

# Planned scientific activities of ELI-ALPS



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ELI-HU Non-profit Ltd.



The projects are supported by the European Union.

# Planned scientific activities of ELI-ALPS

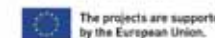


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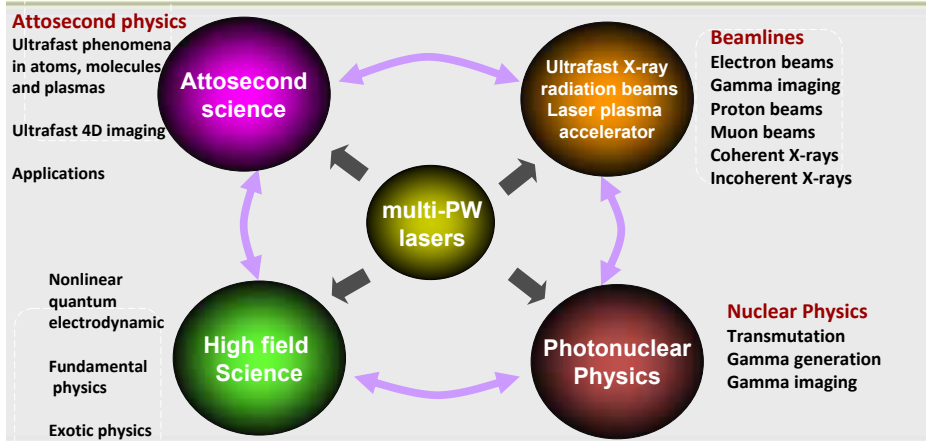


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# 4 scientific pillars of ELI



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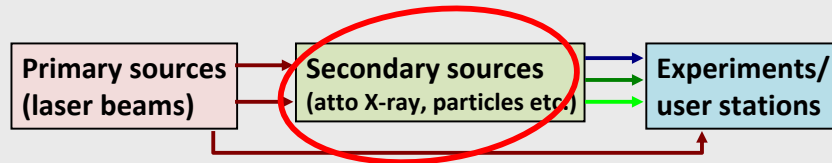
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ELI's ultimate scientific goal:  
 „Study of the structure of matter from Atom  
 to Vacuum”

1. Construction of a unique attosecond facility with additional sources spanning the THz...X-ray range for users
2. All of these wavelengths delivered in ultrashort (few-cycle) pulses and high repetition rates (100 kHz/TW... 10 Hz/PW)
3. Possibility for novel time-resolved experiments in atomic, molecular and plasma physics  
 + interdisciplinary applications
4. Operating as a user facility

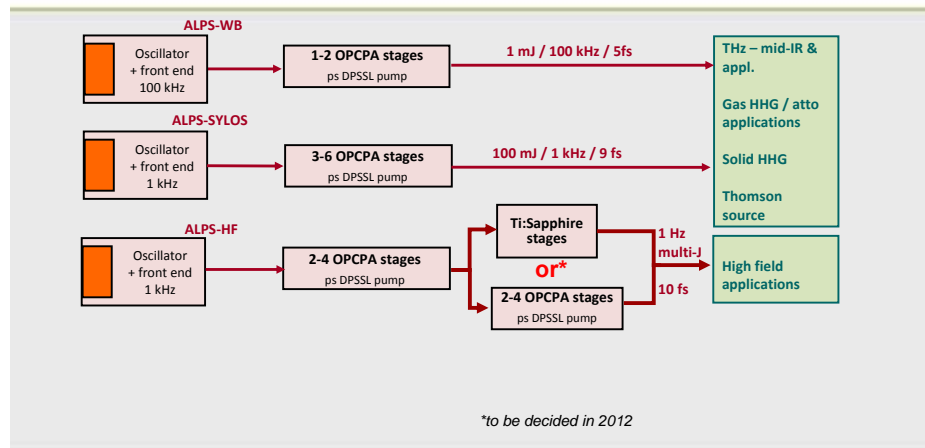
## Talk overview



## Secondary sources of ELI/ALPS

- based on 100 kHz / 1 mJ laser chain:  
**spectral coverage from THz to XUV (some hundreds eV)**
- based on 1 kHz / 100 mJ laser chain:  
**XUV to X-ray (10 eV – 10...100 keV)**
- based on 1(...10) Hz PW laser source:  
**PW class IR pulses for high field science**

## Block scheme of primary and secondary sources



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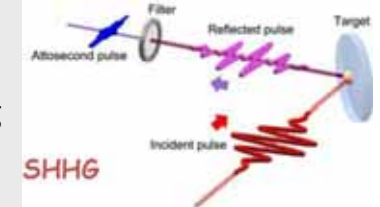
## Attosecond source development



