



# Control Systems and Integrated Engineering at ELI-ALPS

SZÉCHENYI 



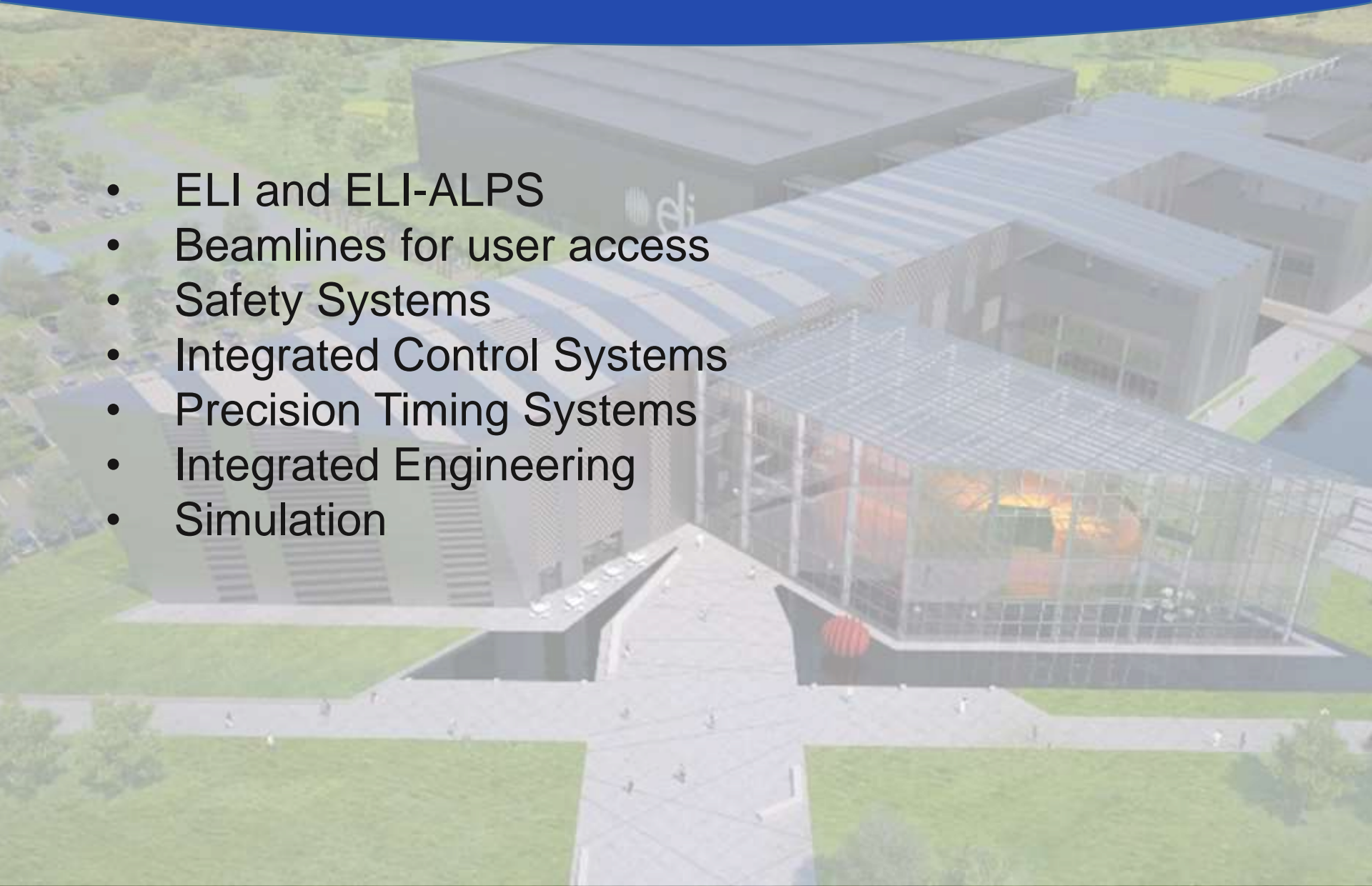
HUNGARIAN  
GOVERNMENT

European Union  
European Regional  
Development Fund

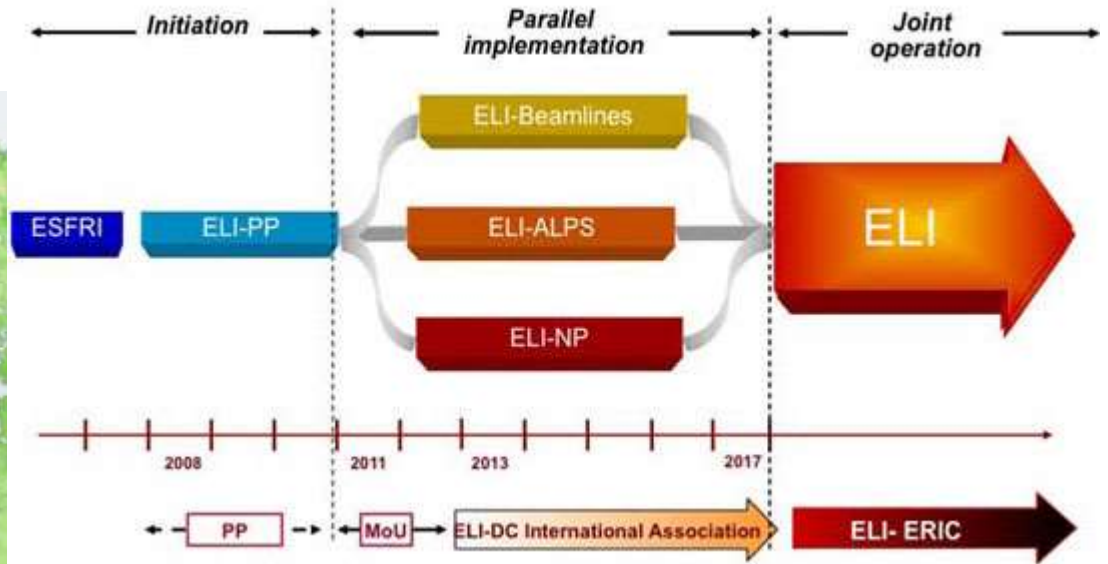


INVESTING IN YOUR FUTURE

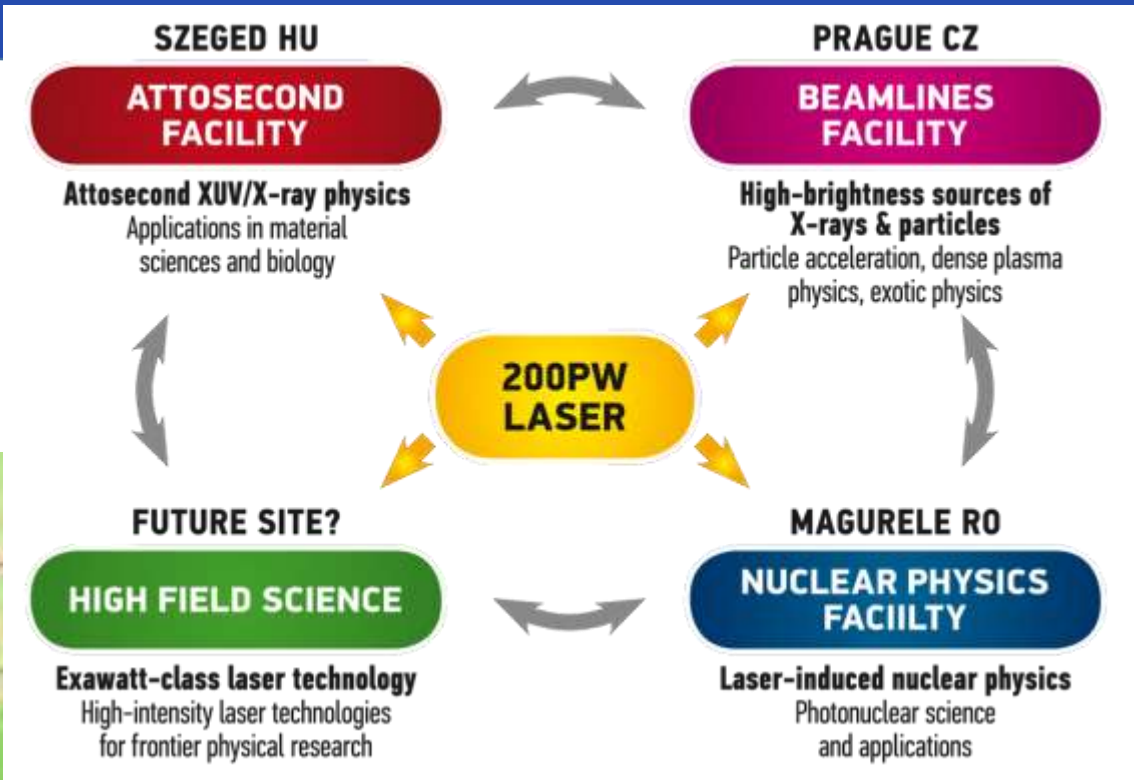
