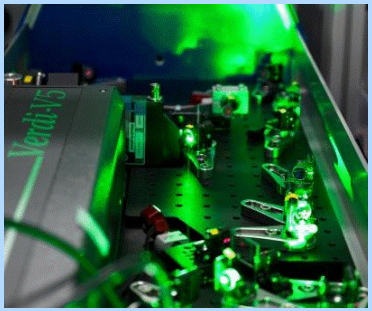
PAUL SCHERRER INSTITUT

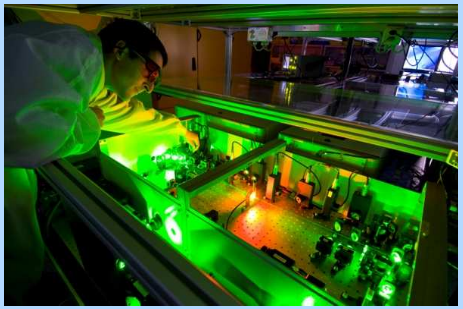
09:00	**Welcome and Introduction to SwissFEL**	*ABELA, Rafael*	*OSGA/EG06, PSI*	09:00 - 09:05
	Overview Talk - Aramis Laser System (PSI)	*LASERGROUP PSI*	*OSGA/EG06, PSI*	09:05 - 09:30
	Introduction to ESA	*MILNE, Chris*	*OSGA/EG06, PSI*	09:30 - 09:45
10:00	**ESA - Talk 1: Structural Dynamics in Hydrogen-Bonded and Transition-Metal Systems**	*HUSE, Nils*	*OSGA/EG06, PSI*	09:45 - 10:15
	ESA - Talk 2	*GALLER, Andreas*	*OSGA/EG06, PSI*	10:15 - 10:45
11:00	**Coffee break**		*OSGA/EG06, PSI*	10:45 - 11:10
	Introduction to ESB	*BEAUD, Paul*	*OSGA/EG06, PSI*	11:10 - 11:25
	ESB - Talk 1	*FOERST, Michael*	*OSGA/EG06, PSI*	11:25 - 11:55
12:00	**ESB - Talk 2: Ultrafast dynamics in strongly correlated systems: from melting to control**	*JOHNSON, Steven*		
	Discussion - Wrap up ESA and ESB User Ddemands	*BEAUD, Paul et al.*	*OSGA/EG06, PSI*	12:25 - 13:00
13:00	**Business Lunch**		*OSGA/EG06, PSI*	13:00 - 14:00
14:00	**Laser Responsible - Talk 1: Lasers in FEL science: bringing ultrafast optical to ultrafast x-ray experimental stations**	*COFFEE, Ryan*		
	Laser Responsible - Talk 2	*LEDERER, Maximilian*	*OSGA/EG06, PSI*	14:30 - 15:00
15:00	**Industry - Talk 1: Reliability and stability of the novel ultra-fast, high repetition rate light sources based on Ti:sapphire : the impact of pump sources**	*CANOVA, Federico*		
	Industry - Talk 2: Ultrafast oscillator and kHz amplifiers for use in FELs and Synchrotrons: meeting performance and reliability demands	*ARRIGONI, Marco*		
	Coffee break		*OSGA/EG06, PSI*	15:40 - 16:00
16:00	**Discussion - Wrap up afternoon**	*HAURI, Christoph et al.*	*OSGA/EG06, PSI*	16:00 - 17:00
17:00				

