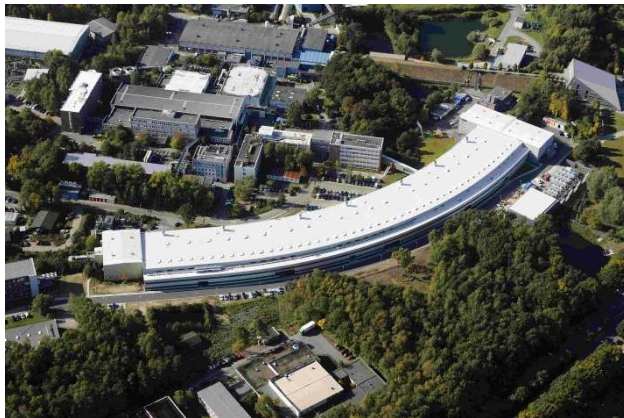


# PETRA III Status Report 2014.

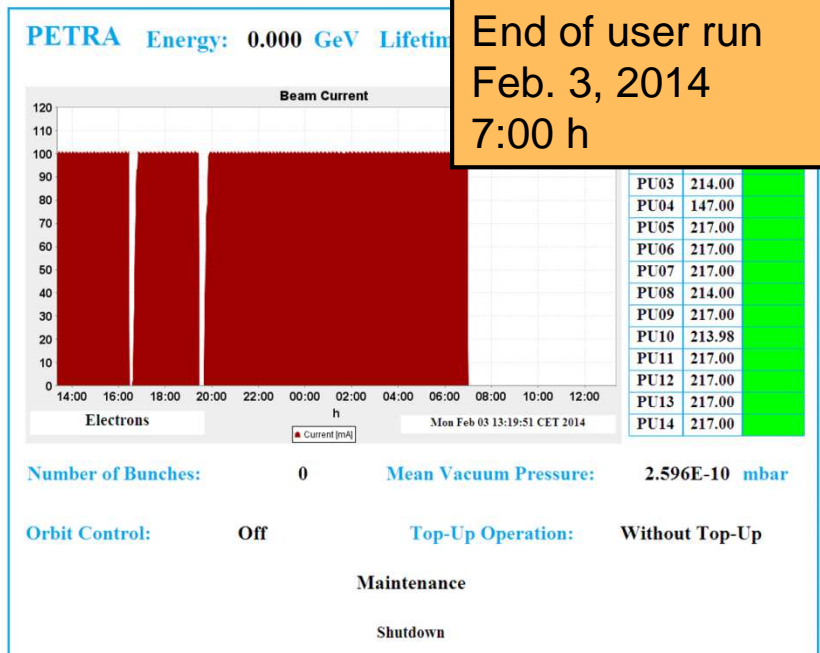
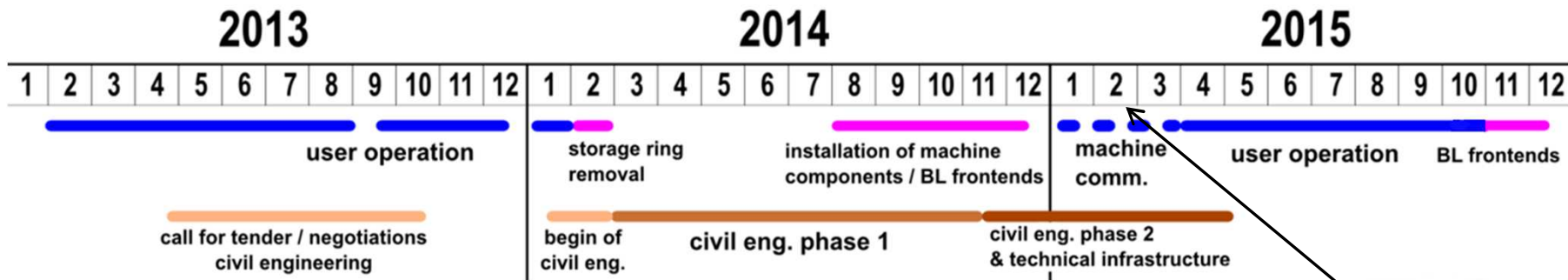
- Overview
- User Run 2013/14
- Radiation Damage at Insertion Devices
- Status of the Extension Project



**Rainer Wanzenberg**  
**MPE - DESY**

XXII European Synchrotron Light Source  
Workshop, Grenoble  
**Nov 25/26, 2014**

# Overview



End of user run  
Feb. 3, 2014  
7:00 h



Shut down (~ 1 year)  
PETRA Extension  
Project

Restart  
with beam  
Feb. 2015



# Overview (cont.)

10 New Beamlines

PETRA III: 14 + 10 = 24 Beamlines

2 New Halls

North:

Damping Wiggler straight

4 x new straight sections (2 m)  
(2 DBA cells in the arc)

East:

Long straight section  
2 Insertion devices

4 x new straight sections (2 m)  
(2 DBA cells in the arc)