- ELI and ELI-ALPS
- Beamlines for user access
- Safety Systems
- Integrated Control Systems
- Precision Timing Systems
- Integrated Engineering
- Simulation



# Extreme Light Infrastructure (ELI)

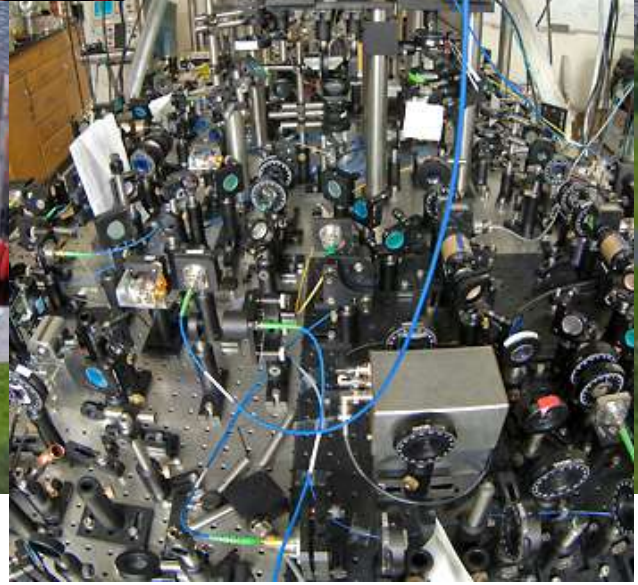
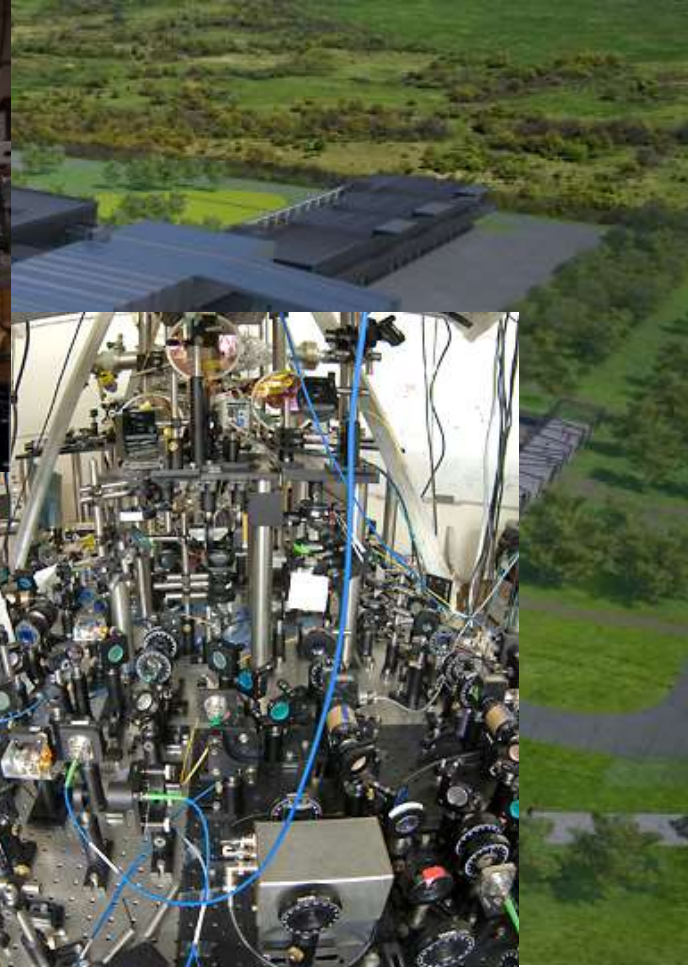
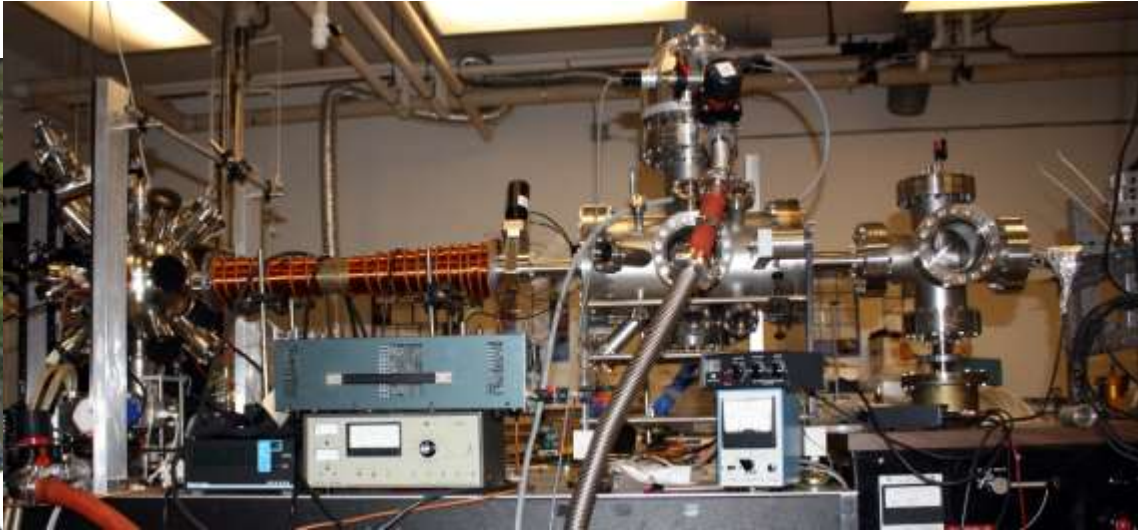


