HELMHOLTZ ZENTRUM BERLIN für Materialien und Energie

Status FLASH II Project

DESY

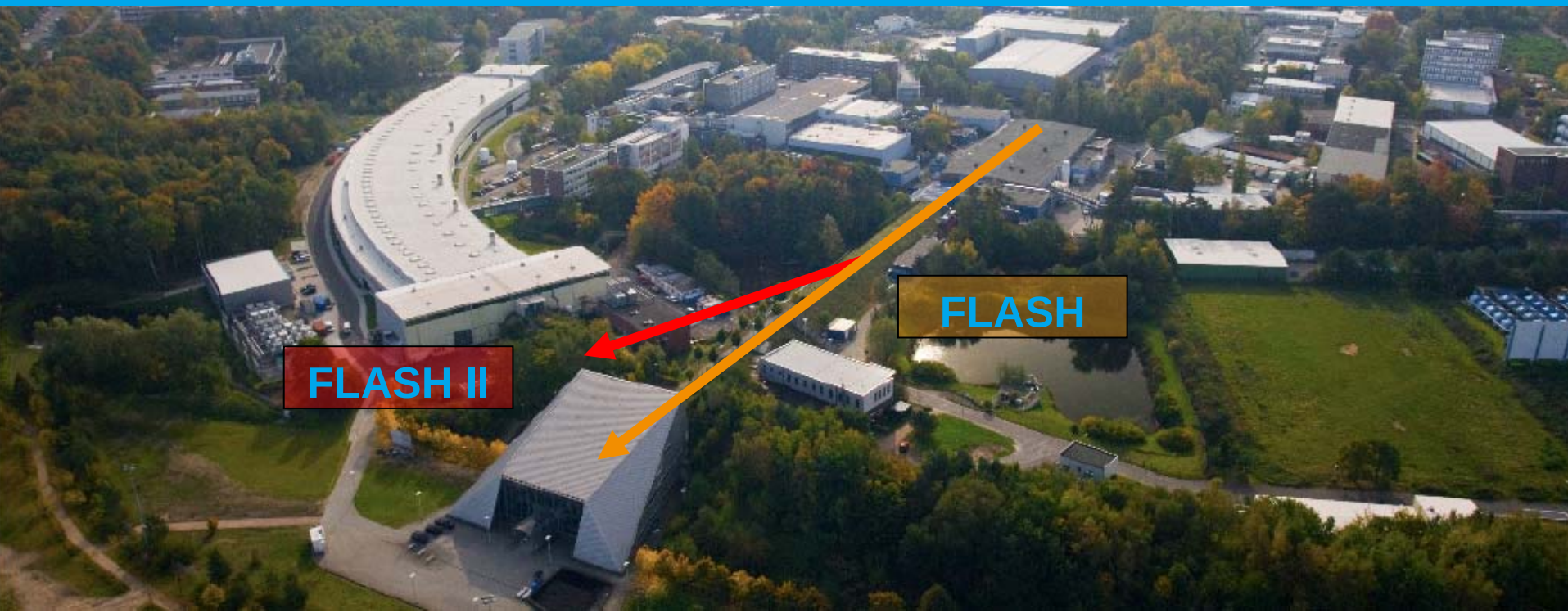
1. FLASH II: Seeding schemes.
2. Parameters.
3. Tunnel Layout.
4. Time schedule.

Bart Faatz
FLASH II
Hamburg, January 27, 2011

Collaboration with PSI and SINAP (Shanghai)

HELMHOLTZ ASSOCIATION

What is FLASH II.

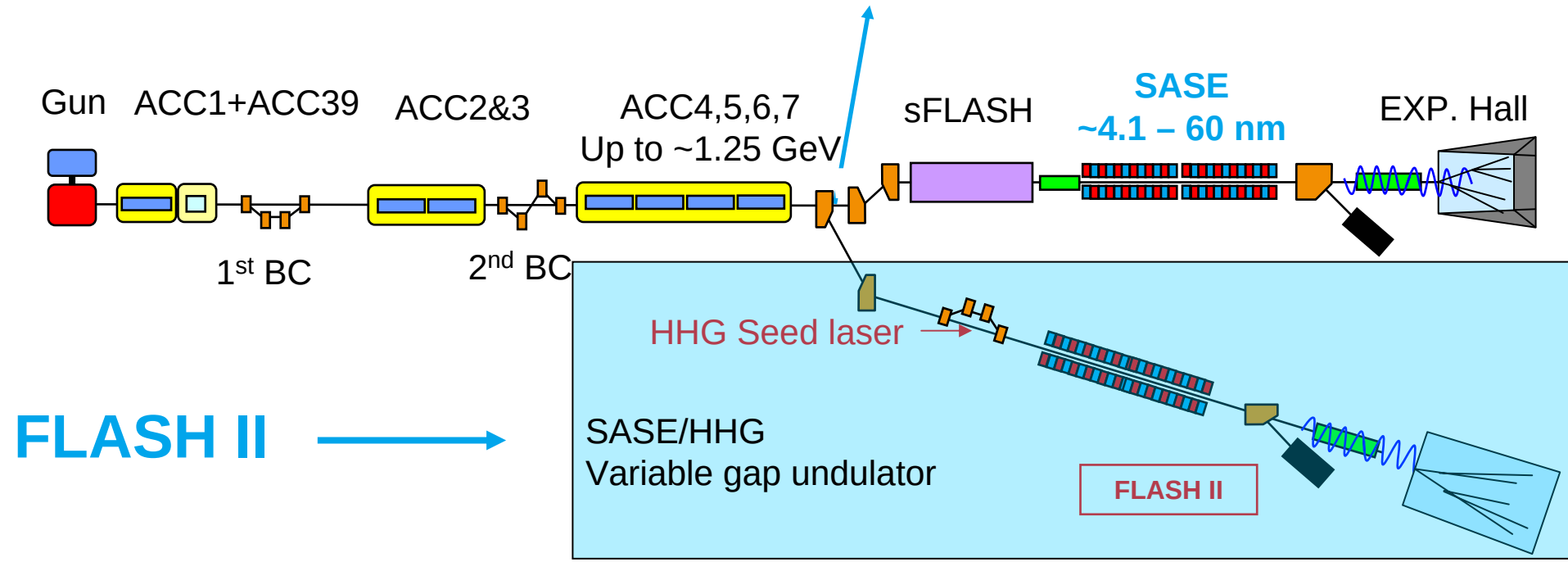


A major extension of FLASH

- 2nd, variable gap, variable polarization undulator in a separate tunnel
- >5 more experimental stations in a new experimental hall
- next generation FEL: seeding

Upgrade: layout after upgrade FLASH II.

- Separation FLASH and FLASH II behind last accelerator module
- Tunability of FLASH II by undulator gap change
- Extend user capacity with SASE and HHG seeding
- Use of existing infrastructure up to last accelerating module



FLASH II: foreseen operation modes.

Self Amplified Spontaneous Emission (**SASE**) mode: Start from fluctuation in electron density
spiky, but at full rep.rate and short and long pulses possible.

SEEDING SCHEME PHASE 1:

High Harmonic Generation (**HHG**) mode (see also sFLASH):

Amplify an external, frequency multiplied seed laser.

Only short pulses, but close to single mode down to ~10 nm.

Study for seeding towards shorter wavelength:

High Gain Harmonic Generation (**HGHG**) mode:

Amplify a long wavelength seed and apply frequency multiplication in FEL process.

