Status of the PETRA III Project

Edgar Weckert

• Introduction
• Project Organization
• Finances
• Schedule
• Selection of Phase I Beamlines
• Summary
Parameters:
- rebuild of 1/8 of PETRA
- refurbishment of 7/8 of PETRA
- circumference: 2304 m
- energy: 6 GeV
- current: 100 mA
- emittance: 1 nmrad
- straight sections: 9
- undulators: 13
- undulator length: 2, 5, 20 m
- top up operation mode

Brilliance Comparison

Petra U1 (20m)
Petra U1 (5m)
APS U1A (5m)
Diamond U36
SLS U17
ESRF ID16 (5m)
Spring-8 BL4

Brilliance [s⁻¹ mm² mrad⁻² 1% BW⁻¹]
Photon energy [keV]
Options for Hard X-ray Devices

Calculation: Flux through a 1x1 mm² @40m distance
all undulators were treated as wiggles!!
**Photon beam parameters**

Comparison of photon beam sizes and divergences (@ 12keV)

<table>
<thead>
<tr>
<th></th>
<th>$\beta_x$ [m]</th>
<th>$\beta_y$ [m]</th>
<th>$\sigma_x$ [(\mu)m]</th>
<th>$\sigma_y$ [(\mu)m]</th>
<th>$\sigma_{x'}$ [(\mu)rad]</th>
<th>$\sigma_{y'}$ [(\mu)rad]</th>
<th>ID-length [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>low-(\beta) 5 m</td>
<td>1.3</td>
<td>3</td>
<td>35.9</td>
<td>5.7</td>
<td>28</td>
<td>5.0</td>
<td>5</td>
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<tr>
<td>high-(\beta) 5 m</td>
<td>20</td>
<td>2.38</td>
<td>141</td>
<td>5.2</td>
<td>8.6</td>
<td>5.2</td>
<td>5</td>
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<tr>
<td>low-(\beta) 2\times2 m</td>
<td>1.4</td>
<td>3</td>
<td>37</td>
<td>5.6</td>
<td>28</td>
<td>7.7</td>
<td>2</td>
</tr>
<tr>
<td>high-(\beta) 2\times2 m</td>
<td>16.2</td>
<td>2.6</td>
<td>127</td>
<td>5.2</td>
<td>10.8</td>
<td>7.7</td>
<td>2</td>
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<tr>
<td>20 m-ID</td>
<td>16</td>
<td>5</td>
<td>126</td>
<td>7.5</td>
<td>8.6</td>
<td>3.6</td>
<td>10</td>
</tr>
<tr>
<td>DW-drift</td>
<td>16</td>
<td>16</td>
<td>126</td>
<td>12.7</td>
<td>10.5</td>
<td>4.4</td>
<td>5</td>
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<tr>
<td>ESRF low-(\beta)</td>
<td>0.5</td>
<td>2.73</td>
<td>60</td>
<td>8.4</td>
<td>89.3</td>
<td>6</td>
<td>5</td>
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<td>ESRF high-(\beta)</td>
<td>35.2</td>
<td>2.52</td>
<td>403</td>
<td>8.2</td>
<td>11.8</td>
<td>6</td>
<td>5</td>
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<tr>
<td>Spring-8</td>
<td>22.6</td>
<td>5.6</td>
<td>277</td>
<td>6.4</td>
<td>13</td>
<td>5</td>
<td>4.5</td>
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<tr>
<td>APS</td>
<td>15.9</td>
<td>5.3</td>
<td>217</td>
<td>12.6</td>
<td>15.3</td>
<td>5.7</td>
<td>4</td>
</tr>
</tbody>
</table>

- two $\beta$-function values possible in the new eighth of the storage ring (can be changed)
- main gain in performance of PETRAIII is in the horizontal direction
- transverse coherence length $\xi \sim L \lambda/S$ (low-\(\beta\) FWHM @ 60m, 1Å): $\xi_h \sim 70\mu$m, $\xi_v \sim 450\mu$m (high-\(\beta\) FWHM @ 60m, 1Å): $\xi_h \sim 18\mu$m, $\xi_v \sim 490\mu$m
- horizontal beam size (FWHM@12keV) in 100m distance: low-\(\beta\): 6.7mm high-\(\beta\): 2mm
- vertical beam size: 1.2mm

9-Nov-04

Edgar Weckert: DESY-MAC Nov. 2004
## Organisation

### DESY Directorate

#### PETRA III Coordination Board

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
</tr>
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<tbody>
<tr>
<td>Chair: M Division Leader</td>
<td>D. Trines</td>
</tr>
<tr>
<td>Co-Chair: FS Division Leader</td>
<td>J. Schneider</td>
</tr>
</tbody>
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<th>Role</th>
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<tr>
<td>PETRA-III project leader photons</td>
<td>E. Weckert</td>
</tr>
<tr>
<td>PETRA-III project leader machine</td>
<td>K. Balewski</td>
</tr>
<tr>
<td>Deputy project leader photons</td>
<td>H. Franz</td>
</tr>
<tr>
<td>Deputy project leader machine</td>
<td>W. Brefeld</td>
</tr>
<tr>
<td>Scientific program</td>
<td>G. Grübel</td>
</tr>
<tr>
<td>PR representative</td>
<td>P. Folkerts</td>
</tr>
<tr>
<td>Representative of V3 (PoF related issues)</td>
<td>U. Wolframm</td>
</tr>
</tbody>
</table>

### PETRA-III Project Group

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<td>E. Weckert</td>
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<td>K. Balewski</td>
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<th>Role</th>
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<td>people responsible for the individual work packages</td>
<td></td>
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<tr>
<td>members of the Coordination Board</td>
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### DESY technical/administrative groups