# Extreme Light Infrastructure Attosecond Light Pulse Source (ELI-ALPS)



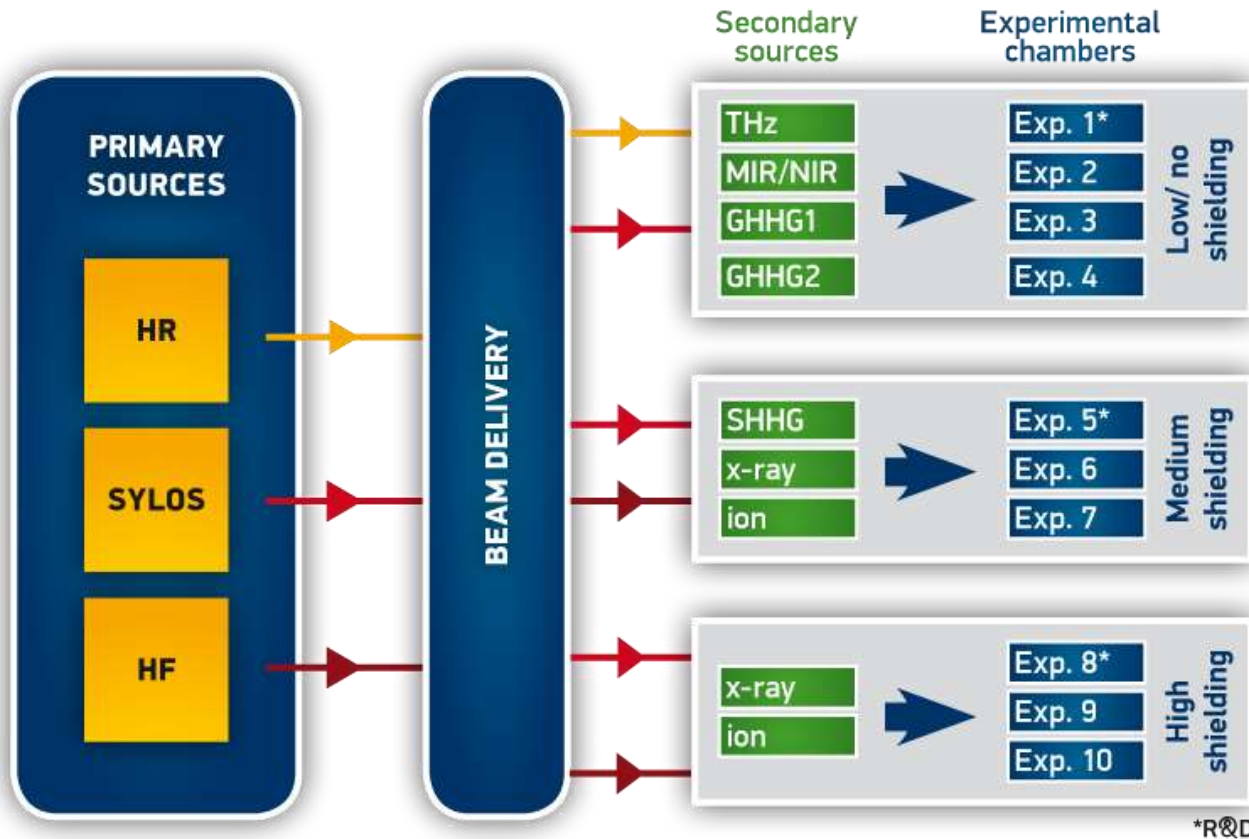


# Extreme Light Infrastructure Attosecond Light Pulse Source (ELI-ALPS)



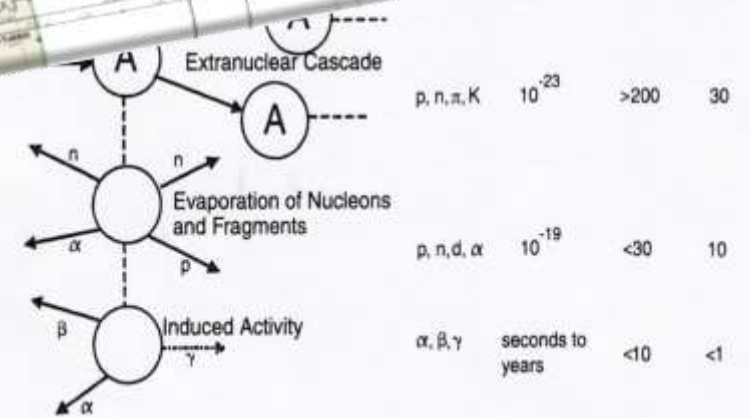
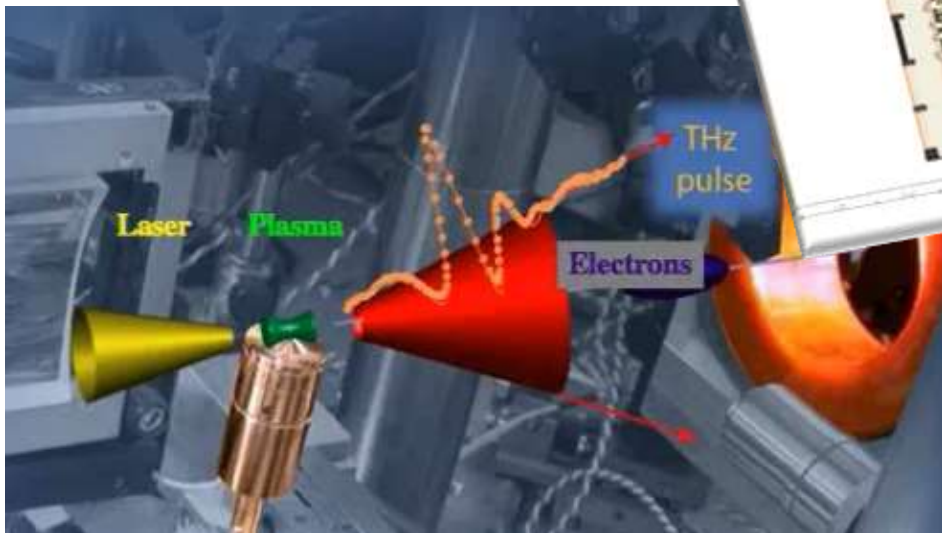
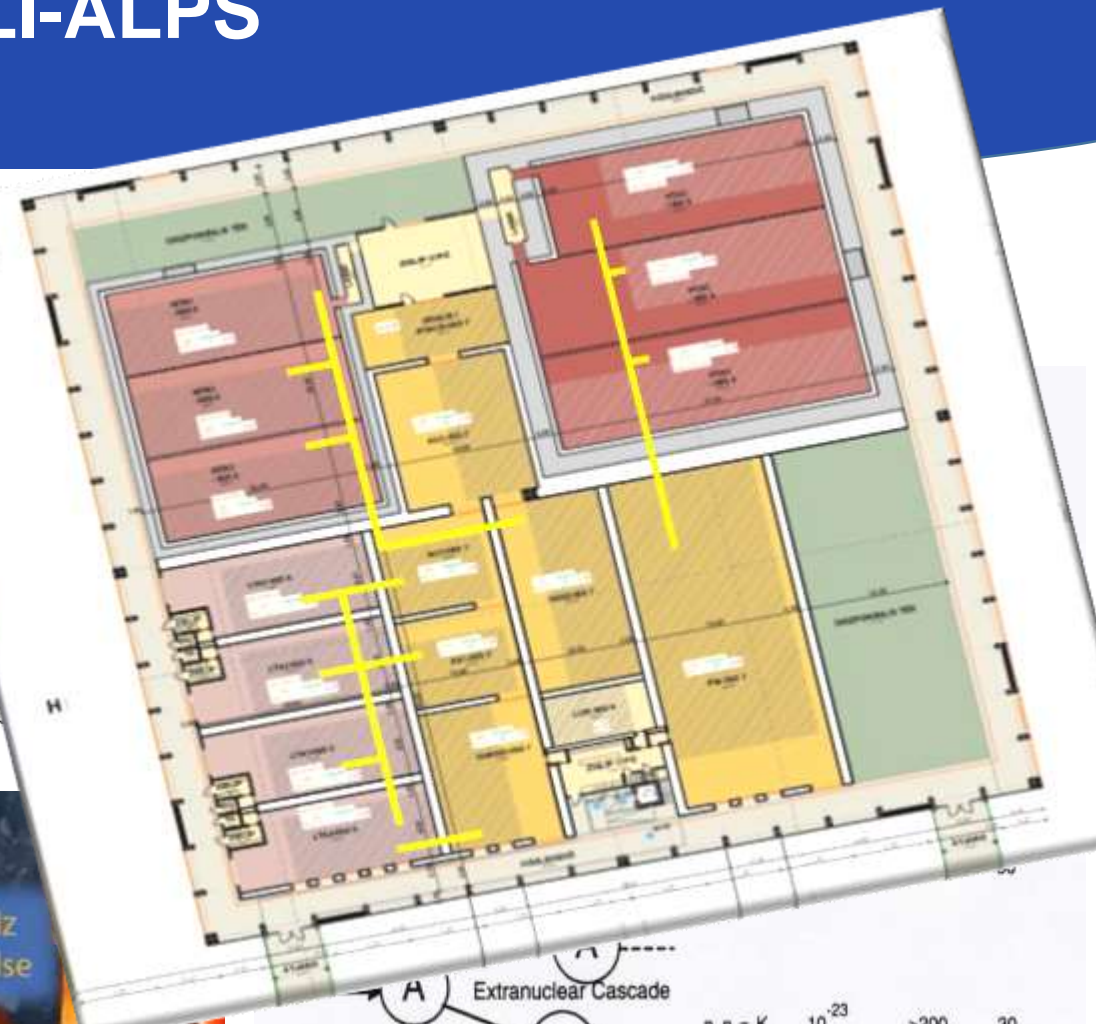
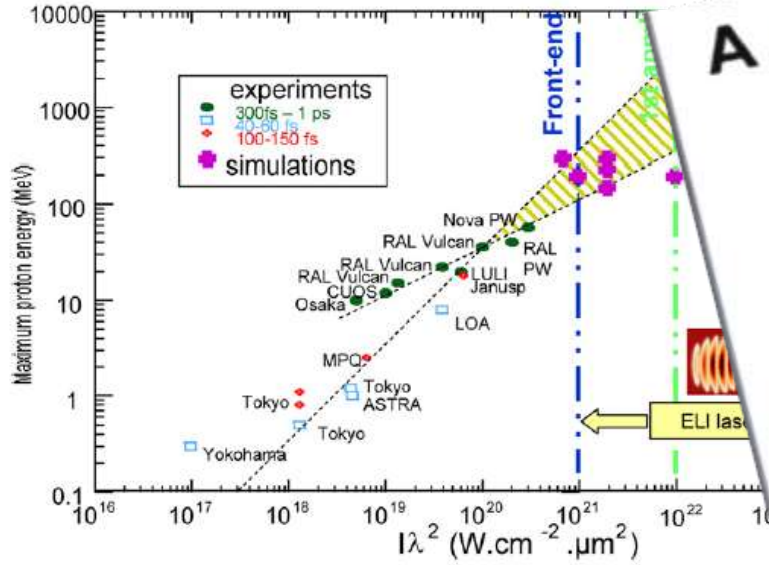
# ELI-ALPS

## Attosecond user facility





# Shine of the ELI-ALPS



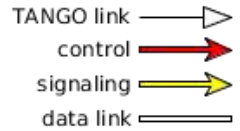
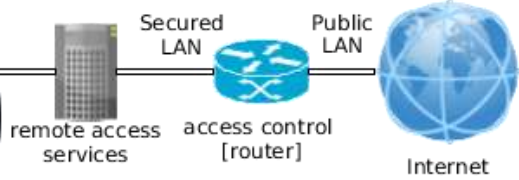
**<<<DAQI>>>**  
**Supervisory Control Services**

**Integration logics:**

- Complex Commands
- Supervisory functions
- Error recovery
- Impact model

**TANGO database**

**TANGO bus**



**Inhouse API**

**Inhouse API**

**Machine Protection System**

- Low level, local interlock logic
- Embedded driver level protection
- watchdog
- Low level electrical and/or mechanical protection