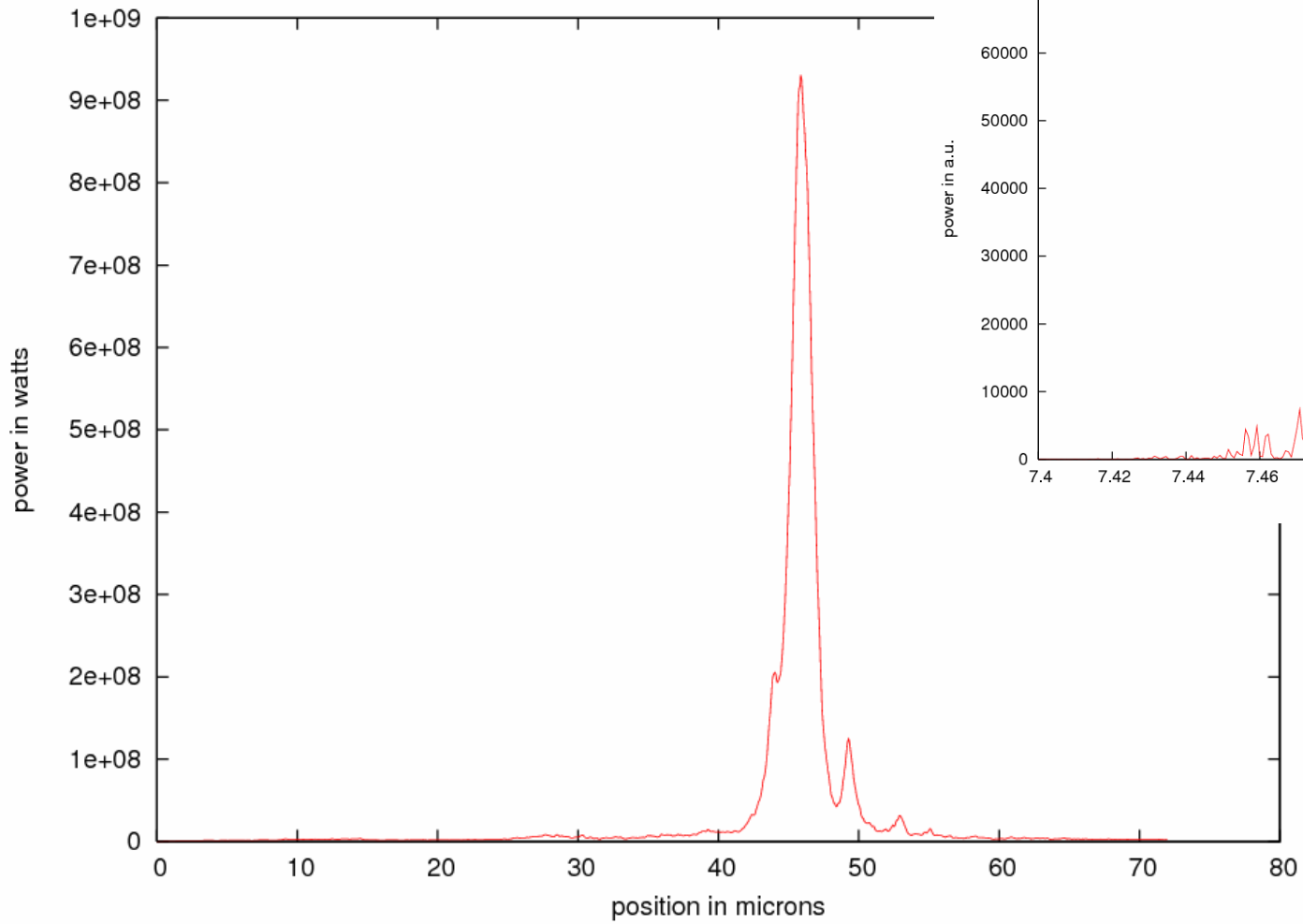
Only short pulses (up to ~5-30 fs), but close to single mode down to ~4 nm.

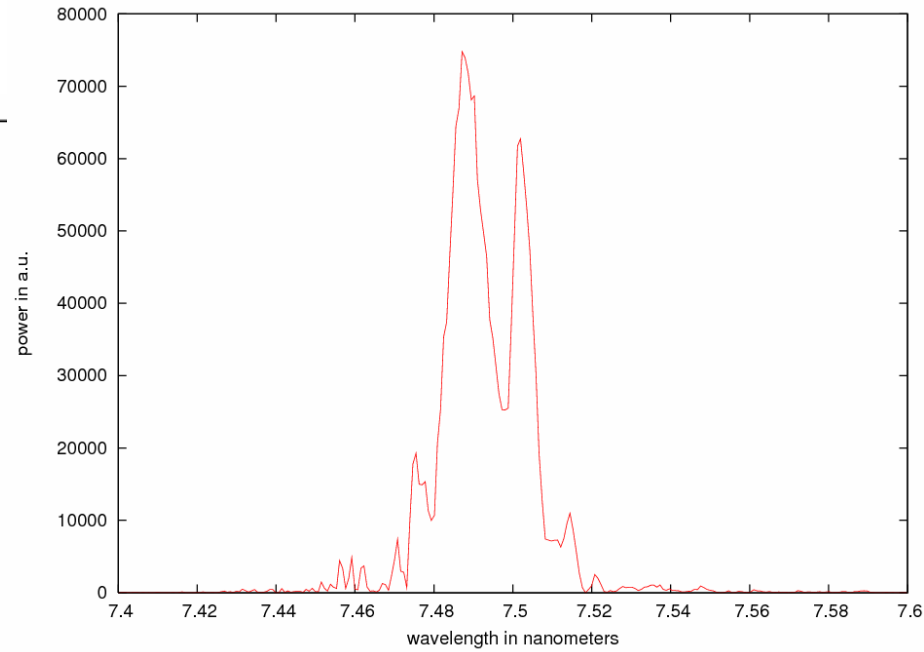
Echo Enabled Harmonic Generation (**EEHG**)

