

PETRA II Installation Experience



Michael Bieler
for the PETRA Team
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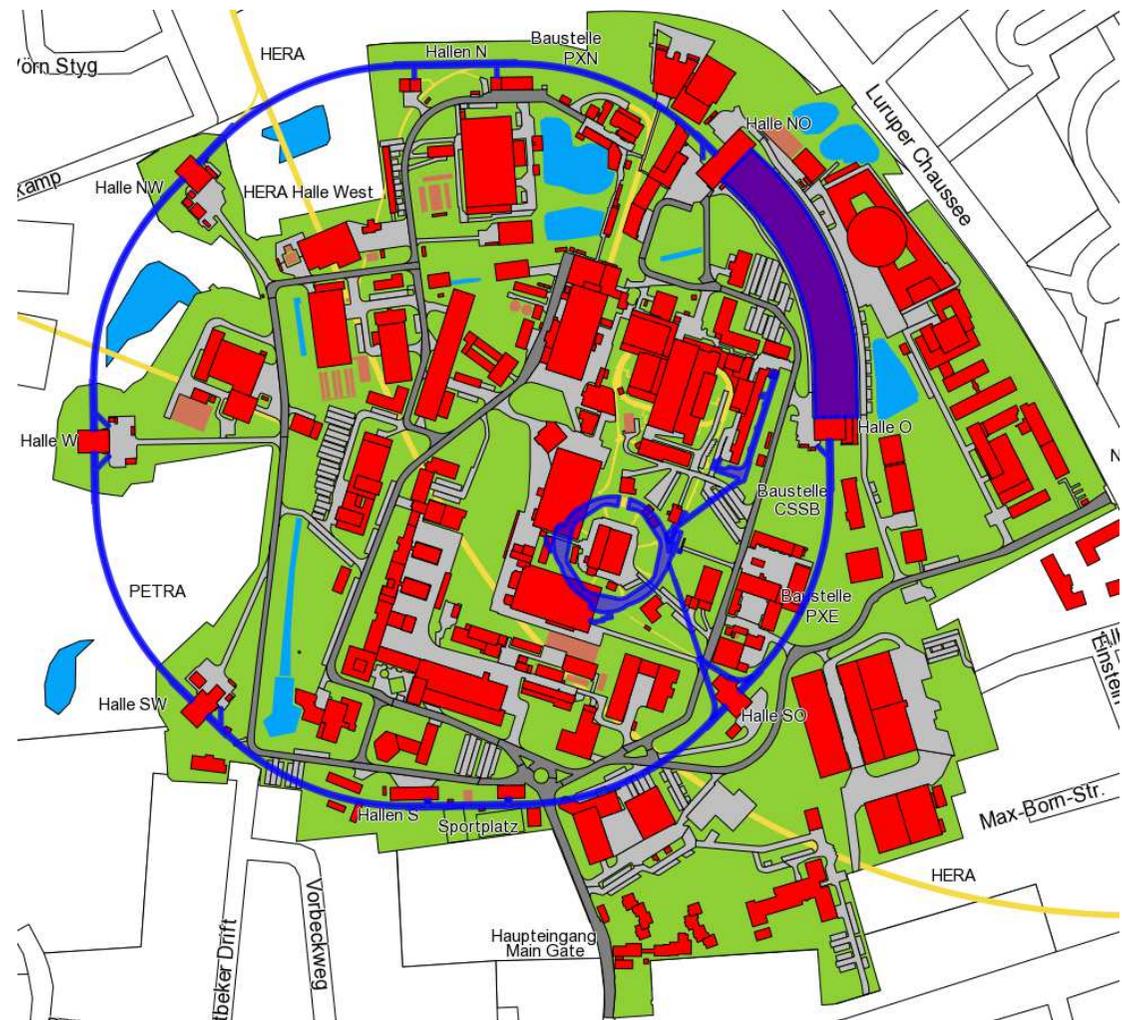
PETRA III Overview

- Circumference 2.3 km
- Former use as
 - e⁺/e⁻ collider (1978 – 1990)
 - e/p injector for HERA (1990 - 2007)
 - 3rd generation light source (since 2009)
- Horizontal emittance 1nm
 - Large circumference
 - 20 damping wigglers
- Full energy (6 GeV) injector, Top Up, 100 mA
- 14 photon beam lines, concentrated in 1/8 of the ring



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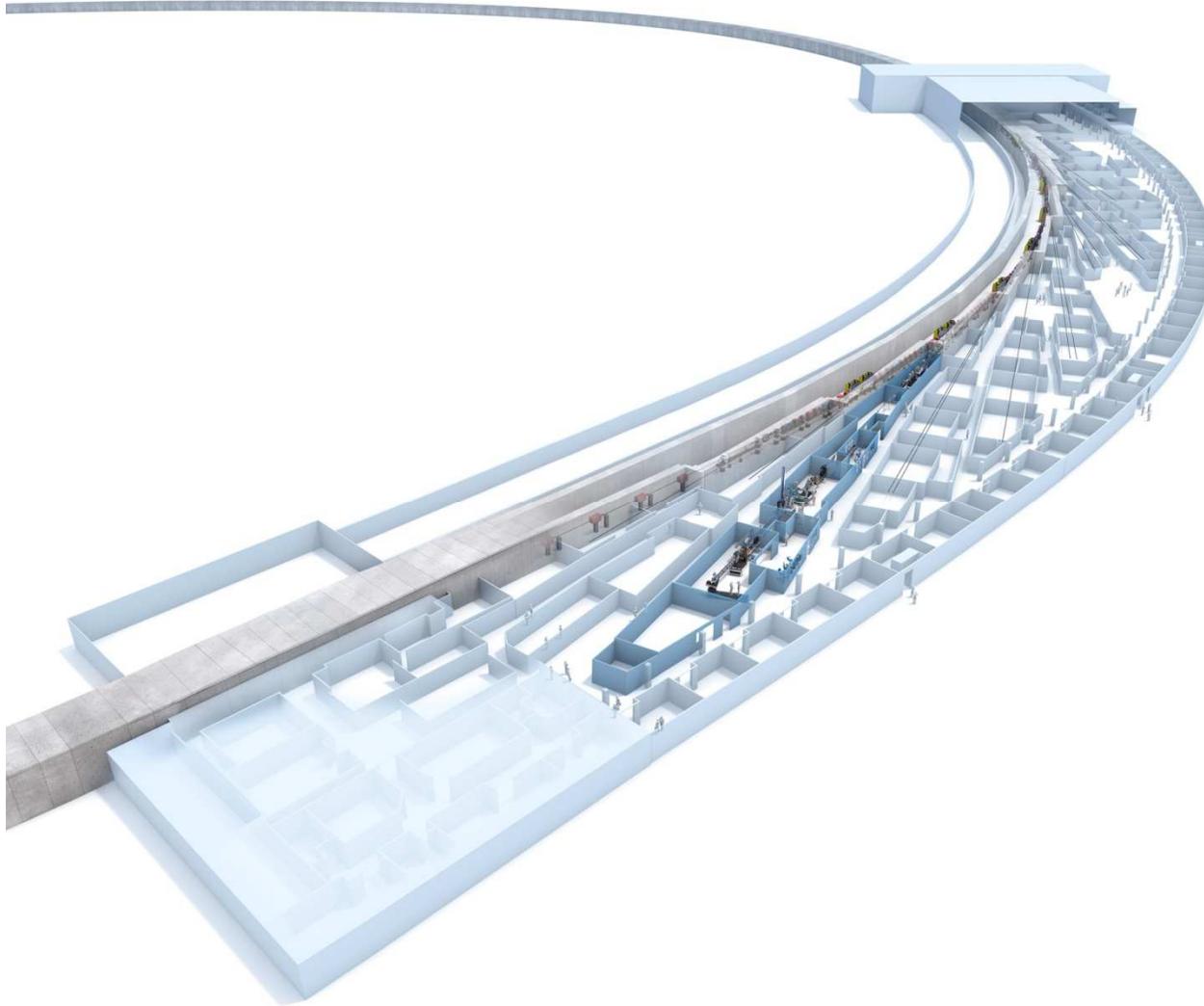
PETRA III Overview

