of the pan-European Research Infrastructure ELI



Szeged

Szeged, Southern Great Plain

- **Brownfield investment
100 / 10 ha**
- **165 km from Budapest
on motorway M5**
- **5 km from the city centre**
- **Perfect transport connection
on the motorway to the
international airport**



Milestones of ELI-ALPS construction



- April 2014: construction begins
- March 2017: end of construction
- 23 May 2017: official inauguration
- 12 June 2017: moving in the new facility
- 9 November 2017: Grand scientific opening
- 12 February 2018: first pilot experiment



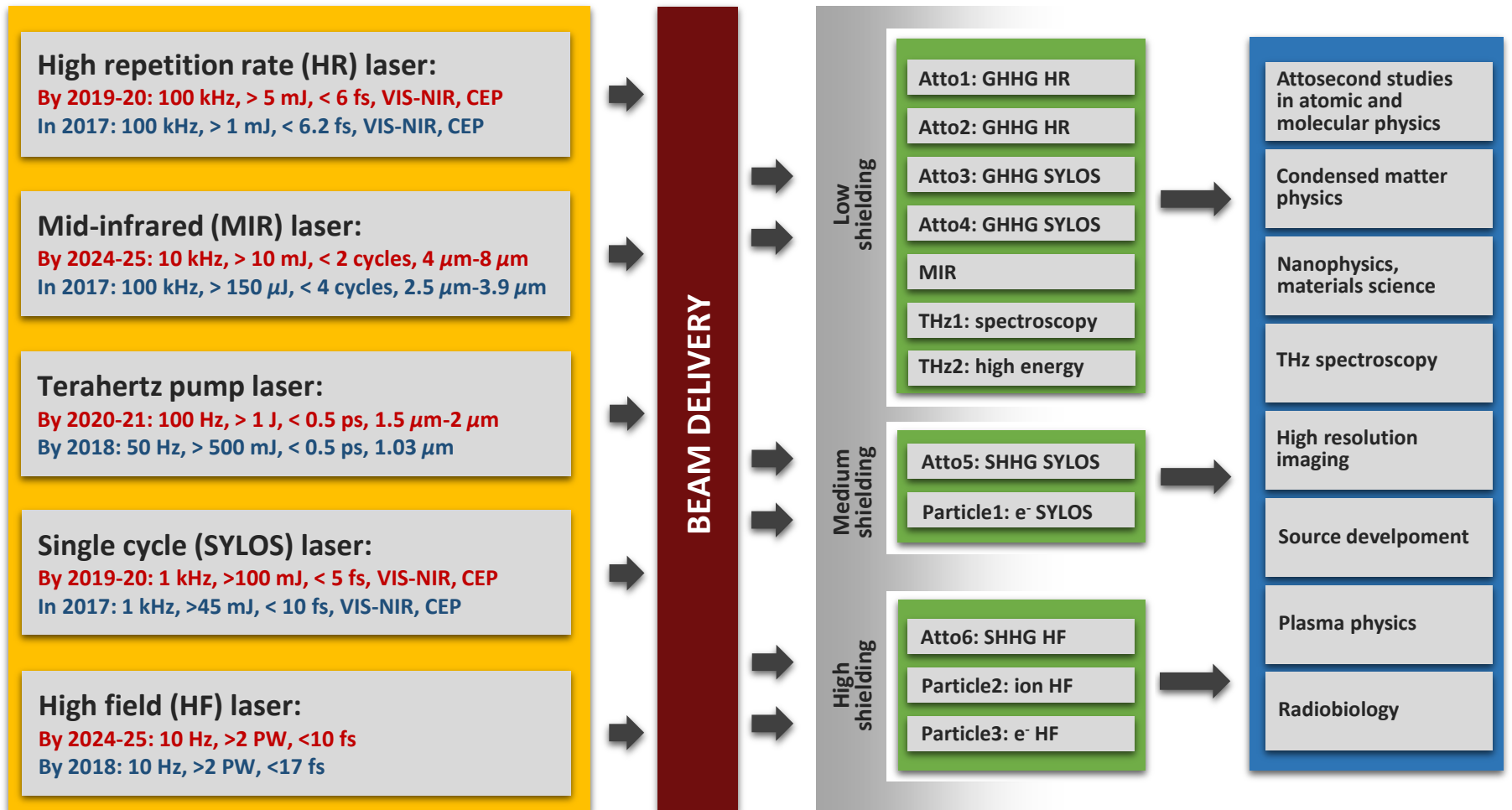
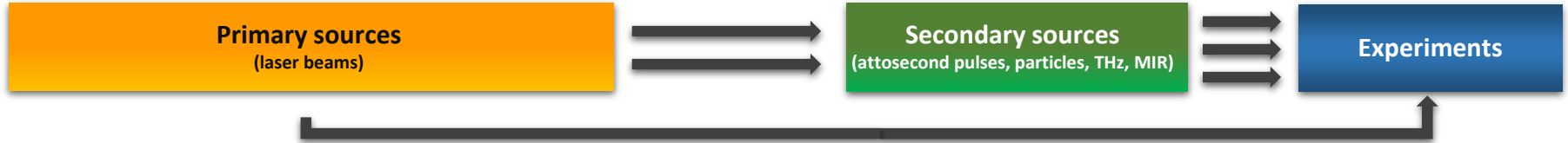