Hybrid mode: HGHG with HHG source

S2E simulation of HGHG: 32.harm of 240 nm Seed

~4 fs FWHM pulse length at 7.5 nm





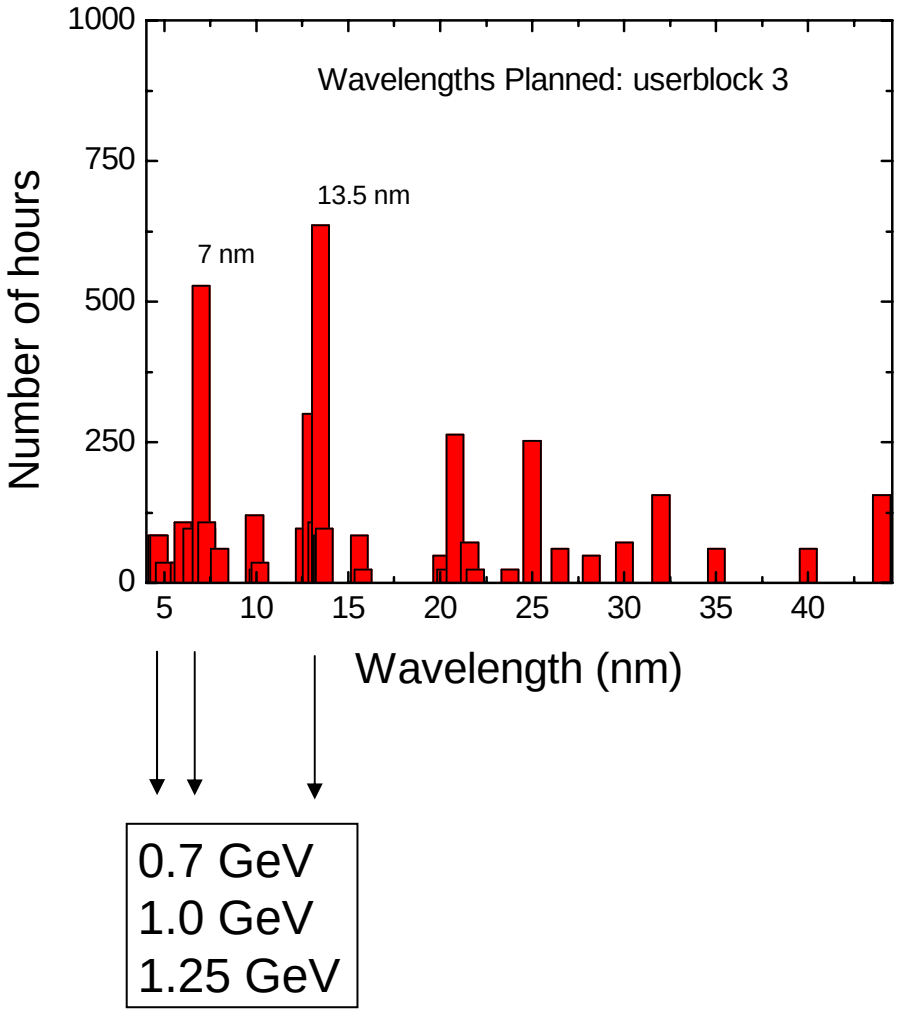
FLASH II: parameters.

Beam parameters	
Beam Energy	0.5 – 1.25 GeV
Normalized emittance (proj.)	1.4 mm mrad
Energy spread	0.5 MeV
Peak Current	2.5 kA
Bunches per second	<8000***
Undulator parameters	
Period	31.4 mm
Segments length	2.5 m
Number of segments	<=12
Focusing Structure	F0D0
Radiation	
Wavelength range SASE*	4-60 nm
Wavelength range HHG*	10-40 nm

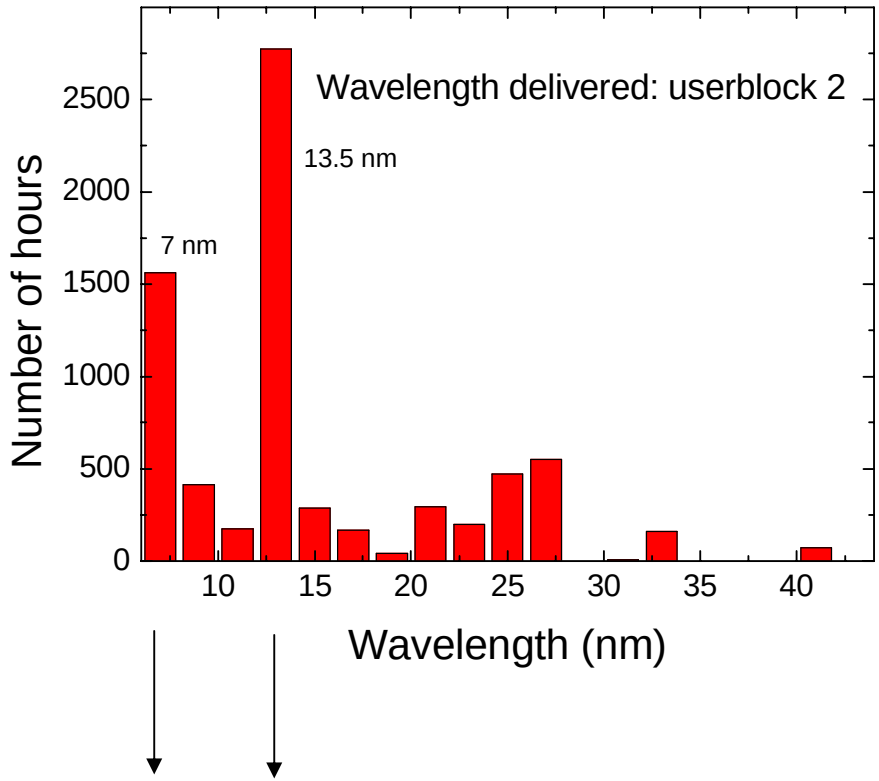
*At fundamental wavelength
***depending on FLASH I up to 800 bunches with 1 μs separation at 10 Hz