- 14 photon beam lines, concentrated in 1/8 of the ring



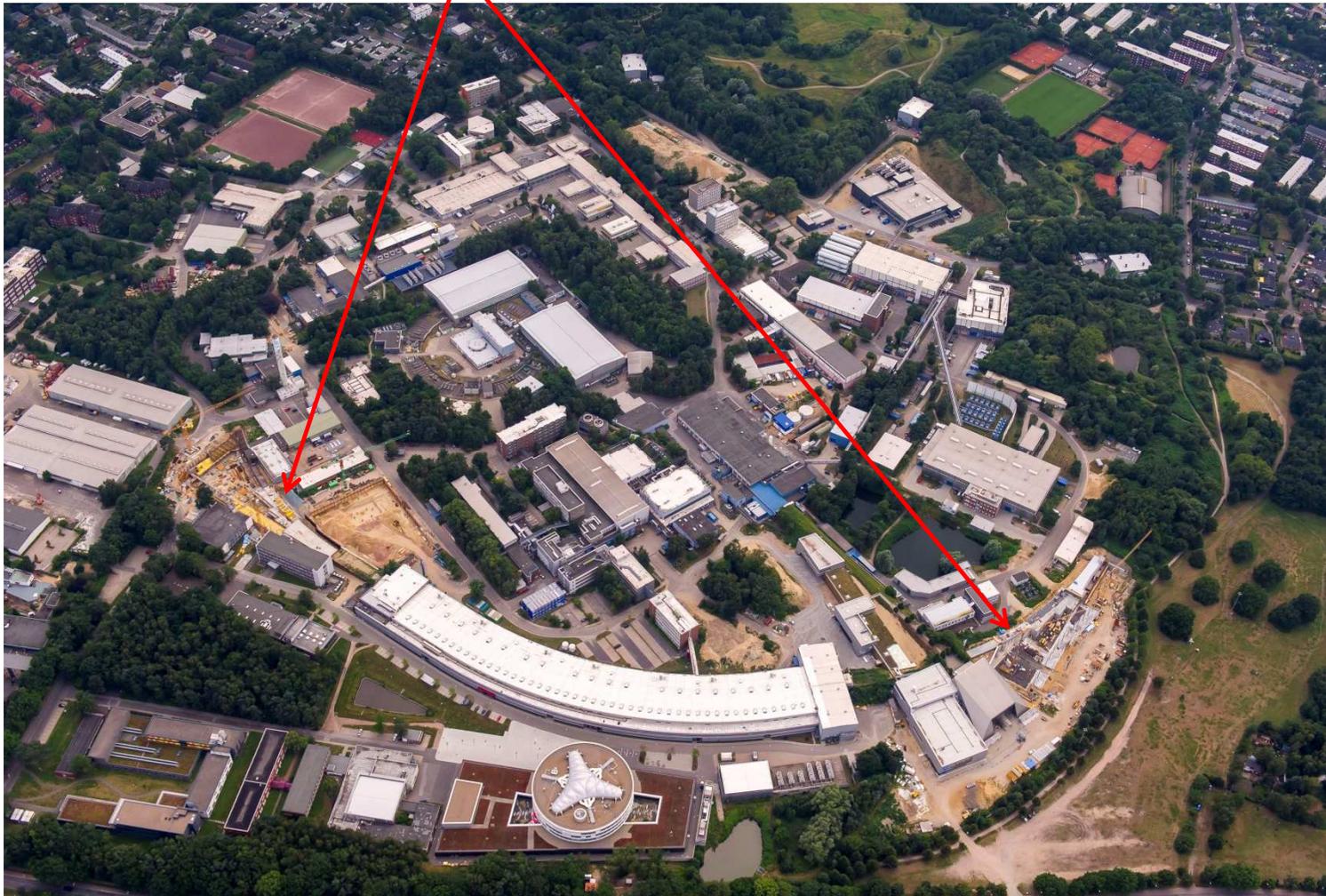
PETRA III Overview

- > 14 photon beam lines, concentrated in 1/8 of the ring



PETRA Extension 2014

- 2 new experimental halls with 5 beam lines each

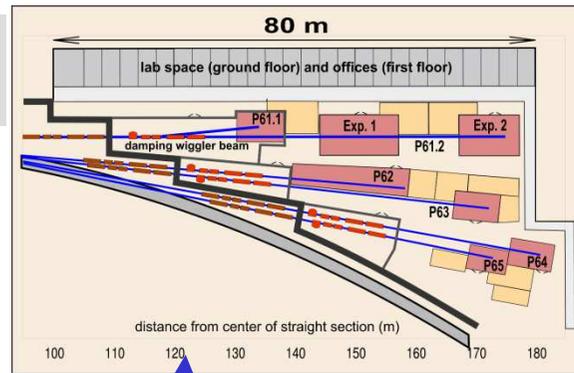


PETRA Extension 2014

Hall North