Wir schaffen Wissen – heute für morgen

towards the SwissFEL laser facility

Christoph Hauri, EPFL/PSI





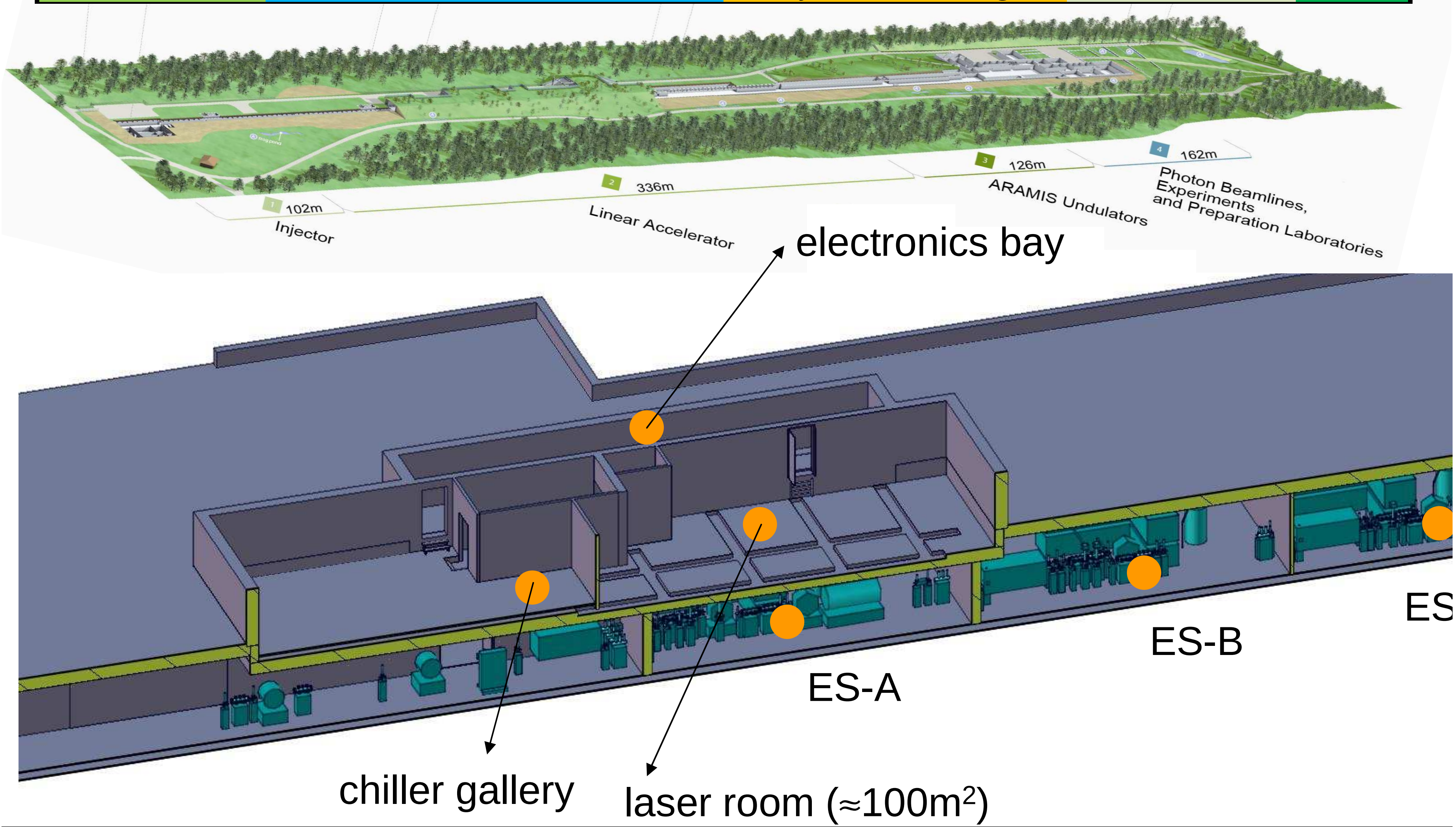
A.Trisorio, C. Vicario, M. Divall, C. Erny, C. Ruchert, F. Ardana-Lamas

overview

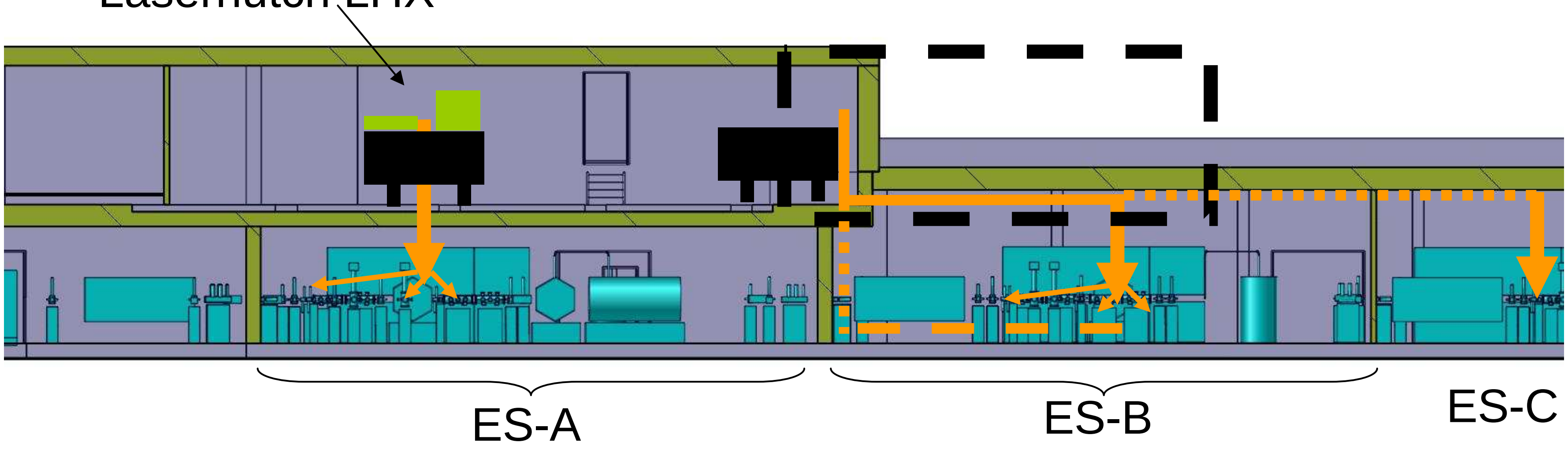
- laser room at SwissFEL
- laser and beam transport concept
- laser infrastructure at EHs
- laser performance
- pump laser technology
- organization
- future developments

