

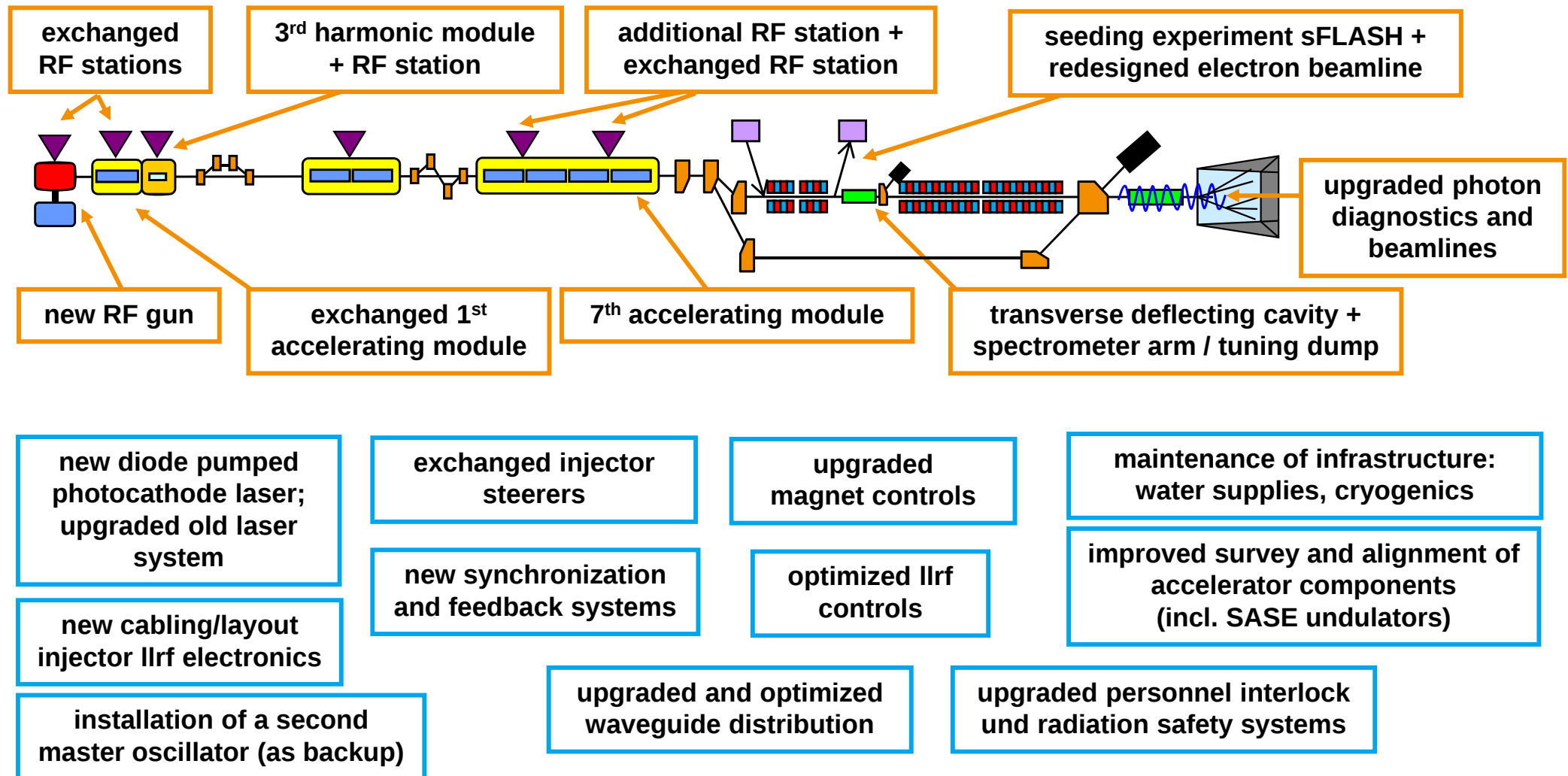
Status of FLASH & FLASH II



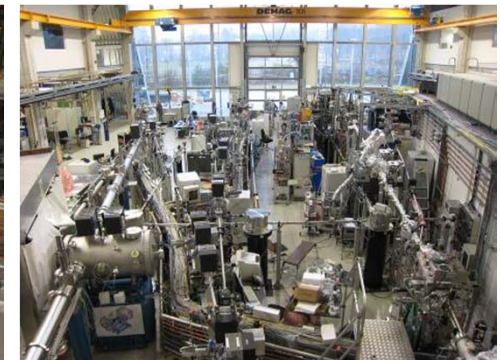
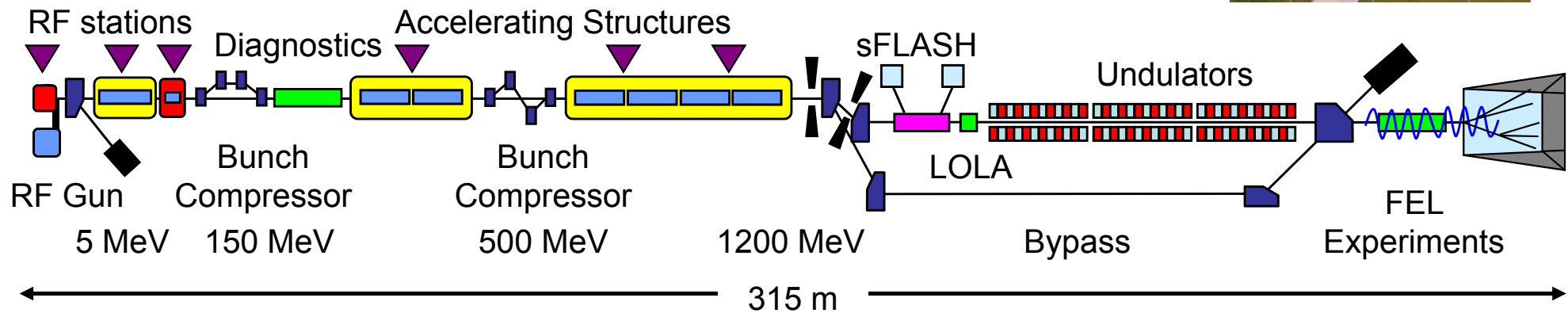
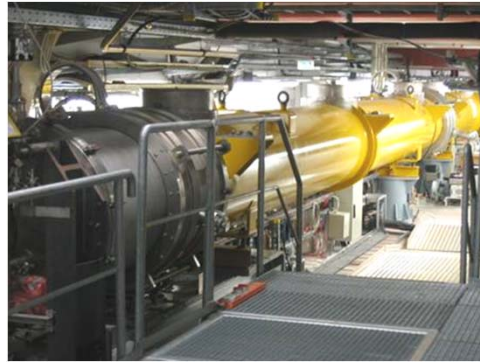
Rolf Treusch

**IRUVX-PP 3rd Annual Meeting
HZB, Berlin, March 21-23, 2011**

FLASH: Upgrade Shutdown 21.9.2009 – 15.2.2010



The new FLASH layout.