North

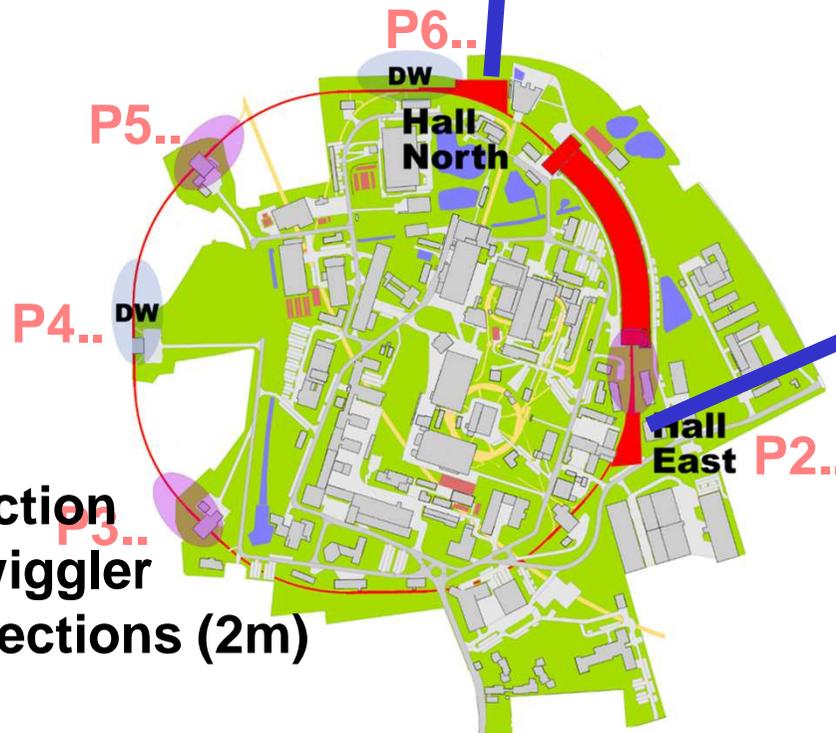
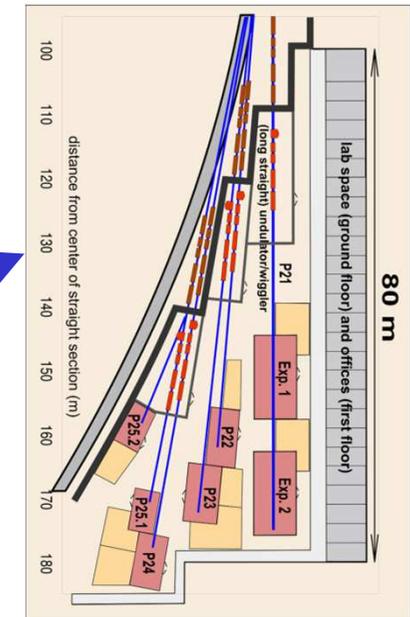
- o Damping wiggler section (existing)
- o 4 new straight sections (2m) in the arc



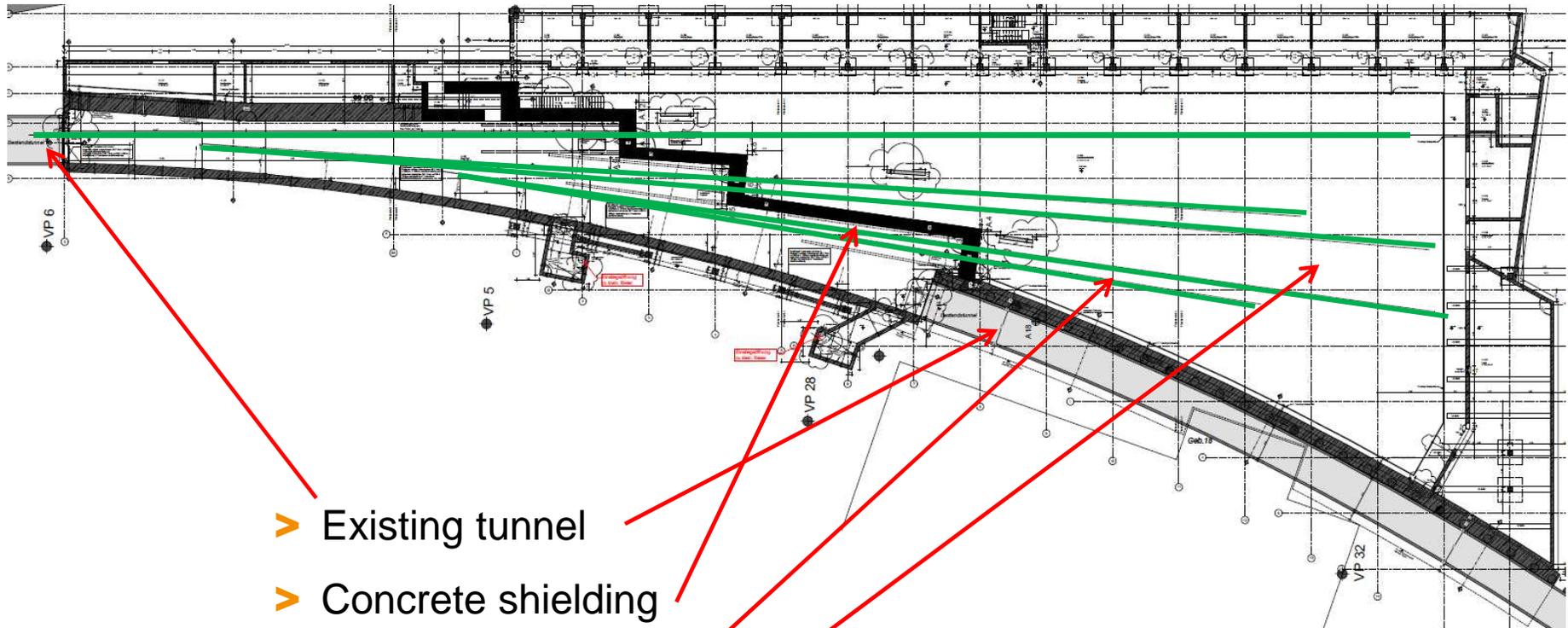
Hall East

East

- o long straight section for undulator / wiggler
- o 4 new straight sections (2m) in the arc