SwissFEL

2012	2013	2014	2015	2016	2017
component procurement accelerator and ARAMIS FEL				preparation ATHOS FEL	
prepatory work	building construction		Accelerator and ARAMIS FEL installation interleaved with injector commissioning	Linac and ARAMIS commissioning	friendly users



Laserhutch LHX



general transport concept

- controlled area (safety,T,H)

  ↓

  controlled area(safety,T,H)
- transfer in evacuated tube
- laserhutch next to beamline
- T,H,dust controlled
  (T +/- 0.1, H+/- 2%,class 10'000)

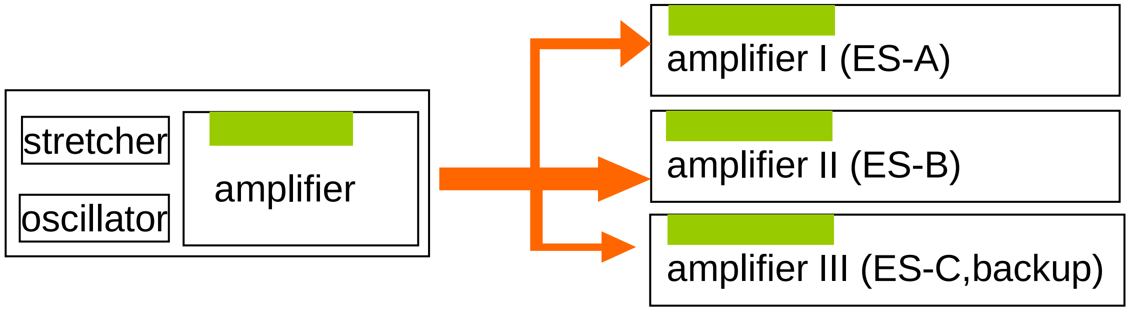
laser beam transport

- stretching LHX
- amplification LHX
- transport streched, $\lambda_{Ti:sa}$ (LHX → EHx)
- split (EHx)
- compression (EHx)
- frequency conversion (EHx)
- distribution to experiment, diagnostics

options for TL for ES-B:
- TL on floor
- (extended laserhutch)

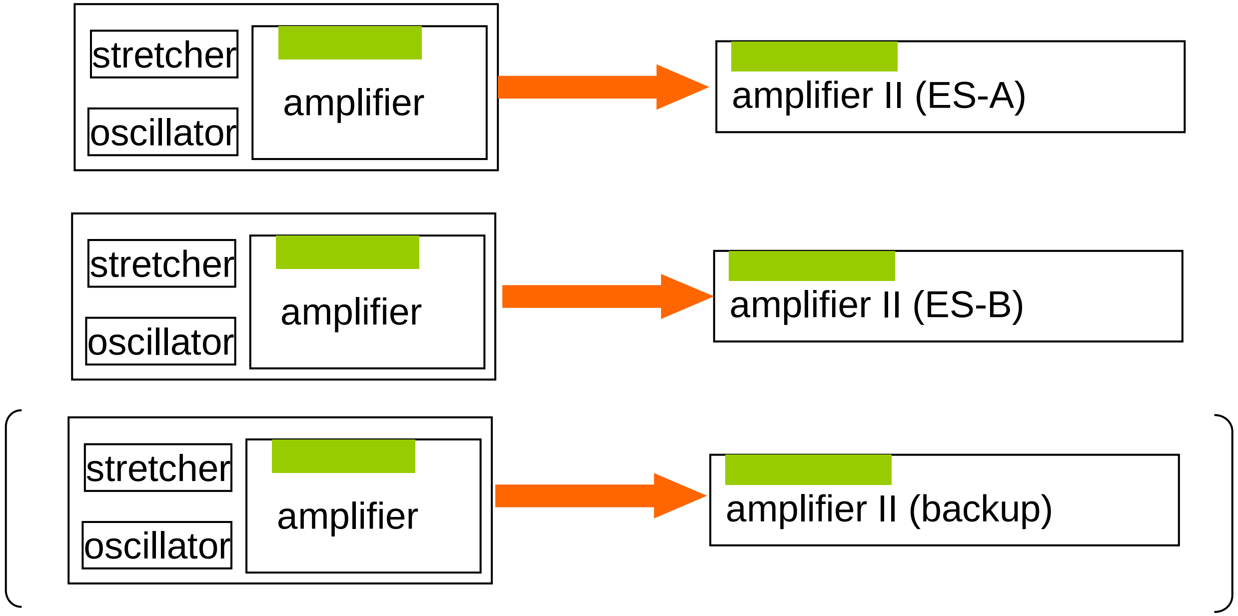
SwissFEL - lasers

(i)