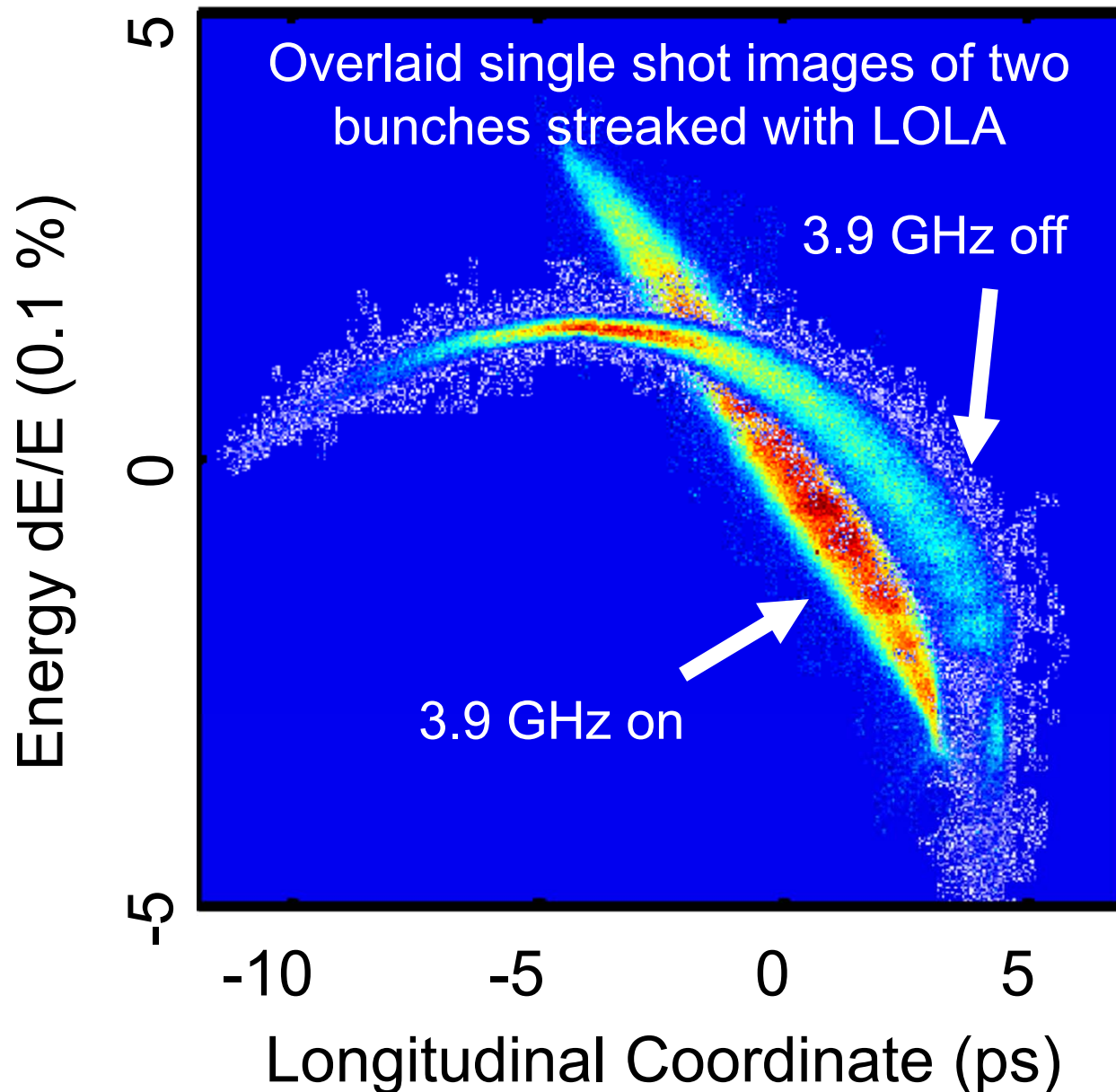


3.9 GHz (3rd harmonic) Module and Module 1.

- > New 1st accelerating module with improved cavities and Piezo tuners
- > 3rd harmonic module with four nine-cell superconducting cavities operated at 3.9 GHz
 - includes RF system and LLRF regulation
 - built at FNAL (Fermilab) in a collaboration with DESY

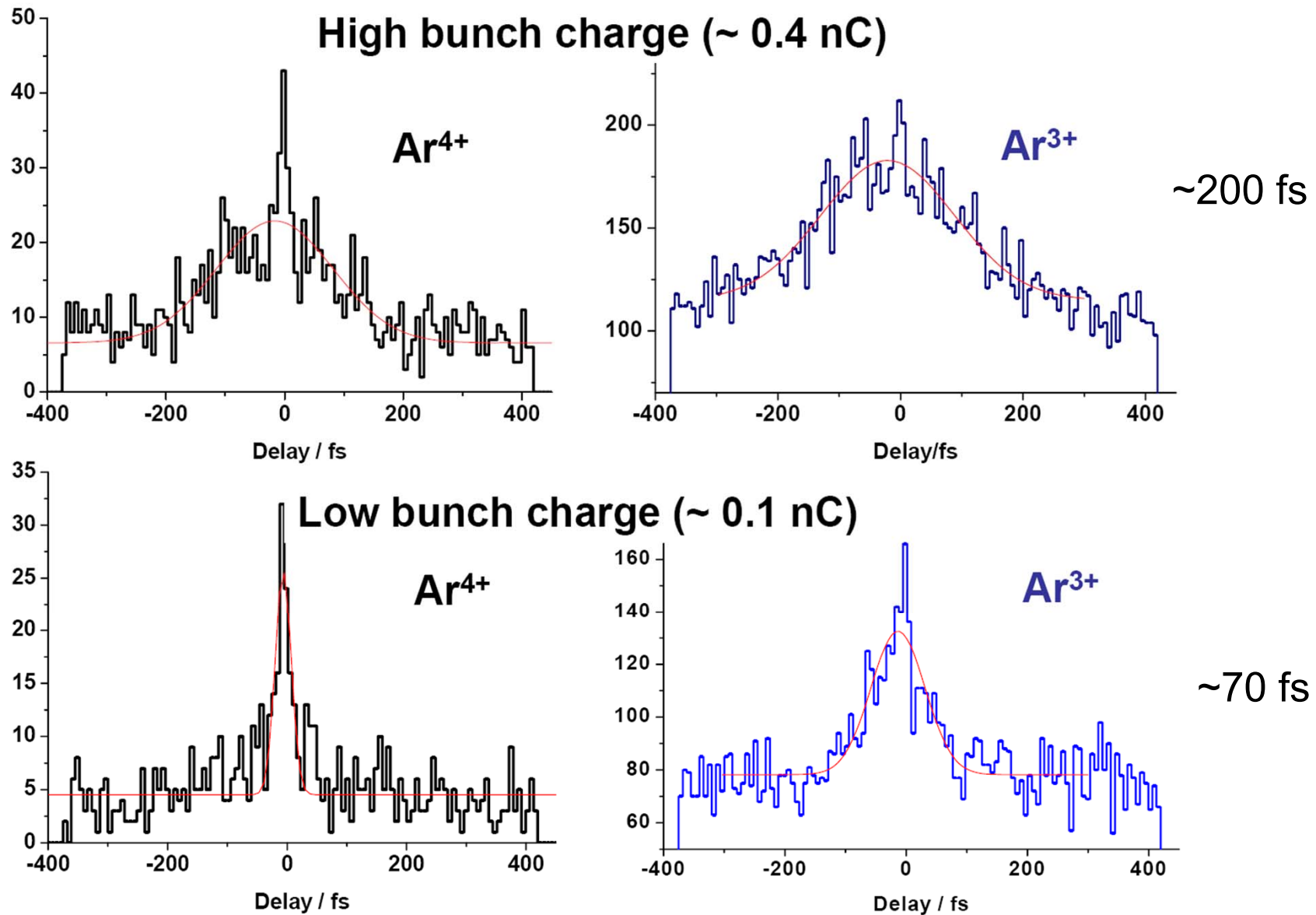


Bunch compression using 3rd-harmonic cavities.



- > measured with LOLA,
- > dispersive section
- > beam energy 700 MeV
- > slight compression with 1st module (ACC1)
- > 3.9 GHz cavities on/off

Long pulses!



R. Moshhammer, A. Rudenko et al.

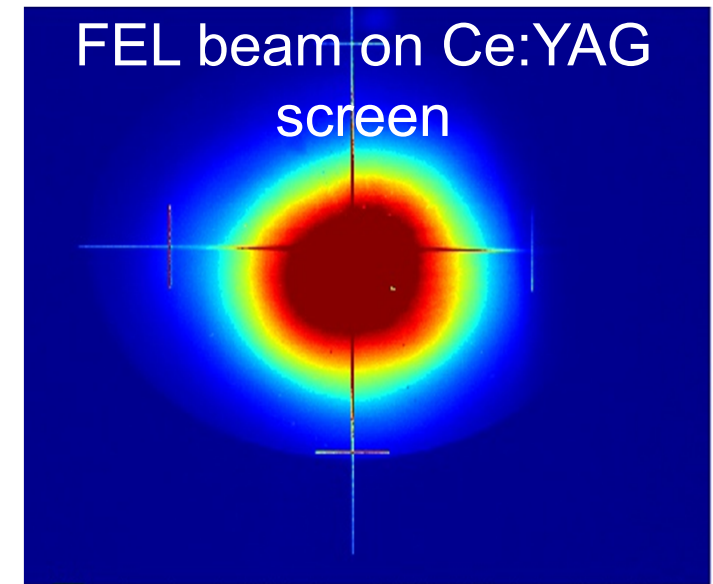


Examples of lasing during commissioning.

- > 10 Hz, between 1 and 120 bunches (1 MHz), compression using 3.9 GHz cavities

Examples:

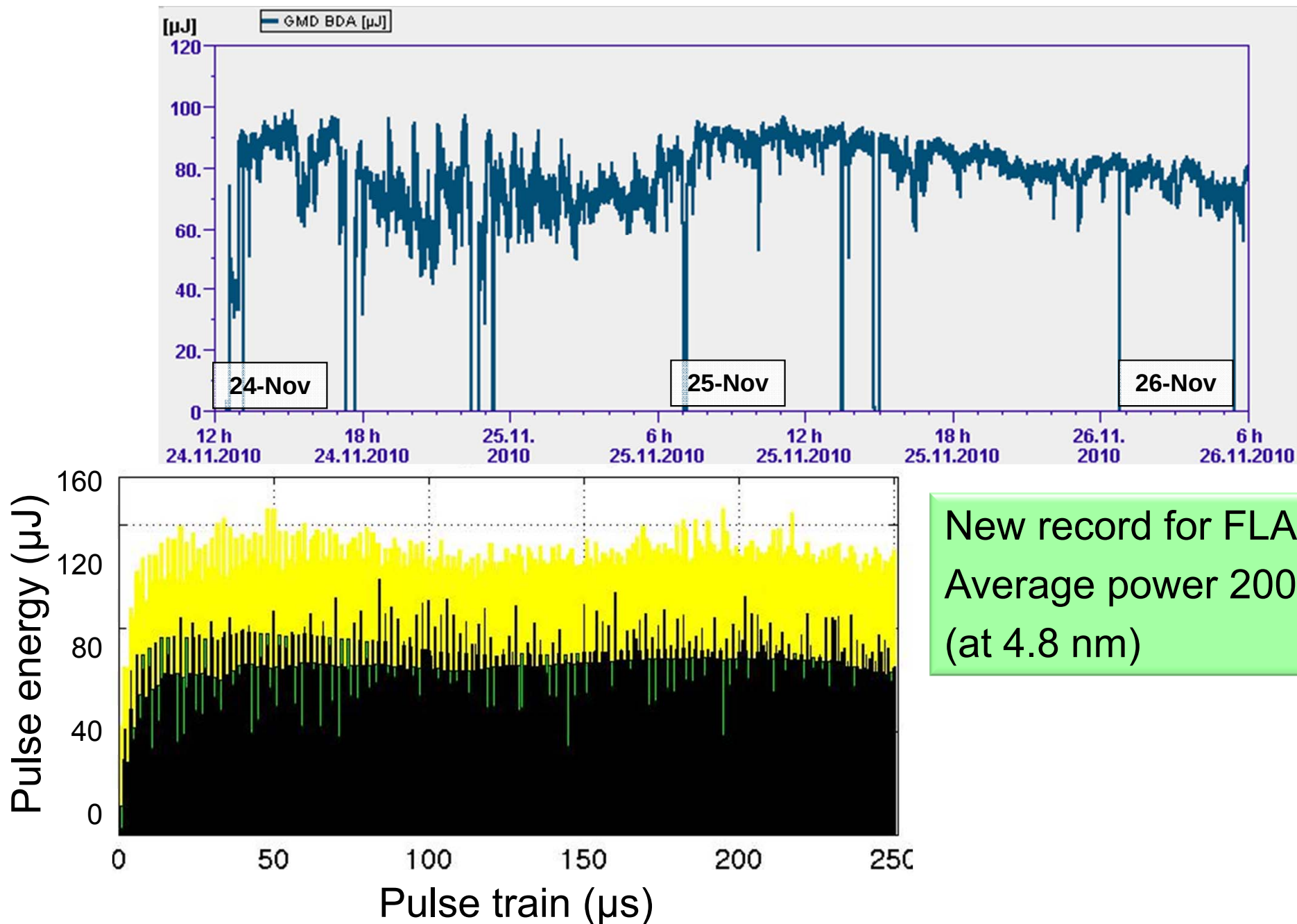
- > 4.45 nm, 140 μJ max, average 75 μJ per pulse
- > 12.4 nm, 105 μJ max, average 75 μJ per pulse
- > 13.4 nm, 300 μJ max, average 250 μJ per pulse
- > 19.2 nm, 350 μJ max, average 230 μJ per pulse
- > 26.2 nm, 280 μJ max, average 160 μJ per pulse



13.4 nm, distance to screen 23.5 m,
horizontal ticks at ~ 3.5 mm,
vertical ticks at 5 mm

Radiation pulse energies are significantly higher and easier to tune compared to roll-over compression

4.8 nm, 250 Pulses/Train, 1 MHz.



New record for FLASH:
Average power 200 mW
(at 4.8 nm)

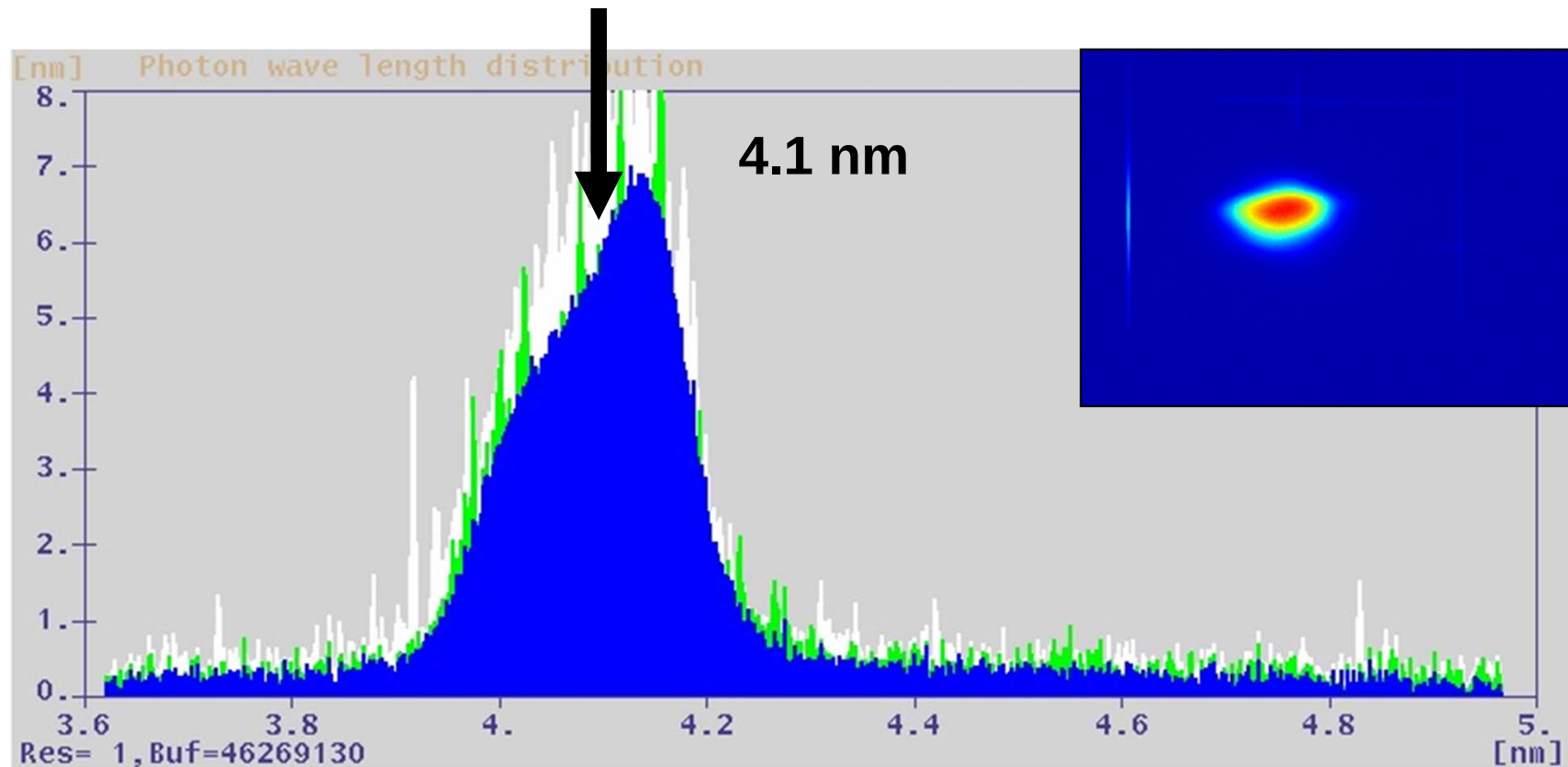
Lasing in the water window.