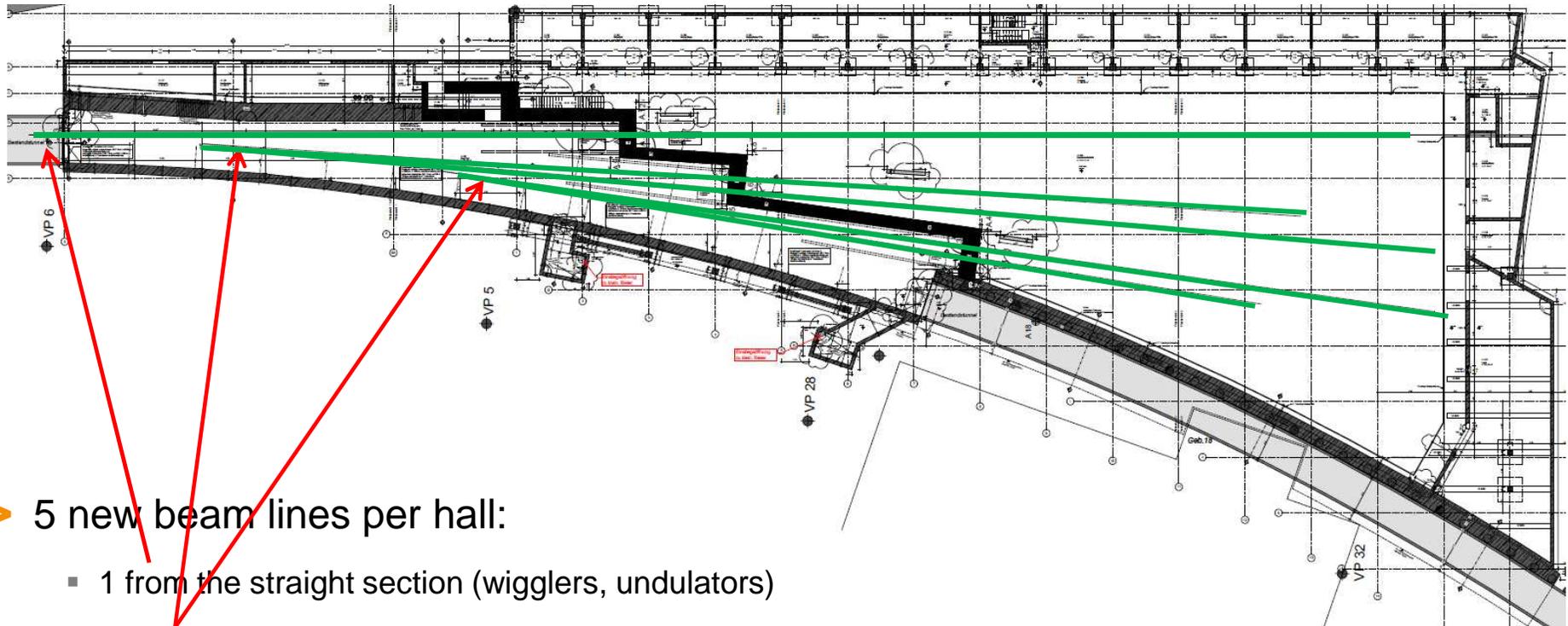
PETRA Extension 2014



- Existing tunnel
- Concrete shielding
- Photon beam lines
- Experimental floor



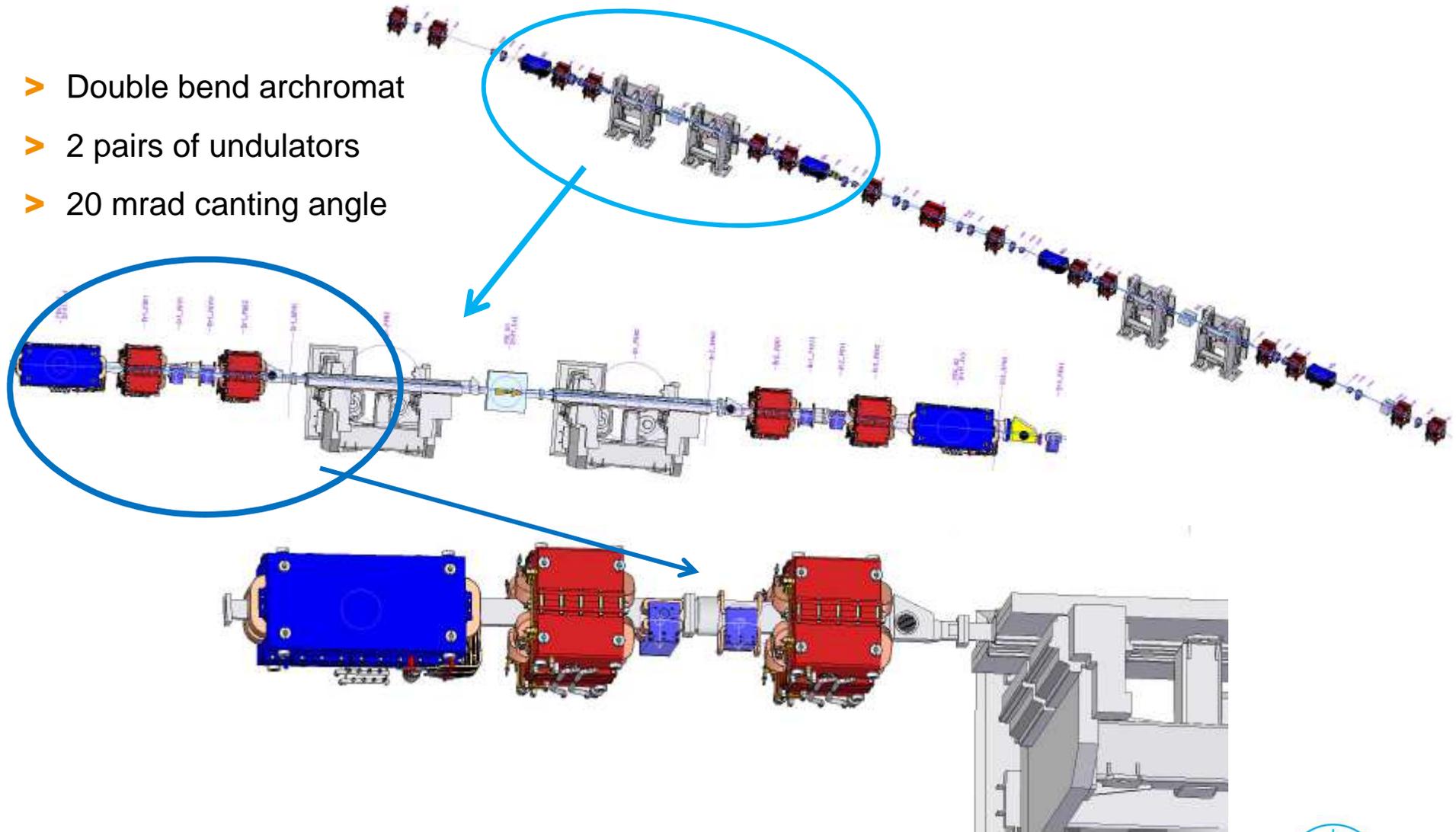
PETRA Extension 2014



- 5 new beam lines per hall:
 - 1 from the straight section (wigglers, undulators)
 - 2 pairs of undulators in the new arc

PETRA Extension 2014

- Double bend archromat
- 2 pairs of undulators
- 20 mrad canting angle



Civil Construction

PETRA operation ended on Febr. 3, 2014. From than on 4 weeks were foreseen to empty 200 m tunnel. Due to a great effort of many people this was accomplished in less than 3 weeks.