Wavelengths requested for this user period and delivered the previous

Started September 2010

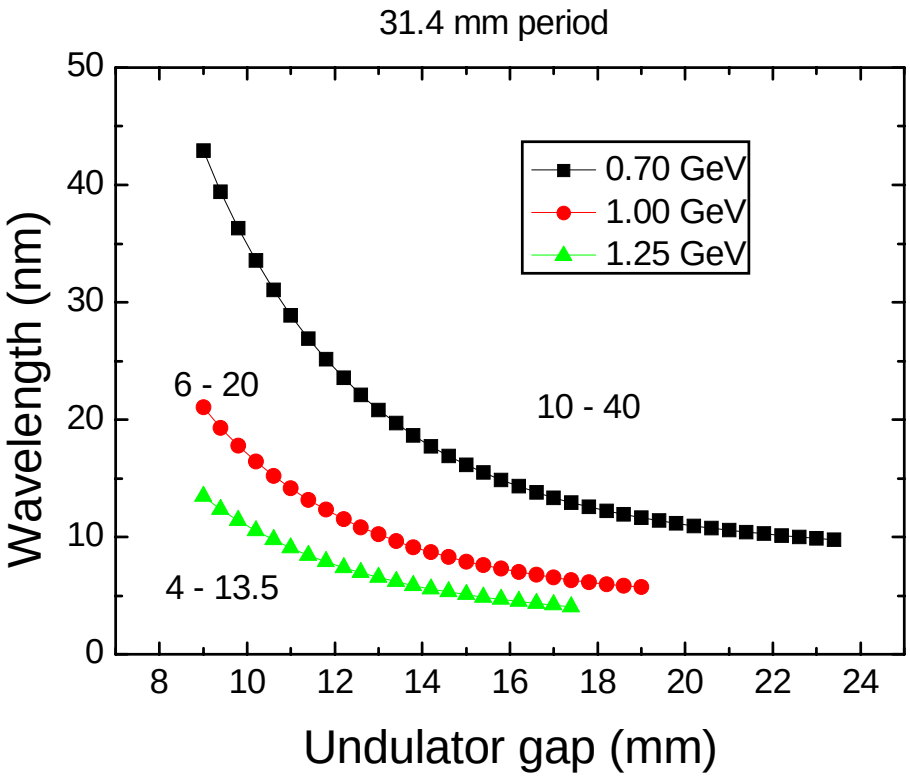


0.7 GeV
1.0 GeV
1.25 GeV



0.7 GeV
1.0 GeV

Wavelength range for main energies by varyang the undulator gap



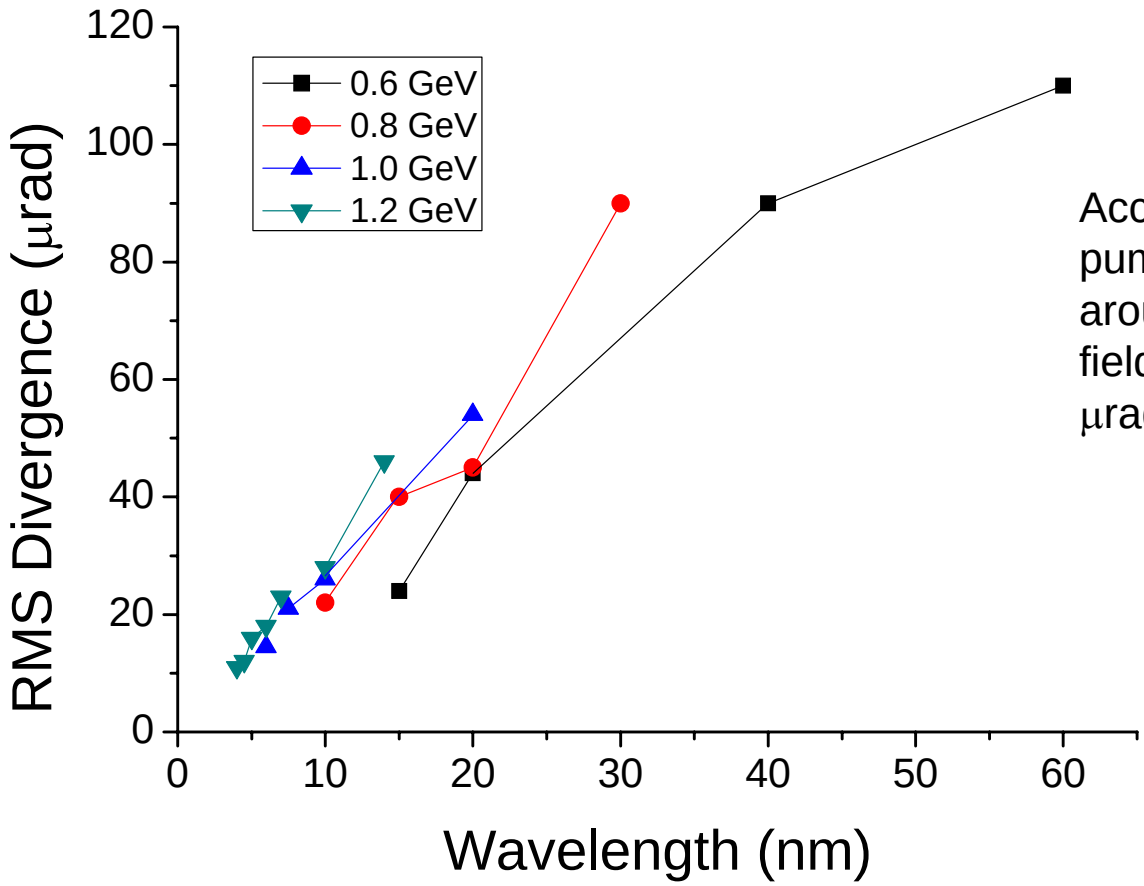
Energy (GeV)	31.4 mm
0.7	10 – 40
1.0	6 – 20
1.25	4 – 13.5

NOTE: proposal for FLASH I upgrade is 23 mm period!!!!!

Definitive undulator period to be decided soon

10-40 nm at 0.7 GeV with HHG seeding
>40 nm with energies below 0.7 GeV

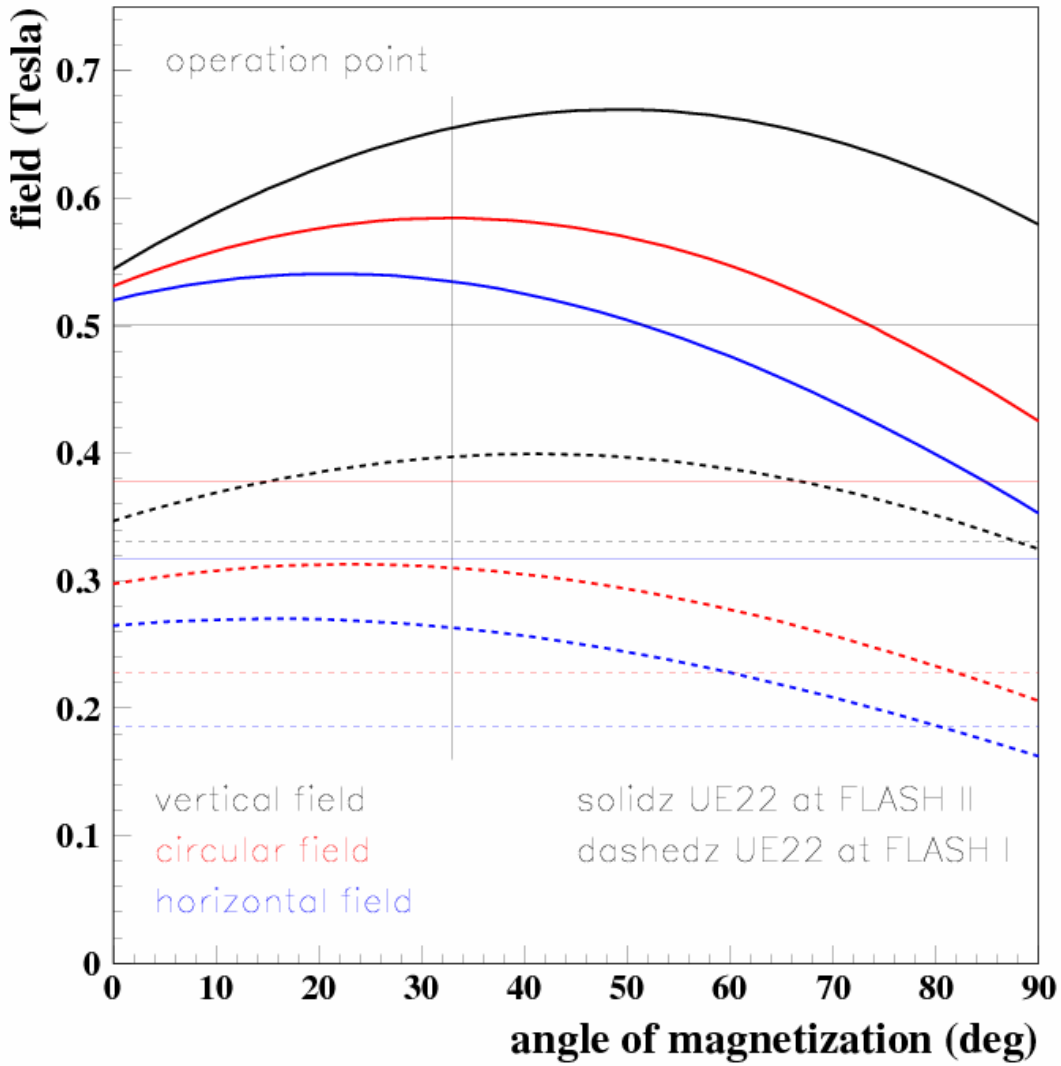
Divergence for different wavelengths.



Acceptance (6.σ) by differential pumping stations and mirrors is around 100 μrad (limited by far-field in the Hall: in tunnel ~140 μrad for 80 nm).