- scaling of gas harmonic generation schemes



- development and scaling of plasma harmonic generation schemes

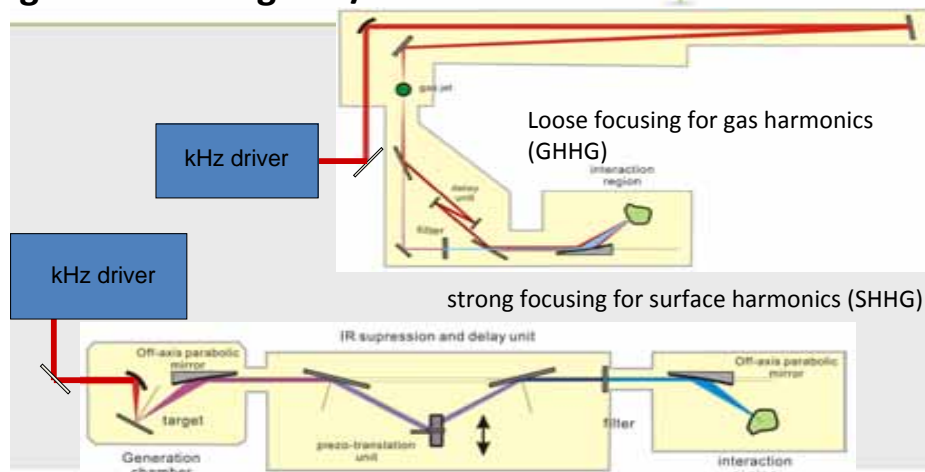


- atto pulses by Thomson scattering



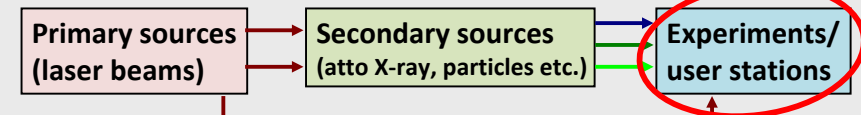
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## Secondary sources – high harmonic generation in gases/solids



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## ELI general facility scheme



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## ELI-ALPS science

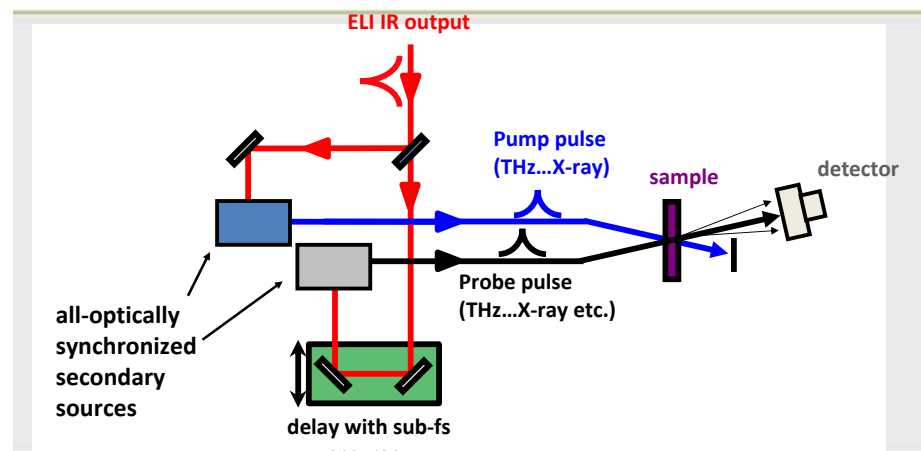


1. atomic physics: valence electron science
2. atomic physics: core electron science
3. sub-atomic 4D imaging
4. attosecond high-field science
5. photon sources for biological/medical/industrial applications



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## All-optical synchronization → extension of pump-probe methods



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## 1&2 Core/valence electron science



- X-ray/vis or vis/X-ray or X-ray/X-ray pump-probe studies

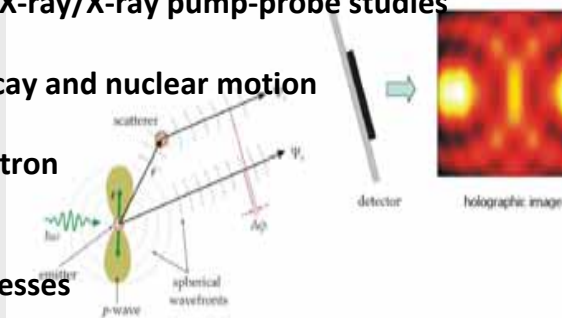
- interplay btw. Auger-decay and nuclear motion

- time-resolved photoelectron holography

- multi-X-ray-photon processes

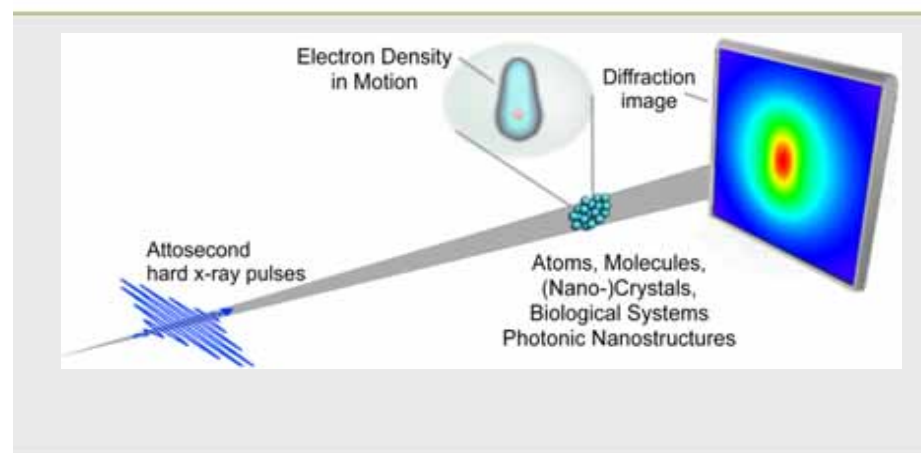
- controlling valence electrons to steer chemical reactions

- etc. etc.