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Civil Construction

Dismantling of the old tunnel began 1-2 weeks ahead of schedule.



Civil Construction

Due to good weather conditions (no hard frost, hardly any rain) both construction sites were very well on schedule.



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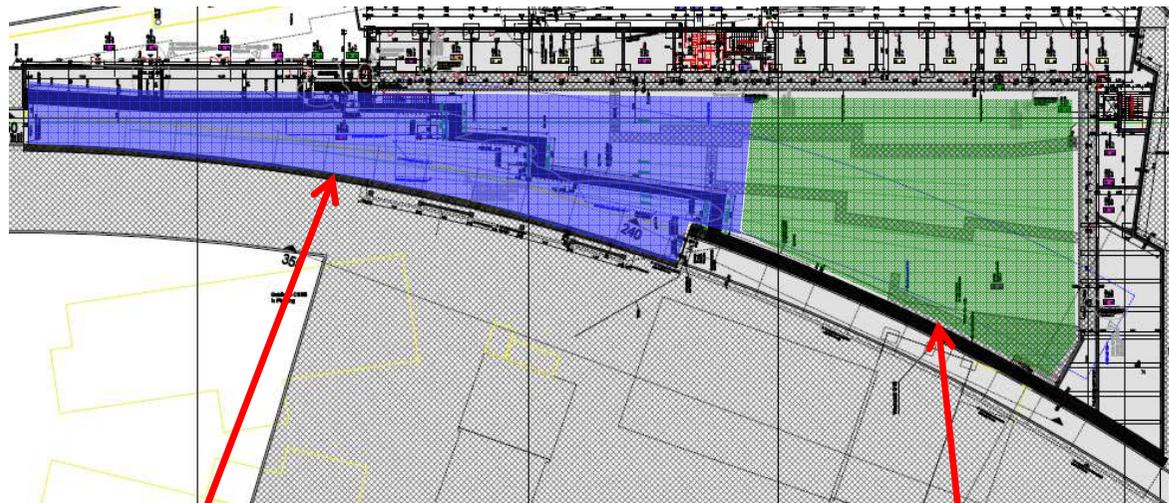
Civil Construction



Concrete slabs (part 1) were poured on April 29th 2014



Civil Construction



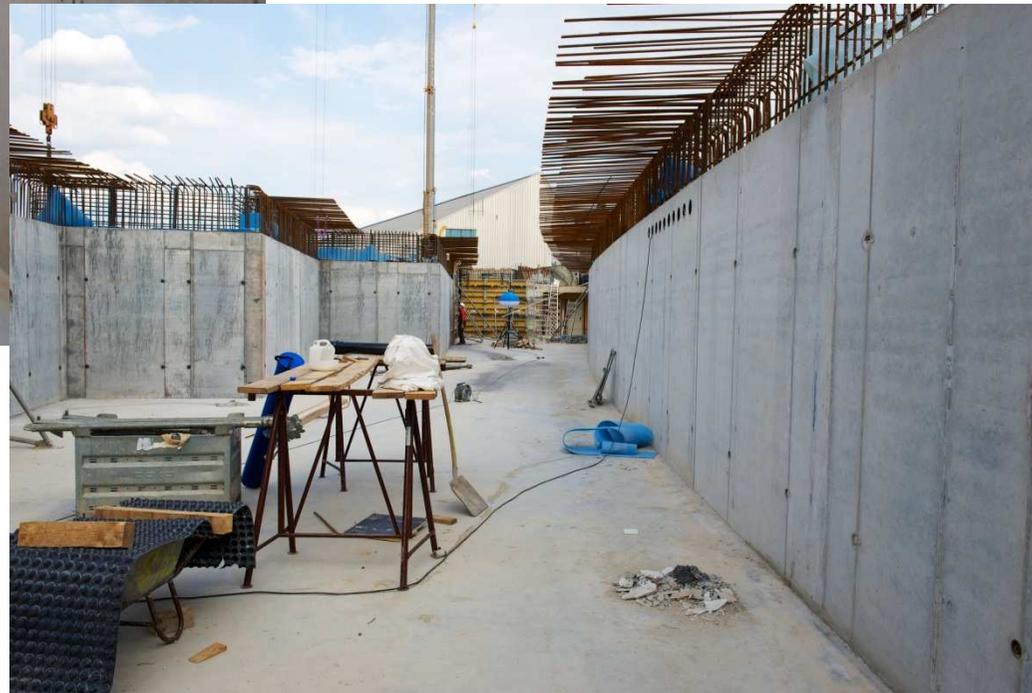
Slab, part 1,
supporting
the tunnel

Slab, part 2,
supporting most
of the hutches

Civil Construction



Tunnel walls under construction



Civil Construction



Tunnel walls under construction



Civil Construction



Tunnel roof under construction



Civil Construction



Tunnel North taken over by DESY on July 30,
tunnel East taken over by DESY on Aug. 12,
both on time and within spec.

Civil Construction



The contracts included:

- Paint
- Light
- Front end cranes
- Some cable trays



Installation in the Tunnel

First work in the tunnel:

- Installation of survey points
- Survey
- Survey marks on the floor
- Holes in the floor
- Magnet supports
- Magnets



Installation in the Tunnel

Additional installations:

- Cable trays
- Signal cables
- Water, nitrogen, compr. air
- Safety installations