PLC access point

**Proprietary API [driver|PLC gateway]**

**Facility maintenance**

- Firewall / Access point
- database
- control server

**Proprietary API [driver|PLC gateway]**

**Personal Safety System**

- Firewall / Access point
- database
- control server

**Proprietary API**

**Radiation Monitoring System**

- CAS server: access point
- database
- Logging server
- Sensors

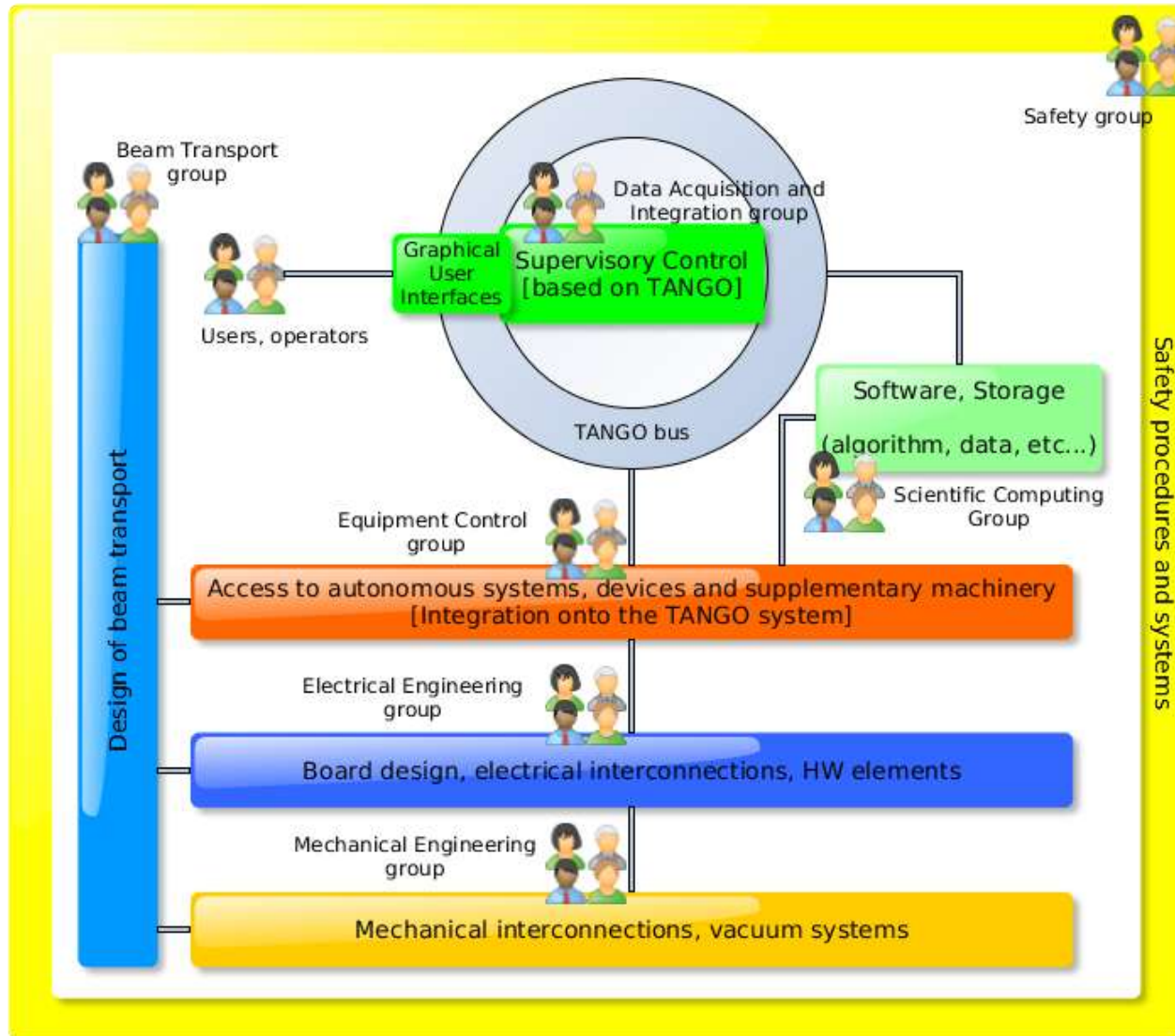
**PLC/wired interconnection**

Controller/monitor

controller/monitor

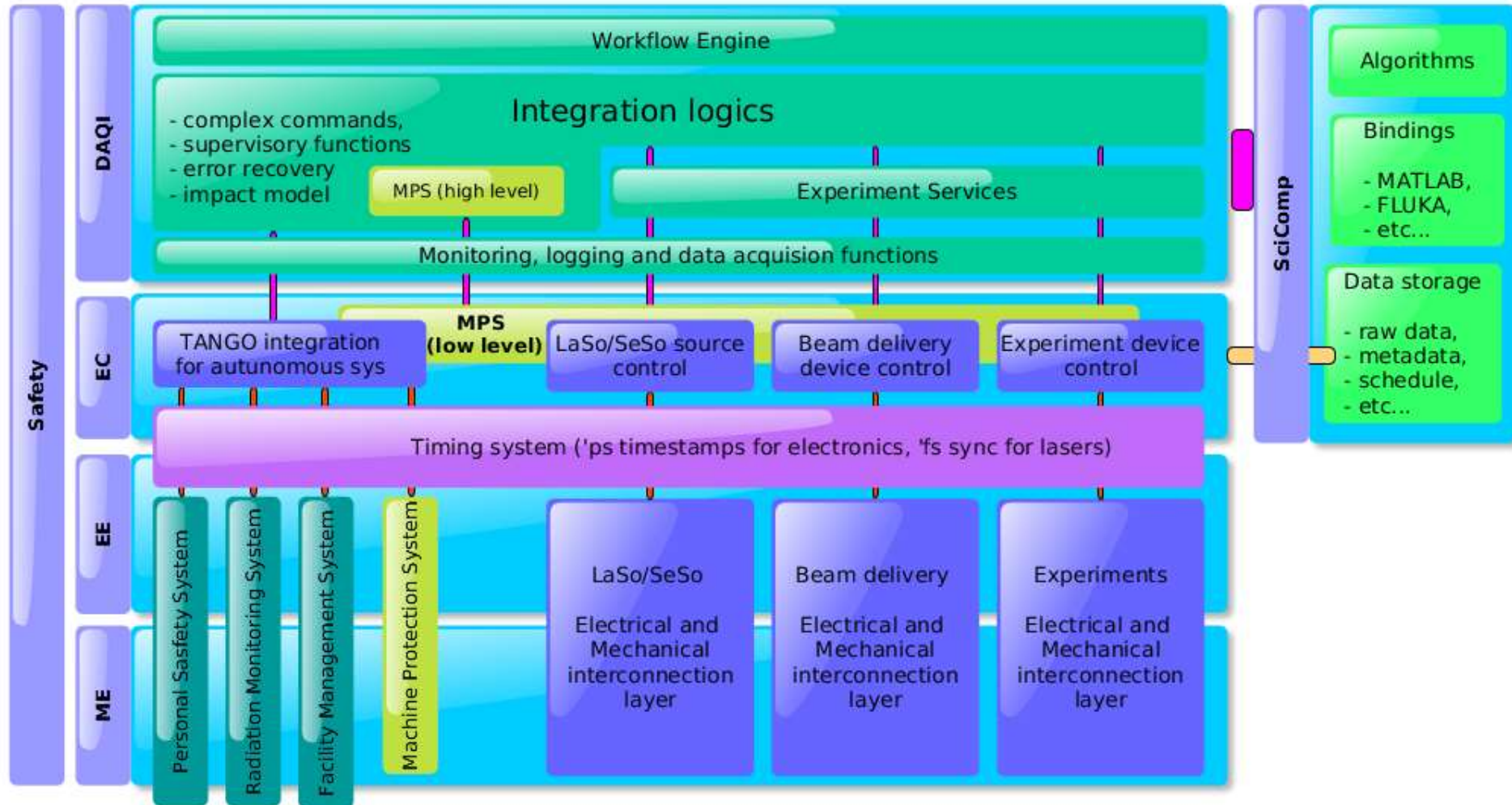


# Equipment Control group in view of the command and control perspective



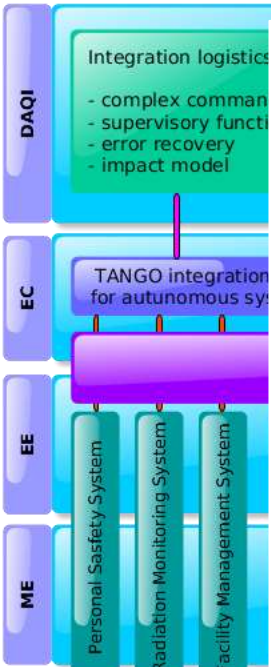
# Control System Overview

- details

