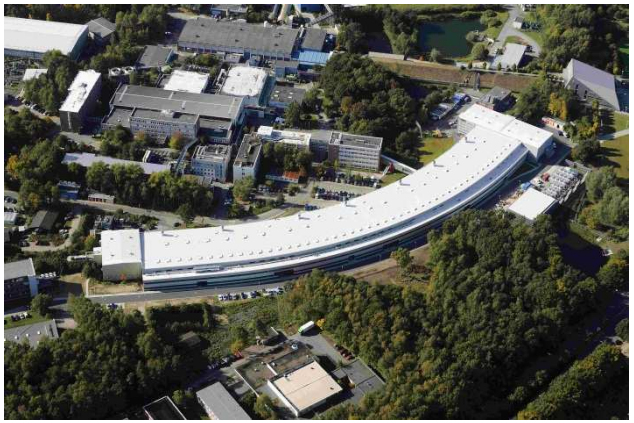
PETRA III Status Report 2014.

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



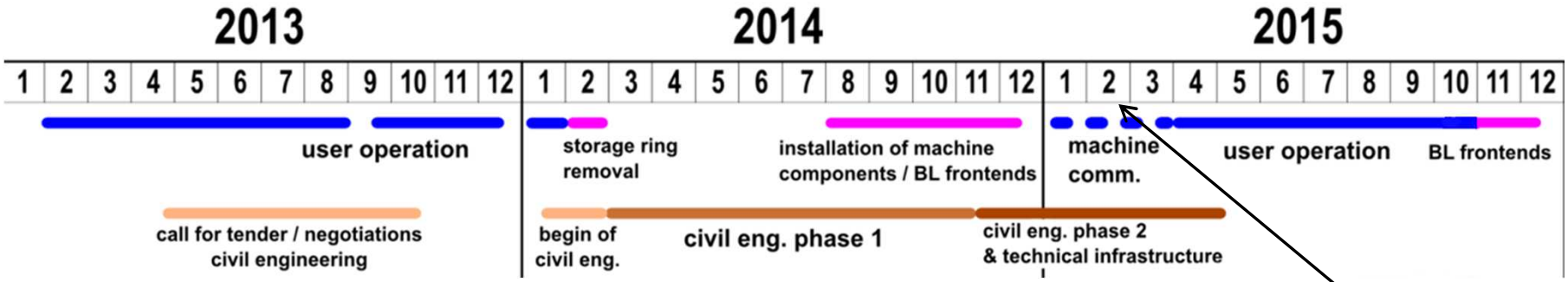
Rainer Wanzenberg
MPE - DESY

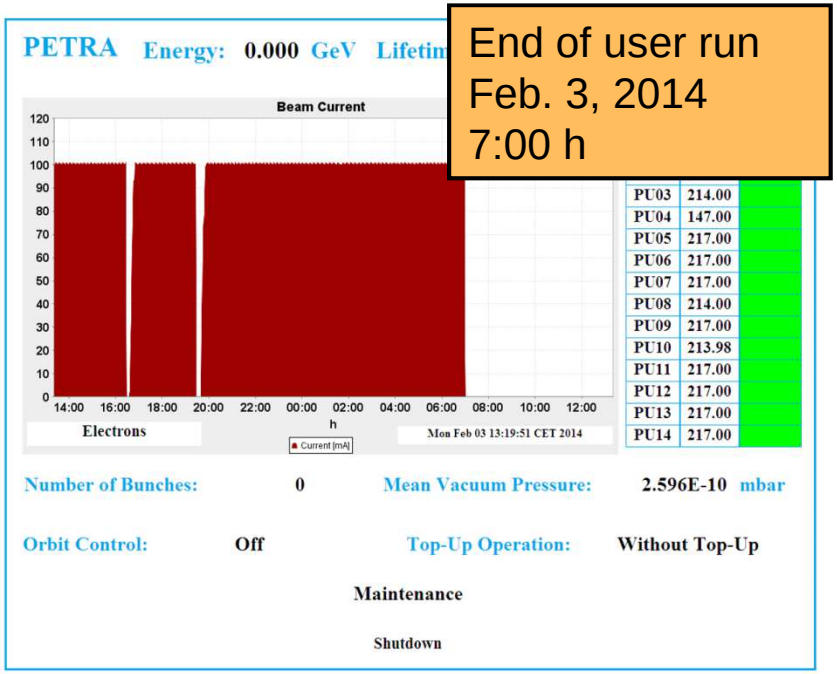
XXII European Synchrotron Light Source Workshop, Grenoble
Nov 25/26, 2014