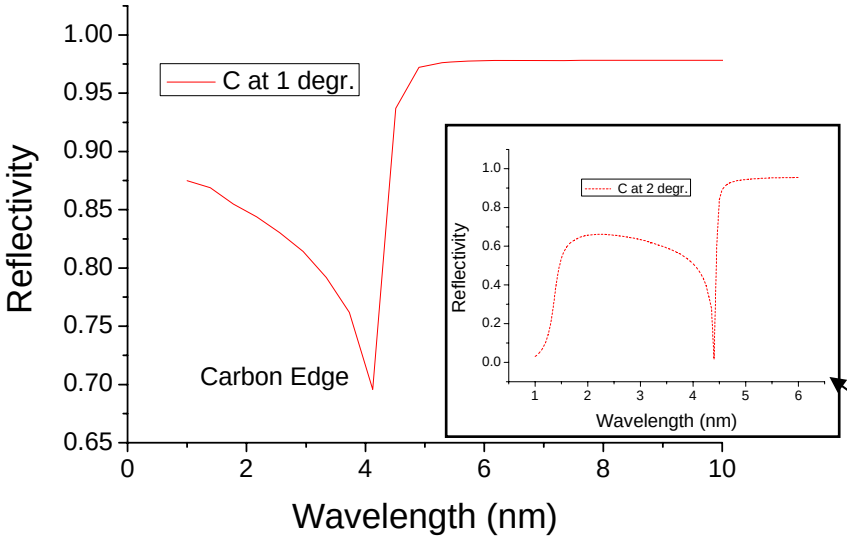
Divergence for all wavelengths depends on beam energy and (slightly) on beam emittance

First simulations for variable polarization with an APPLE III at the 2nd harmonic (~2 nm)



Offers **limited** tunability at the 2nd harmonic with variable polarization with around ~1% of power compared to the fundamental.

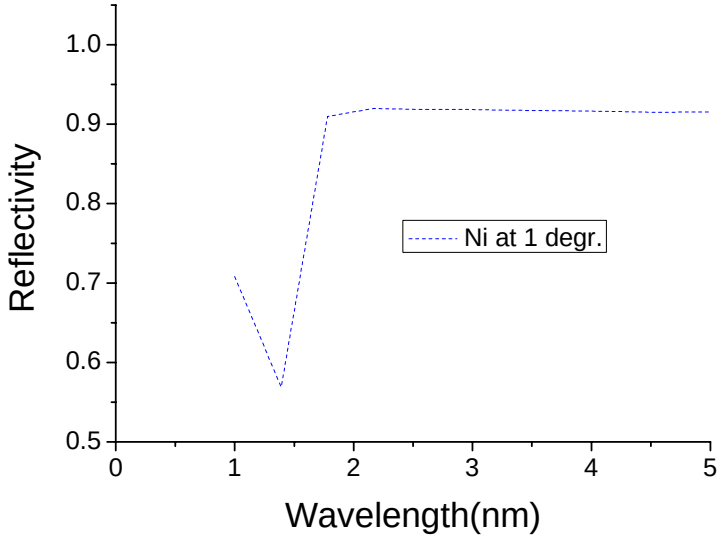
Mirror Geometry and material optimized for 2nd, 3rd and 5th harm.



Mirror geometry changed
- 1 mirror at 2 degree angle (abandoned!)
- 2 mirrors at 1 degree to create offset (see LCLS)

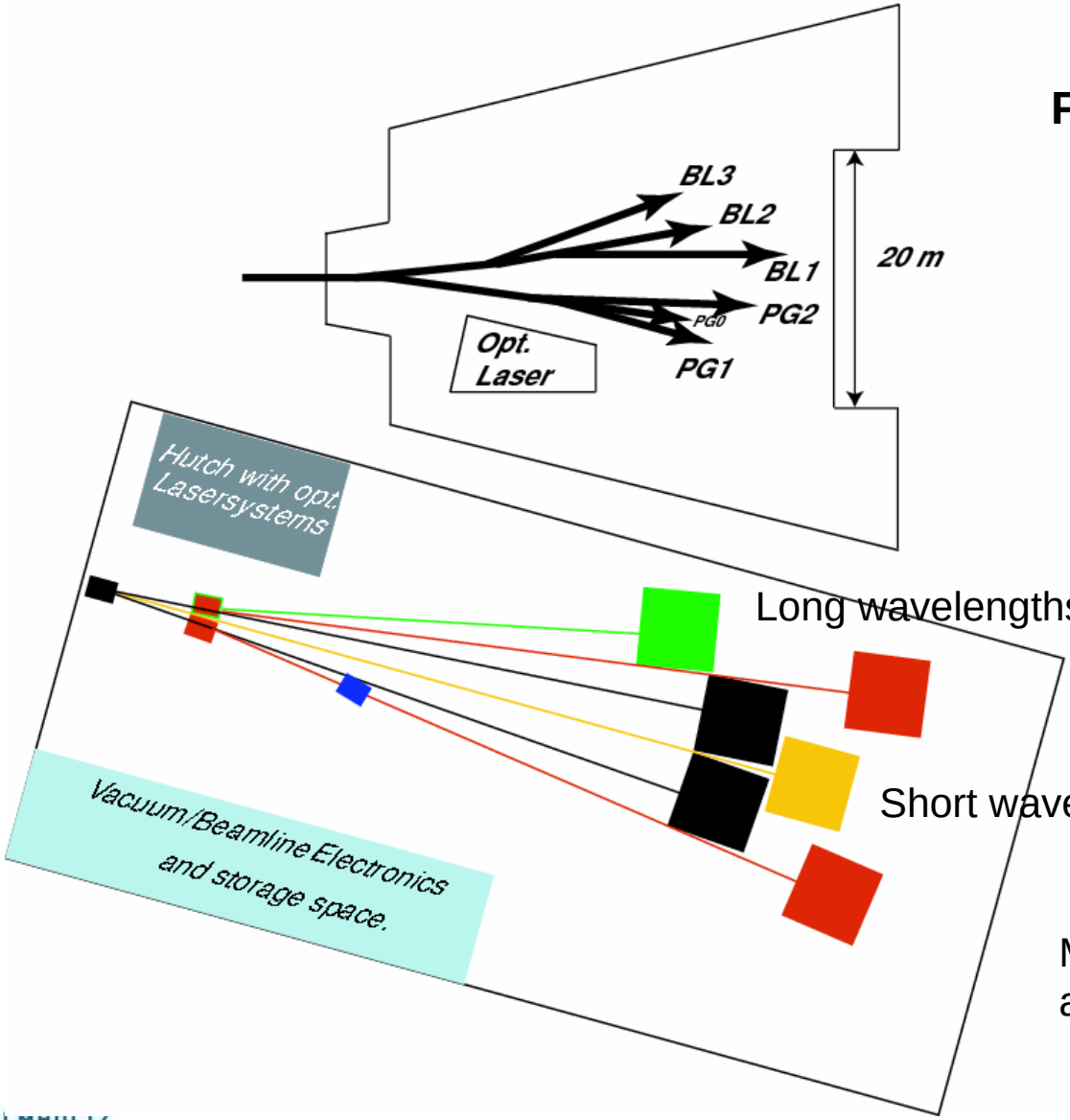
Consequence is changed e-beam angle and a re-iteration of the separation of FLASH II from FLASH I

At 2 degree angle



Material (not yet finalized):
- Down to 5 nm Carbon
- From 2 to 5 nm Nickel
- Below 2 nm again Carbon

Preliminary Hall layout.