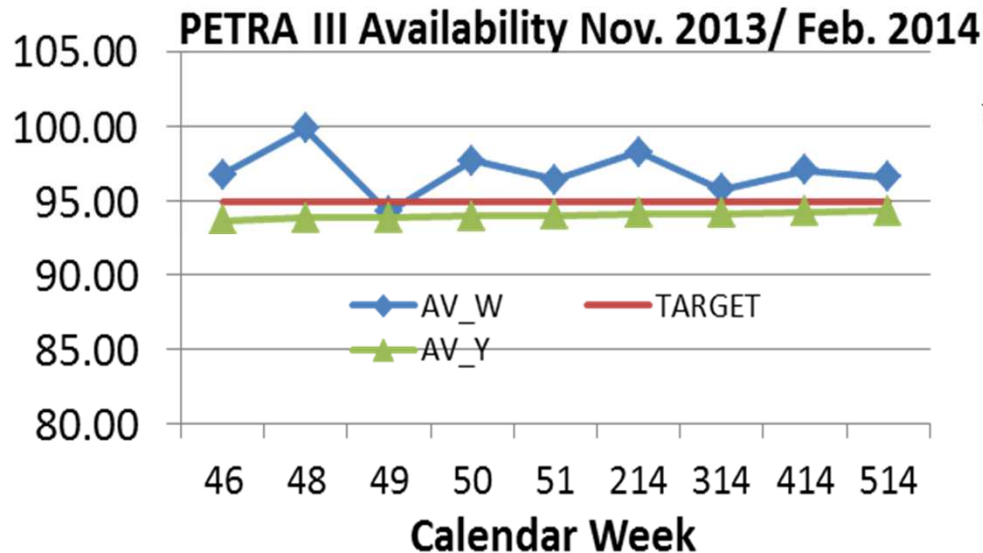
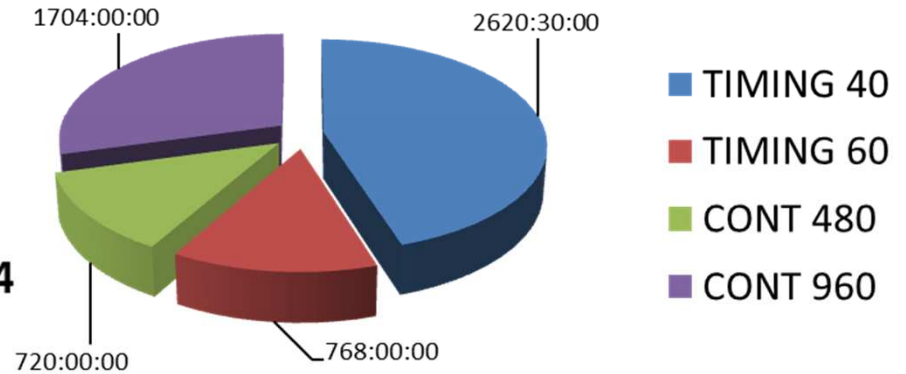
# PETRA III – User Run 2013/14

User Run 2013/14

Scheduled time 5812 h (**58.3 % Timing**)

Availability 94,3 % (2013/14)

## DISTRIBUTION OF OPERATION MODES 2013/14



**October 2013:**  
**40 bunches, 100 mA**  
**bunch spacing 192 ns**  
**bunch charge 19 nC**  
**1.2 10<sup>11</sup> e-**

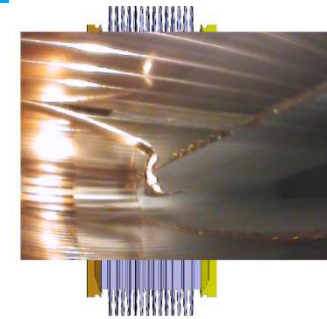
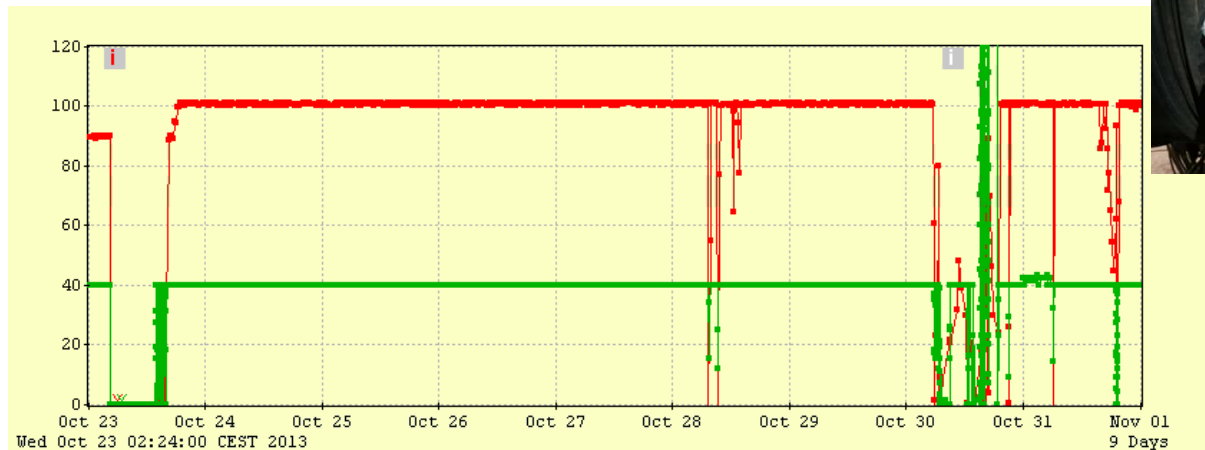