HELMHOLTZ ASSOCIATION

DESY

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

2 New Halls

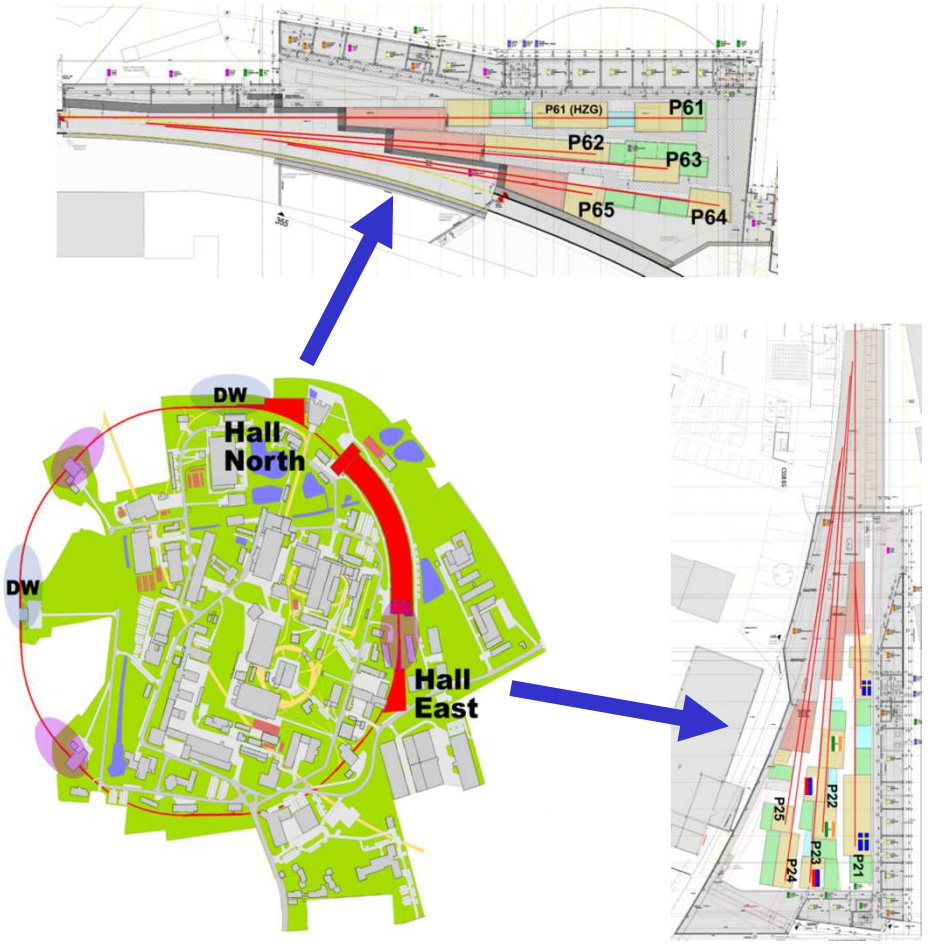
North:
Damping Wiggler straight

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

East:
Long straigth section
2 Insertion devices

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

PETRA III: 14 + 10 = 24 Beamlines

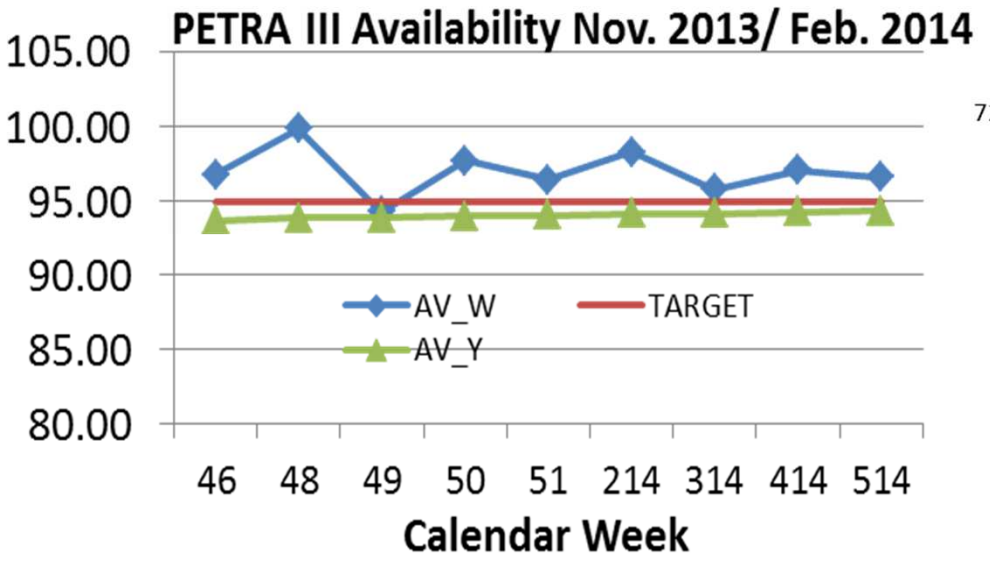


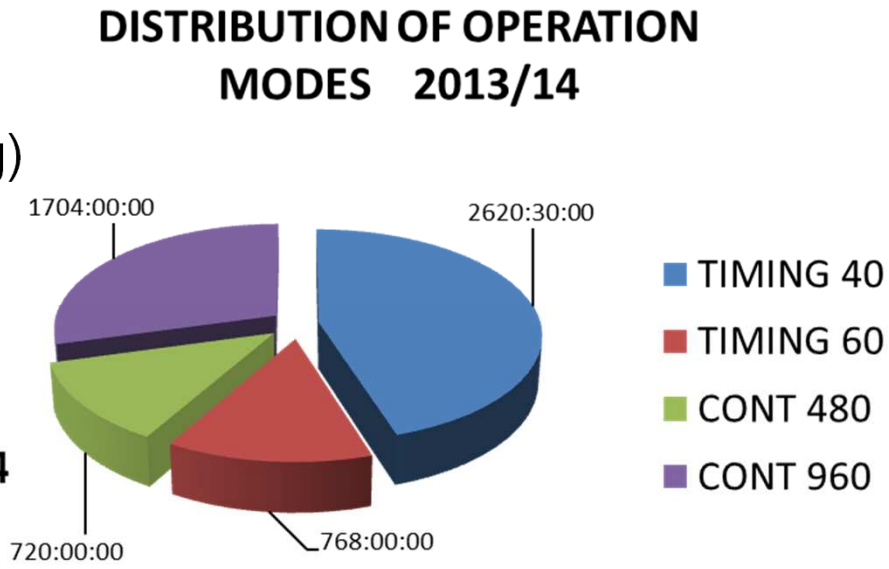
PETRA III – User Run 2013/14

User Run 2013/14

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

Availability 94,3 % (2013/14)





October 2013:

40 bunches, 100 mA

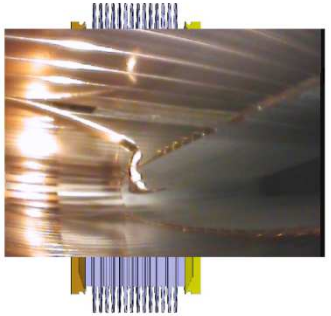
bunch spacing 192 ns

bunch charge 19 nC
$1.2\ 10^{11}$ 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
- Temprature problems at Feedback Cavities (Circulators, Absobers) solved
- Problems with rf diagnostic window, solved Sept. 2013 (additional rf shielding)