FLASH I Hall

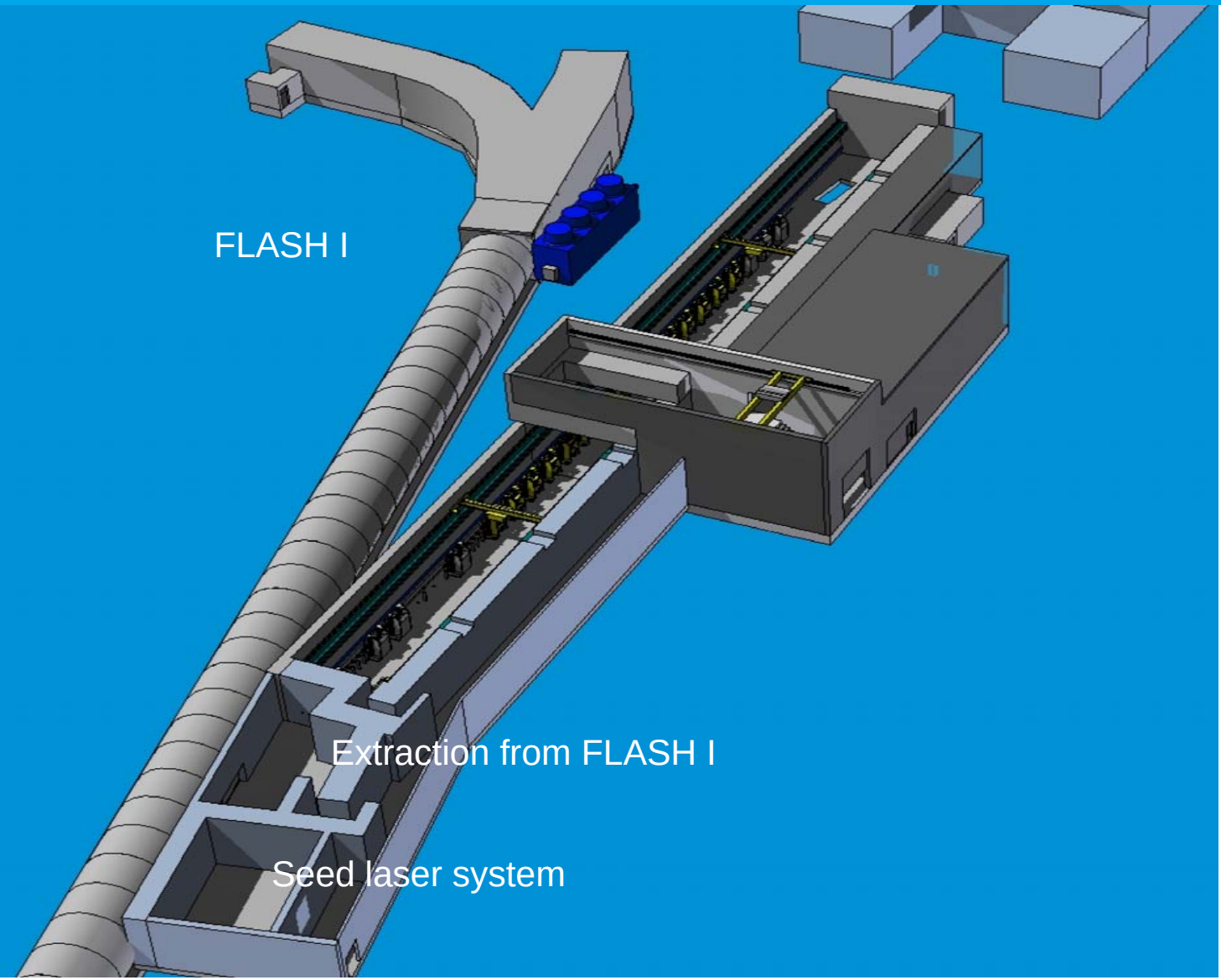
Long wavelengths (>~4 nm at 4 degr. Angle)

FLASH II Hall

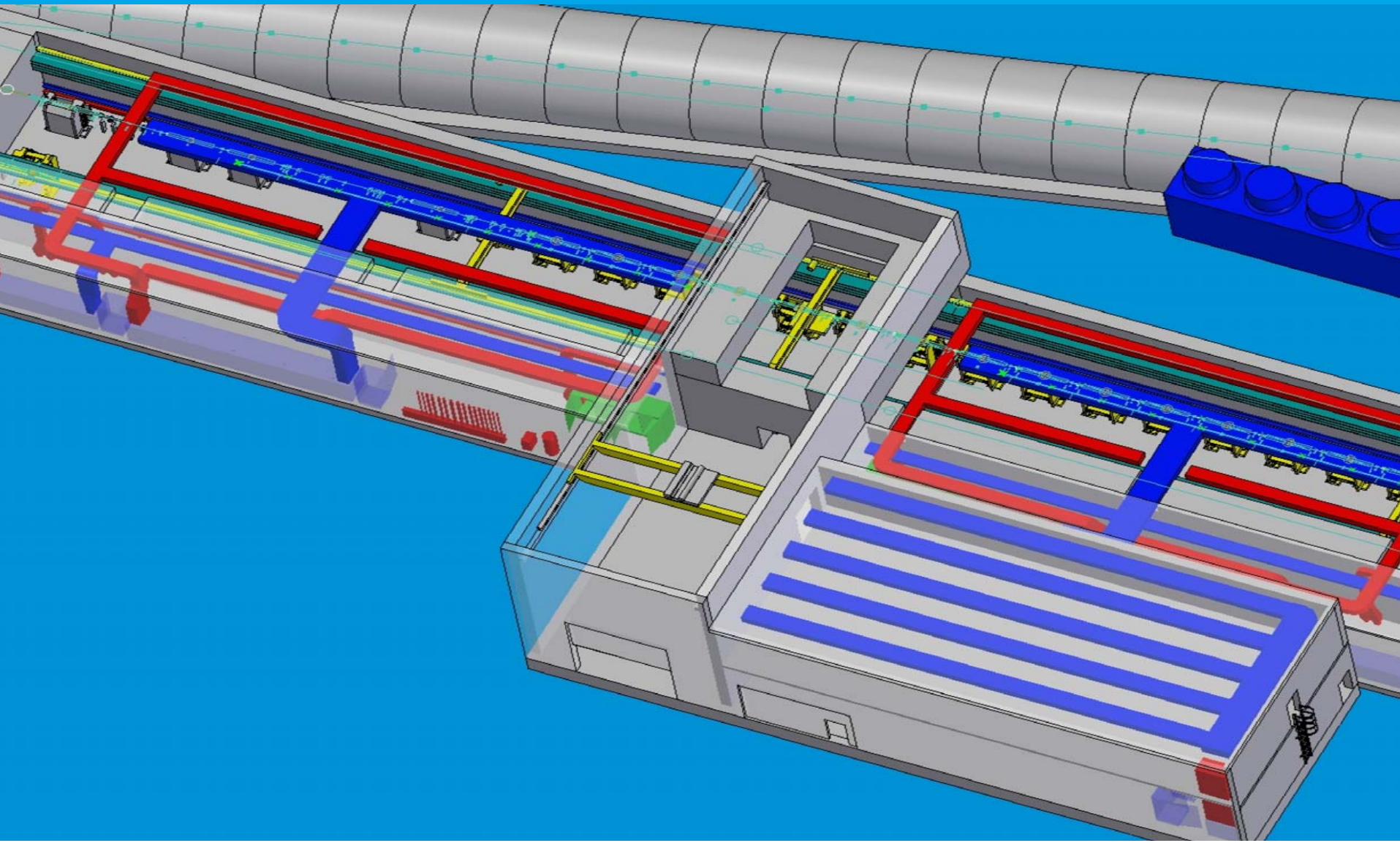
Short wavelengths (0.8 nm at 1 degr. angle)