# Timing Mode with 40 bunches and 100 mA

**Limitation of the total beam current to 80 mA in the 40 bunch mode until Oct. 2013**

- Problems with bellows in the undulator section, solved July 2013
- Temperature problems at Feedback Cavities (Circulators, Absorbers) solved
- Problems with rf diagnostic window, solved Sept. 2013 (additional rf shielding)

**First full week of user operation: 40 bunches, 100 mA Oct 24 – Oct 30, 2013**



2011:  
damaged  
rf finger



2013:  
damaged  
window



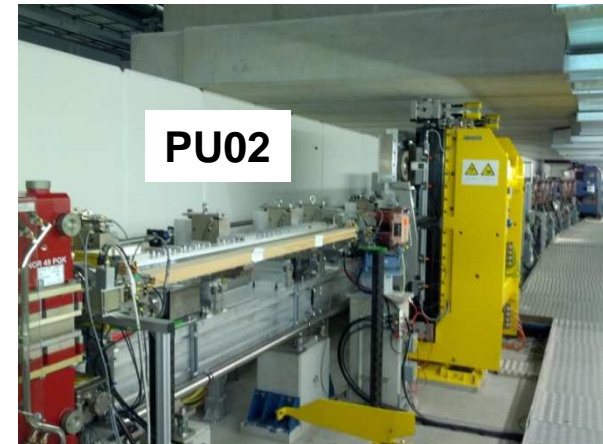
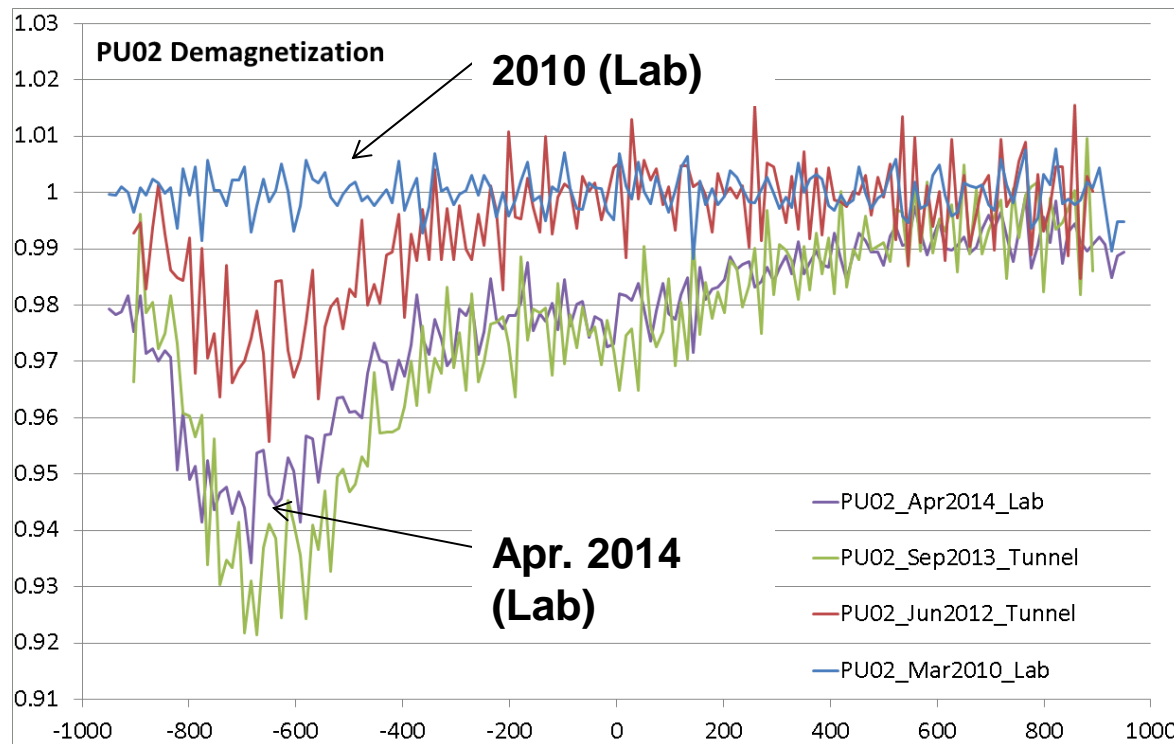
window  
with new  
HOM  
shielding



# Radiation Damage of Insertion Devices

- Degradation of the field quality at several undulators were observed (2 m long devices: PU02, PU03, PU08, PU12, 5 m long devices: PU01a, PU01b, PU10)
- Undulator PU02 and PU08 were removed from the tunnel
  - The degradation of the field quality was confirmed in laboratory measurements
  - The device will be refurbished

P. Vagin et al.  
RADIATION DAMAGE OF UNDULATORS AT PETRA III  
IPAC 2014, Dresden, Germany



~ 6 % demagnetization

# PETRA III: 14 Beamlines in the Max von Laue Hall

Number	ID Type	Energy range (keV)	Cell
P01	10 m U32 (2 x 5 m)	5 – 40	
P02	2 m U23	20 – 100	1
P03	2 m U29	8 – 25	1
P04	4 m U65 (APPLE)	0.2 – 3.0	2
P05	2 m U29	8 – 50	3
P06	2 m U32	2.4 – 50	3
P07 (option low beta)	4 m U19 (IV) (pres. 2m)	50 – 300	4
P08	2 m U29	5.4 – 30	5
P09	2 m U32	2.4 – 50	5
P10	5 m U29	4 – 25	6
P11	2 m U32	8 – 35	7
P12	2 m U29	4 - 20	7
P13	2 m U29	5 – 35	8
P14	2 m U29	5 - 35	8