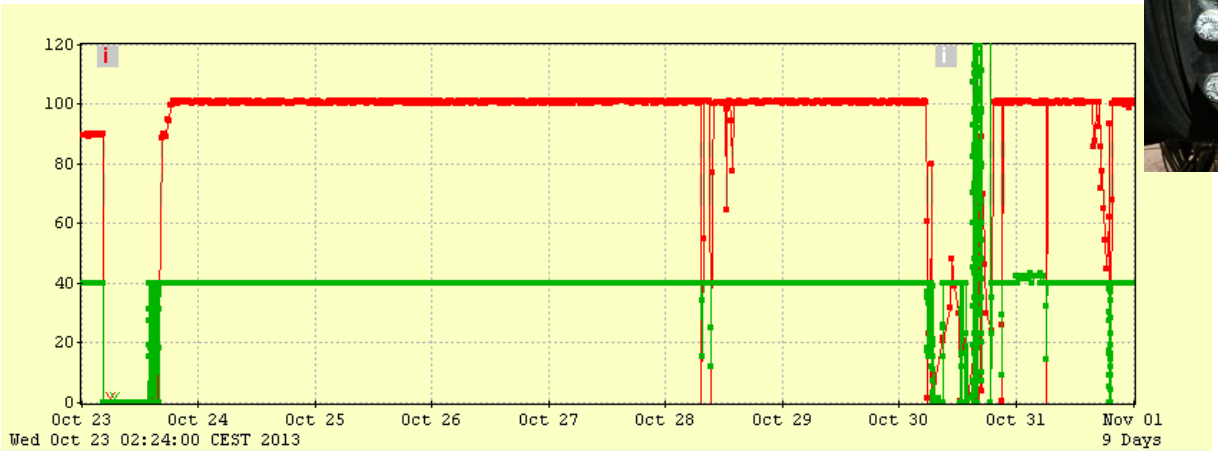


2011: damaged rf finger

2013: damaged window

window with new HOM shielding

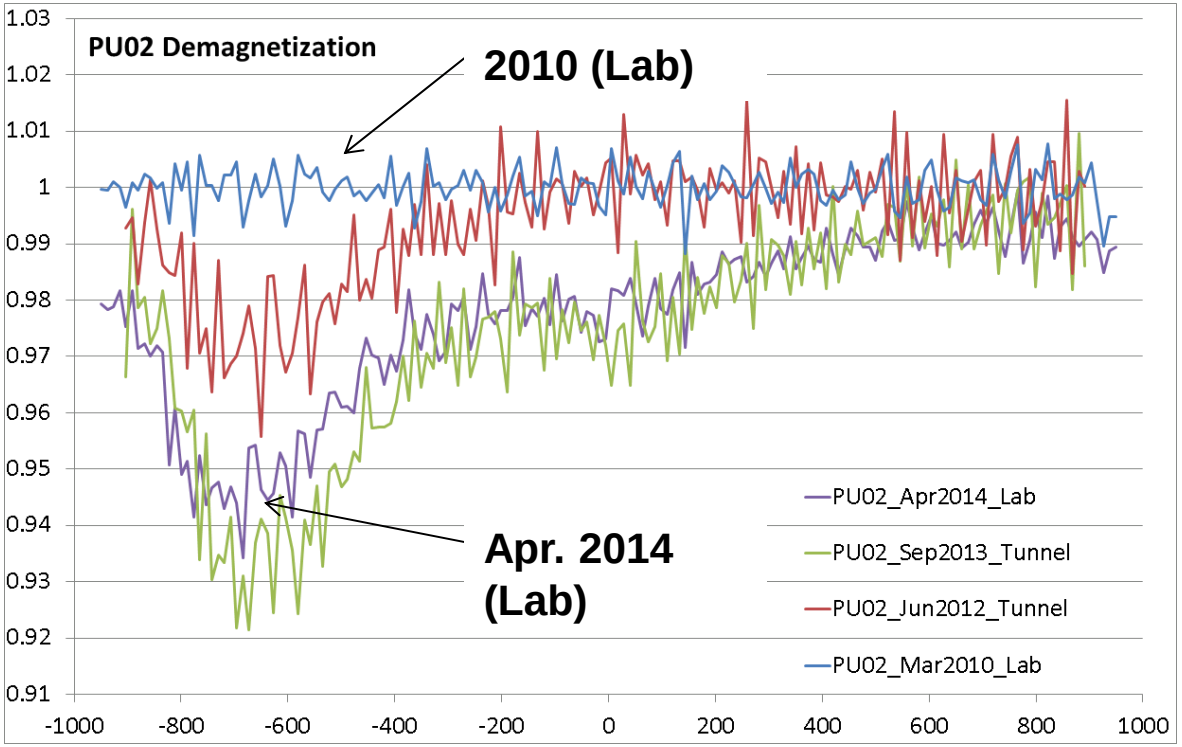
First full week of user operation: 40 bunches, 100 mA
Oct 24 – Oct 30, 2013

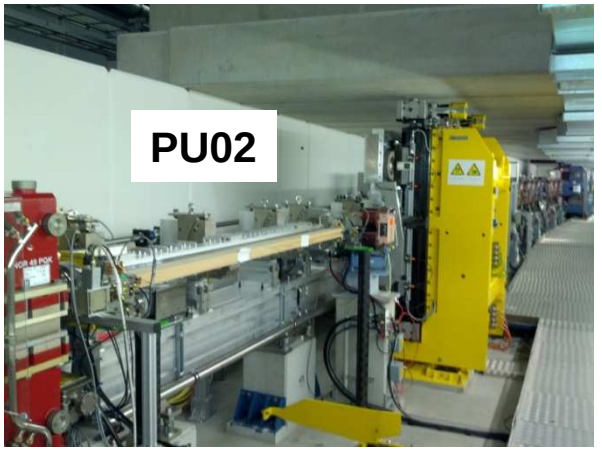


Radiation Damage of Insertion Devices

- 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





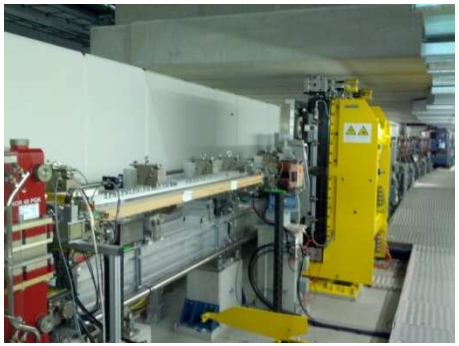
~ 6 % demagnetization

Markus Tischer, Pavel Vagin (FS-US)

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 β_x
Low β_x

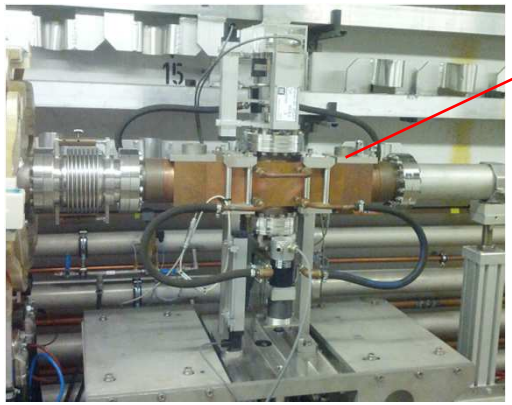
High beta: β_x = 20 m β_y = 4 m
Low beta : β_x = 1.4 m β_y = 4 m