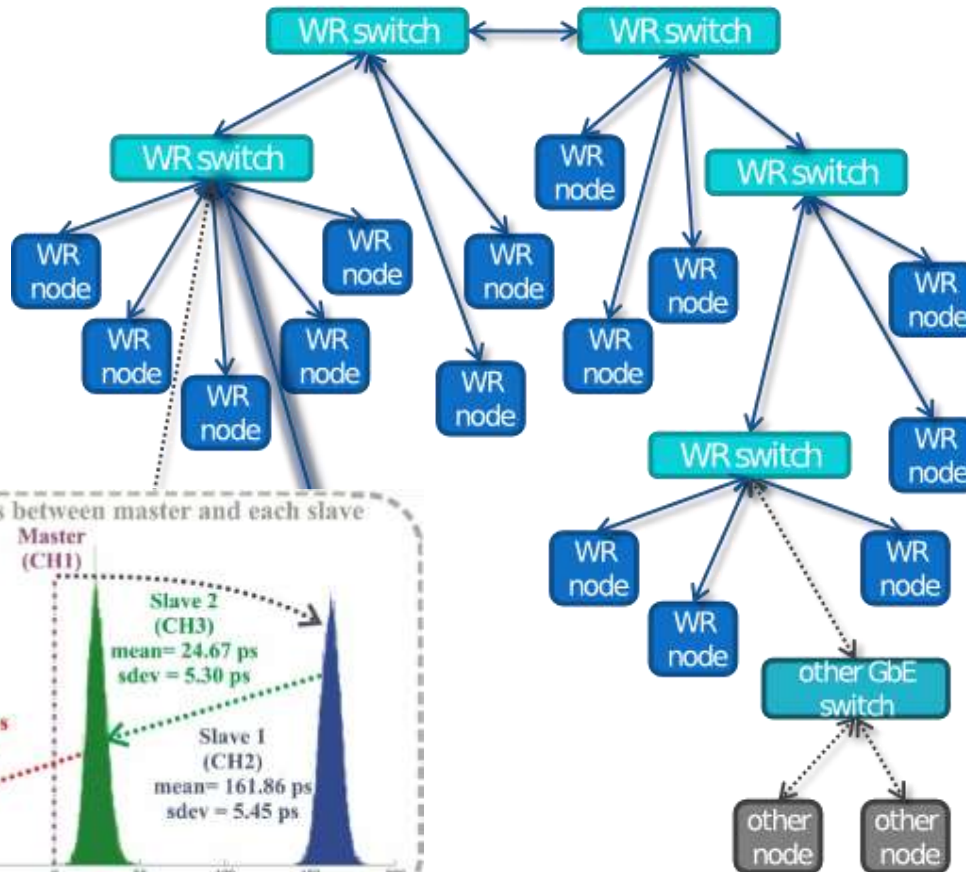


# Precision timing system over Ethernet, that is, a custom network

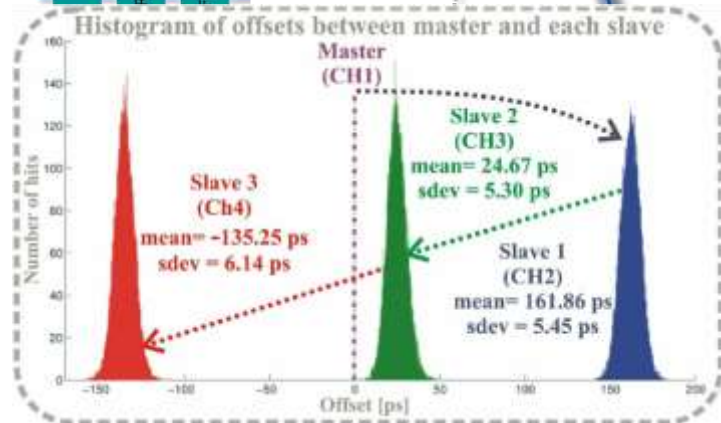
Custom Ethernet network w/ fine ('ps grade) clock distribution capability



## Ethernet

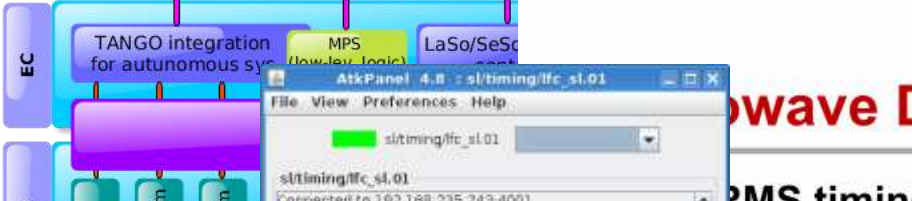
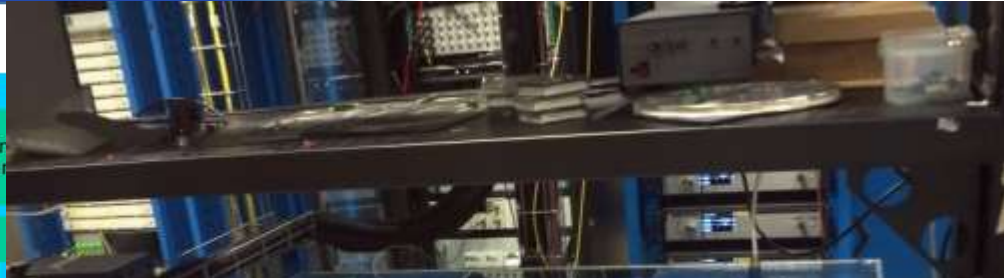


- ▼ Up to 2000 nodes
- ▼ Copper or fiber medium
- ▼ Up to 10 Km fiber links
- ▼ Bandwidth: 1 Gbps
- ▼ WR switch: 18 ports
- ▼ Add/ Remove nodes dynamically
- ▼ Non WR devices





# 'fs clock distribution system



AtkPanel 4.8 - sl/timing/lfc\_sl.01

File View Preferences Help

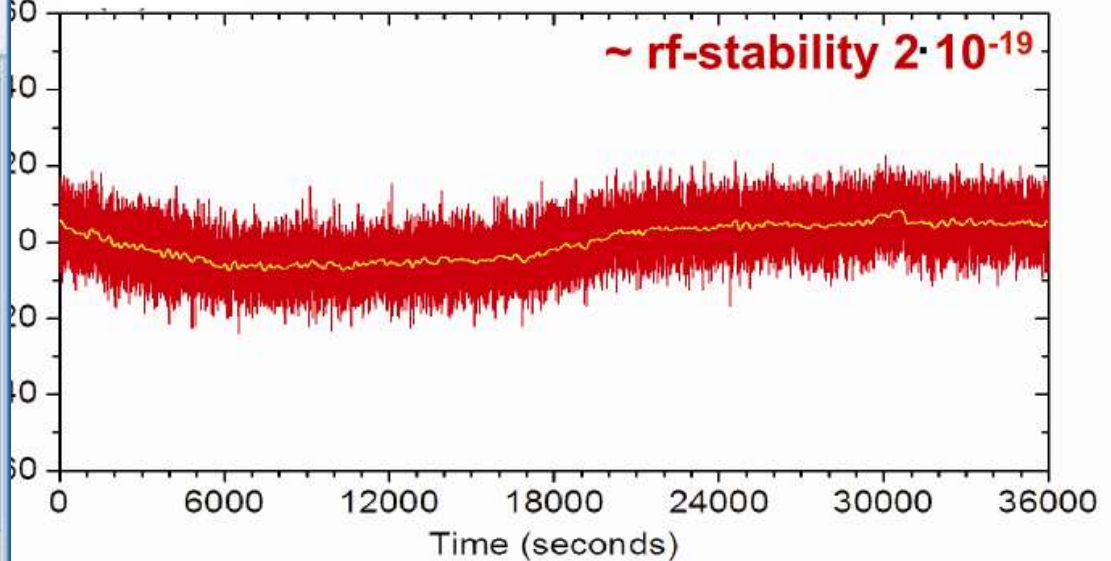
sl/timing/lfc\_sl.01  
Connected to 192.168.235.243:4001