Photon beam characterisation on 24-25 September, 2010

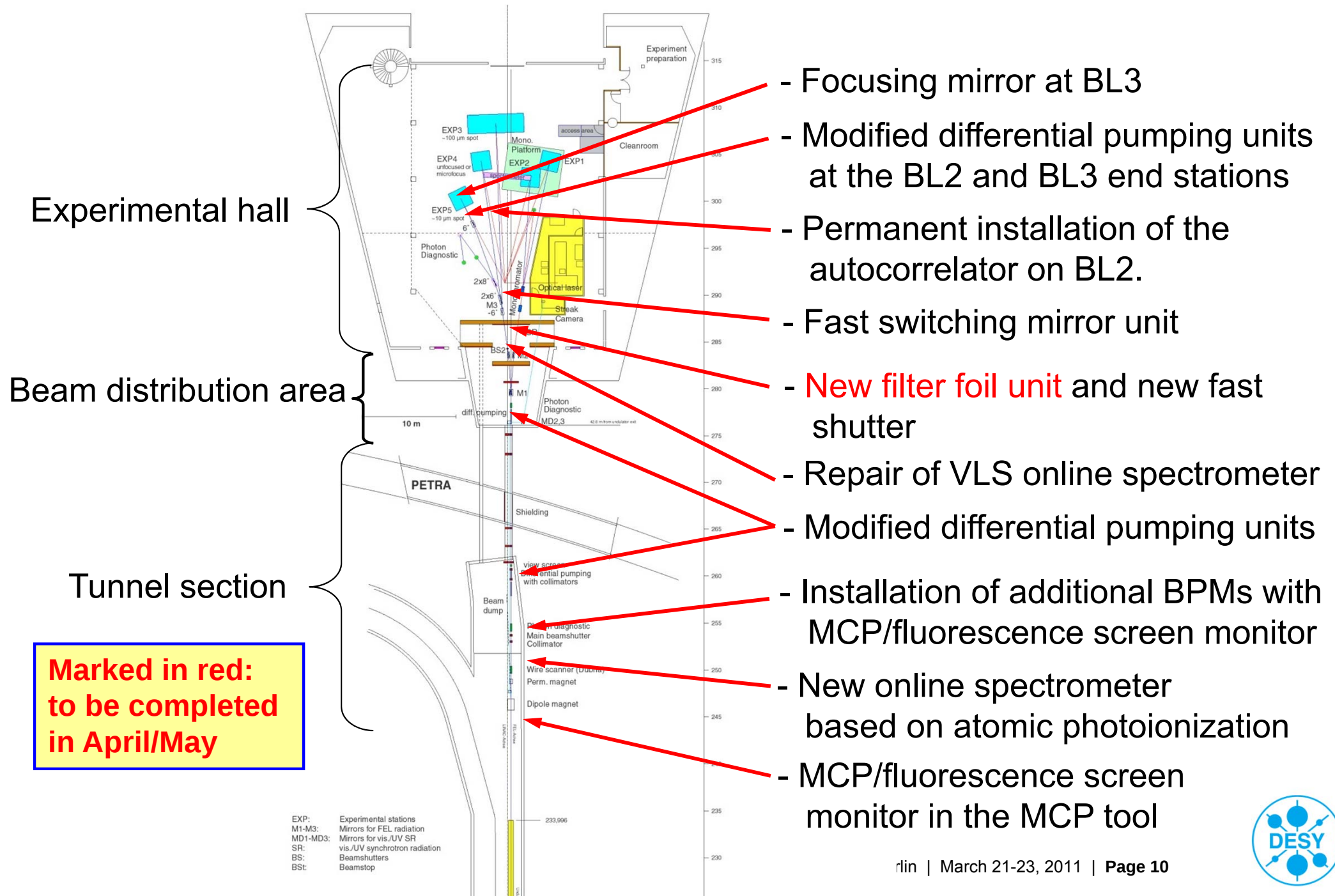
4.6 nm 120 μJ av. pulse energy

4.2 nm 90 μJ

4.12 nm ~70 μJ

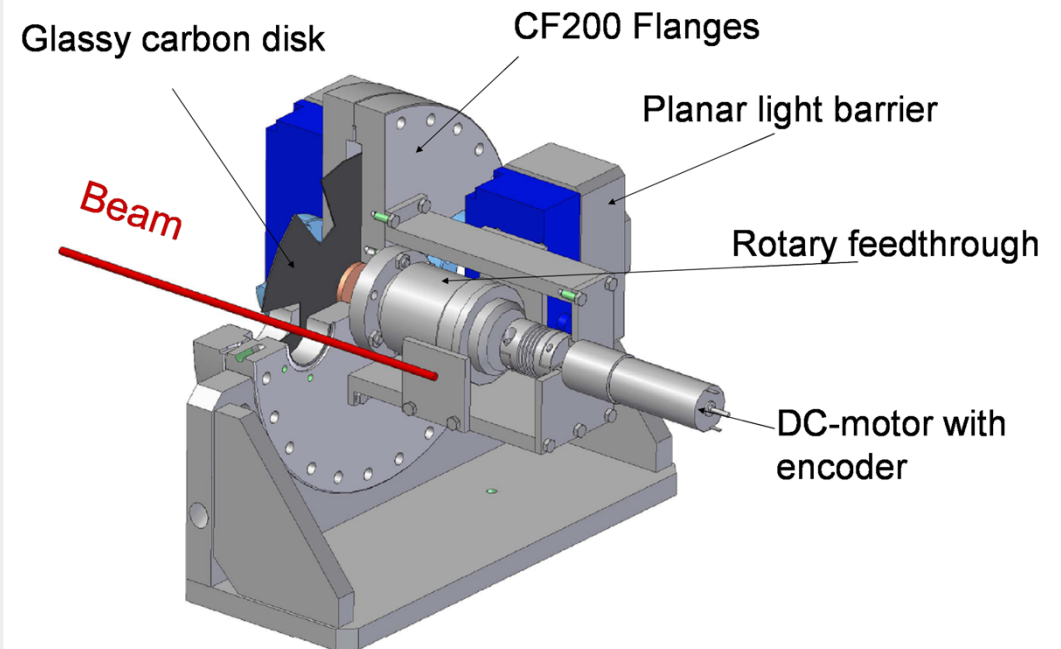
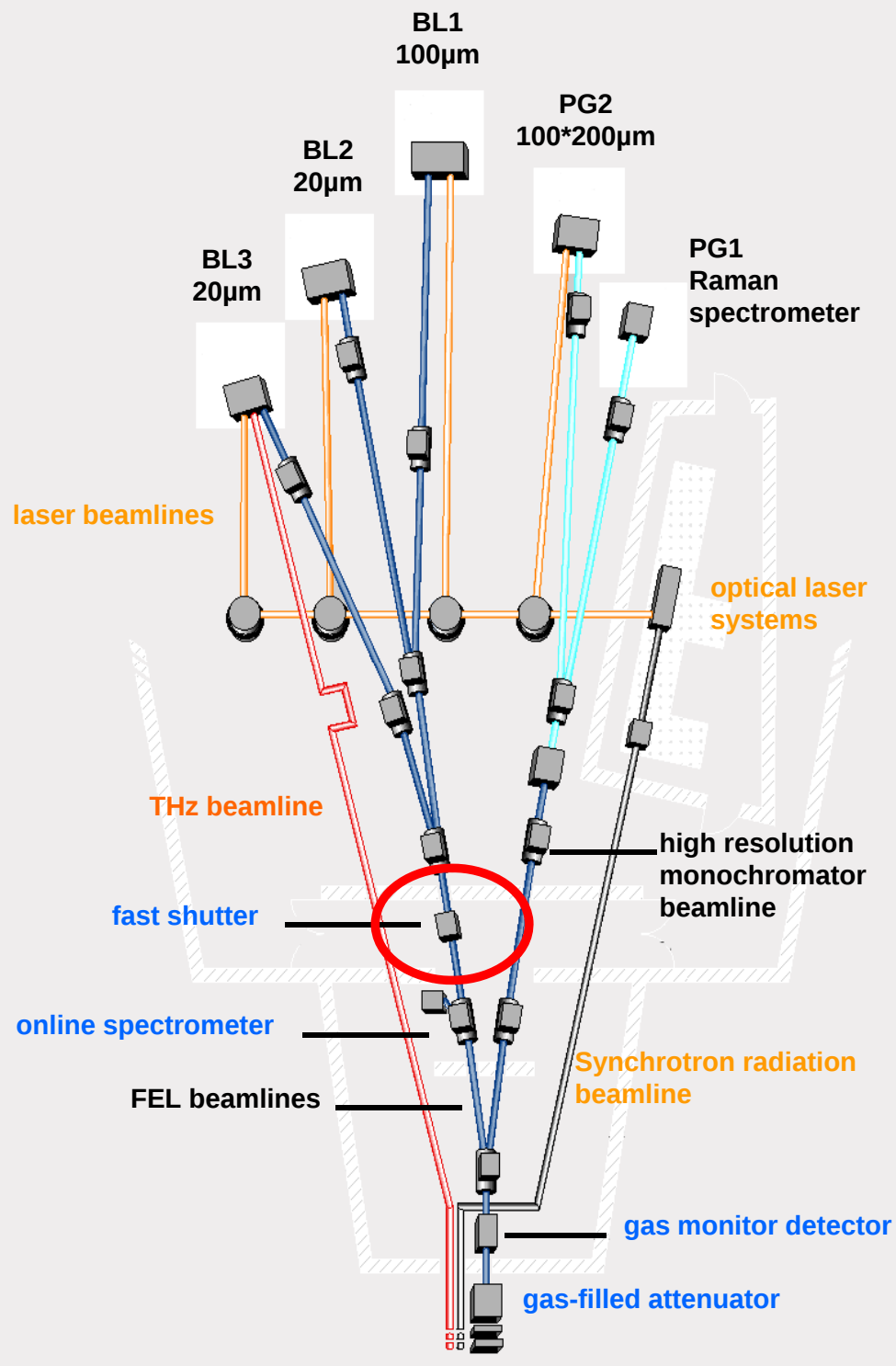


Overview of new Installations in Photon Beamlines.



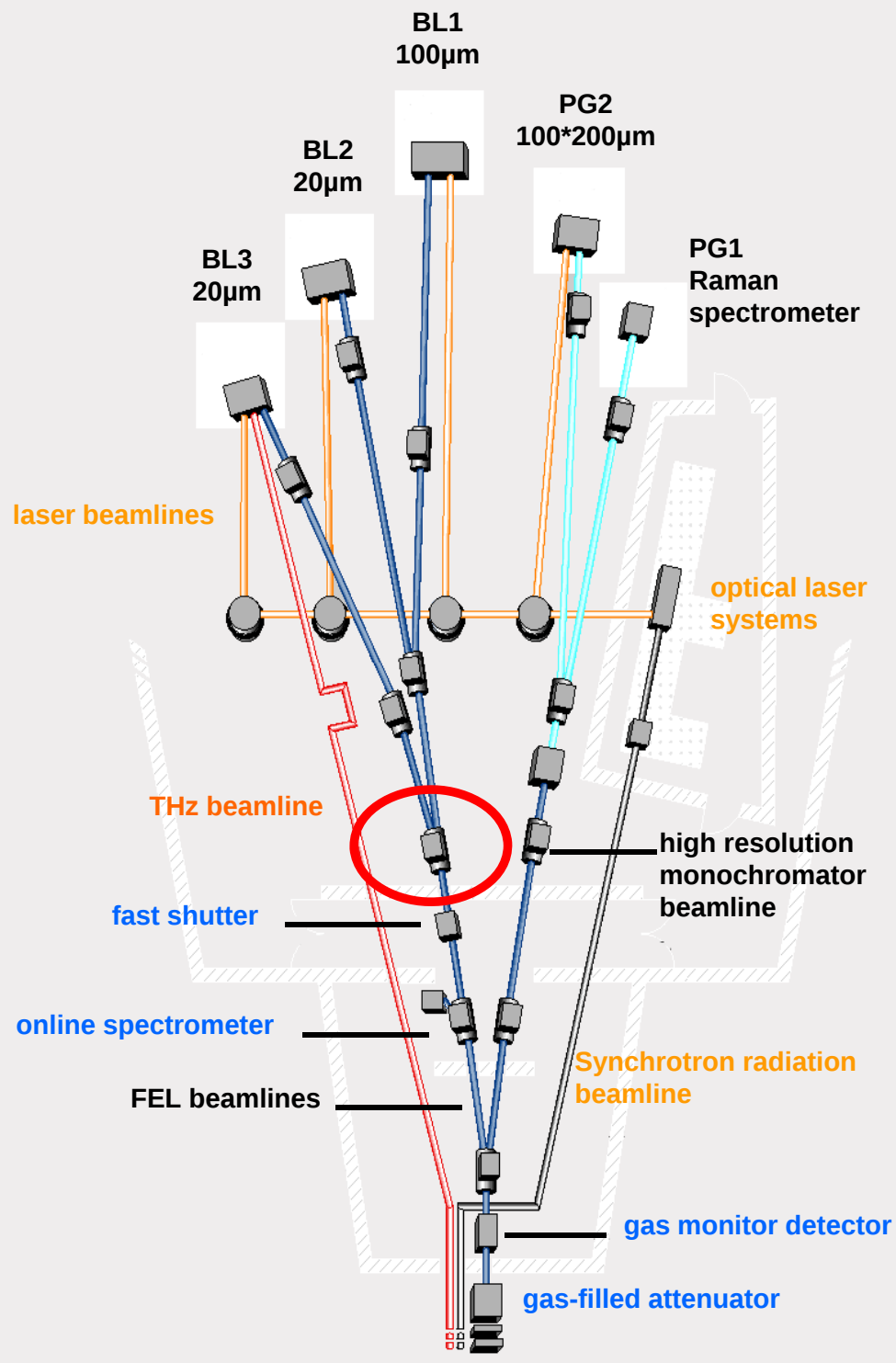
Experimental hall.