- 1 frontend
- redundancy
+ reduced # pumps
+ lower maintenance & cost

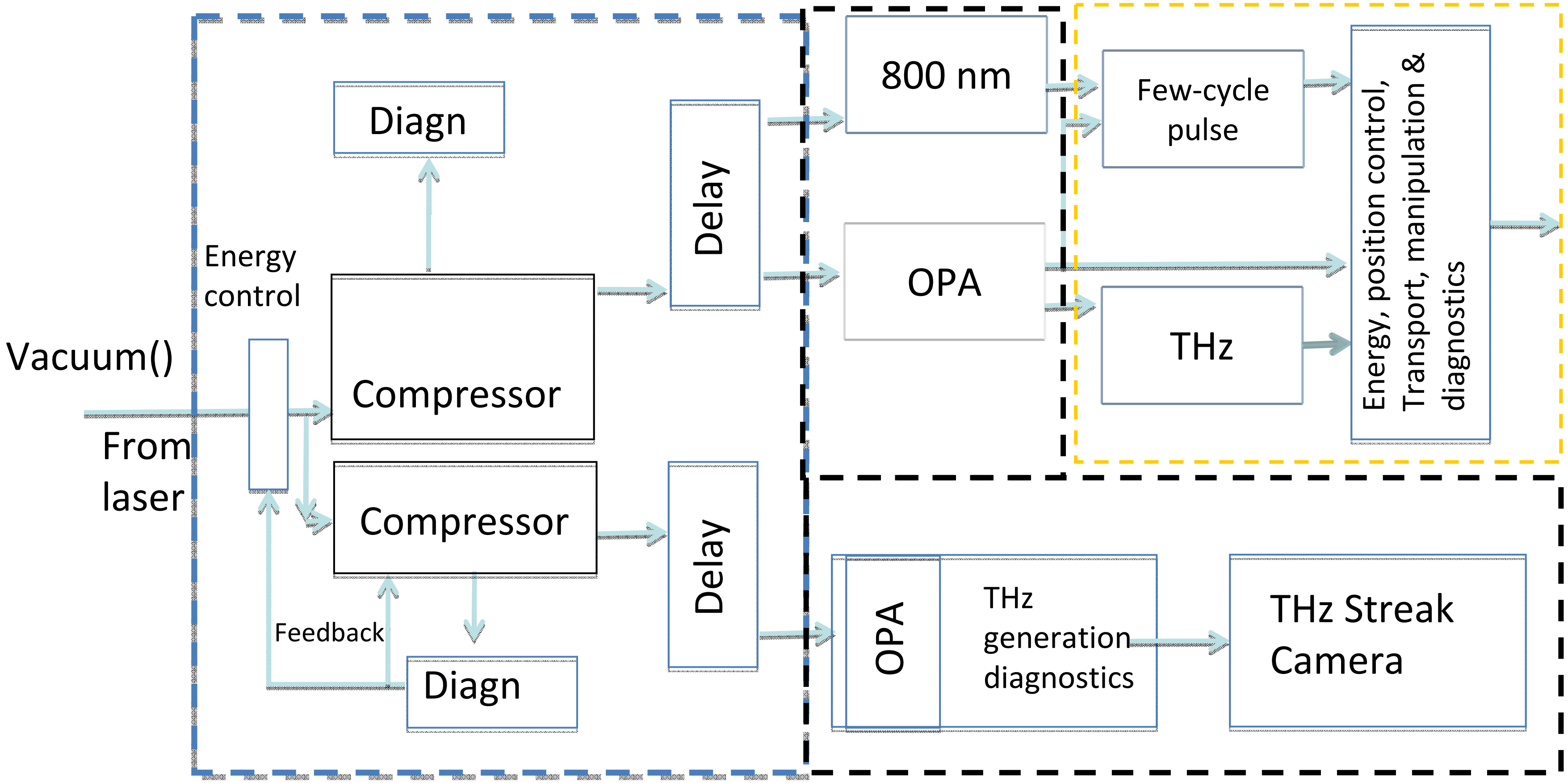
(ii)