Undulator PU02 and PU08 will be refurbished and reinstalled in Dec. 2014 and Jan. 2015



High $\beta_x$
Low $\beta_x$

High beta:  $\beta_x = 20$  m  $\beta_y = 4$  m

Low beta :  $\beta_x = 1.4$  m  $\beta_y = 4$  m

Max von Laue Hall: 14 beam lines

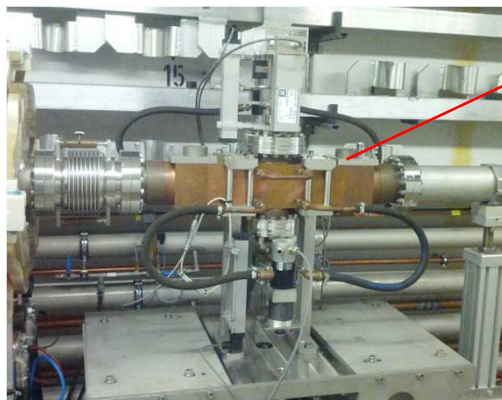
8 DBA cells ( length 23 m)



# Damping Wigglers and Collimators

- One Damping Wiggler was temporarily removed from the tunnel
  - The field quality was checked in the laboratory
  - No significant degradation was found (max. 0.3 %)

P. Vagin et al.  
IPAC 2014, Dresden, Germany



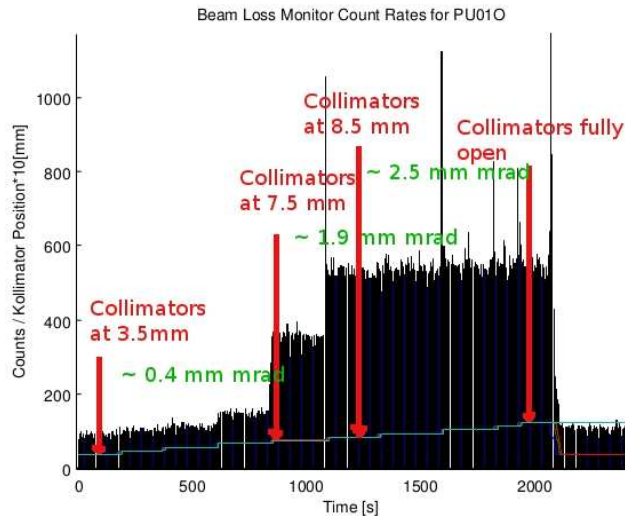
- It is planned to install two additional collimators in the hall North East using the same design as the presently installed collimators

- Presently two collimators are installed in the hall South West

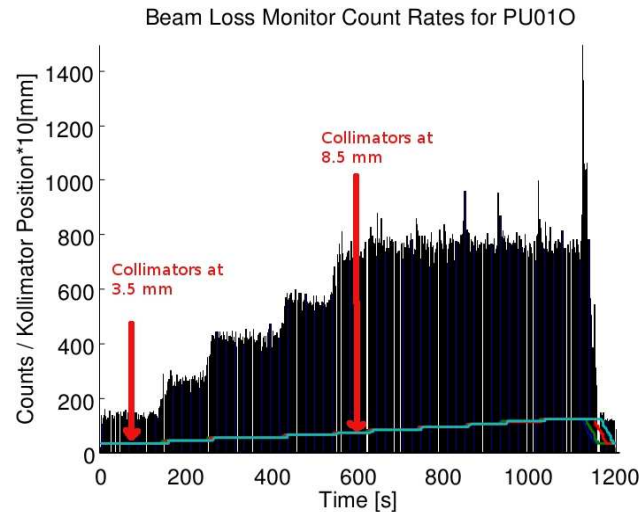


# Study of beam losses

- Loss detectors were installed at the insertion devices (PIN diodes)
- Measurement of the loss rate versus collimator settings
- Measurements with different filling patterns (40 bunches, 960 bunches)



**960 bunches, 100 mA**



**40 bunches, 50 mA**

**40 bunches:**

**Touschek**

**Lifetime**

**~ 2 h**

**Aperture of  
low gap devices**

**~ 2.5 mm rad**

- A region of constant count rates at narrow gap values of the collimators is not observed when PETRA III is operated with large single bunch currents.
- The count rate at large single bunch currents is considerably higher reflecting the low beam lifetime dominated by Touschek scattering