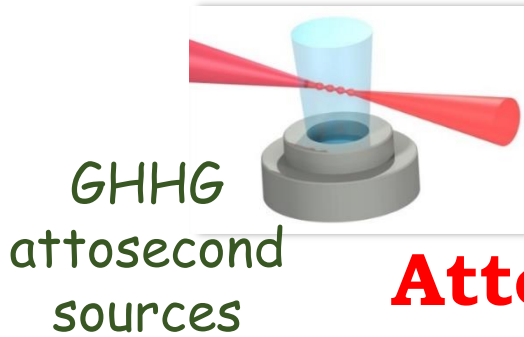
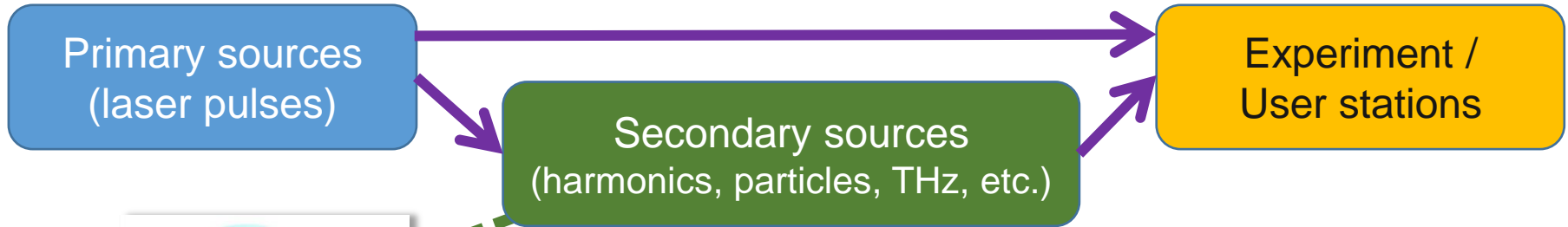
- To generate X-UV and X-ray femtosecond and attosecond pulses, for temporal investigation at the attosecond scale of electron dynamics in atoms, molecules, plasmas and solids.
- A user facility offering access to few cycle electromagnetic pulses (atto- and THz beamlines)
- To contribute to the technological development towards high average power, high peak intensity lasers.

- **Laser research and development**
- **Research and development of secondary sources**
- **Atomic, molecular and nanophysical research**
- **Applied research activities: biomedicine, materials science**
- **Industrial applications**

ELI-ALPS SAC: Scientific Advisory Committee

ELI-ISTAC: International Scientific and Technical Advisory Committee

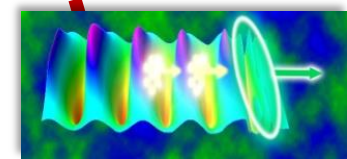




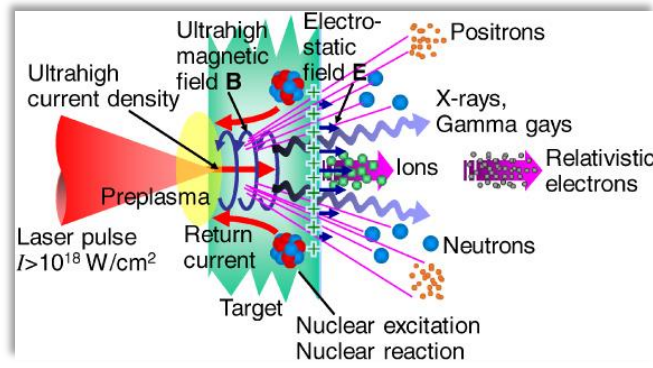
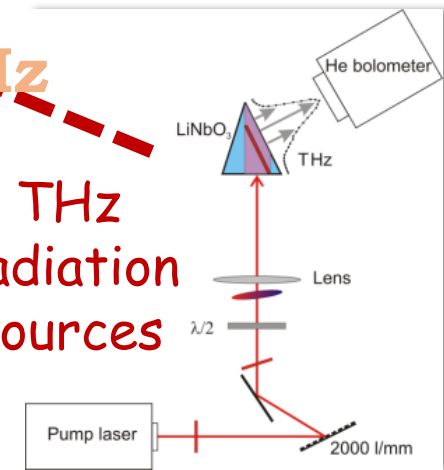
**Attosecond
Sources**