+ 2 oscillator (T&S)
+ 2x #pump lasers
+ redundancy
- higher maintenance & cost

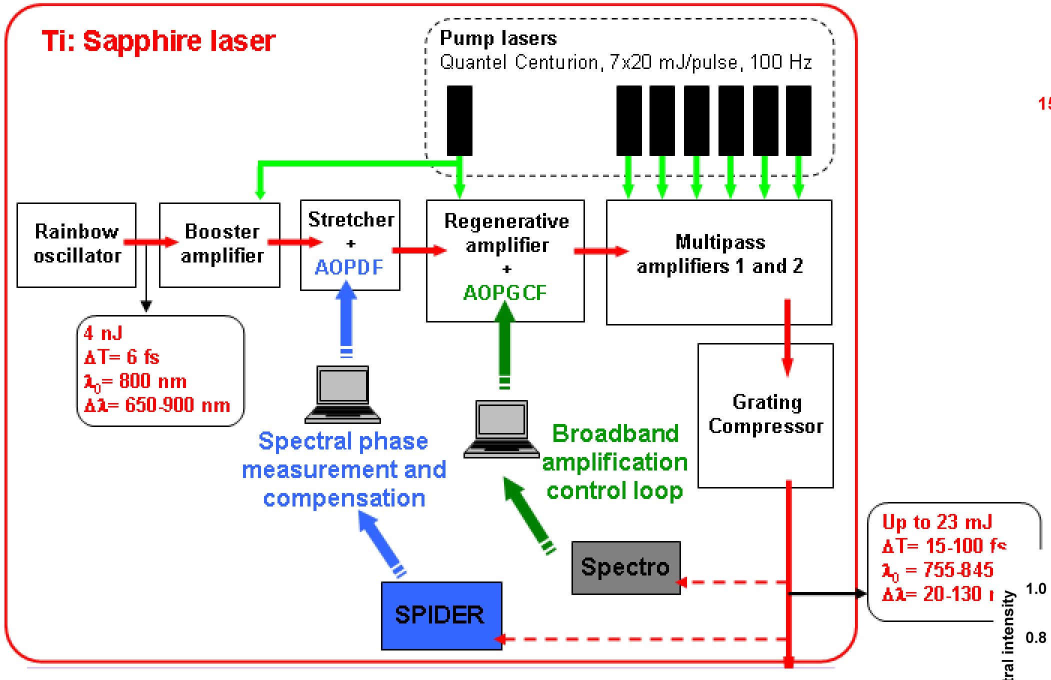
…and additional laser systems for R&D and preparation of upcoming experiments at ESA/B

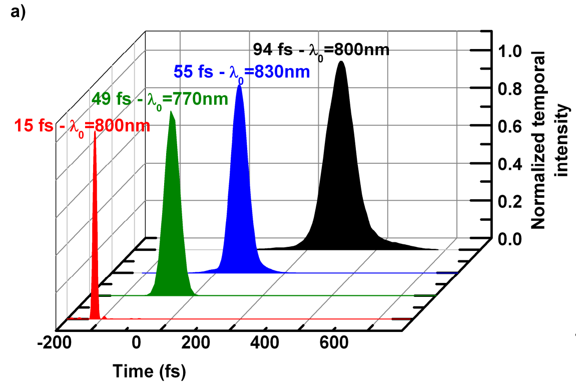
laser layout in experimental hutch



- dedicated beamline for x-ray diagnostics (time of arrival)
- intrinsically small jitter btw pulses for diagnostics and experiment
- stabilization loops (pointing, energy, phase)