- Project support office
  - W. Krechlok, H. Grabe-Celik, K. Kluth
  - Support: data management, SAP, controlling, archiving, WEB presentation
Project Organization

DESY Directorate

PETRA III Coordination Board
(D. Trines, J. Schneider)

PETRA III Project Management
(E. Weckert, K. Balewski)

1. Accelerators
(K. Balewski, W. Brefeld)

1.01 Magnets
(A. Petrov)
1.03 Vacuum System
(M. Seidel)
1.05 Damping Wigglers
(M. Tischer)
1.07 Controls and Interlock
(K. Bacher)
1.09 Radiation Protection
(N. Tesch)
1.11 Mains and Utilities
(J.P. Jensen)
1.13 RF Power Supplies
(W. Mens)
1.15 LINAC-II / PIA
(H. Weise)
1.17 Installation
(H. Grabe-Celik)
1.19 Beam Optics and Dyn.
(W. Becking)
1.21 Orbit Movement
(K. Sahoo)

1.02 Magnet Supp., Girder
(G. Welcher)
1.04 HF-System
(M. Ebert)
1.06 Multi-Bunch-Feedback
(J. Klute)
1.08 Diagnostics
(K. Wittenburg)
1.10 Alignment
(J. Prenting)
1.12 Magnet Power Suppl.
(H.J. Eckoldt)
1.14 Water Cooling System
(A. Wannig)
1.16 Kicker and Septa
(H. Weise)
1.18 DESY-II
(M. Minty)
1.20 Beam Instabilities
(R. Wanzenberg)

2. Experiments
(E. Weckert, H. Franz)

2.01 Beamline 1
(NN)
2.03 Beamline 3
(NN)
2.05 Beamline 5
(NN)
2.07 Beamline 7
(NN)
2.09 Beamline 9
(NN)
2.11 Beamline 11
(NN)
2.13 Beamline 13
(NN)
2.22 Vacuum and Optics
(K. Röhlsberger)
2.25 Hall Infrastructure
(T. Wroblewski)

2.02 Beamline 2
(NN)
2.04 Beamline 4
(NN)
2.06 Beamline 6
(NN)
2.08 Beamline 8
(NN)
2.10 Beamline 10
(NN)
2.12 Beamline 12
(NN)
2.21 Generic Beamline
(K. Röhlsberger)
2.23 Insertion Devices
(M. Tischer)

3. Buildings
(L. Hänsich)

3.01 Petra-III Main Exp. Hall
(L. Hänsich)
3.02 DESY Cooling Water
(L. Hänsich)
3.03 RF Power Support
(L. Hänsich)
3.04 Petra Cooling Water
(L. Hänsich)

Project Support Office
(W. Krechlok)
DESY Organigramm
Schedule

• Submission of the TDR: Feb. 2004
• Selection of the phase I beamlines: end of 2004
• Start of beamline R&D, prototyping: mid 2004
• Start detailed beamline planning: end 2004/2005
  ➔ user workshops on detailed beamline design
• Start of component production: 2006
• Start of reconstruction: July 2007
• Installation of first beamlines: mid 2008
• Start of user operation: 2009
Activities in 2004

• Publication of the PETRA III - TDR
• R&D for the storage ring related work packages
• R&D for beamline vacuum system and optics
• Tendering and purchase of first prototypes/components
• Advertising of positions and hiring of first people
• Detailed site characterization
• Formal project approval (Dec. 04)
• Beamline selection procedure (continued today)
TDR: Beamlines

2001: Workshop ‘Upgrade Studies’
Colloquium ‘Upgrade Studies DORIS/PETRA’

July
Oct.

2002: Materials Science
Structural biology
Spectroscopy
Condensed matter physics
XUV spectroscopy

Mar.
Sep.
Sep.
Oct.
Nov.

2003: Experimental Stations

May

• In total more than 500 participants
• The results of the work shops are documented as beamline proposals in the PETRA III Technical Design Report.
• 209 authors from 65 institutions
• Specialized workshops to finalize the beamline design will be organized in 2005 - 2006.
• Storage ring part is under review by an extend MAC
TDR: Beamlines

- **Idea:** each community makes its own case

- **22** experimental stations proposed
  several with more than one experiment/technique

- **after publication of the TDR:**
  with assistance of an **external advisory board**, selection of
  those stations to be built or joined in the **first phase**

- **further stations will be built at a later stage** (103 m space / BL)
Beamline Selection Panel: 9./10. Sep. 2004

Tim Salditt  
Uni. Goettingen

Thomas Brueckel  
FZK Juelich

Jose Goulon  
ESRF

Jean Susini  
ESRF

Hermann Duerr  
BESSY

Gopal Shenoy  
APS

Harald Reichert  
MPI Stuttgart

Kristina Djinovic  
Elettra

Keijo Hamaleinen  
Helsinki

Jean-Piere Samama  
Strassburg

Peter Fratzl  
MPI Golm

Gisela Schuetz  
MPI Stuttgart

Ilme Schlichting  
MPI Heidelberg

Rudolf Rueffer  
ESRF

Denis Raoux  
SOLEIL

Friso van der Veen  
SLS

Tetsuya Ishikawa  
SPring8

Robert Feidenhans'l  
RISØ

Tim Salditt  
Uni. Goettingen
Experimental Hall I

PETRA III  Experimental Hall

8 new straights
beam separation:
5° - 23 m

max. BL-length within exp.-hall: 103m

HF, Version 02.10.2003
Summary

- PETRA III will be the lowest emittance hard X-ray source
- Cost effective solution for the achievable performance
- A number of future upgrade possibilities are given
- Technical parameters meanwhile well defined
- Project (R&D, tendering and ordering for components, hiring of people) for the storage ring as well as for the beamlines has already started
- Next major step: definition of phase I beamlines