**Beam Dynamics Activities at PETRA III**

**Alexander Kling** and R.W.,

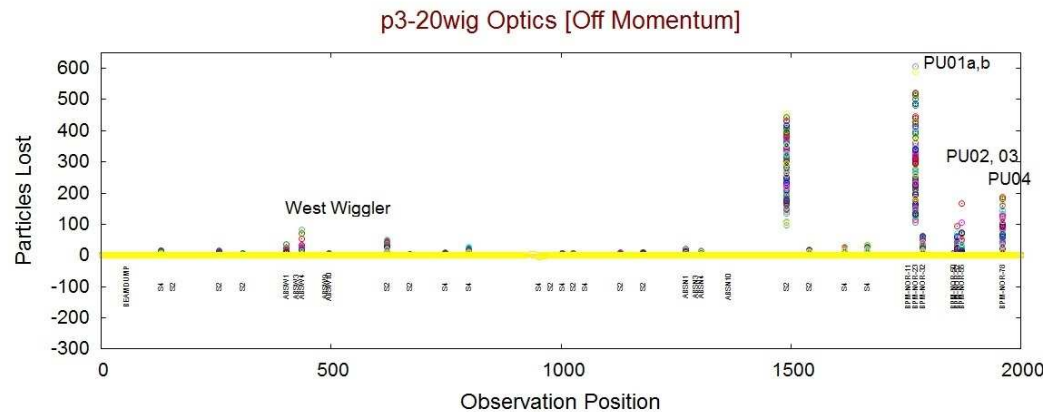
ICFA Beam Dynamics Newsletter No 62, Dec 2013



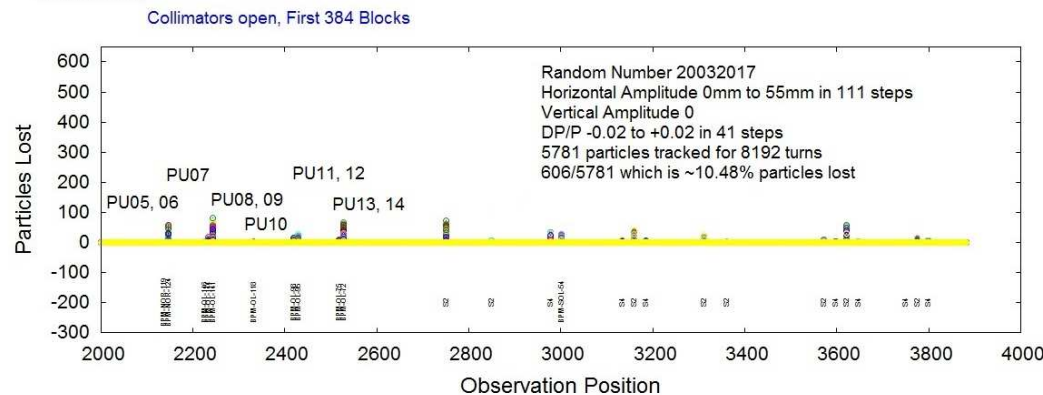
# Particle Tracking using Sixtrack

## Tracking studies with sixtrack:

- Collimators open (SW)
- Different initial conditions (horz. amplitude
- off momentum particles (-0.2 % ... +0.2 %)



30/10/2014 13:17



Devices with radiation damage:

PU01a, PU01b,  
**PU02**, PU03,  
**PU08**,  
 PU10,  
 PU12

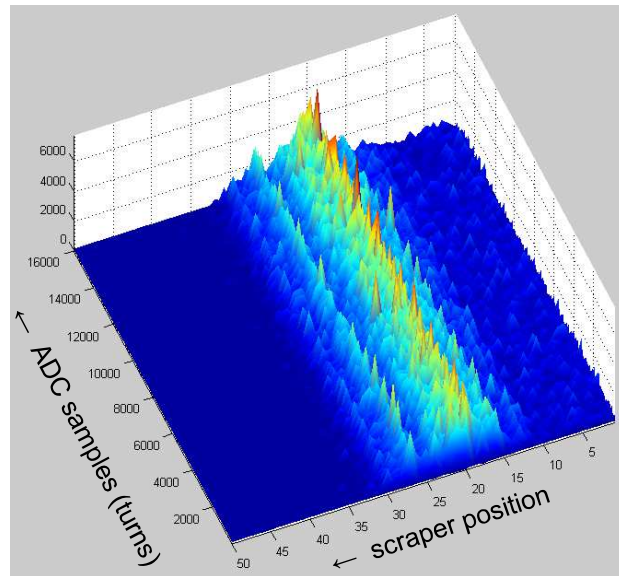
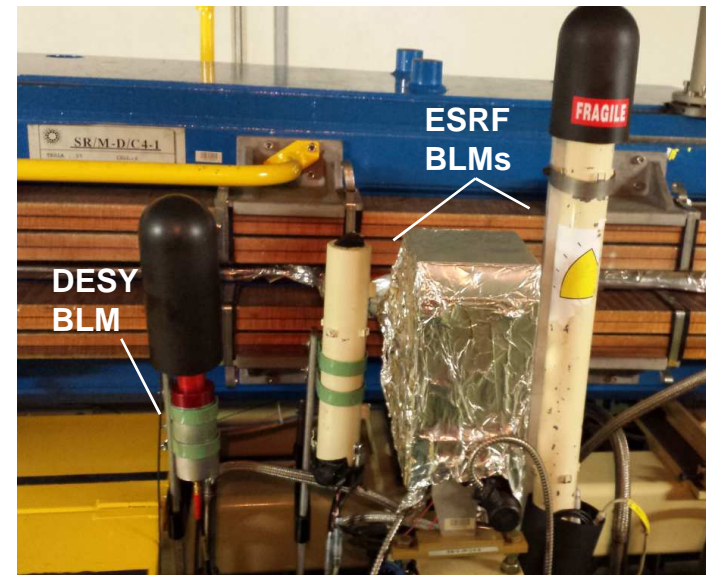
Further simulations are necessary, different effects:

- Dynamic aperture,
- momentum acceptance (+/- 1.5 %)
- Touschek scattering have to be differentiated in the simulations.