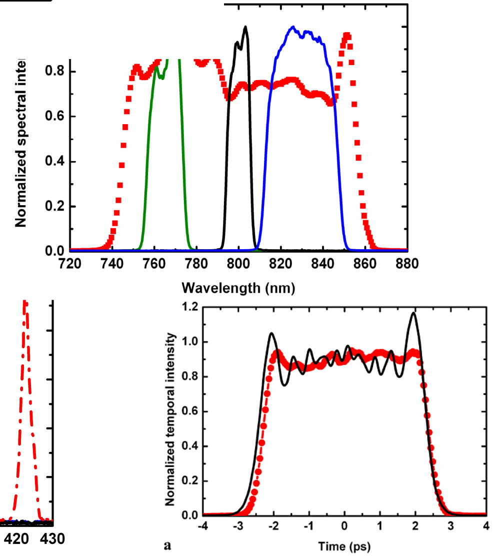
work horse Ti:Sapphire – status



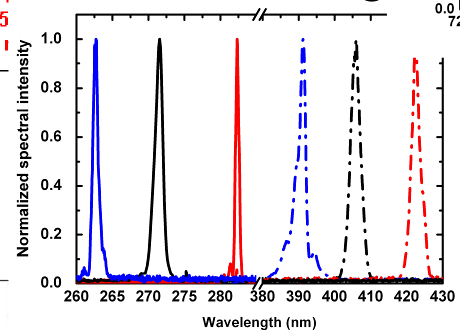


τ-tuning

λ-tuning

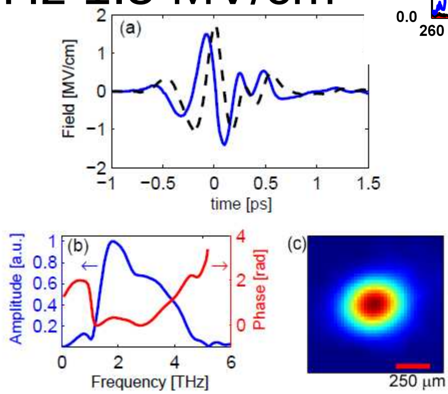


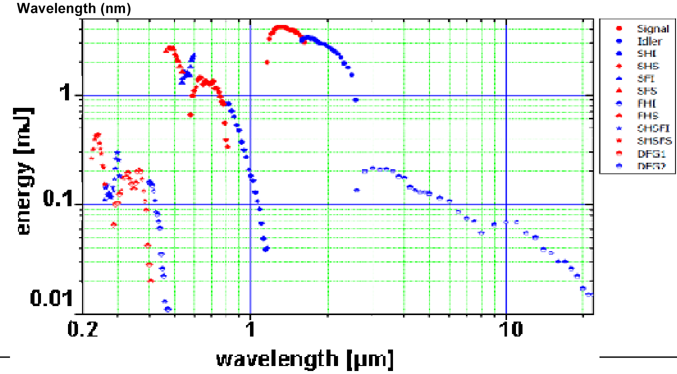
DUV tuning



- + IR (1-20 µm)
- + THz
- + DUV
- + HHG

THz 1.5 MV/cm





Opt. Lett. 37, 2892 (2012)
Opt. Lett. 37, 1619 (2012)
Opt. Lett. 37, 5 (2012)
Opt. Express 19, 20128, (2011)
Appl. Phys. B 105, 255 (2011)
Appl. Phys. Lett. 99, 161116 (2011)

performance wish list

Laser characteristics

	expected		
energy stability TiSa	<1-2%	(required for OPAs)	
timing jitter	≈150 fs or better	ES-A,ES-B,ES-C	
wavelength ranges	750-850 nm	1-20 mJ	MC, FC
	200-1000 nm	0...1mJ	SC, MC, shaping
	1-20 um	0...500 µJ	SC, MC, shaping(?)
	1-15 THz	0...20 uJ	HC, SC, MC
tilted pulse front			
repetition rate	0...100 Hz		

HC: half cycle
SC: single cycle
FC: few cycle
MC: multi cycle pulse

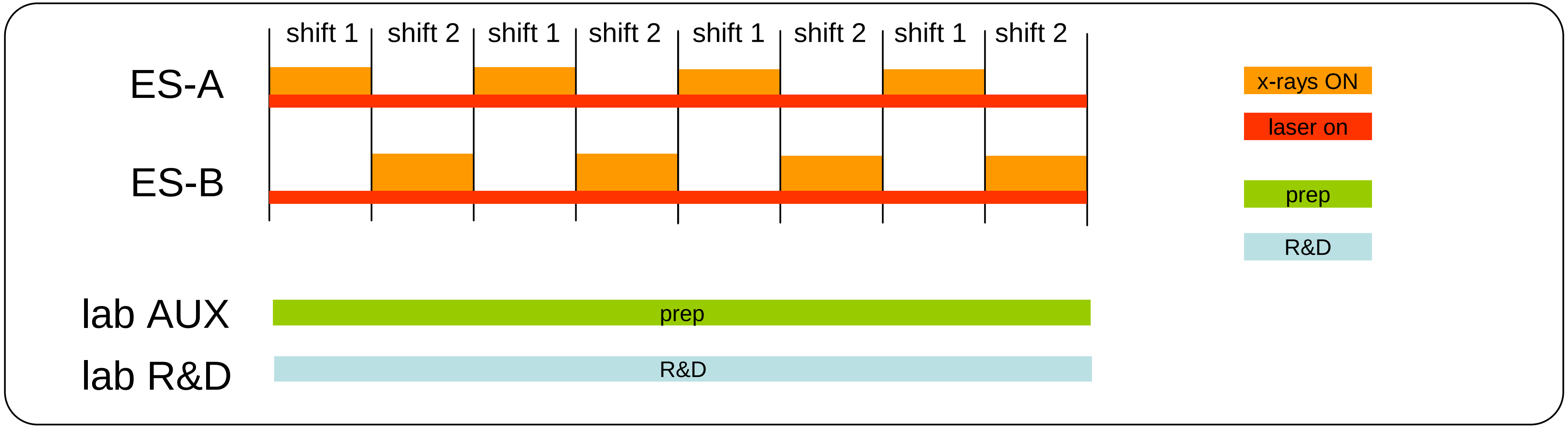
User information/control - online diagnostics and control at experiment

- single shot pulse energy
- beam pointing/beam position
- timing jitter/arrival time (laser (LAM), x-ray/nIR crosscorrelator based on SiN_2;
  THz streak camera
- pump probe delay
- temporal and spatial profile

auxiliary laser systems

during shift operation

- no time for R&D on LHX lasers
- no time for prealignment etc for next experiments



Additionally required laser systems outside SwissFEL building (no space)

- lab AUX: preparation of upcoming experiment for ES-A and ES-B
- R&D lab: (source, stability, new lasers, x-ray arrival time, upgrades, ...)