ISET	450 mA	000.00
Amplifier_State	<input checked="" type="checkbox"/>	True
Tstamp	1392746070.47 s	
RTstamp	1392744279.00 s	
TstampDiff	-1787.46 s	
TstampStart	1377619383.00 s	
Uptime	15126693.46 s	
IACT	449 mA	
PACT	278 mW	
DIODE_TSET	25000 uC	000.00
DIODE_TACT	25272 uC	
MODULE_TACT	33063 uC	
TCORR	0 -K/A	000.00
PACT_1	226.67 uW	
PMIN_1	0.00 uW	

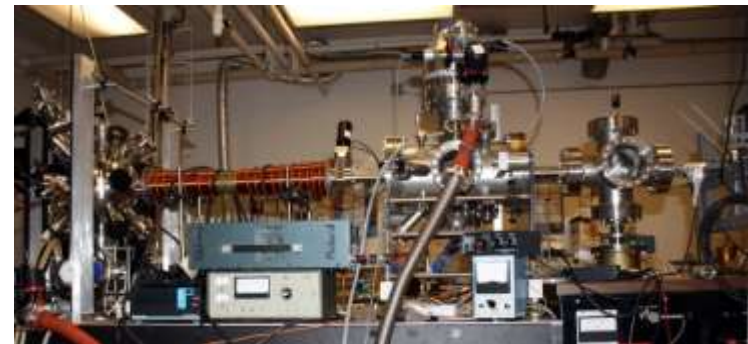
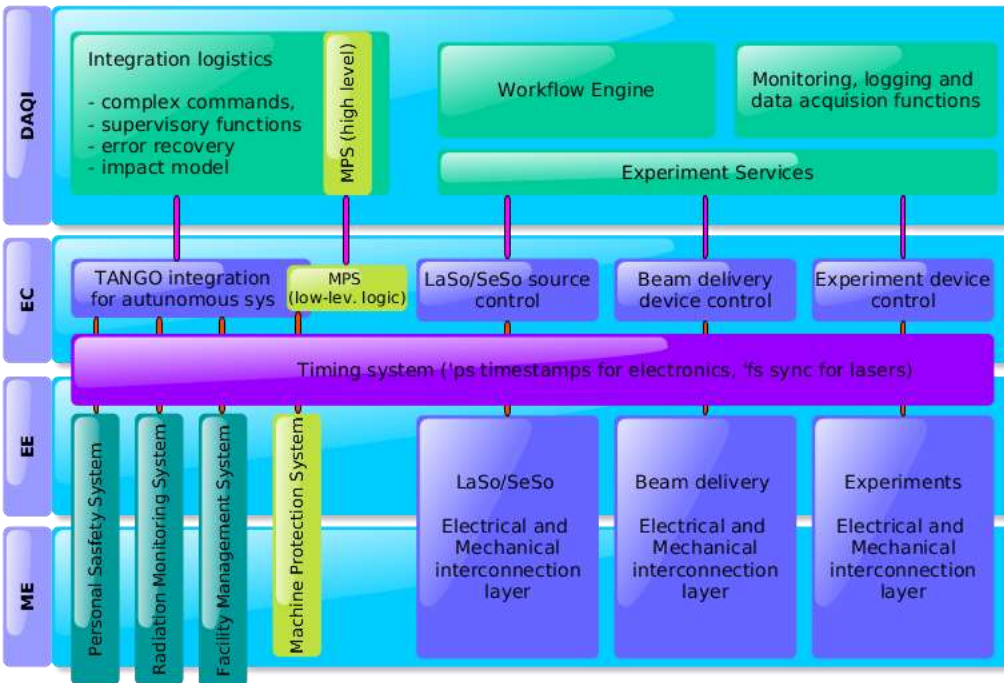
Scalar: DeviceError DetAckIn DetAckVW DetAckVW DetDcVal Laser Amplifier Power ScramblerEnable ScramblerTriangleTime ScramblerLockTime ScramblerLockSteps ScramblerLockDelay SystAutoScr

**Wave Distribution: 6.8 fs drift over 10 hours**

**RMS timing jitter integrated in 27  $\mu$ Hz – 1 MHz: 6.8 fs (3fs)**



# Scientific Computing: Data rates and volumes



~500Gb/s

**top 3 worldwide**

~300TB raw data (lifetime: 1 day)

Data filtering

Irrelevant data will be filtered out

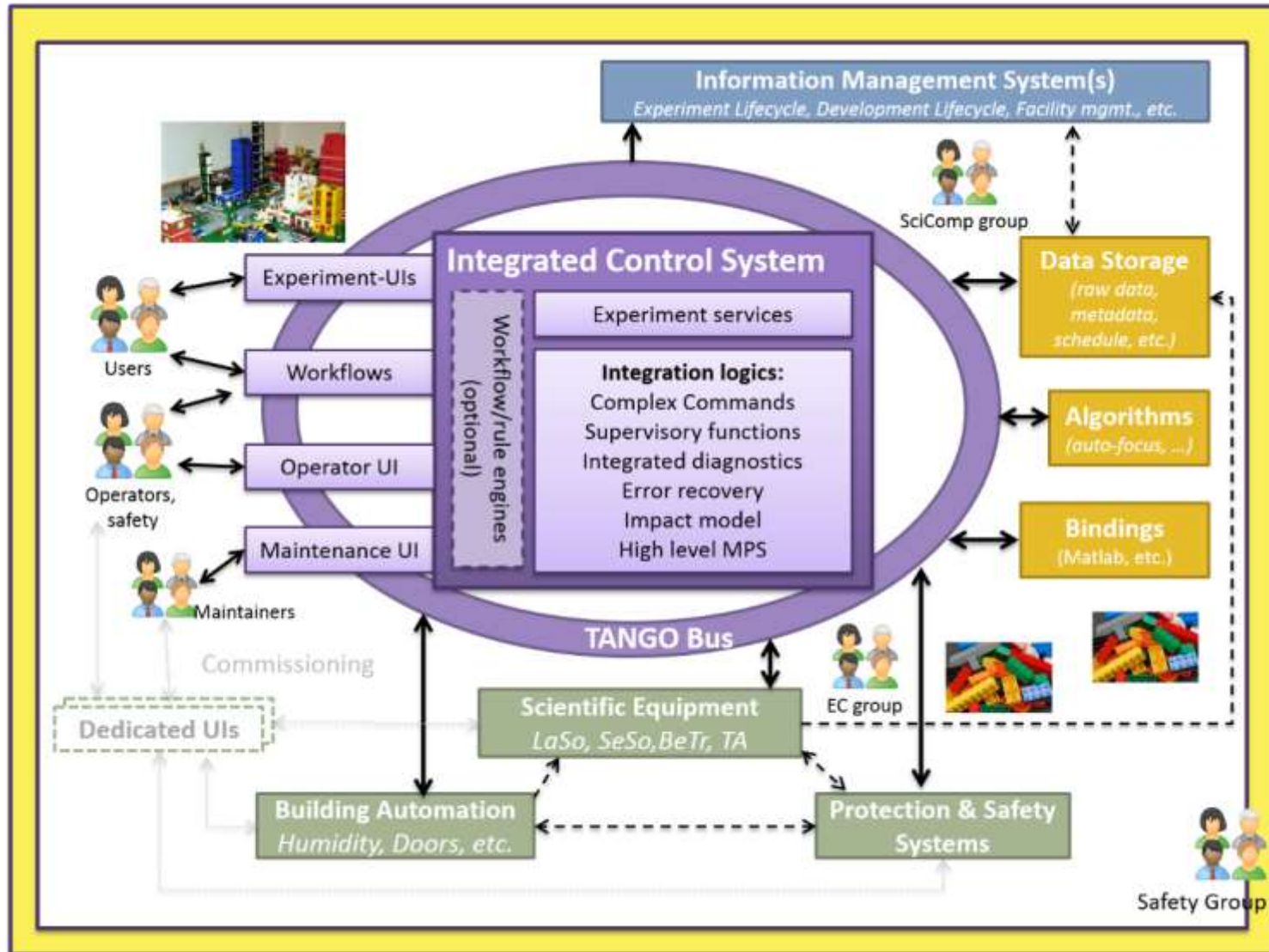
~75TB filtered data per day

~1,6PB (lifetime: 1 month)