# Beam Loss Monitor Test at the ESRF

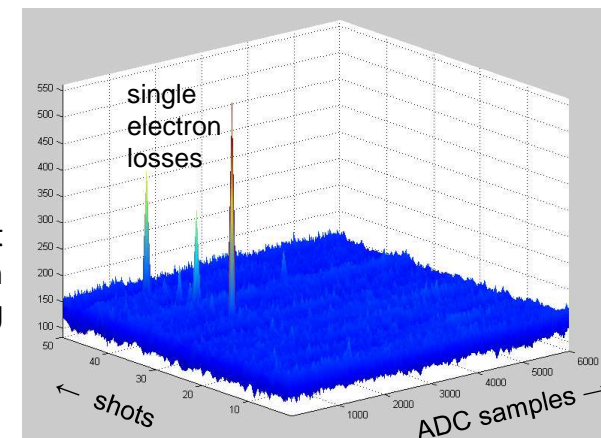
- Test of BLM at ESRF in October 2014
- Detector:  
Cherenkov radiator (SQ1 synthetic quartz)  
Photomultiplier (Hamamatsu R5900U)  
originally developed for the European-XFEL  
→ A. Kaukher et al., Proc. BIW2012, Newport News (VA, USA) , p.35
- installed 8-9 m behind injection point, 7 m behind horizontal scraper
- comparison with ESRF BLMs



16 bunch mode  
10 mA stored beam  
move internal scraper in

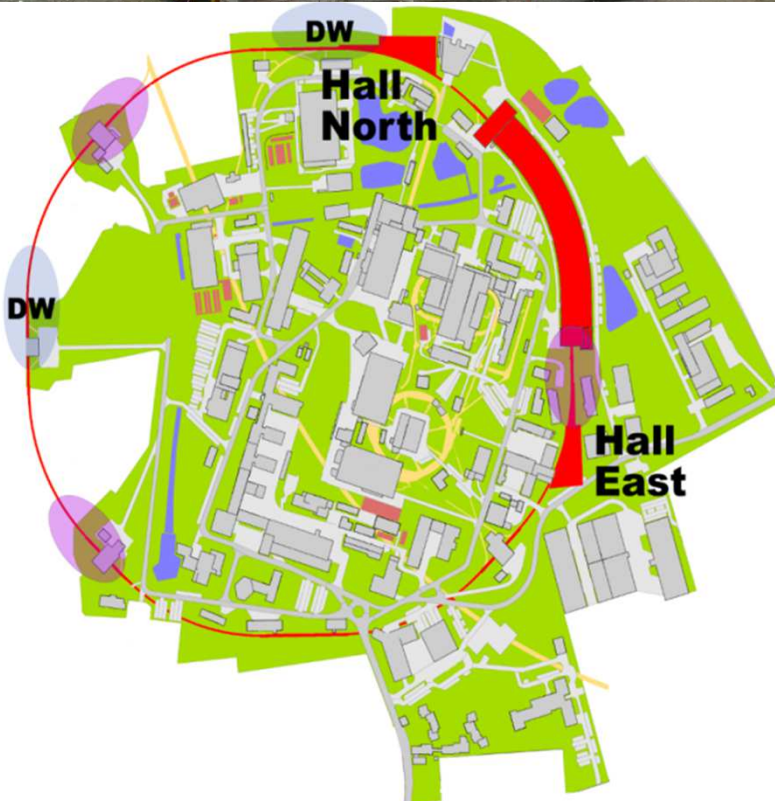
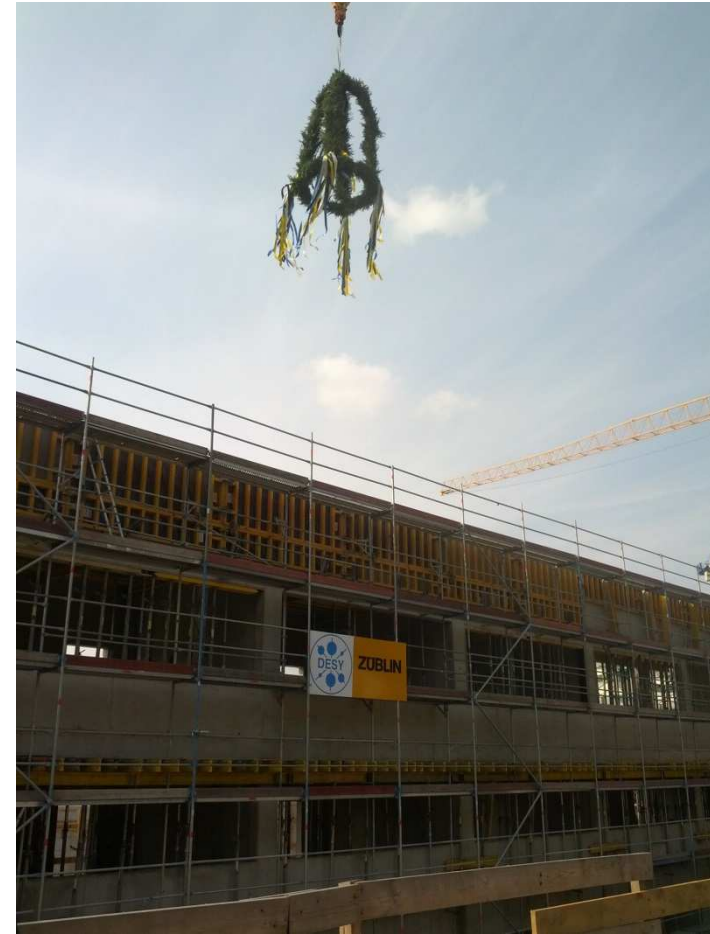
dark current  
injection  
in main ring