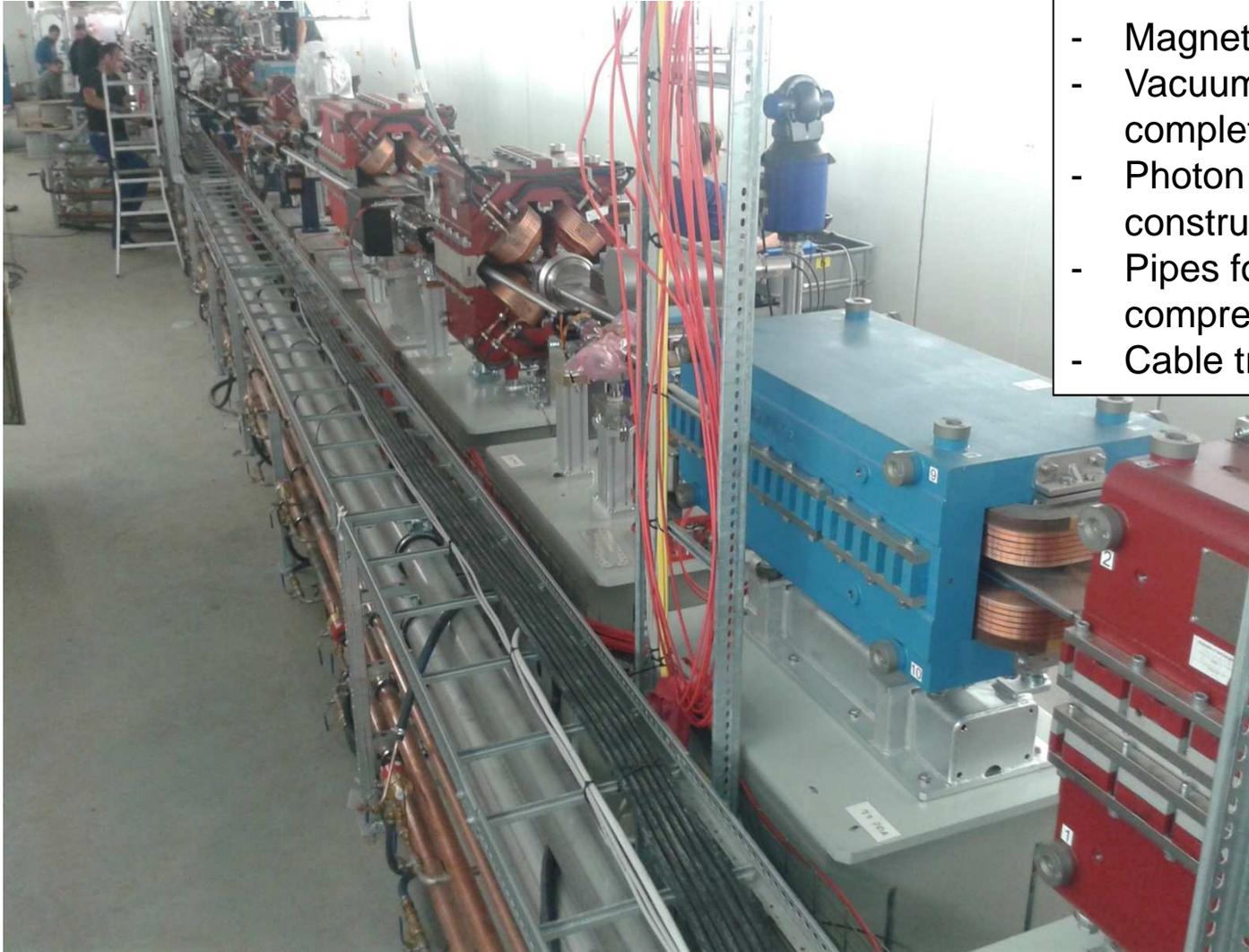
Installation in the Tunnel

Additional installations:
- Photon beam lines



Only 2 out of 10 new photon beam lines will be installed and operational in 2015.

Installation in the Tunnel



Recent status:

- Magnets completed
- Vacuum system almost completed
- Photon beam lines under construction
- Pipes for water, nitrogen, compressed air completed
- Cable trays completed

Installation in the Tunnel

Recent status:

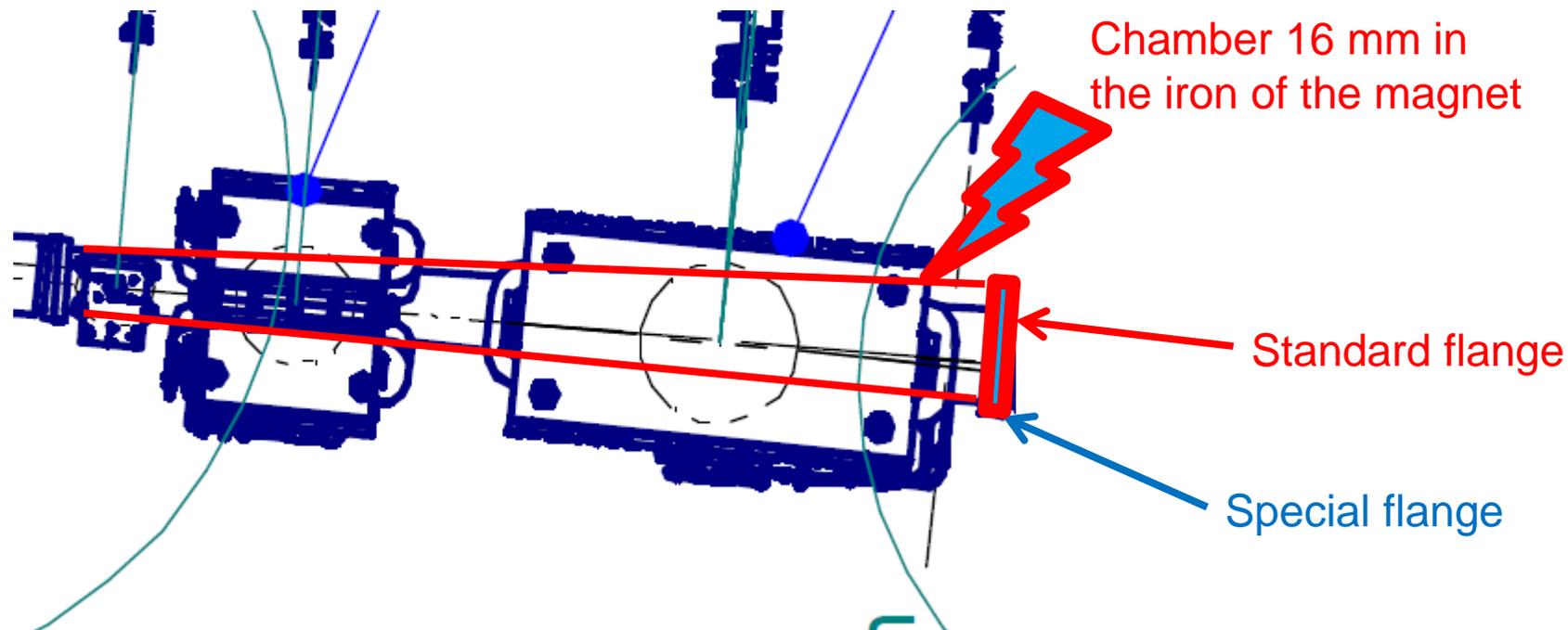
Missing:

- Many cables
- Undulator beam pipes
- Undulators



Potential Problems

Design of a vacuum chamber went wrong,
16 mm overlap between vacuum chamber and
dipole magnet.