Estimated yearly data volume: 7,2PB

**top 10 worldwide**

# Integrated Control System





*„The use of simulation systems to test configurations and applications early has enabled more mature applications to be available before first commissioning with real hardware. As a result the commissioning of the Diamond Control System went very smoothly with a high level of functionality available for day one commissioning with beam.”*

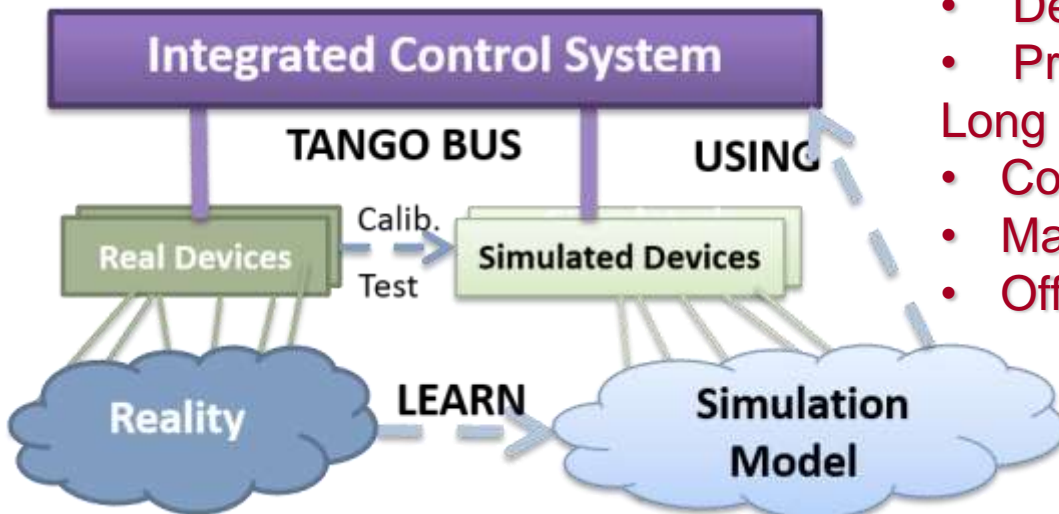
Heron et al.: THE DIAMOND LIGHT SOURCE CONTROL SYSTEM  
10<sup>th</sup> European Particle Accelerator Conference, 2006

### Goals:

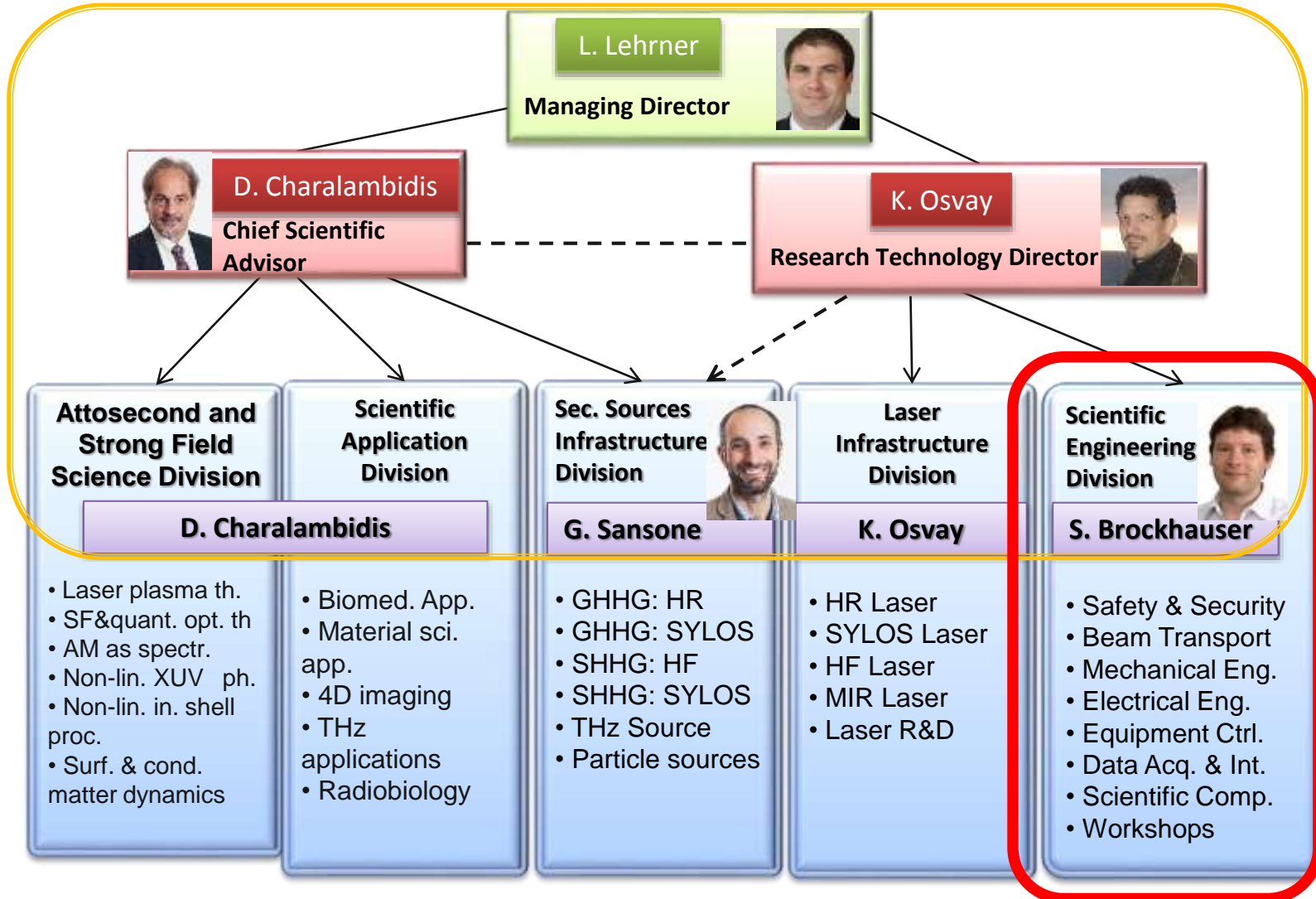
- Skeleton of the system
- Device naming convention, etc.
- Prototype, test, communicate

### Long term:

- Collision check / machine protection
- Maintenance: develop, test, fix, migrate
- Offline experiment preparation



## Scientific Board





# THANK YOU FOR YOUR ATTENTION!

**SZÉCHENYI** 



HUNGARIAN  
GOVERNMENT

European Union  
European Regional  
Development Fund



**INVESTING IN YOUR FUTURE**