**Gero Kube (DESY)**  
**Kees Scheidt (ESRF)**





# Status of the PETRA III Extension Project



Sep 15, 2014  
topping-out ceremony





# Civil Construction

## Civil construction

- Concrete slabs (part 1) were poured on April 29, 2014
- Delivery of the tunnel building
  - ✓ North July 30, 2014
  - ✓ East Aug. 12, 2014on time and within specs



# Installation in the tunnel

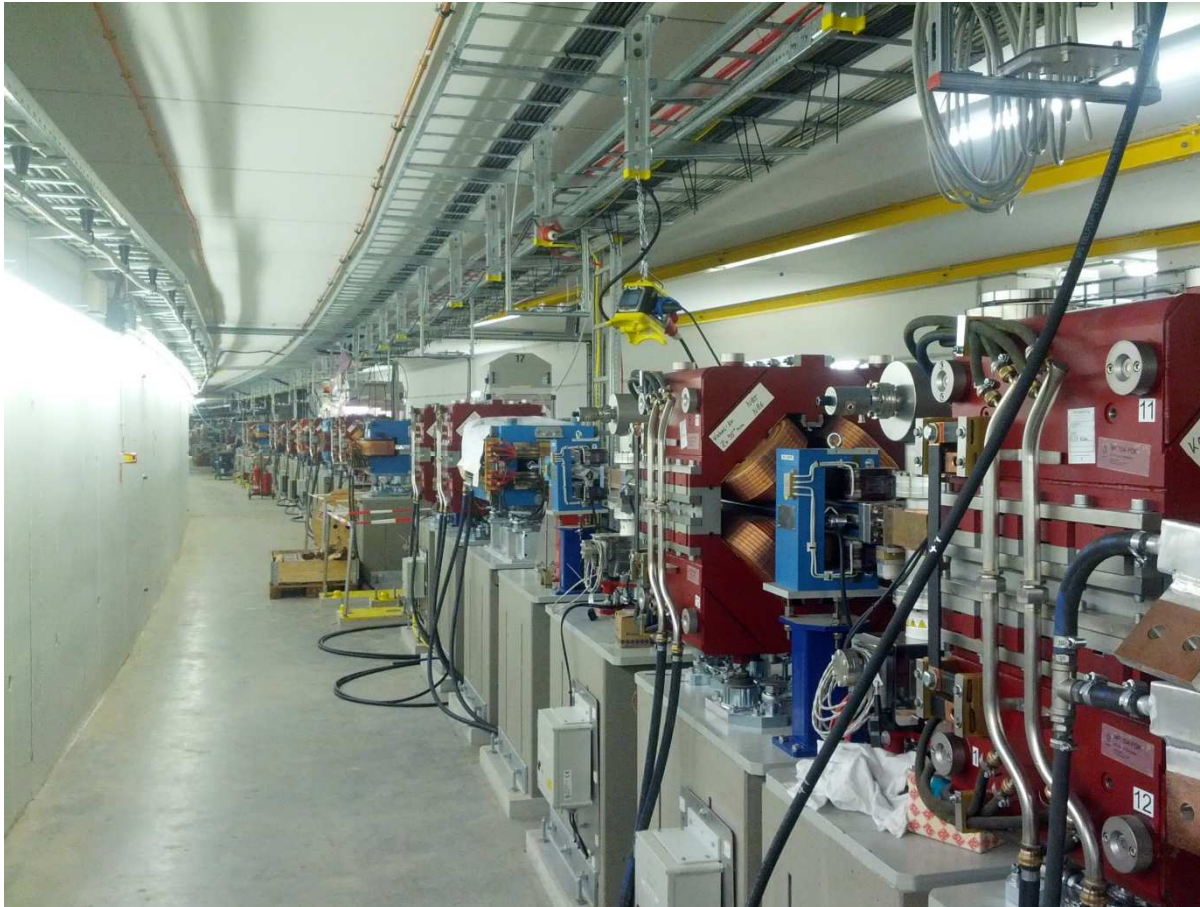
## Installation of infrastructure:

- Installation of survey marks
- Magnet foundations
- Cable trays
- Signal cables
- Water, nitrogen, compr. air
- Safety installations