Potential Problems

Design of a vacuum chamber went wrong,
16 mm overlap between vacuum chamber and
dipole magnet.



Solution:

In hall north:
Magnet moved outwards
by 16 mm to check the
rest of the vacuum
system.

Chamber for hall east
and spare chamber
have been modified.
Both chambers have
been installed.

Potential Problems

Design of a vacuum chamber went wrong,
16 mm overlap between vacuum chamber and
dipole magnet.



Potential Problems

Delivery of undulator beam pipes slow,
but still on time.
Need to be NEG coated afterwards,
but that is no problem.

Solution (if necessary):

Start with uncoated cambers where there are
no photon beam lines in the beginning.



Potential Problems

Magnet ring circuits (Dipole, main quadrupoles, sextupoles,...) are on bus bars in the old part of PETRA. They need to bypass the new halls outside the tunnel.

Landscaping outside the tunnel was delayed (due to installation of cooling water pipes). This delayed the cabling.



Potential Problems

Cabling outside the tunnel is under way now at hall North and will end up on schedule.
Hall East will follow soon, but is significantly delayed.



Potential Problems

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Potential Problems

For some magnet circuits the wrong type of cable was ordered .
Replacement not before December 2014.

Solution:

There are enough cables in house (XFEL) to finish hall North.

Hall East will follow in December and January (originally foreseen for power supply tests).

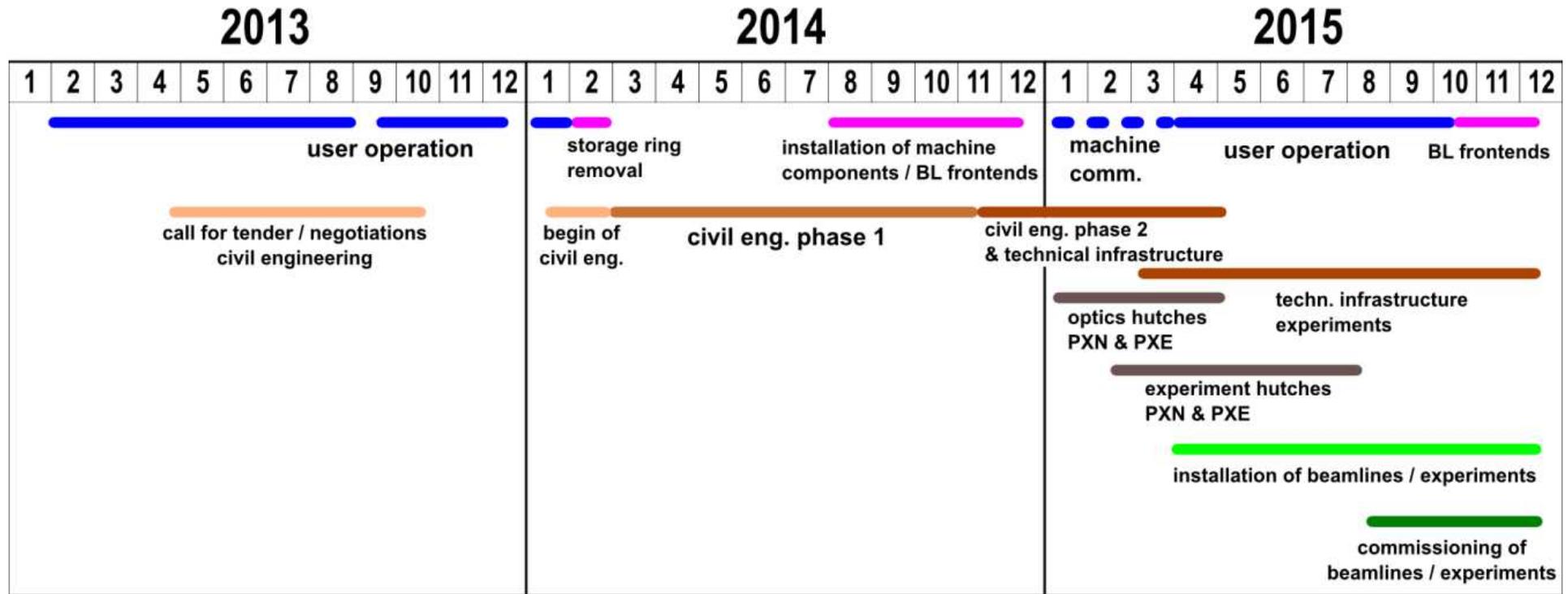


PETRA Project Schedule

- Beginning of shutdown Feb. 3, 2014 OK
- 1 month to clear the tunnel OK
- 5 month to dismantle and rebuild the tunnel OK
- ~ 4.5 month to build up machine and front ends mostly on schedule (potential problems with vacuum and cabling)
- ~ 3.5 month commissioning
 - Interlock checks
 - Power supplies
 - Studies with beam
- User operation from end of March 2015 on



Project Schedule



One year between last beam and first beam.
 14 month break for internal users,
 15 month break for external users.
 18 month until the first new beam line is tuned up.



Project Schedule

2014

2015

	Juli		August		September		Oktober		November		Dezember		Januar		Februar
	PXN	PXE	PXN	PXE	PXN	PXE	PXN	PXE	PXN	PXE	PXN	PXE	Maschine	Exp	
1															
2						Wasser					Netzgeräte		1		
3						Verm. Fertig							2	Netzgeräte	Polaritäten-
4						Aufbau Sokel							3		Tests,
5													4		Ringkreise,
6			Vermessung										5	Netzgeräte	Etc.
7			MEA2										6	NORD/OST	
8							Aufbau		Vakuum fert.				7		
9					Wall fertig		Beamlines				Netzgeräte		8		
10						Aufbau Mag.							9		Inbetriebnahme
11								Wasser fertig	Vakuum				10		Strahl
12					Mag. fertig				justieren			Fertig	11		
13				Übergabe								Netzgeräte	12	Netzgeräte	
14				PXE									13	NORD/OST	
15						MVS					Interlockprüfung		14		
16						Vakuum					Maschine		15		
17						Magnetkabel							16		MDT
18			Wasser										17		MDT
19			Verm. Fertig	Vermessung									18		MDT
20			Aufbau Sokel	MEA2			Vakuum						19	Netzgeräte	Interlock-
21							Beamlines	Aufbau	Vakuum fert.				20	NORD/OST	Prüfung
22							Beamlines				Netzgeräte	Netzgeräte	21		Experimente
23													22		
24										Vakuum			23		MDT
25						Mag. fertig			justieren			Weihnacht	24		MDT
26			Aufbau Mag.		Wasser fertig								25		MDT
27								Vakuum	Fertig				26	Netzgeräte	MDT
28								Beamlines	Netzgeräte				27	NORD/OST	MDT
29						MVS							28		
30	PXN					Vakuum				1. Advent			29		
31													30		
													31		



