Research at DESY

Th. Naumann

X International Workshop on Advanced Computing and Analysis Techniques in Physics Research

ACAT05

May 22–27, 2005, DESY, Zeuthen, Germany

Thanks ...

Topics

I. Computing Technology and Environment for Physics Research

- Parallel and Vector Computing Technologies and Applications
- Distributed Computing: Tools for the GRID
- Data Fabric and Data Management
- Online Monitoring and Control
- Software Engineering
- Graphic User Interfaces, Common Libraries

II. Data Analysis - Algorithms and Tools

- Neural Networks and Other Pattern Recognition Techniques
- Evolutionary and Genetic Algorithms
- Advanced Data Analysis Environments
- Statistical Methods
- Detector and Accelerator Simulations
- Reconstruction Algorithms

III. Simulations and Computations in Theoretical Physics and Phenomenology

- Automatic Computation Systems: from Processes to Event Generators
- Multi-loop Calculations and Higher Order Corrections
- Multi-dimensional Integration and Event Generators
- Intensive High Precision Numerical Computations: Algorithms and Systems
- Computer Algebra Techniques and Applications

Local Organizing Committee

Riemann, Tord	*DESY, Zeuthen*	Gensch, Ulrich	*DESY, Zeuthen*
Blümlein, Johannes	*DESY, Zeuthen*	Kasemann, Matthias	*DESY, Hamburg*
Fleischer, Jochem	*Bielefeld Univ.*	Naumann, Thomas	*DESY, Zeuthen*
Friebel, Wolfgang	*DESY, Zeuthen*	Wegner, Peter	*DESY, Zeuthen*

International Advisory Committee

Bhat, Pushpalatha	*Fermilab, Batavia*	Naumann, Thomas	*DESY, Zeuthen*
Brun, Rene	*CERN, Geneva*	Ohl, Thorsten	*Würzburg University*
Denby, Bruce	*Versailles University*	Overmann, Peter	*Wolfram Research, Inc.*
Fleischer, Jochem	*Bielefeld University*	Perret-Gallix, Denis	*IAC Chair, CNRS*
Foster, Ian	*ANL, Argonne*	Remiddi, Ettore	*Bologna University*
Gerdt, Vladimir	*JINR, Dubna*	Riemann, Tord	*DESY, Zeuthen*
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Kaneko, Toshiaki	*KEK, Tsukuba*	Shimizu, Yoshimitsu	*KEK, Tsukuba*
Kasemann, Matthias	*DESY, Hamburg*	Shirkov, Dmitri	*JINR, Dubna*
Kataev, Andrei	*INR RAS, Moscow*	Smirnitsky, Alexandre	*ITEP, Moscow*
Kawabata, Setsuya	*KEK, Tsukuba*	Vermaseren, Jos	*NIKHEF, Amsterdam*
Kiesling, Christian	*MPI, Munich*	Wegner, Peter	*DESY, Zeuthen*
Kunze, Marcel	*Forschungsz. Karlsruhe*	Werlen, Monique	*LAPTH, Annecy-Le-Vieux*
Lonnblad, Leif	*Lund University*		

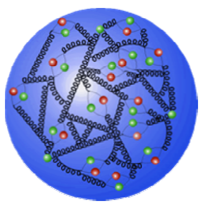
E-mail: acat05@desy.de http://www.desy.de/acat05

Research at DESY

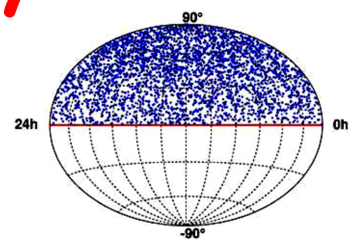
Staff: 1150 **Budget:** 158 M€

Hamburg/Zeuthen ~ 10/1

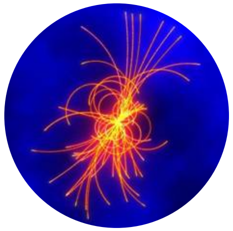
- **Particle Physics**



HERA

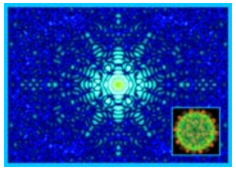


Astro-Particle Physics

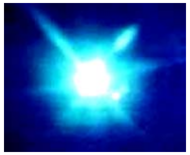


ILC

- **Synchrotron Radiation**



PETRA3



VUV-FEL

XFEL

DESY at Zeuthen

- Particle Physics Experiments
  H1+HERMES at HERA
- Theoretical Physics
  Lattice supercomputing
- ILC Project
  physics + detector studies