**Particle and THz
Sources**

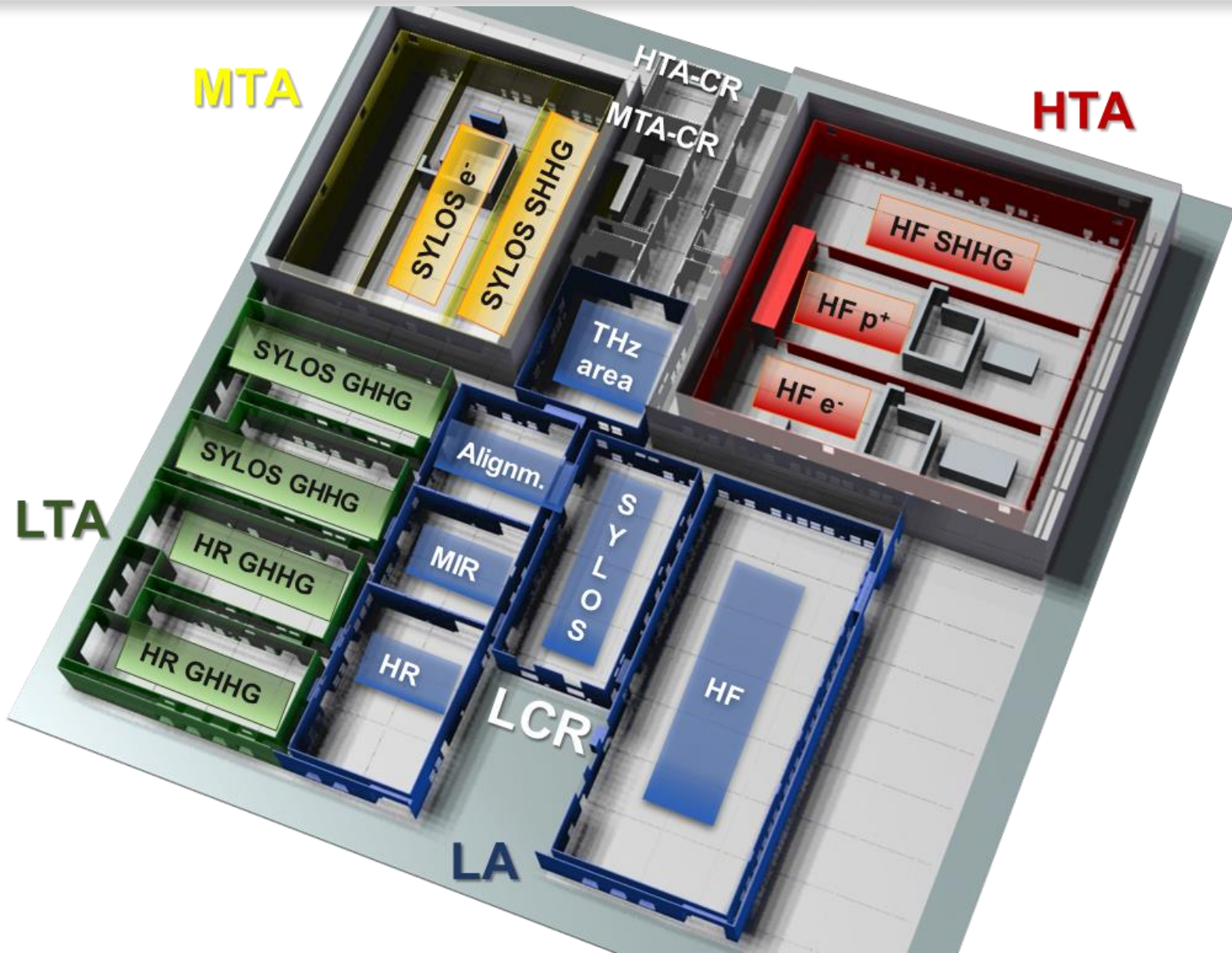


**THz
radiation
sources**



**Electron, ion
accelerators**

FLOOR PLAN: Main experimental halls



Mechanical and electrical workshops



Optical preparation laboratory



Optical workshop for custom optics and coatings



Commissioning users

Expert users in a field
 Part of commissioning, testing.
 For equipment has just been installed
 Full time operation is not guaranteed.
 Upon collaboration agreements
 Discretion of ELI-ALPS scientific management

"Zeroth call" users

(call to be launched in 2019 by ELI-DC/ERIC)

For selected, user ready equipment (HR1, MIR, THzSp)
 Full time operation is on a best effort basis.
 Based on scientific merit – international peer-review committee

Regular users

For the user ready equipment
 Full time operation is guaranteed.
 Based on scientific merit – international peer-review committee