Project Schedule

2014

2015

Dezember			Januar	Februar	März	April	Mai	Juni		Juli	Aug.	Sep.	Okt.	Nov.
PXN	PXE		Maschine	Exp										
Netzgeräte	Vakuum	1				MDT	01. Mai		1	Service				
	justieren	2	Netzgeräte		Polaritäten	MDT			2	Week		MDT		Front
		3			Tests,	MDT		MDT	3					End
		4			Ringkreise,	MDT			4					
		5	Netzgeräte		Etc.	MDT	Ostern		5		MDT		Service	
		6	NORD/OST			MDT		MDT	6	MDT			Days	
Netzgeräte		7				MDT			7	MDT			MDT	
		8				MDT			8	MDT				
		9		Inbetriebnahme	MDT				9	MDT		MDT		
		10		Strahl	MDT			MDT	10	MDT				
	Fertig	11			MDT				11	MDT				
	Netzgeräte	12	Netzgeräte		MDT				12		MDT			
		13	NORD/OST		MDT	Service	MDT		13					
		14				Week	Himmelfahrt		14				MDT	
	Interlockprüfung	15							15	MDT				
	Maschine	16			MDT	MDT	Vakuum		16			MDT		
		17			MDT	MDT			17					
		18			MDT	MDT			18					
		19	Netzgeräte	Interlock-	MDT	MDT			19		MDT			
		20	NORD/OST	prüfung	MDT	MDT		MDT	20					
		21		Experimente	MDT				21				MDT	
Netzgeräte	Netzgeräte	22					MDT		22	MDT				
		23			MDT	Beam			23			MDT		
		24			MDT	Line		Pfingsten	MDT	24		Service		
	Weihnacht	25			MDT	Set-up			25		Week			
		26	Netzgeräte		MDT			Service	26					
		27	NORD/OST		MDT		External	Week	27					
		28			MDT		Users		28				MDT	
		29					MDT		Service	29	MDT			
		30						Week	30			MDT		
		31							31					

Commissioning w/o beam
Break
Machine Developm. Time
User operation
Sunday



Lessons Learned (mostly common wisdom)

- > See 'Potential Problems'
- > Safety systems and communication will be down!
 - dismantle them last minute
 - put them in first
- > Divide strictly between areas of civil engineering and areas where lab personal is working
- > Dismantling: Offer containers for
 - Radioactive iron, copper, beam pipes, screws and bolts,...
 - Potentially radioactive ...
 - Scrap
- > Survey these containers frequently
- > Install a very sensitive dosimeter at the truck exit



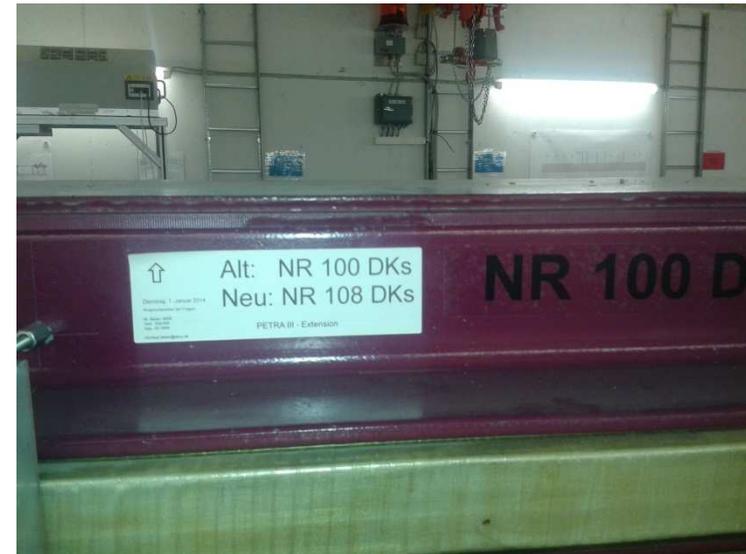
Lessons Learned

- > If it is an extension project:
 - Keep the interruption for the 'old' beam lines short
 - Only very few photon beam line components in the tunnel for early electron beam commissioning
- > Buy simple infrastructure from the general contractor
 - White walls
 - Light
 - Cable trays
- > Divide contracts between two construction companies
 - Competition helps a lot to keep them on schedule



Lessons Learned

- > Magnets that go out and back in get
 - a label with 'old place' and 'new place'
 - a labeled bucket for all the bolts and nuts.
- > Same for Magnet Supports, Cavities, ...
- > Don't underestimate cabling
 - Everybody orders his cables last minute
 - Cable vendors don't deliver on time
 - There will be a lack of cables and a lack of personal
 - Cabling has to be checked carefully
- > Hot check out:
Only where necessary for component safety
(Magnets, power supplies,...) or where it does not cost
commissioning time (polarity checks during 24 hour tests).
The beam will find the rest much faster.



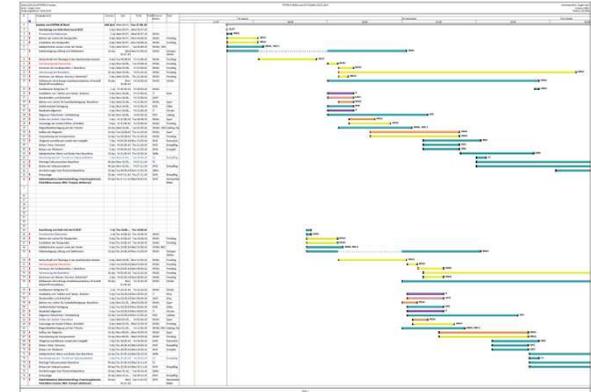
Lessons Learned

- > Don't do such a project in parallel with two other projects (XFEL, FLASH2) and with the lowest priority of these three projects (unless you can ONLY get the money NOW)
- > For a project of this size and priority: Keep the overhead for project planning (reviews, status reports, readiness reviews,...) as small as possible.
- > Let your experienced work package leaders just do their work, trust them! (... and supervise the usual suspects...)
- > Give the work package leaders an informal way to announce problems.



Lessons Learned

- > Write a detailed schedule (in case someone asks for one), but don't follow it in detail
- > Rely on your experienced work package leaders, trust them! (... and supervise the usual suspects...)
- > A biweekly project meeting in the preparation phase is enough
- > During installation one daily meeting in the tunnel is enough
 - 8:30 in the morning, 5 – 10 minutes
 - The real workforce is present
 - Most problems can be solved ad hoc
- > One unofficial meeting at the end will make the next project go even easier



The End

> Thank you for your attention!