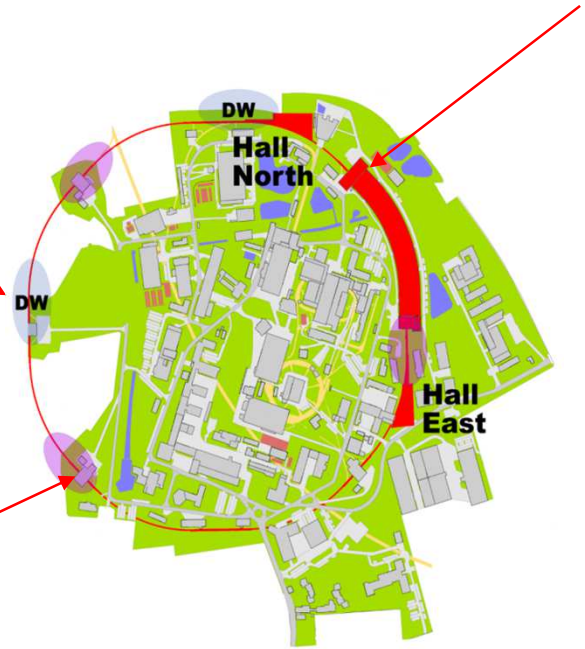
Max von Laue Hall: 14 beam lines
8 DBA cells (length 23 m)

Damping Wigglers and Collimators

- One Damping Wiggler was temporally 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



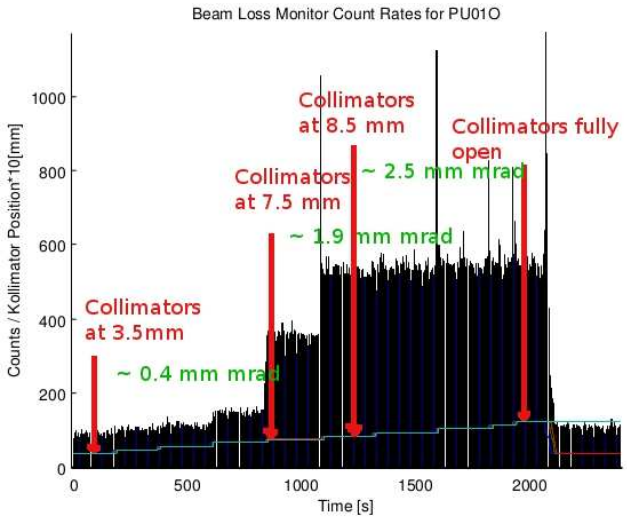


- It is planned to install two additional collimators in the hall North East using the same design as the presently installed collimators

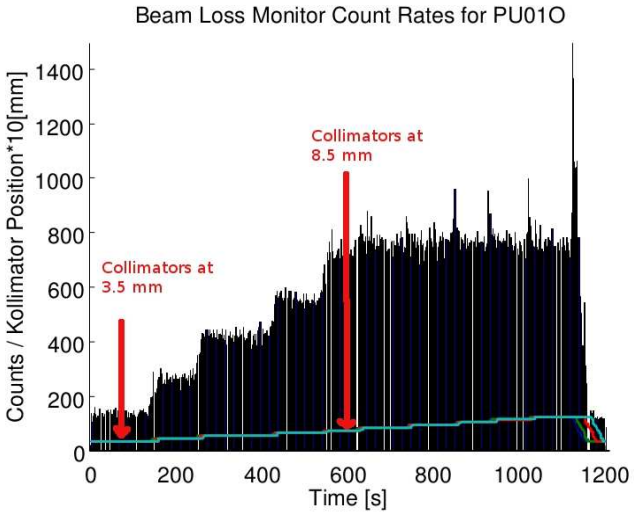
- Presently two collimators are installed in the hall South West

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 patters (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

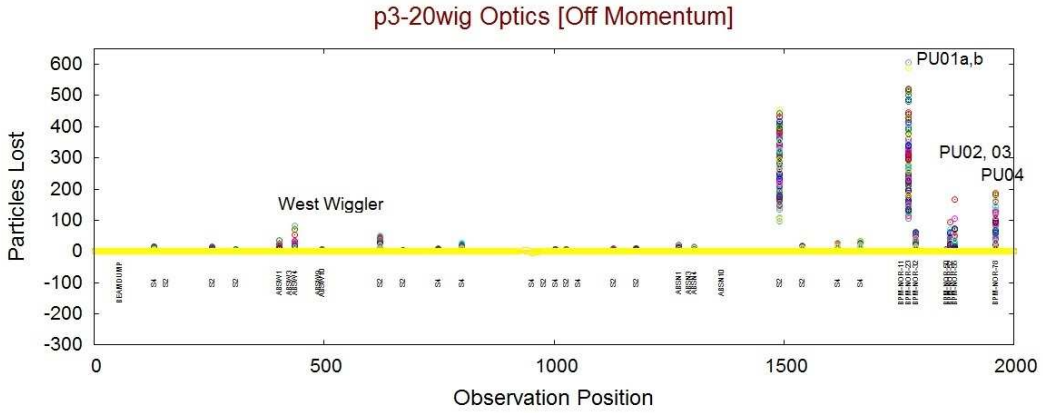
- A region of constant count rates at narrow gap values of the collimators is not observed when PETRA III is operated with large single bunch currents.
- The count rate at large single bunch currents is considerably higher reflecting the low beam lifetime dominated by Touschek scattering