"National" users

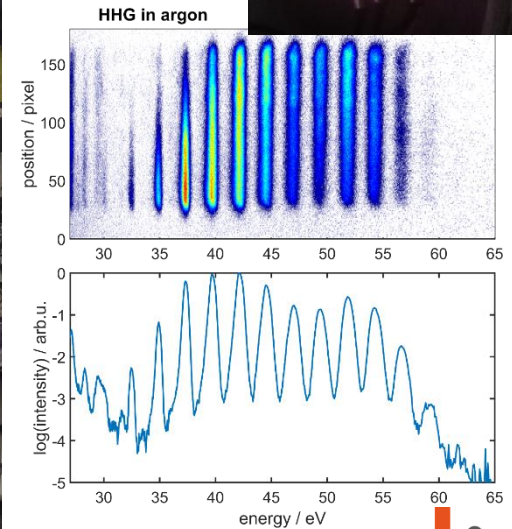
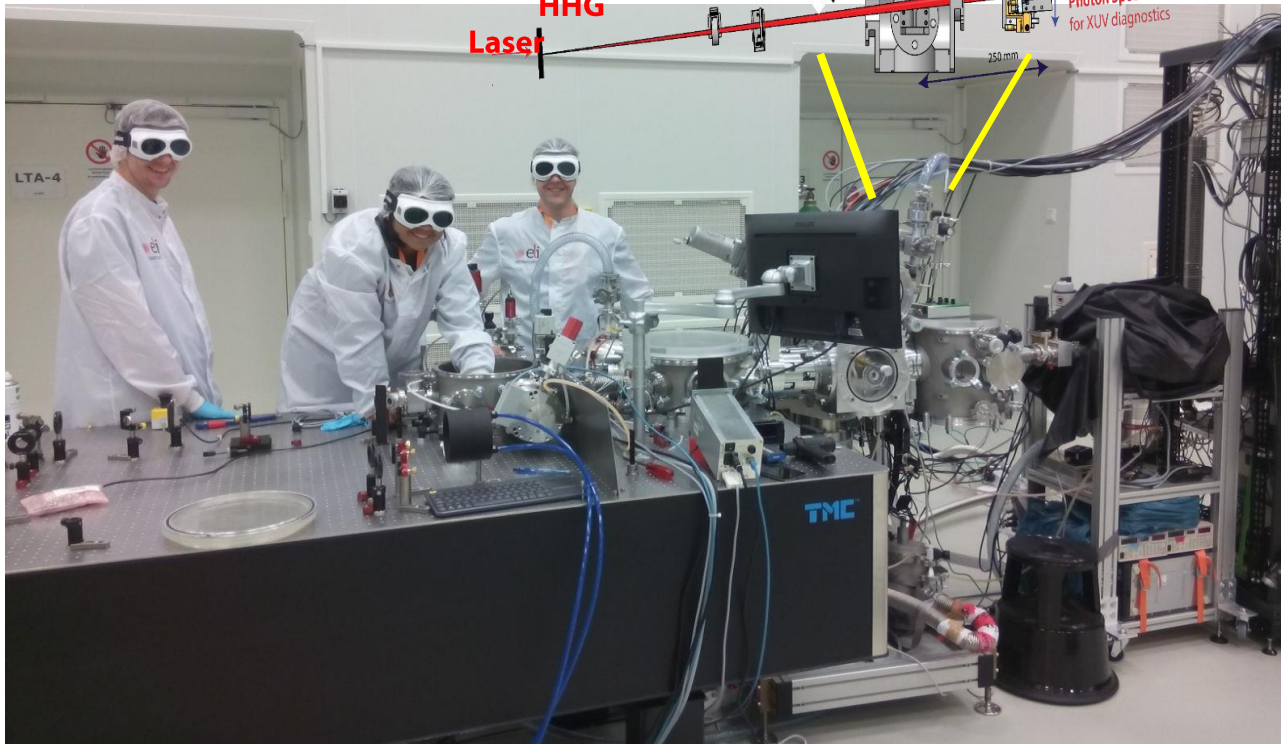
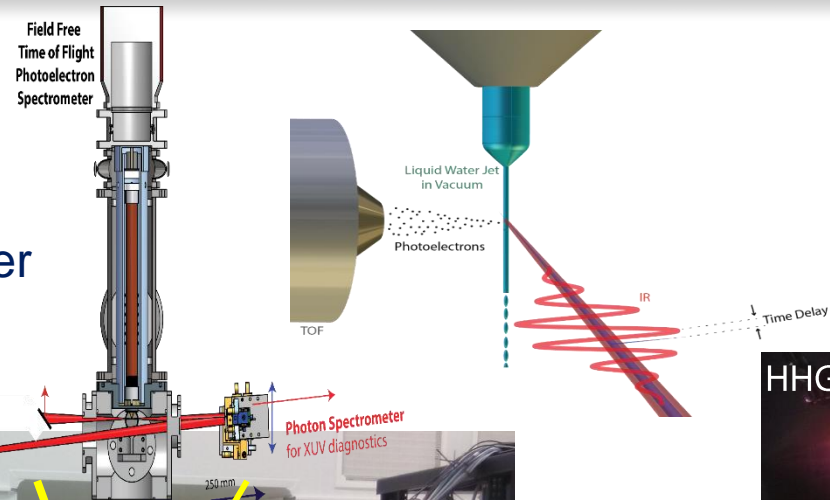
As above, but a dedicated time slot up to 20% of the beam time.
 MUST go through peer review!