Fast (bunchtrain) shutter



J. Tolkiehn, H. Schulte-Schrepping,
U. Hahn, and S. Toleikis

Experimental hall.



Fast switching mirror (2.5Hz)



DESY Zeuthen: M. Sachwitz, R. Heller,
R. Sternberger, D. Thürmann
DESY Hamburg: H. Schulte-Schrepping,
U. Hahn, and K. Tiedtke



4th User Period - tentative schedule 2012.

January 2012	52	26.Dec - 1.Jan	6	
	1	2.Jan - 8.Jan	7	FLASH I commissioning
	2	9.Jan - 15.Jan	7	
	3	16.Jan - 22.Jan	4	Accelerator studies
	4	23.Jan - 29.Jan	4	
	5	30.Jan - 5.Feb	4	
	6	6.Feb - 12.Feb	4	
	7	13.Feb - 19.Feb	4	
	8	20.Feb - 26.Feb	4	
	9	27.Feb - 4.Mar	2	
	10	5.Mar - 11.Mar	2	
	11	12.Mar - 18.Mar	3	
	12	19.Mar - 25.Mar	3	
	13	26.Mar - 1.Apr	1	
	14	2.Apr - 8.Apr	1	
	15	9.Apr - 15.Apr	1	
	16	16.Apr - 22.Apr	1	
	17	23.Apr - 29.Apr	2	
	18	30.Apr - 6.May	3	
	19	7.May - 13.May	1	
	20	14.May - 20.May	1	
	21	21.May - 27.May	1	
	22	28.May - 3.Jun	1	
	23	4.Jun - 10.Jun	2	
	24	11.Jun - 17.Jun	2	
	25	18.Jun - 24.Jun	3	
	26	25.Jun - 1.Jul	1	
	27	2.Jul - 8.Jul	1	
	28	9.Jul - 15.Jul	1	
	29	16.Jul - 22.Jul	1	
	30	23.Jul - 29.Jul	2	
	31	30.Jul - 5.Aug	3	
	32	6.Aug - 12.Aug	1	
	33	13.Aug - 19.Aug	1	
	34	20.Aug - 26.Aug	1	
	35	27.Aug - 2.Sep	1	
	36	3.Sep - 9.Sep	2	
	37	10.Sep - 16.Sep	2	
	38	17.Sep - 23.Sep	3	
	39	24.Sep - 30.Sep	1	
	40	1.Oct - 7.Oct	1	
	41	8.Oct - 14.Oct	1	
	42	15.Oct - 21.Oct	1	
	43	22.Oct - 28.Oct	2	
	44	29.Oct - 4.Nov	2	
	45	5.Nov - 11.Nov	3	
	46	12.Nov - 18.Nov	1	
	47	19.Nov - 25.Nov	1	
	48	26.Nov - 2.Dec	1	
	49	3.Dec - 9.Dec	1	
	50	10.Dec - 16.Dec	1	
	51	17.Dec - 23.Dec	4	
	52	24.Dec - 30.Dec	5	
January 2013	1	31.Dec - 6.Jan	5	
	2	7.Jan - 13.Jan	4	
	3	14.Jan - 20.Jan	4	
	4	21.Jan - 27.Jan	4	
	5	28.Jan - 3.Feb	4	
	6	4.Feb - 10.Feb	6	Connection to FLASH II

- > 3rd user period (~400 12h-shifts total) ends September 11, 2011 (schedule available at flash.desy.de)
- > 4th period is between shutdowns for FLASH II
- > starting March/April 2012
- > ~25 weeks, i.e. 325 12h-shifts
- > Deadline for proposals: June 5, 2011
- > Proposal review: September 2011

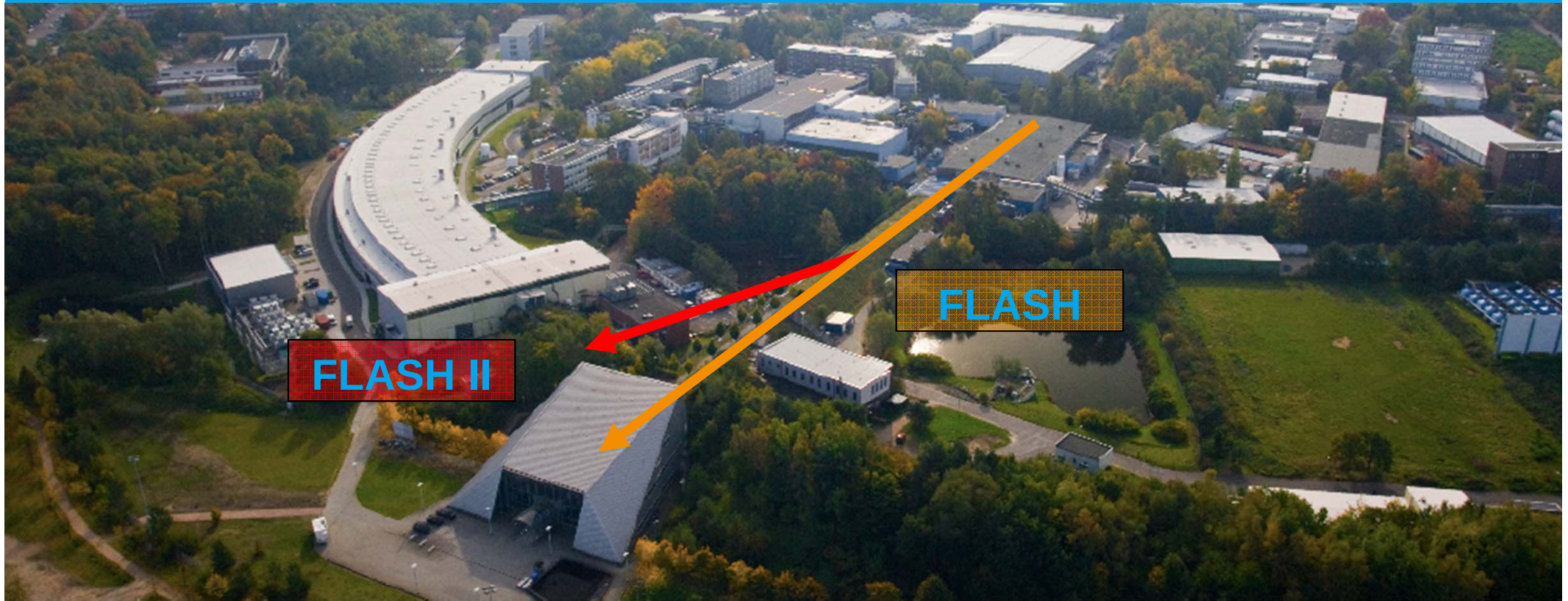


Summary FLASH.

