PAUL SCHERRER INSTITUT

Pump-probe laser systems at SwissFEL for ARAMIS hard X-ray beamlines

SwissFEL

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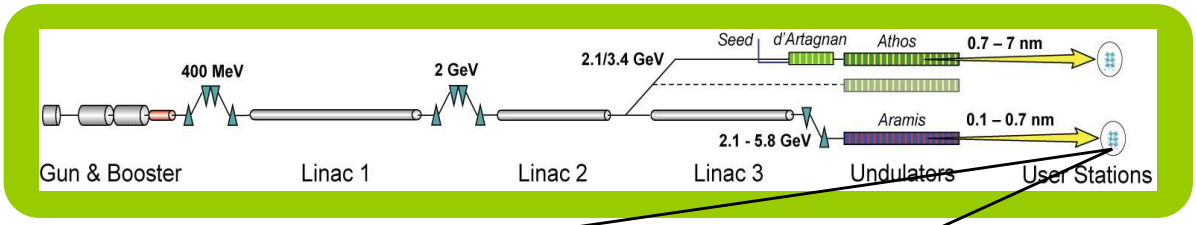
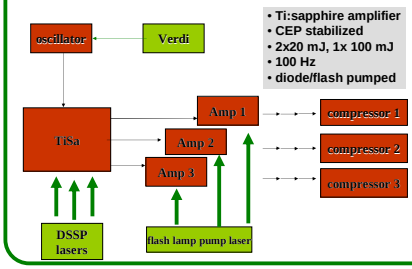
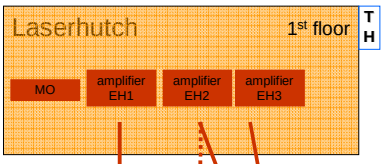


Requirements

- low timing jitter FEL ⇔ pump/probe laser
- characterize temporal jitter shot-to-shot
- large wavelength range to be covered (THz...VIS....DUV...soft x-rays)
- multi-cycle and single-cycle pulses, pulse trains
- carrier-envelope phase stabilized pulses
- long beam path from laserhutch to EHs (up to 40 m)
- high stability and flexibility at user station
- endurance

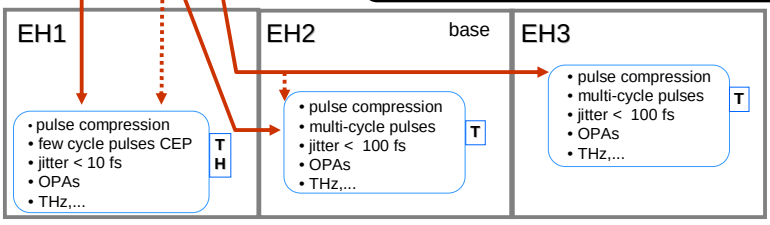
laser system





User information/control

online diagnostics and control at experiment
- single shot pulse energy
- beam pointing/beam position
- timing jitter
- pump probe delay
- CEP phase
- temporal and spatial profile



Laser characteristics

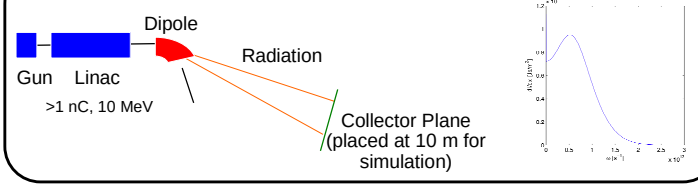
energy stability		< 1-2%	required for OPAs
timing jitter		100 fs	for EH2 and EH3
		<10 fs	for EH1
wavelength ranges	750-850 nm	20 mJ	fundamental laser wavelength Ti:sapphire
	200-1000 nm	0...1mJ	**SC**, MC
	1-20 um	0...500 µJ	**SC**, MC
	1-15 THz	0...20 uJ	**HC, SC**, MC
repetition rate		0...100 Hz	
field-sensitive experiments		yes	**CEP stabilization** in EH1
power level		20 mJ	1 line (freq. conversion)
		20 mJ	1 line (SC pulse generation)
		>>20 mJ	1 line (THz)

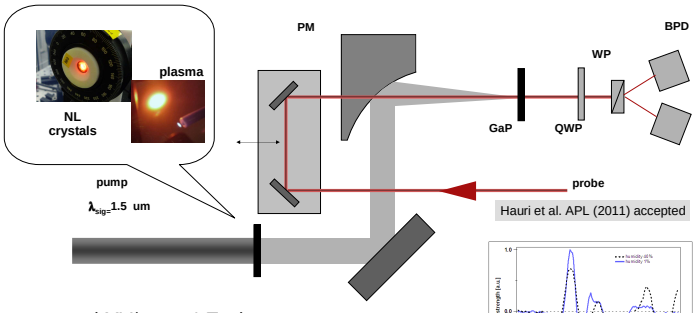
HC: half cycle pulses, SC: single cycle pulses,MC: multi cycle pulses

THz source at SwissFEL

- independent THz source for SwissFEL foreseen
- THz synchronized to hard x-ray for experiments and diagnostics
- either laser-based or accelerator-based approach
- both schemes currently under investigation

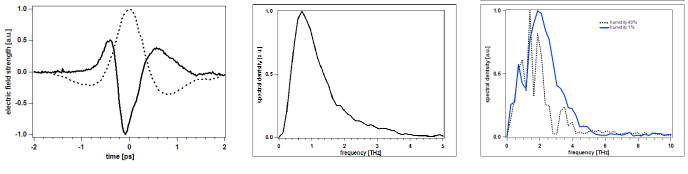
linac-based THz generation



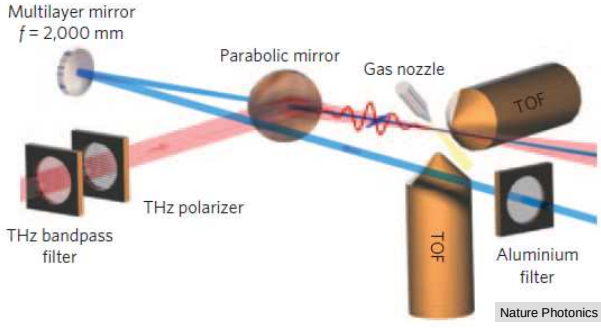


Hauri et al. APL (2011) accepted

- several MV/cm, > 1 Tesla
- single cycle/half cycle pulses of < 1 ps
- THz pump pulse up to 1 ns prio to x-ray probe pulse



Hard x-ray pulse characterization



Nature Photonics 3, 523 (2009)

- single-shot FEL pulse duration
- time structure of FEL pulse
- single shot jitter monitor FEL pulse vs pump/probe laser
- arrival time monitor (sidebands)
- proven for soft x-ray FELs