HR1 laser commissioning experiment

Liquid phase dynamics

The ETH Zurich team

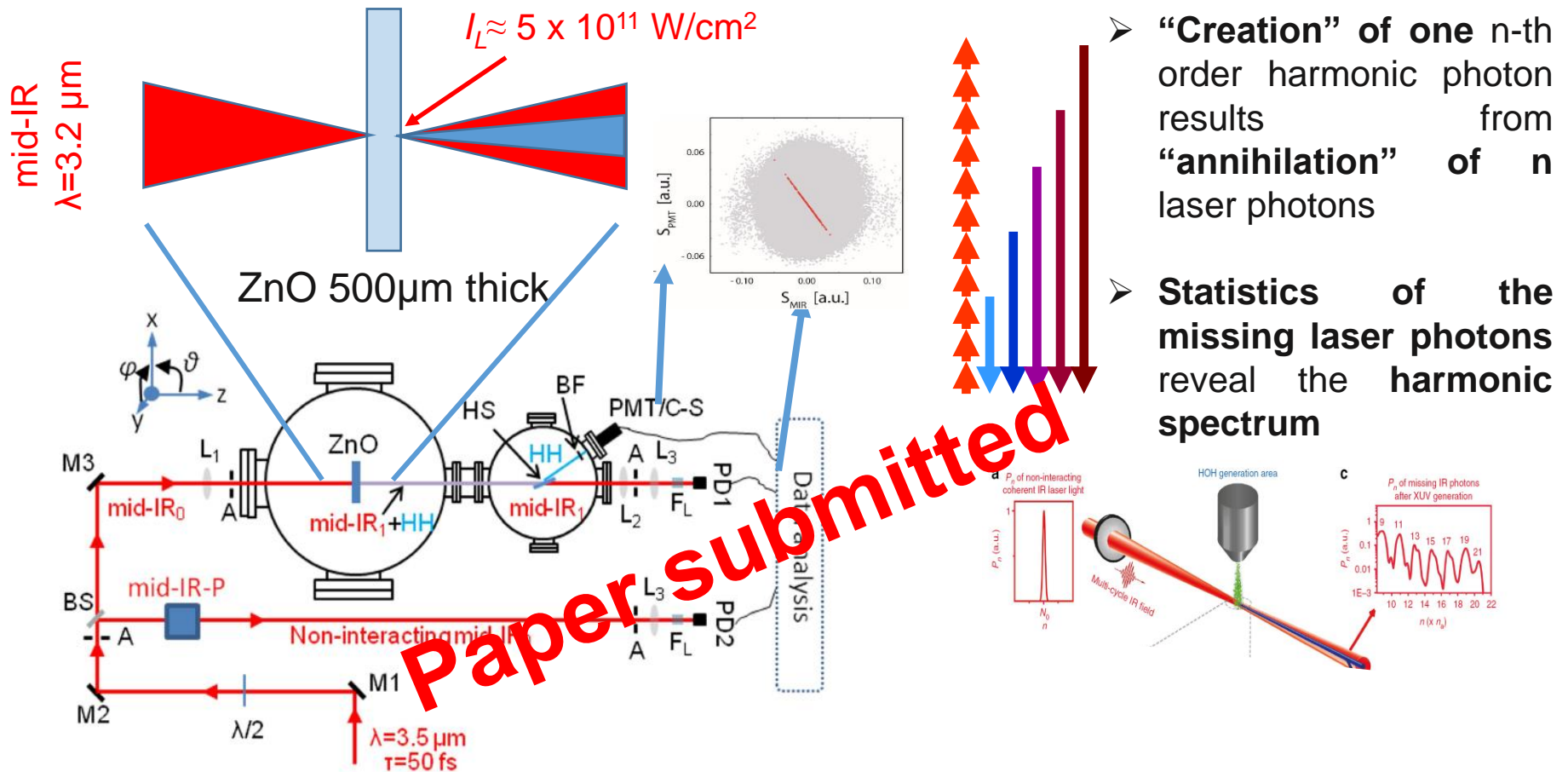
Hans Jakob Wörner, Arohi Jain,
Thomas Gaumintz, Andreas Schneider