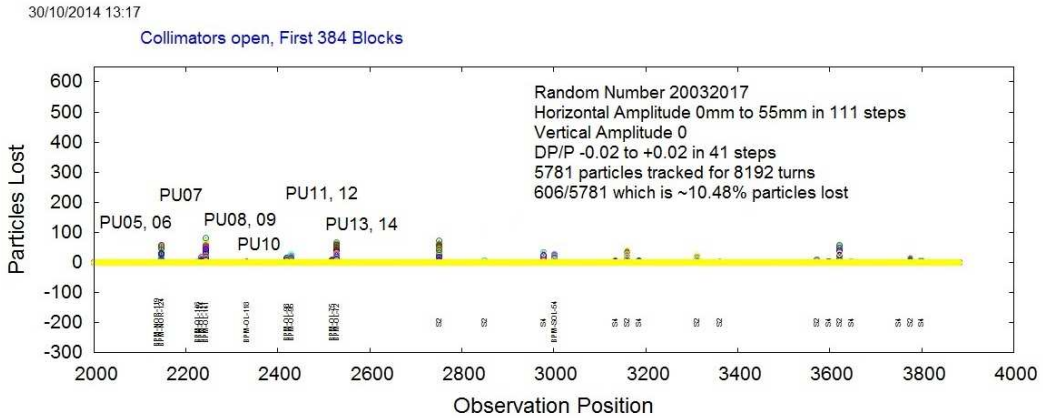
Beam Dynamics Activities at PETRA III
Alexander Kling and R.W.,
ICFA Beam Dynamics Newsletter No 62, Dec 2013

Particle Tracking using Sixtrack

Tracking studies with sixtrack:

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





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.

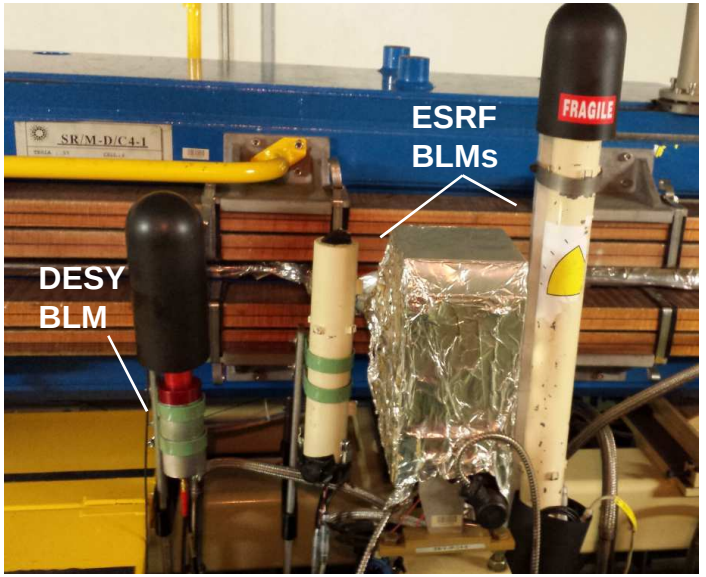
Gajendra K. Sahoo

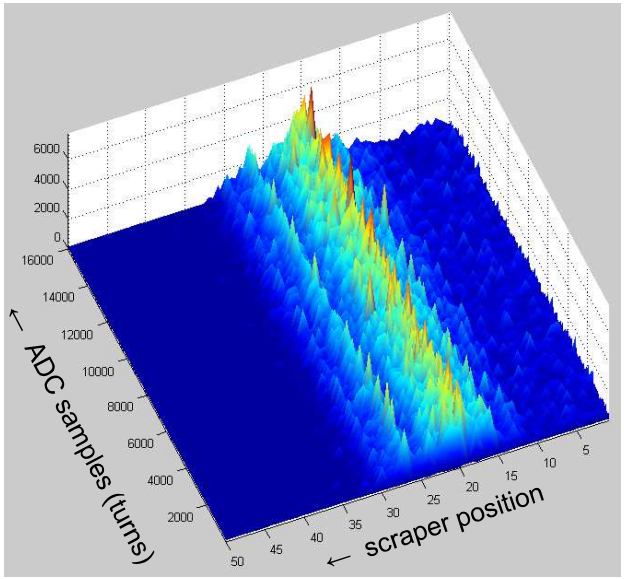
Beam Loss Monitor Test at the ESRF

- Test of BLM at ESRF in October 2014
- Detector:

  Cherenkov radiator (SQ1 synthetic quartz)
  Photomultiplier (Hamamatsu R5900U)
  originally developed for the European-XFEL