Pump laser technology

Diode-pumped solid state lasers (cw, qcw)

≥1 Gigashots (2800h / **115d** @100 Hz)
maintenance (1-3 k€/mJ)

but
stable, longer lifetime, good beam profile
trouble-free replacement

Flash-lamp pumped solid state lasers

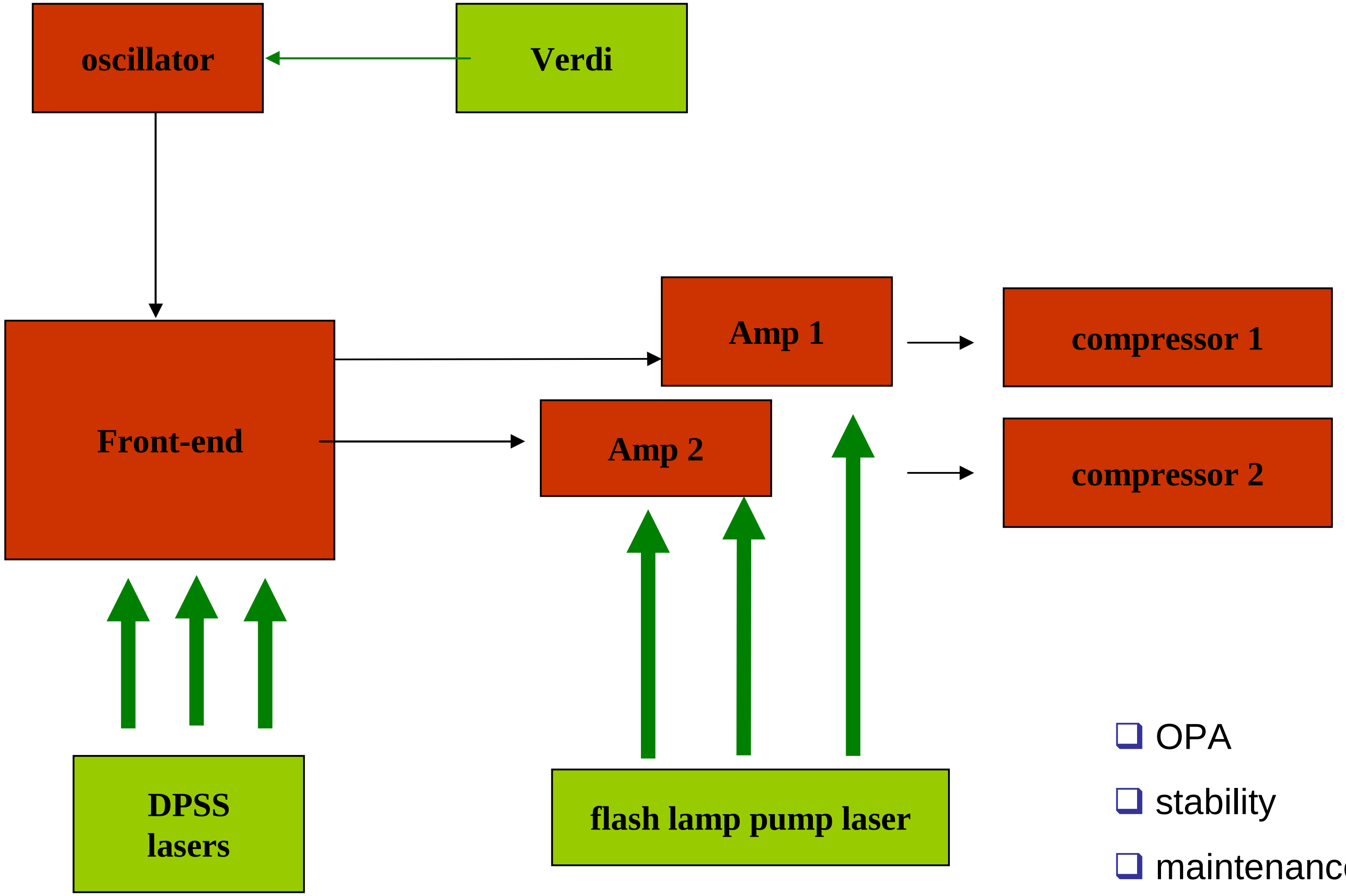
40 Megashots (120h / **5d** @100 Hz)