The FORTH team

N. Tsatrafillis, E. Skatzakis

The quantum (photon) HHG spectrometer Principle: Photon statistics



Paper submitted

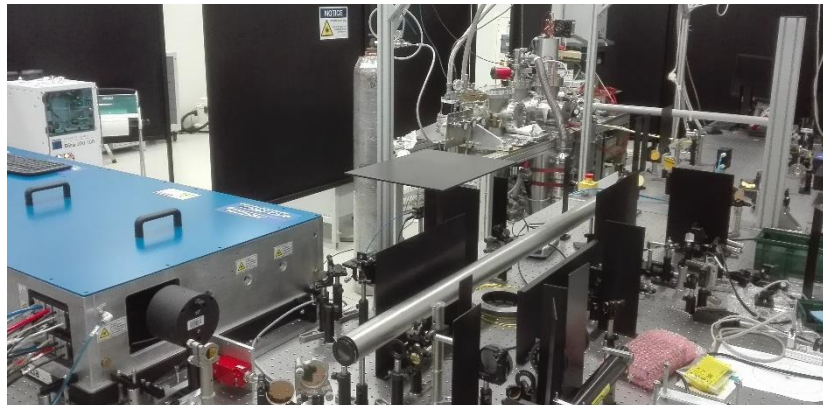
The Uni Freiburg – Uni Aarhus team

Prof. Marcel Mudrich & Frank Stienkemeier

Project:

Study of photoionization of Helium droplets of different size and, eventually with different dopant atoms (usually alkali atoms)

- *Observation of the initial ionization process, charging process and the Coulomb explosion of the clusters that proceeds when using the long wavelength pulses.*
- *Image (using a VMI) the photo-electron and photo-ion angular distributions*

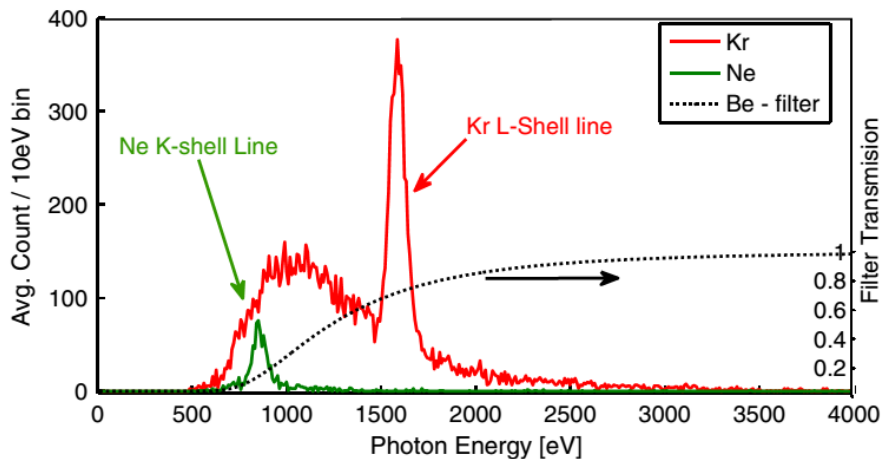


The Hebrew University, Jerusalem

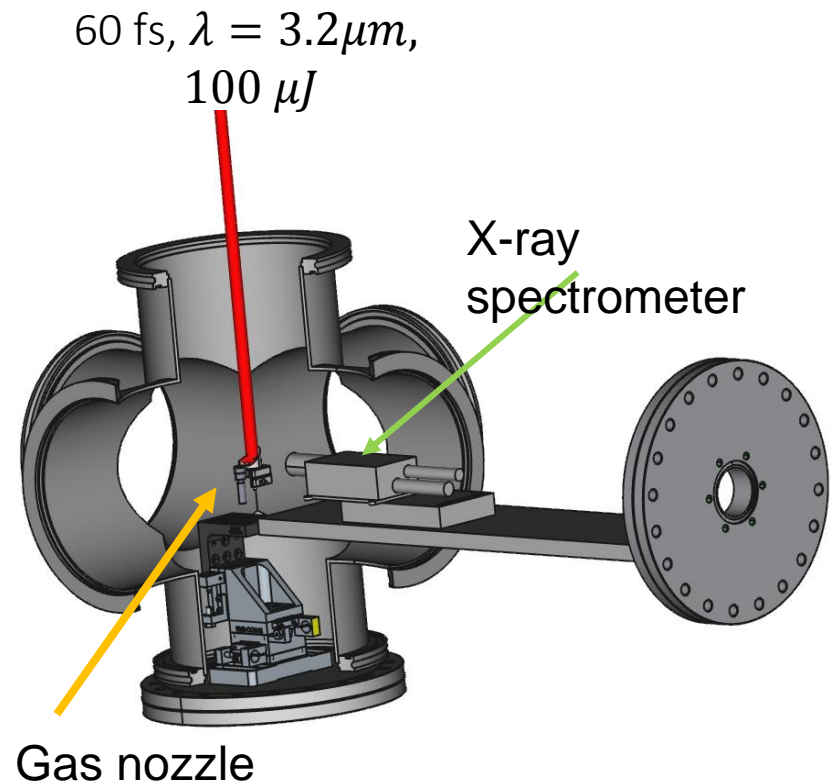
Prof Gilad Marcus (and his team)