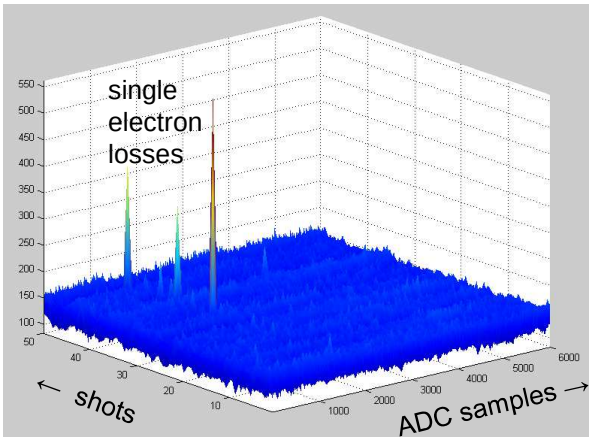
  → A. Kaukher et al., Proc. BIW2012, Newport News (VA, USA) , p.35
- installed 8-9 m behind injection point, 7 m behind horizontal scraper
- comparison with ESRF BLMs





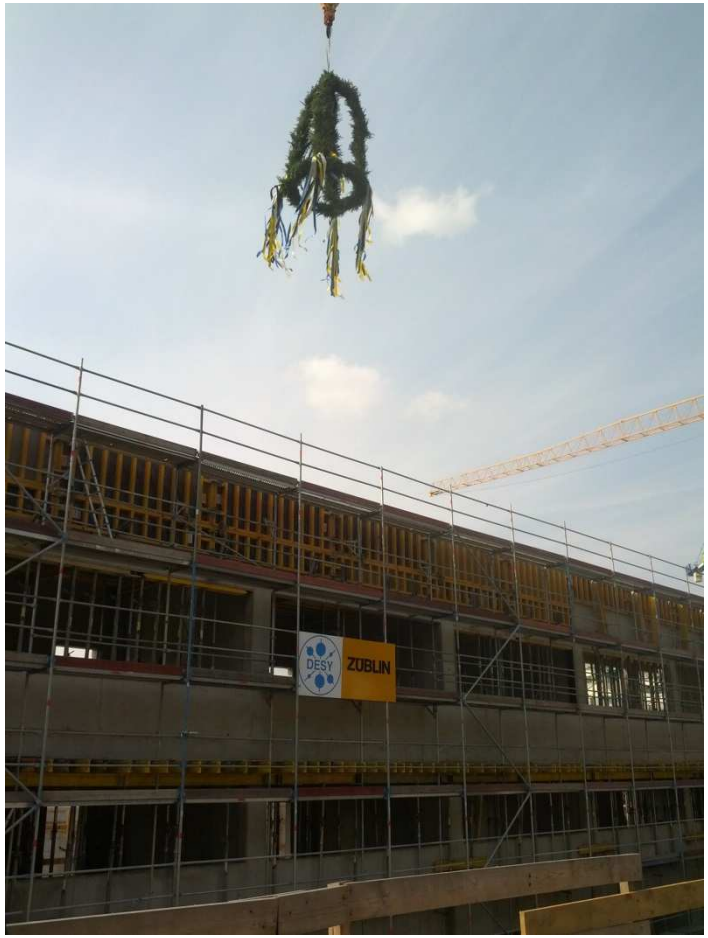
16 bunch mode
10 mA stored beam
move internal scraper in