- > Successful re-start of FLASH after the upgrade
- > We have reached the carbon K-edge
- > FEL beam more intense and stable than ever, tuning easier
- > Tuning of short pulses is possible with linearized compression scheme
- > Photon beamlines and diagnostics have been significantly improved
- > Deadline for new proposals: June 5, 2011



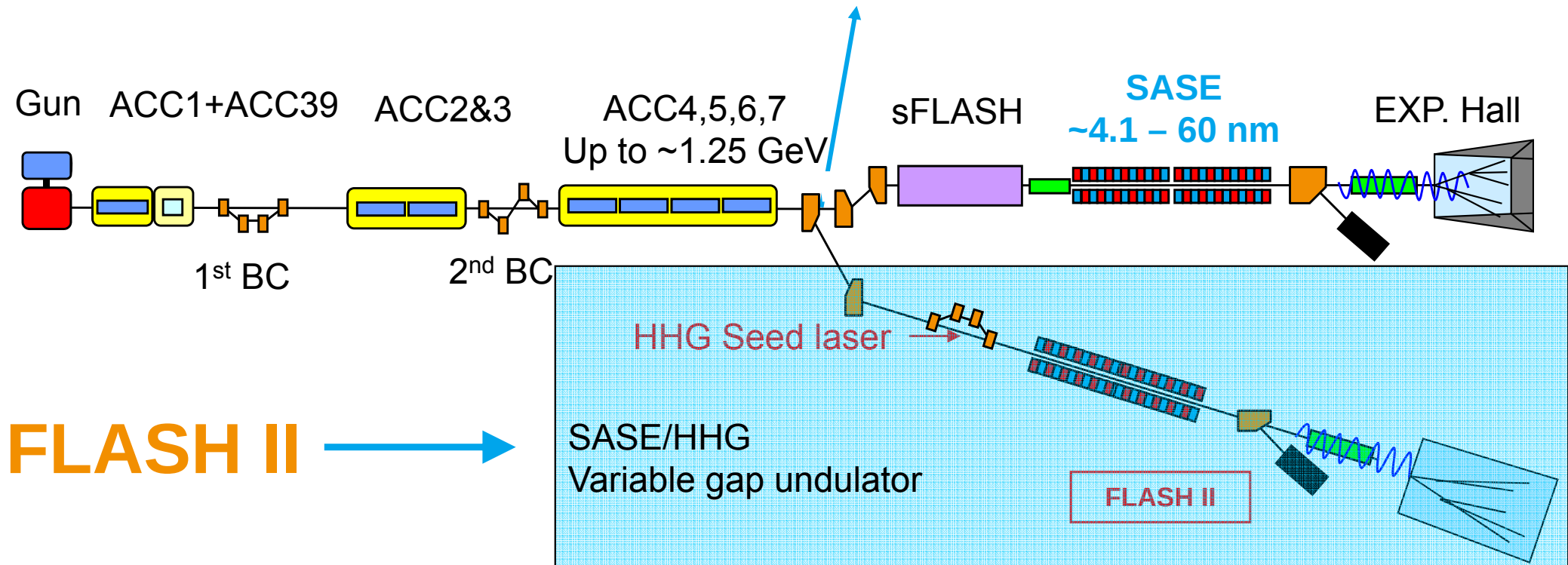
FLASH II.



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: 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

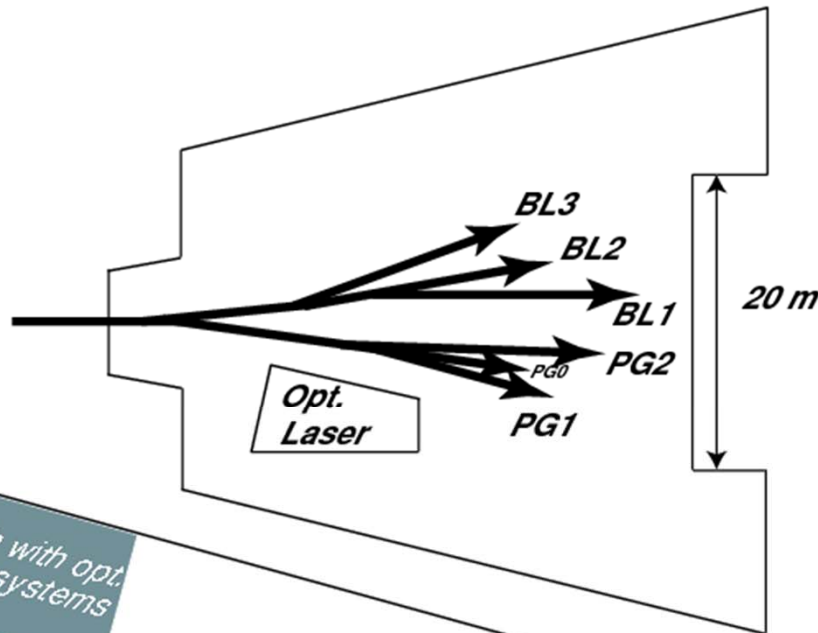
* depending on FLASH I up to 800 bunches with 1 μ s separation at 10Hz

** at fundamental wavelength

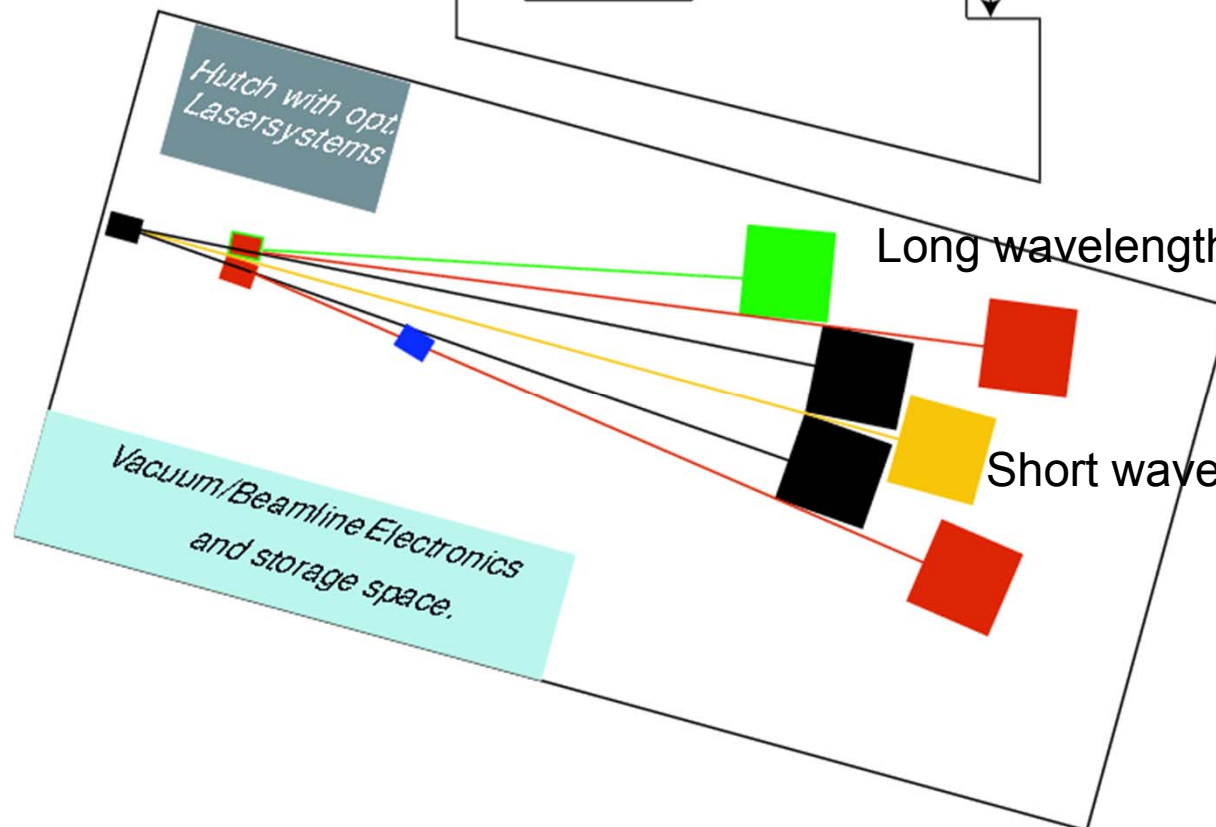


Draft layout of experimental hall.