The goal is to use the quadratic scaling of the ponderomotive energy with wavelength, to reach electrons energies which are enough to excite inner shell electrons. We tightly focused the beam as depicted in the experimental set up. At left side we see two typical obtained x-ray spectra of Ne and Kr. On top of a continuum there are characteristic K and L shell lines, signature of inner-shell excitation with IR laser.

Spectrum obtained with linear polarization



Ne K-shell and Kr L-shell + continuum



A background image showing a close-up, low-angle view of a molecular model. It features several white, spherical atoms connected by thin, metallic-looking rods, creating a complex, geometric structure against a light, hazy background.

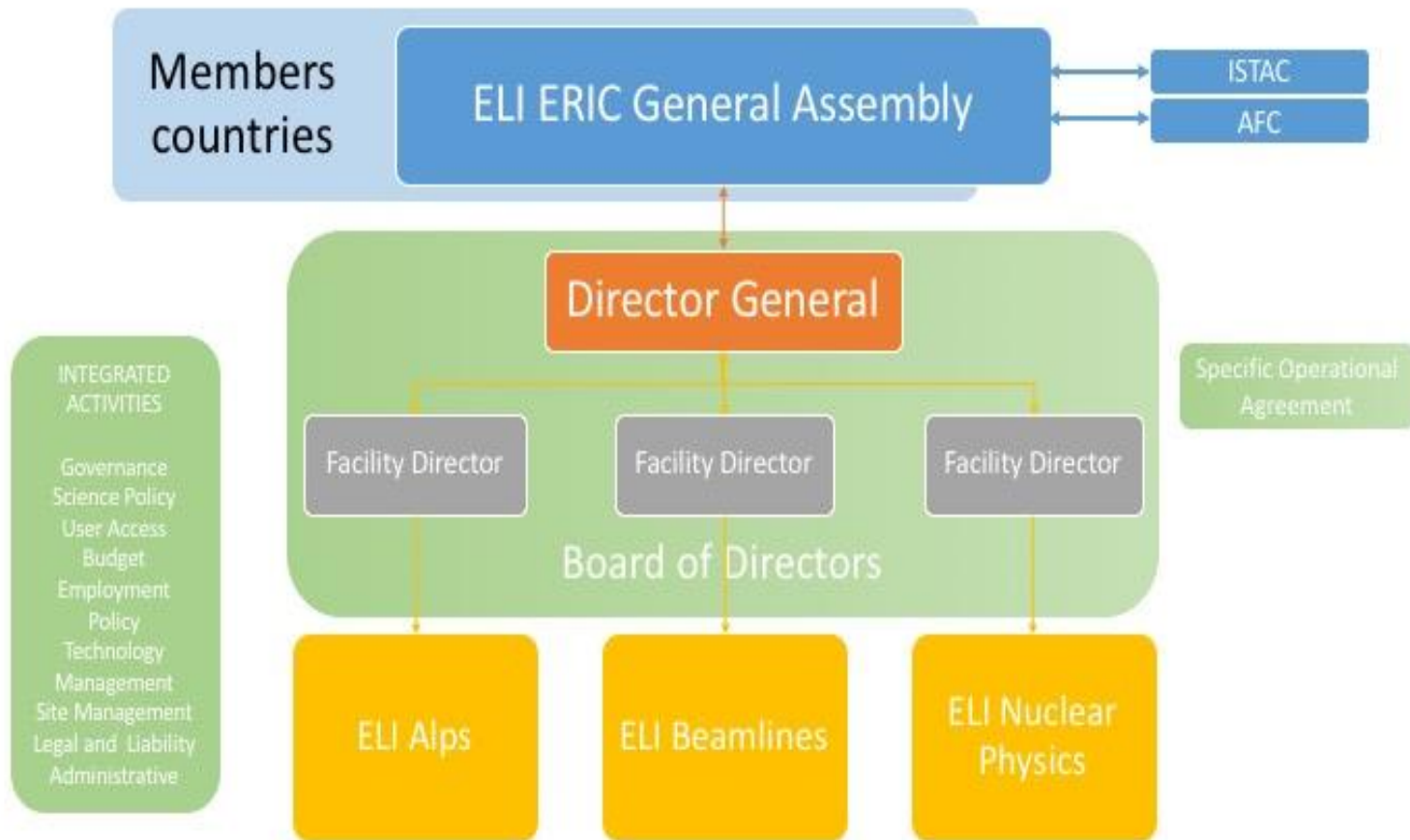
ERIC

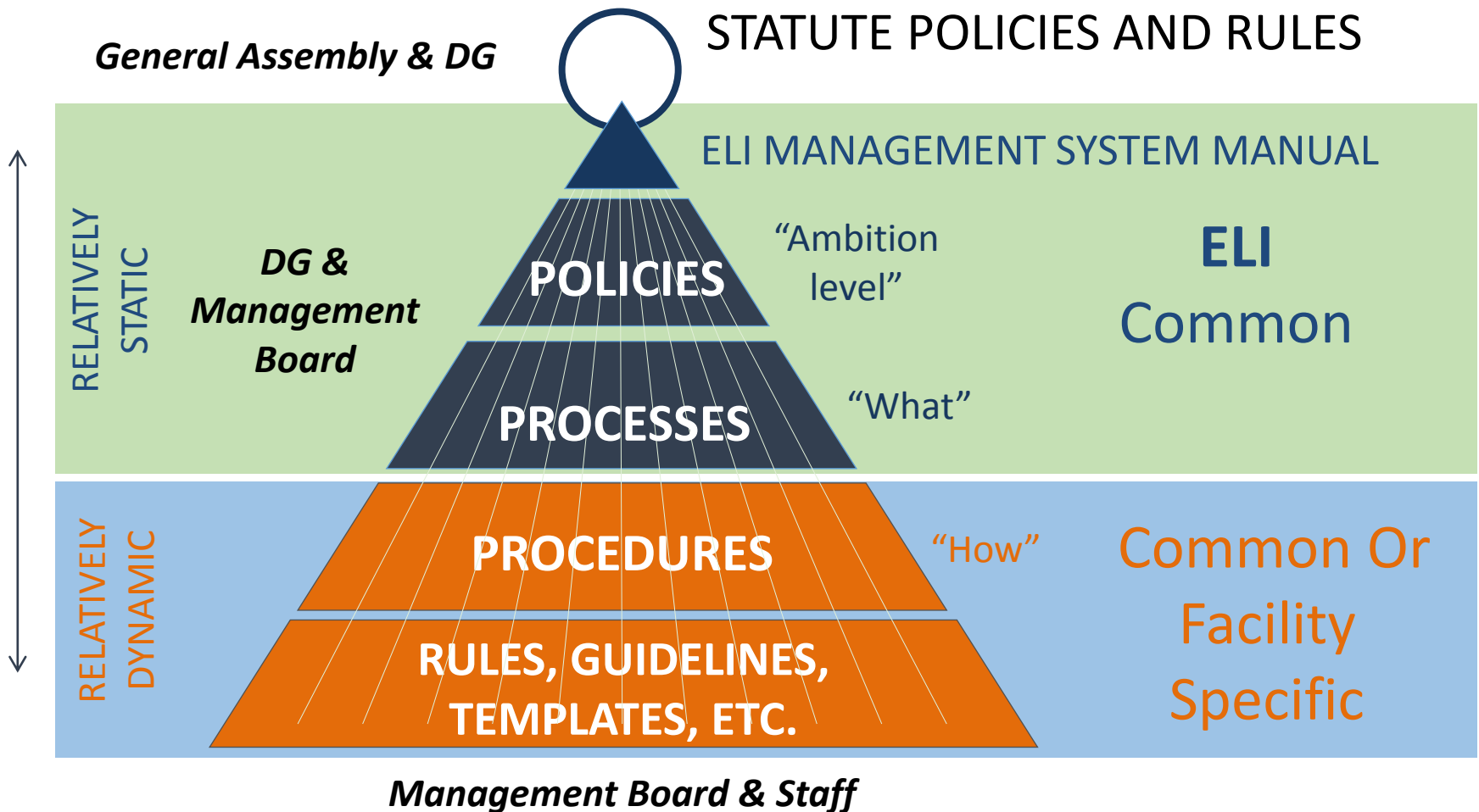
Practical guidelines

*Legal framework for a
European Research
Infrastructure Consortium*

- An ERIC is a legal entity set up by a decision of the European Commission. It has legal personality and full legal capacity recognized in all EU Member States.
- ERICs are not bound by the procedures of the Public Procurement Directive but may set their own procurement rules based on transparency, non-discrimination and competition
- Statutory seat in a Member State or Associated Country; research locations anywhere
- Members' liability:
 - limited to committed contribution (cash, in-kind)
 - may specify in the Statutes a fixed liability above their respective contributions or unlimited liability.

Integrated operation





Ecosystem development: the ELI Science Park





First working day in the facility: 12 June 2017