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, 2014**

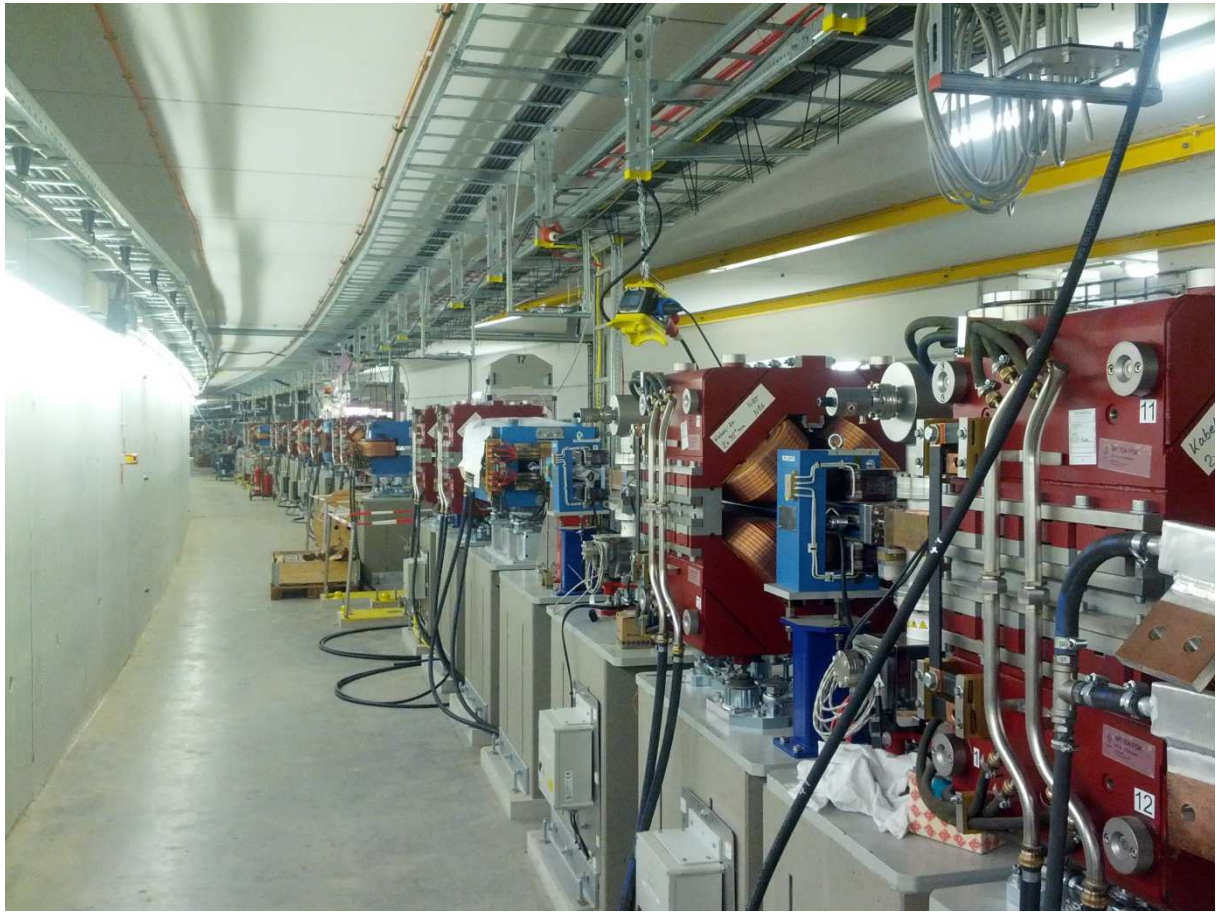
  on time and within specs

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

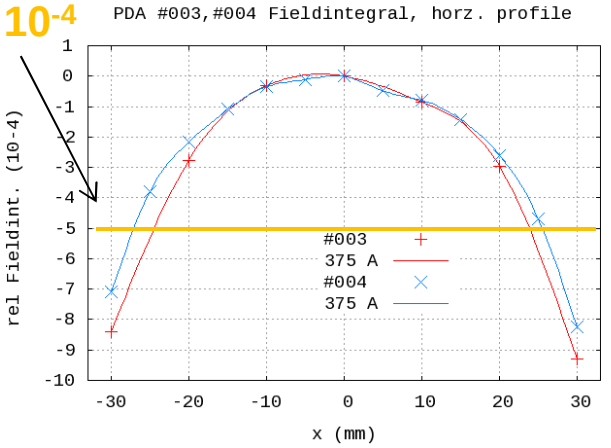
Magnets

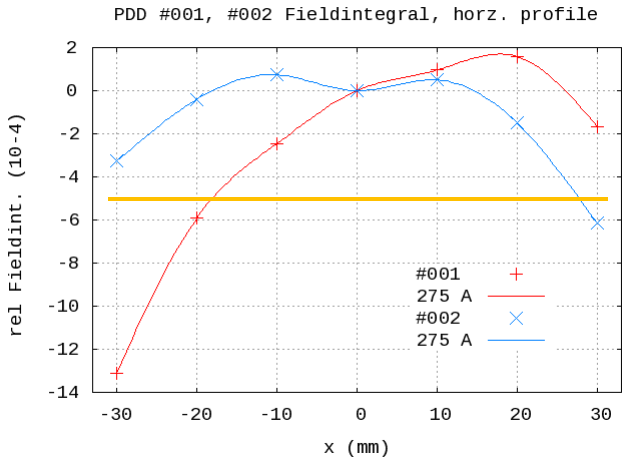
The Magnets are build, measured and certificated at Budker Institut, Novosibirks

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

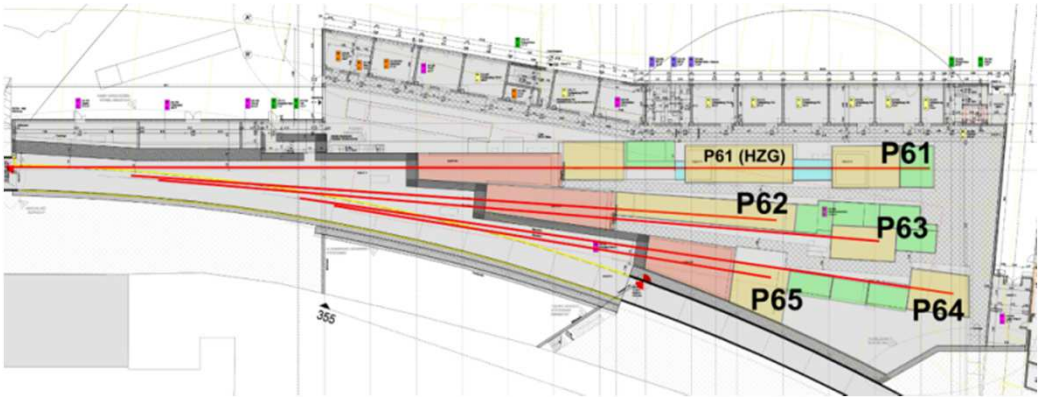
Field measurements at DESY (Y. Holler)

5×10^{-4}





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.**

Recommissing 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 !