FLASH I Hall



FLASH II Hall

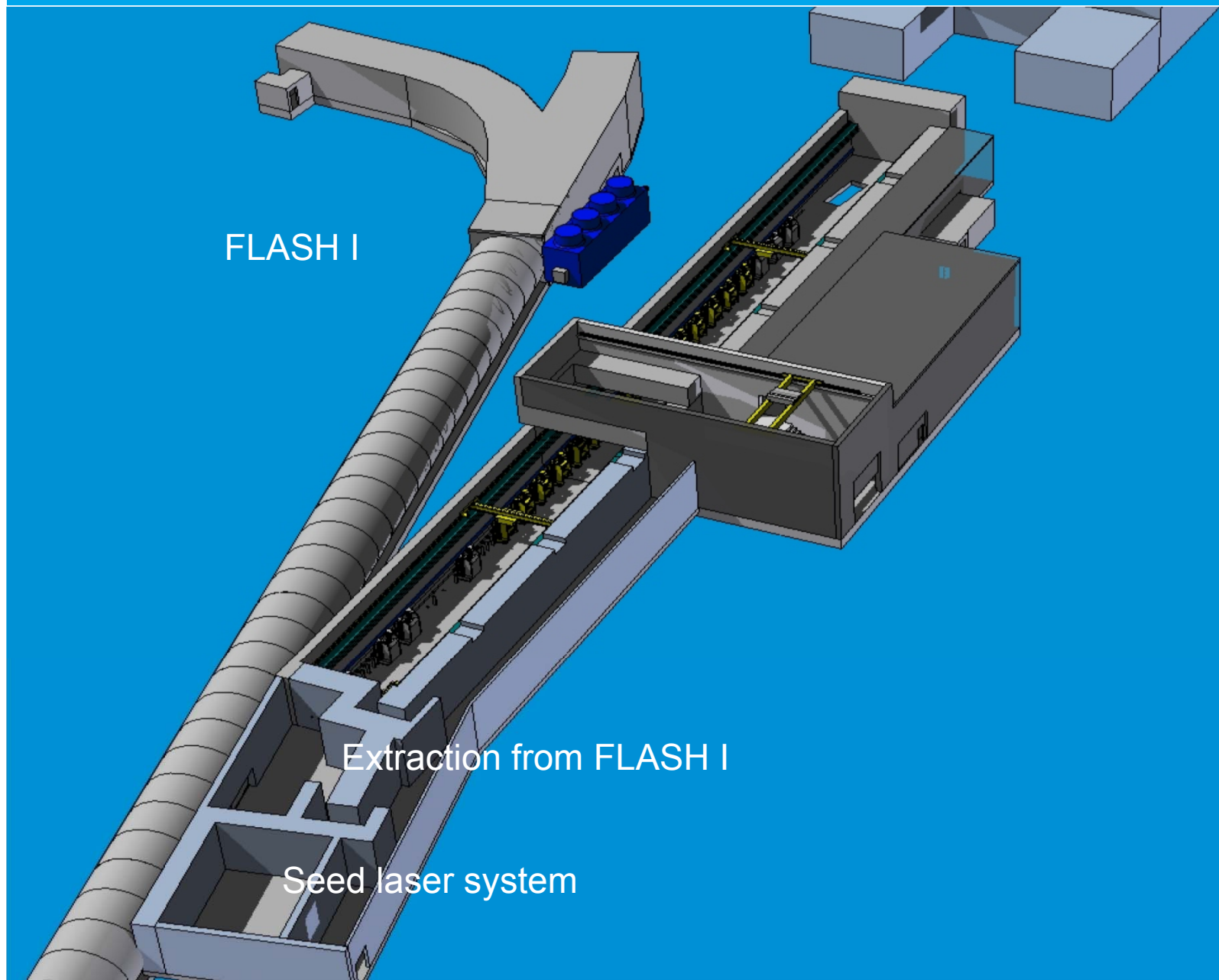


Long wavelengths ($> \sim 4\text{nm}$ at 4° incidence angle)

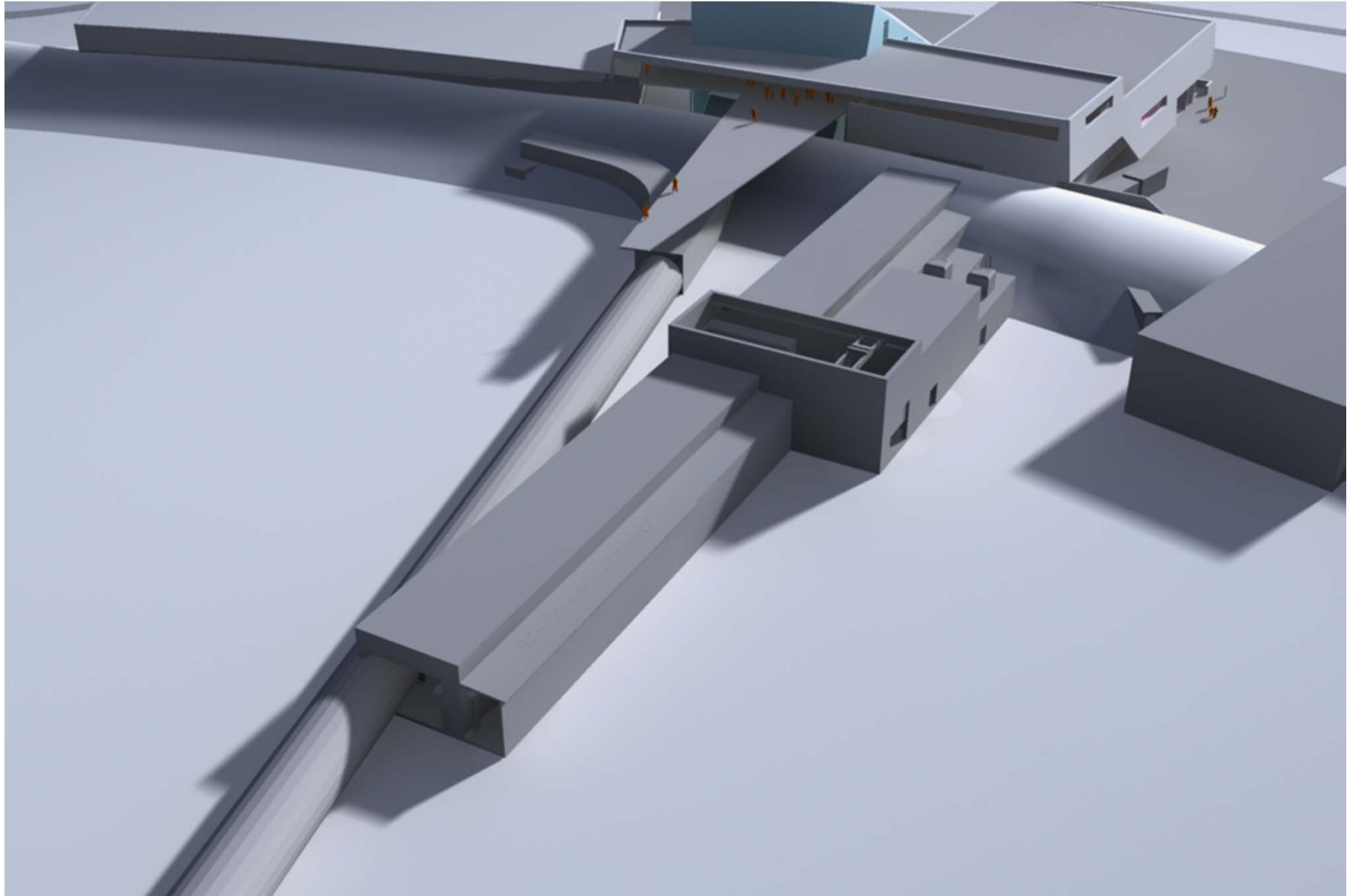
Short wavelengths (0.8nm at 1° incidence angle)

Most beamlines down to 2nm at 2° incidence angle

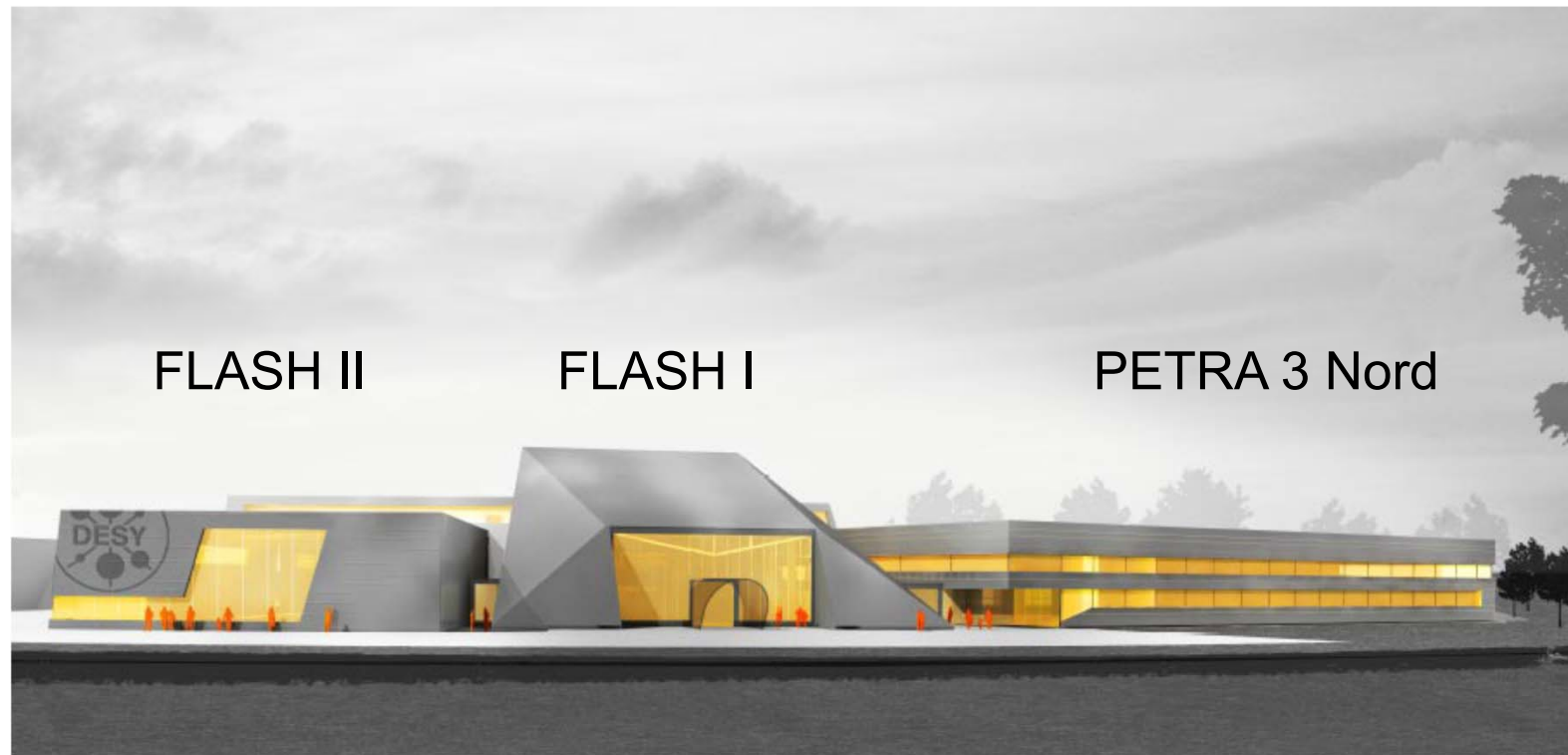
FLASH II Tunnel Layout.