# Installation in the tunnel (cont.)



**PETRA Extension North (Oct 29, 2014)**

## **Status Nov. 2014**

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

## **Missing:**

- **Undulator beam pipes**
- **Many cables (East)**
- **Undulators**

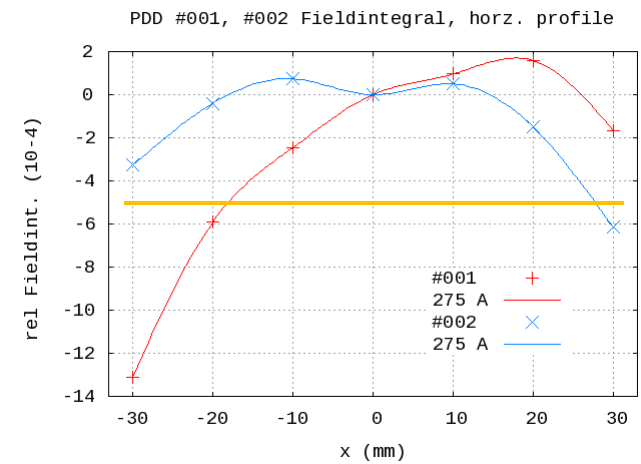
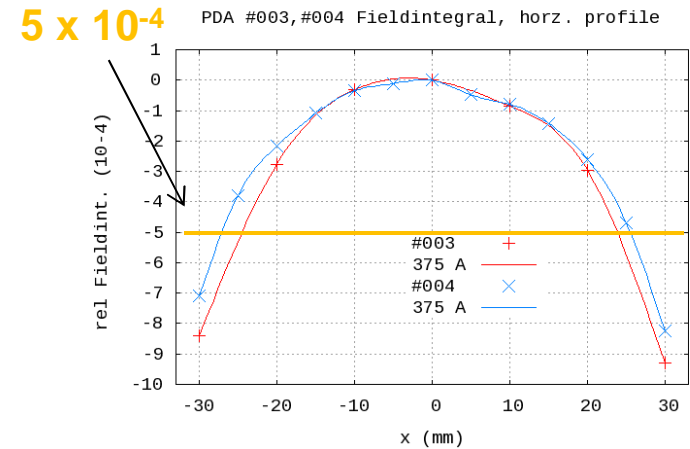
# Magnets

The Magnets are build, measured and certificated at Budker Institut, Novosibirks



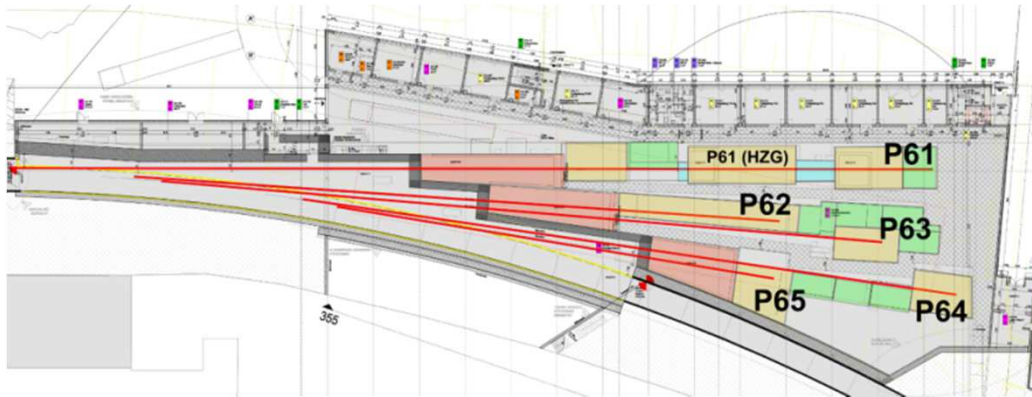
$$k \sim 10^{-3} \text{ 1/m}^2 \quad \Delta\beta/\beta \sim 1 \%$$

Field measurements at DESY (Y. Holler)





# Installation of photon beam lines



**Components for the photon beam lines are installed in the North and East.**

**It is foreseen to install initially two undulators**

**Two photon beam lines (P64/P65 in North) will be operational in 2015.**



# Installation outside the tunnel

**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.**

**Cabling outside the tunnel is under way in the North and will end up on schedule. The East site will follow soon, but is significantly delayed.**



# Recommissioning plan

- Dec. 2014, Reestablish all radiation safety installations, interlock test
- Jan. / Feb. 2015, Commission of the power supplies,  
Installation of missing cables, components (mainly East site)
- Feb. / March 2015, Commissioning with beam (6 weeks)
  - First turn steering, ... , Multibunch Feedback
  - Commissioning: new BPMs, Fast Orbit Feedback
  - Beam line set-up, first and foremost in the existing experimental hall
- April 2015, User Run
  - Internal users
  - External users are scheduled from April 27, 2015
  - Maintenances ~ 0.5 day / week, 4.5 weeks
  - Machine Development, ~ 0.5 day / week , 1 week in summer
- Nov. 2015, Winter shut down, further installations in the new exp. halls



# Acknowledgment

I would like to thank my colleagues from DESY  
Michael Bieler, Joachim Keil, Alexander Kling \*), Gero Kube,  
Gajendar Kumar Sahoo, N.N.,  
Markus Tischer, Pavel Vagin (FS-US), York Holler (MEA)

\*) now at University of Applied Sciences Osnabrück / Lingen





Thank you for your attention !