Most beamlines down to 2 nm
at 2 degr. angle

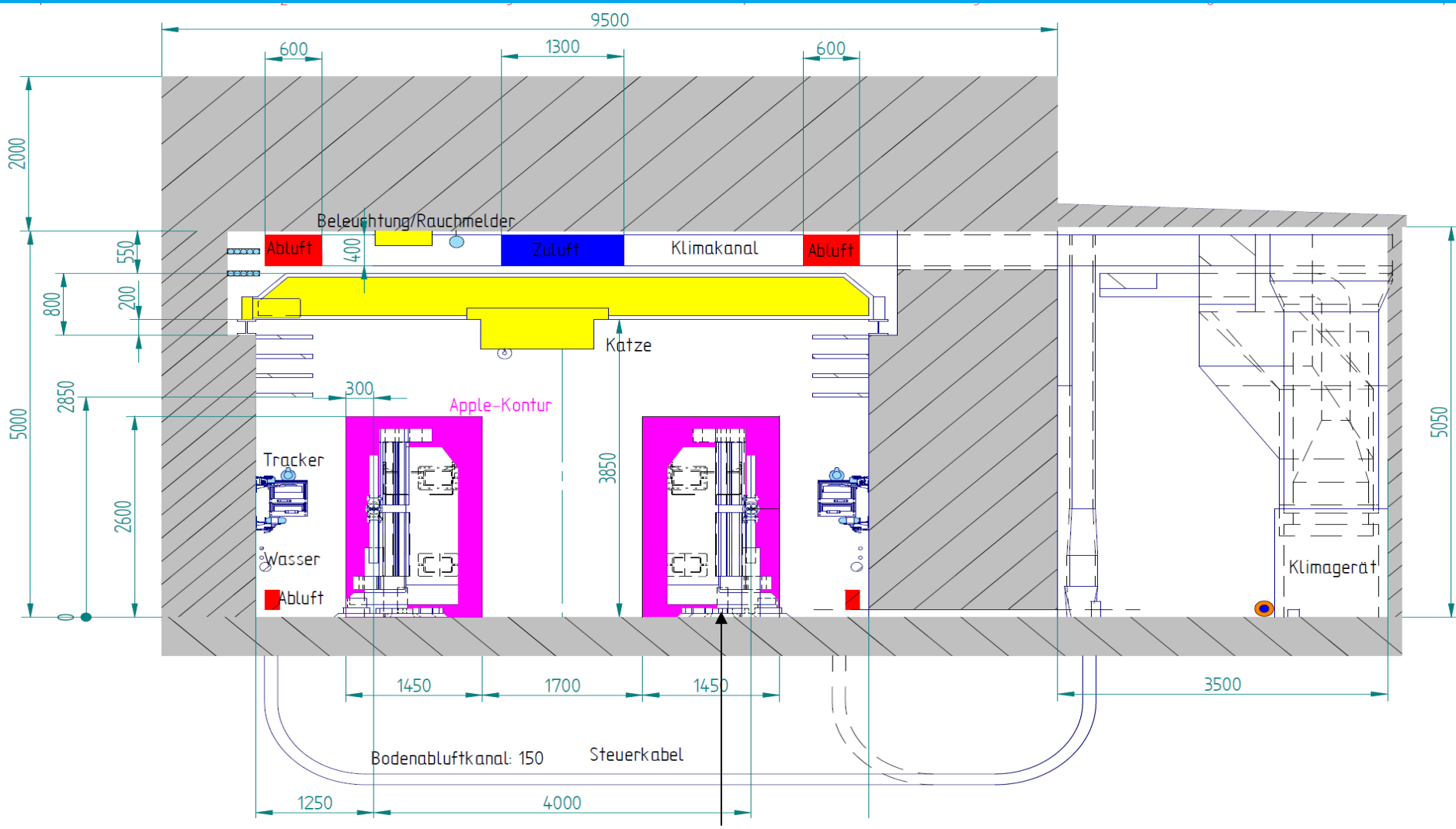
Tunnel Layout



Tunnel Layout

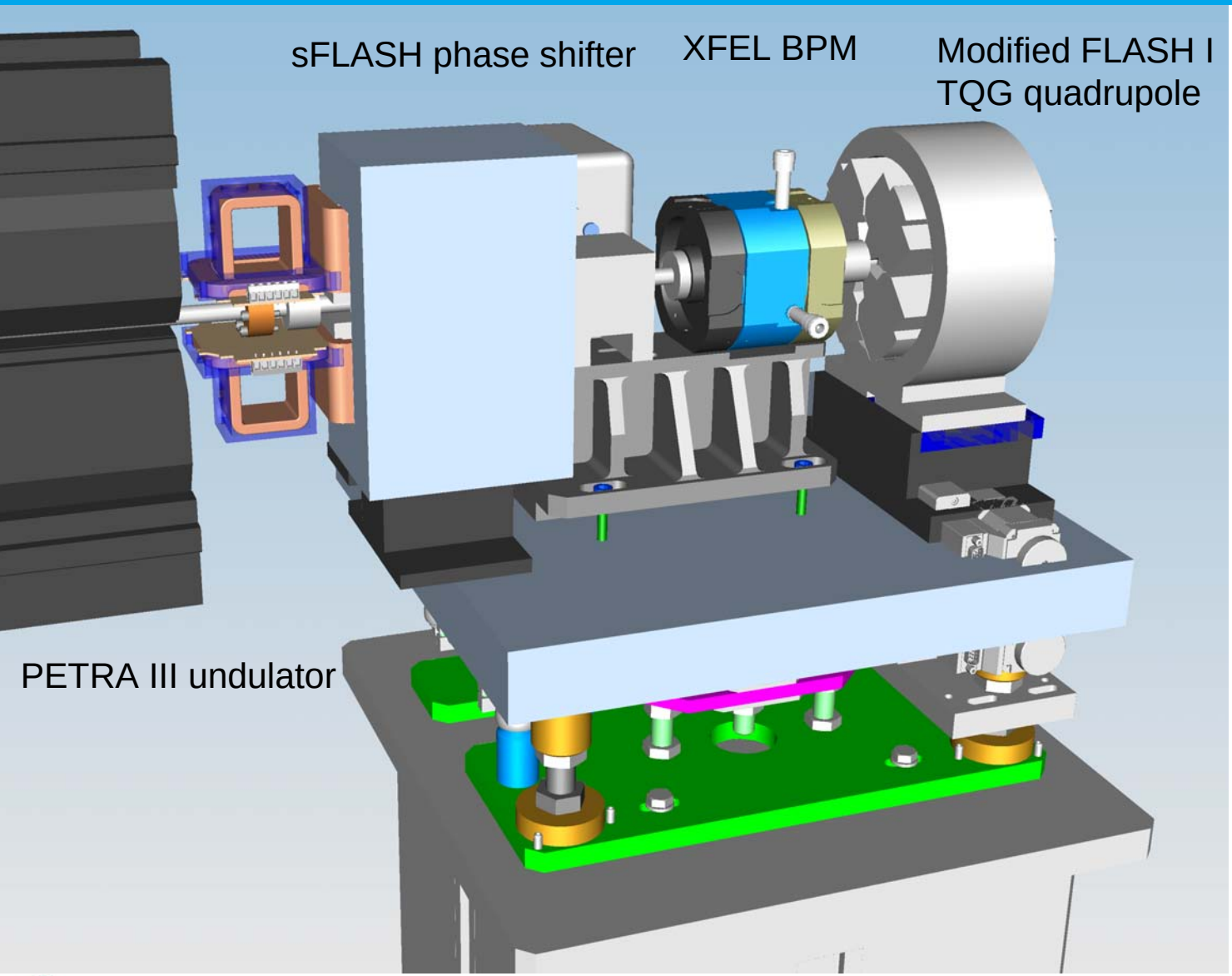


Tunnel Layout: space for future 3rd undulator line

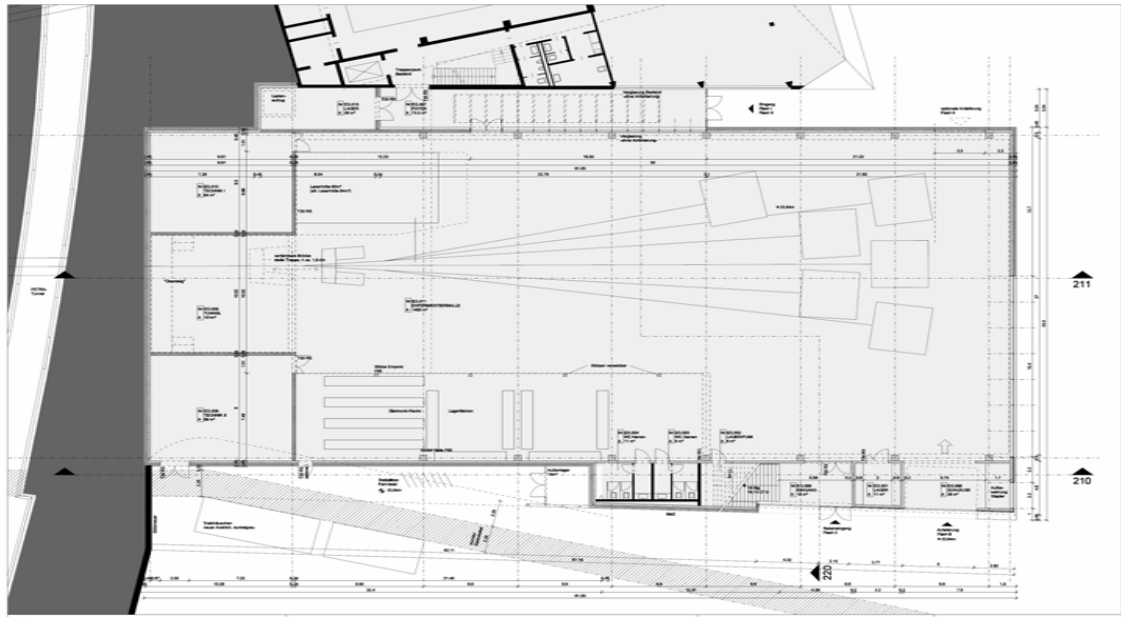


FLASH III: future extension

Technical drawings with first components



Experimental Hall with space for additional stations

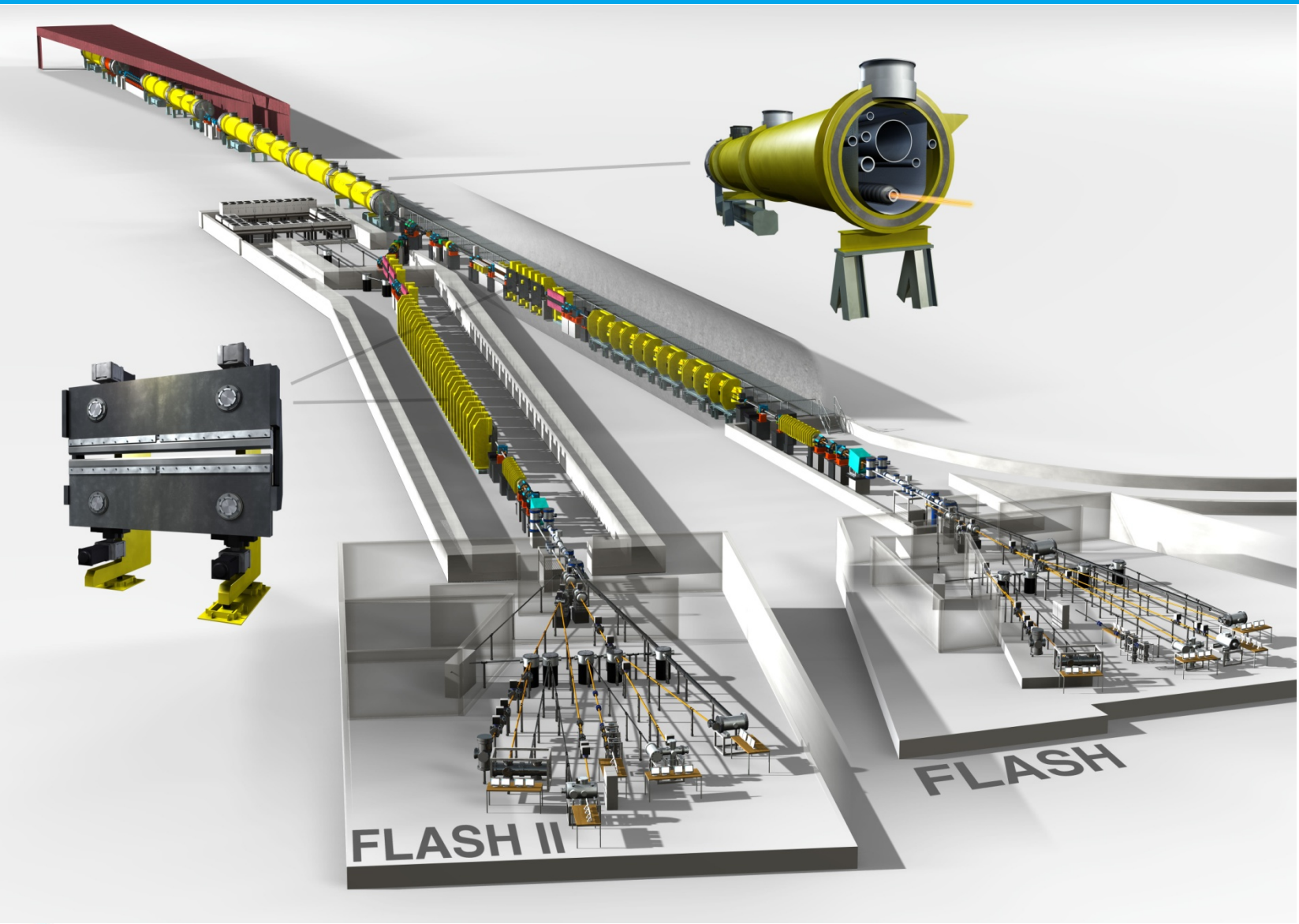


Study of local conditions for FLASH II tunnel

Time plan

Starting NOW 2011:	
	Removal of Bldg. 47A
	Removal of cables along FLASH I
Sept. 2011:	Start of tunnel construction+ foundation of Experimental Hall
	Needs ~3 months interruption of FLASH operation
April-May 2012:	start with technical infrastructure FLASH II tunnel
Summer 2012:	start hardware in tunnel
Winter 2013:	Vacuum connection with FLASH I
Spring 2013:	Start commissioning of FLASH II with beam and seeding
Spring 2014(?):	Start of user operation FLASH II

Experimental Hall will be shifted compared to the tunnel by several months


FLASH II
FLASH

Thank you