FLASH II Tunnel and Exp. Hall.



View into the Future.

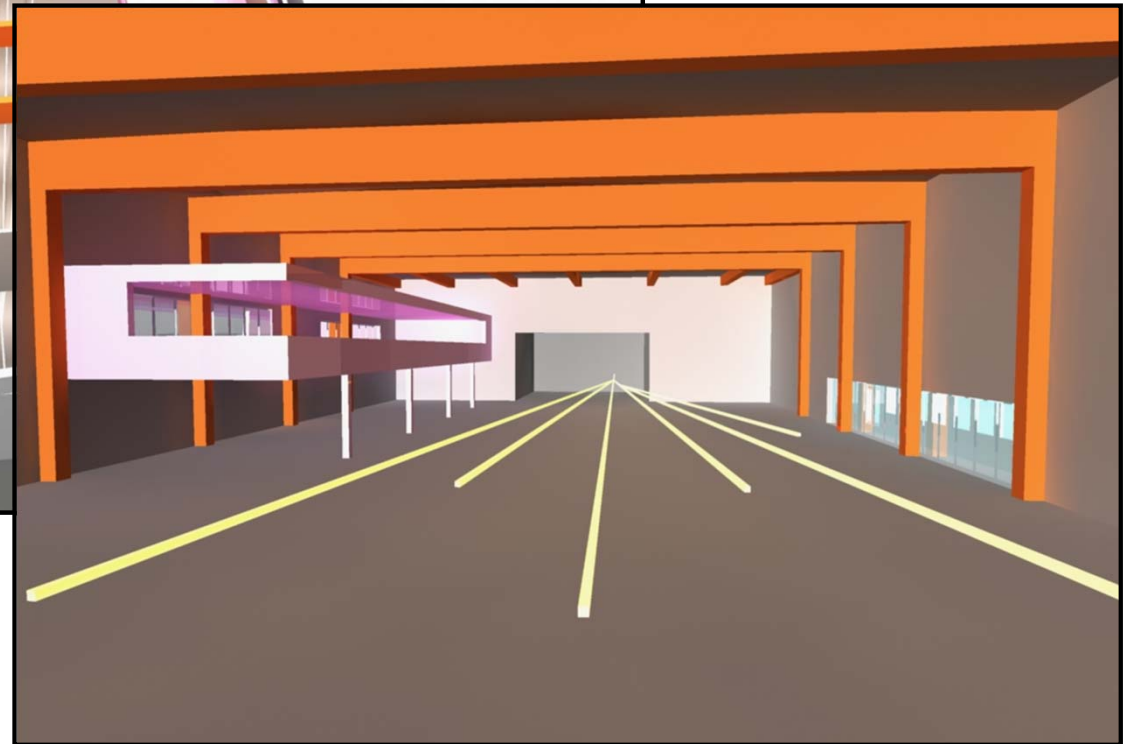
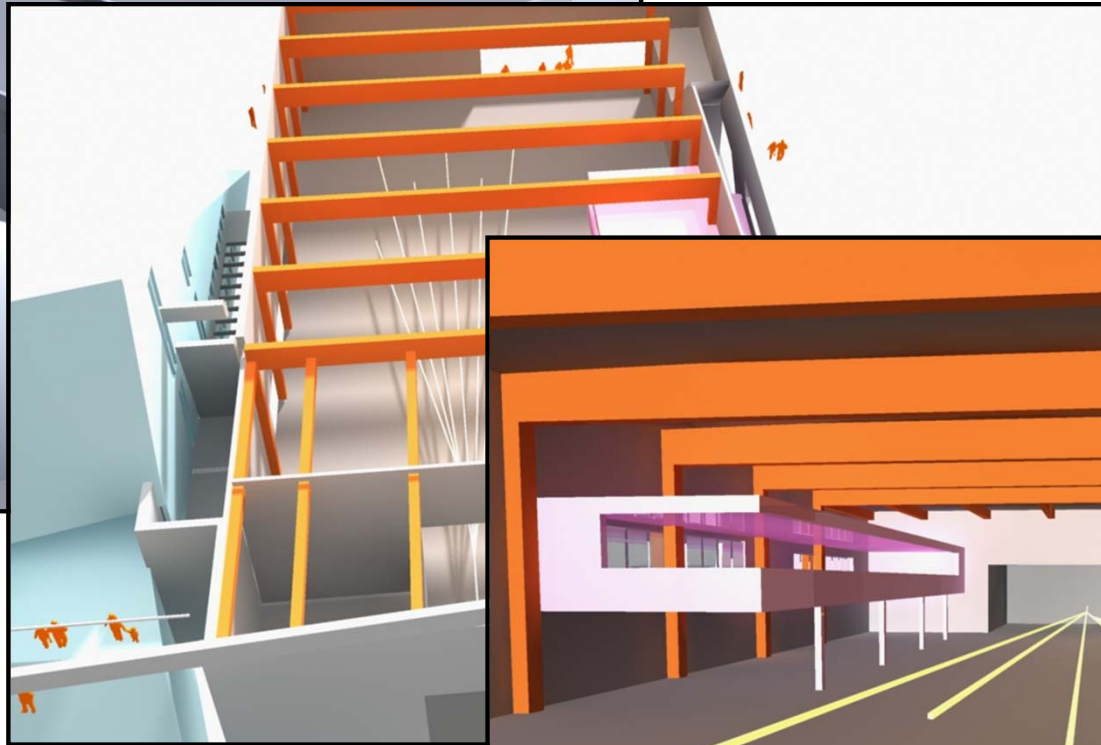
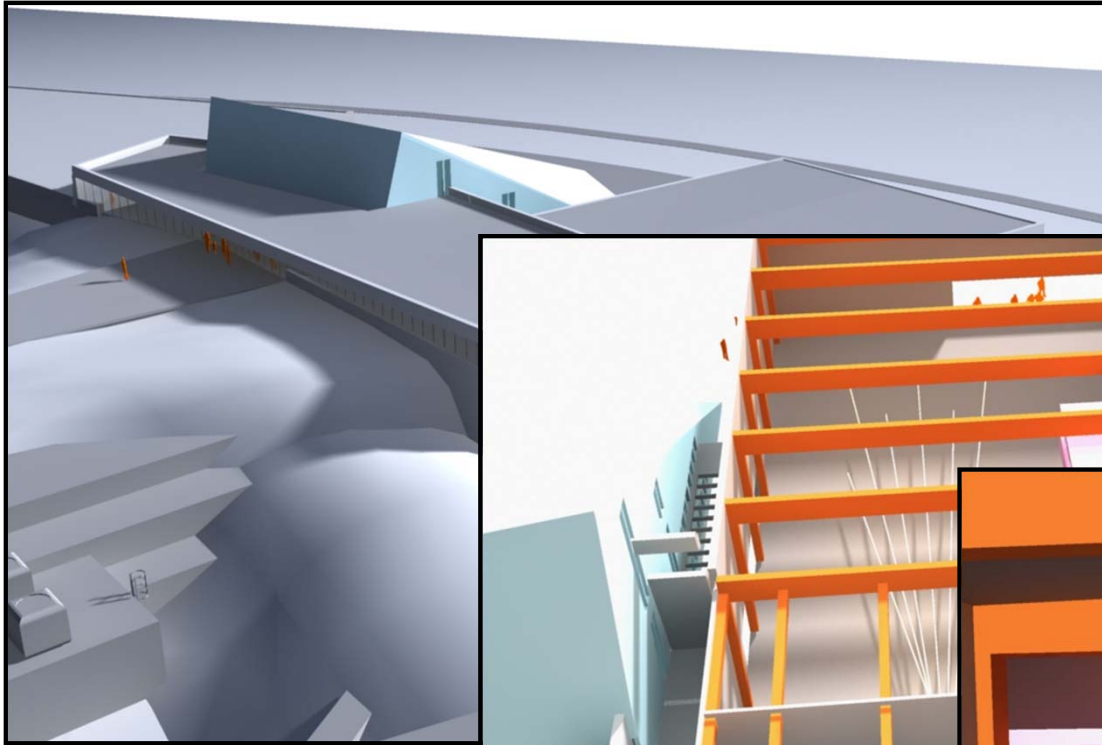


**Future ensemble
seen from North**



**... and
from south**

3d views of Experimental Hall.



FLASH II Time Schedule.

Starting NOW :	Preparation of FLASH II construction Removal of cables along FLASH I
September 2011:	Start of tunnel construction (Needs ~3 months interruption of FLASH operation) foundation of Experimental Hall (maybe spring 2012) in parallel removal of Bldg. 47A
Late spring 2012:	start to install technical infrastructure in FLASH II tunnel
Summer 2012:	start to mount hardware in tunnel
Winter/Spring 2013:	Vacuum connection with FLASH I
Early Summer 2013:	Start commissioning of FLASH II with beam
Spring (?) 2014 :	Start user operation of FLASH II



Summary.



- Exciting times
 - New challenges
 - Great science
- ... to be continued