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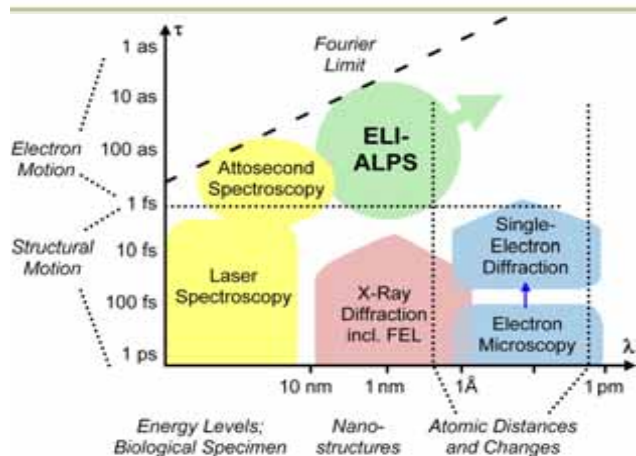
## 3. Sub-atomic 4D imaging



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from Peter Baum

### 3. Sub-atomic 4D imaging



ELI/ALPS advantage:  
 - attosecond X-ray sources for ultrafast diffraction  
 - nm imaging

disadvantage:  
 - poor flux  
 → investigate reversible processes @ high rep. rate



from Peter Baum

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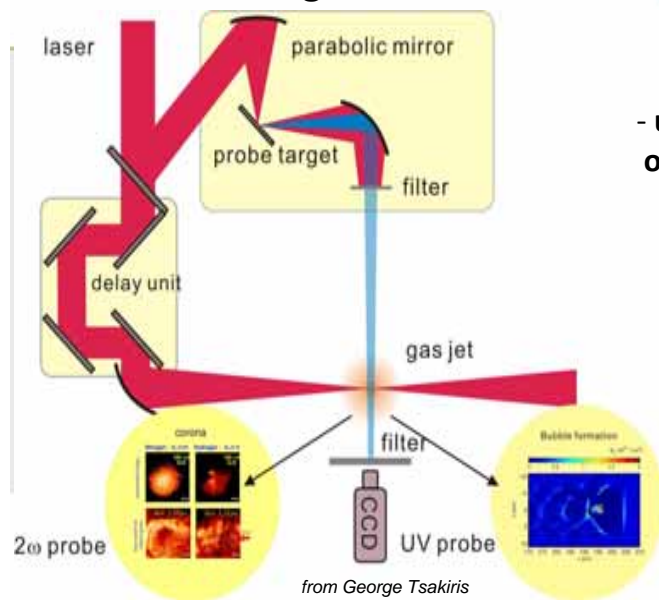
### 4. Attosecond high-field science fs/as probing of relativistic laser plasmas

- Shadowgraphy, polarimetry frequency-domain interferometry and holography of short pulse interaction with plasma
- High temporal resolution diagnostics of plasma sheaths
- Time resolved studies of electron propagation instabilities in high density plasma
- Tracing of the implosion in irradiated pellets



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### 4. Attosecond high-field science

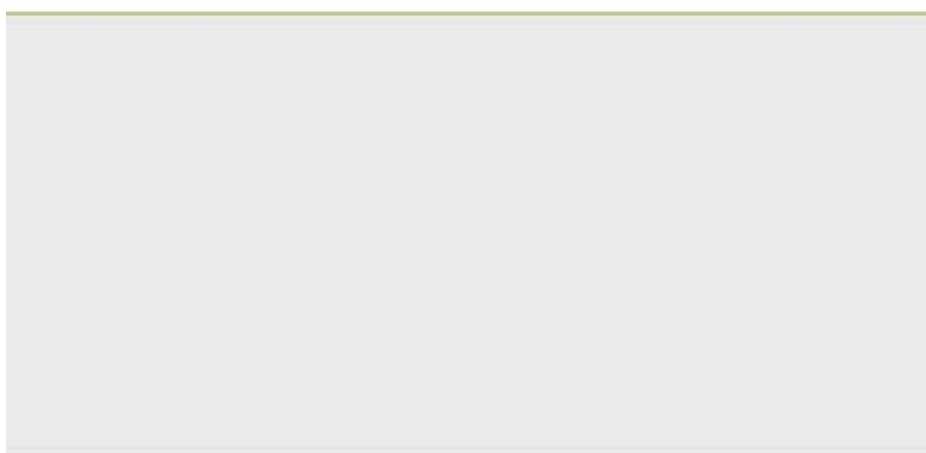


- ultrafast diagnostics of laser plasmas

200 probe

from George Tsakiris

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