cheap (200 $/flashlamp)
high pulse energy

but
unstable, short maintenance intervals, beam profile
downtime

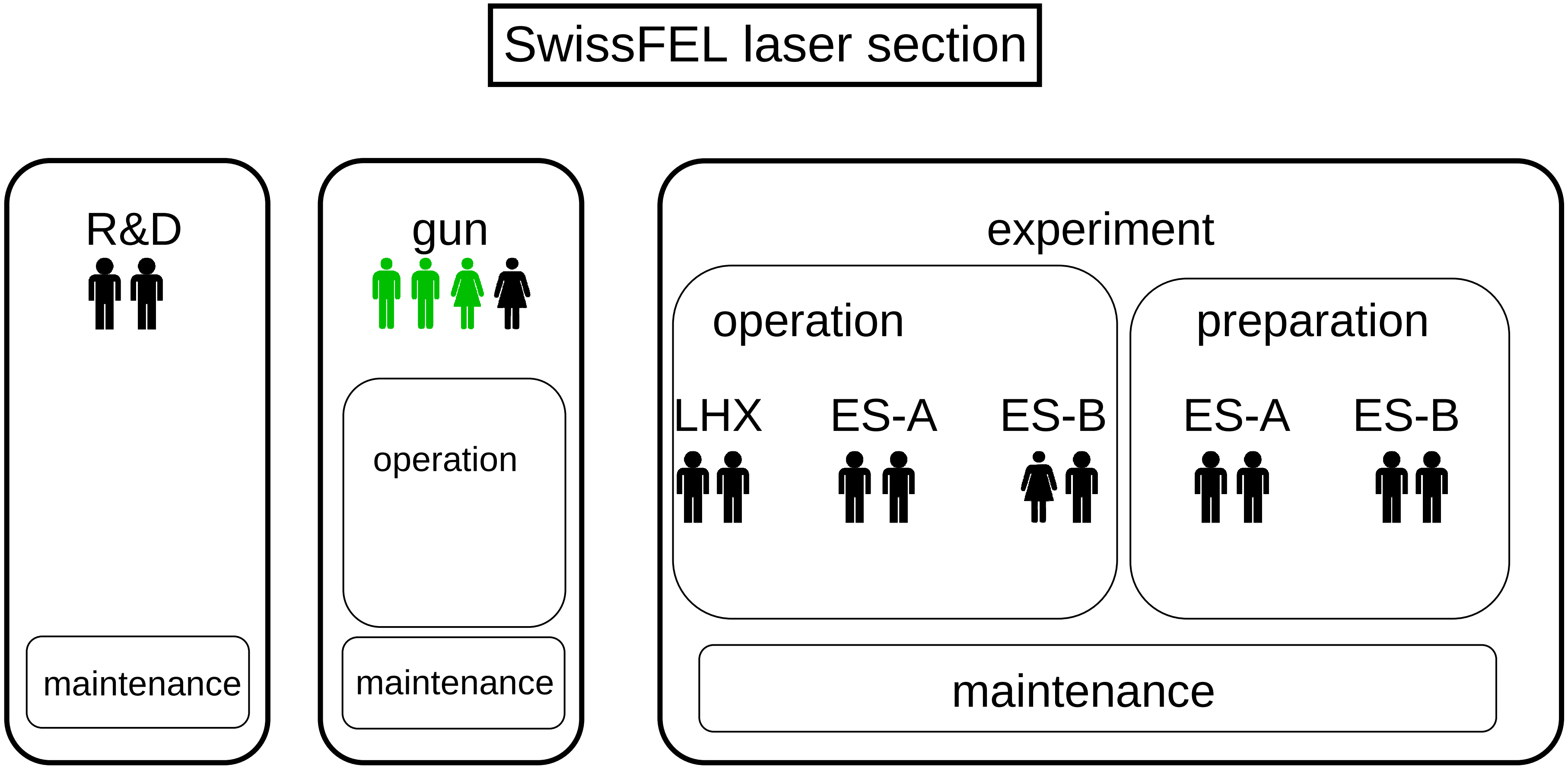
- maintenance cost vs down time (periodic & unforeseen)
- stability (shot-to-shot & mid-term)
- manpower

under test - hybrid approach



- OPA
- stability
- maintenance

organization – SwissFEL phase I (24/7)



- new concepts
- hardware dev.
- source dev.

- strong link to beamline scientists, T&S,…

future developments

Ti:sapphire

- verify hybrid approach
- integration of DPSS lasers
- integration to EPICS

diagnostics

- THz streak camera
- x-ray/nIR crosscorrelator
- laser arrival time monitor
- feedback loops

source

- multi-cycle THz (tunable)
- single-cycle THz pulse
  - upscale peak power
  - absolute phase control
- few cycle UV/VIS/IR

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discussion

- choice of pumplaser technology
- laser design, redundancy
- laserroom on upper floor – EHs on lower floor (vibrations,drift, environmental differences)
- concept of laser transport and integration to ES
- wish list of laser performance/parameter list at day 1
- full laser versatility in both ES-A and B ? (OPAs, THz pump, ...)
- choice of diagnostics
- user interface (control)
- laser maintenance (how much time is needed)
- typical time required for experiment preparation
- typical time to set up laser-based x-ray diagnostics
- day to day quality control (proactiv/reactive)
- future laser developments, which R&D is required
- organization of resources (on-call, present, procedures)

Thank you for your attention