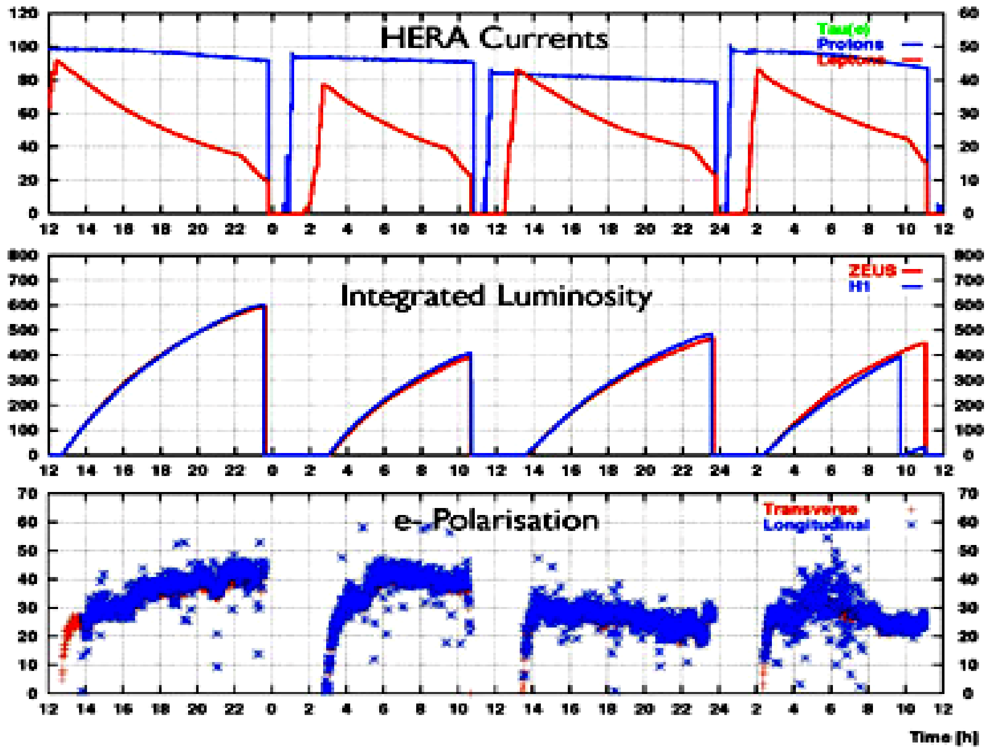
- Particle-Astrophysics
  Baikal, AMANDA, IceCube
  high energy cosmic neutrinos

- Accelerator R&D
  develop components
  for VUV-FEL + XFEL
- PITZ:
  Photo Injector Test Facility Zeuthen

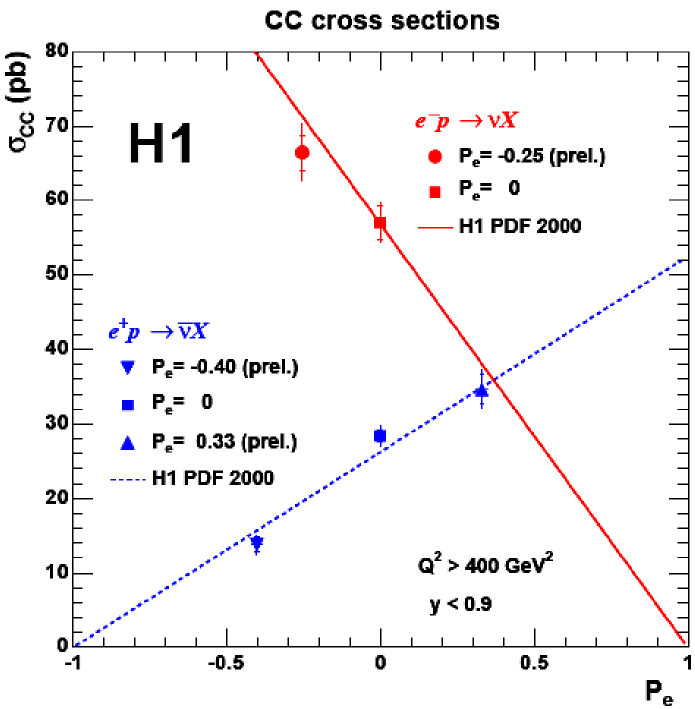
- Zeuthen well integrated in DESY
- rich program with specific flavors

HERA

- **lumi upgrade:** background conditions + stability improved
- **2004: 91 pb^{-1}** highest lumi/year delivered so far
- **2005: 90 pb^{-1}** by now, >1 pb^{-1} /day, ~150 pb^{-1} expected

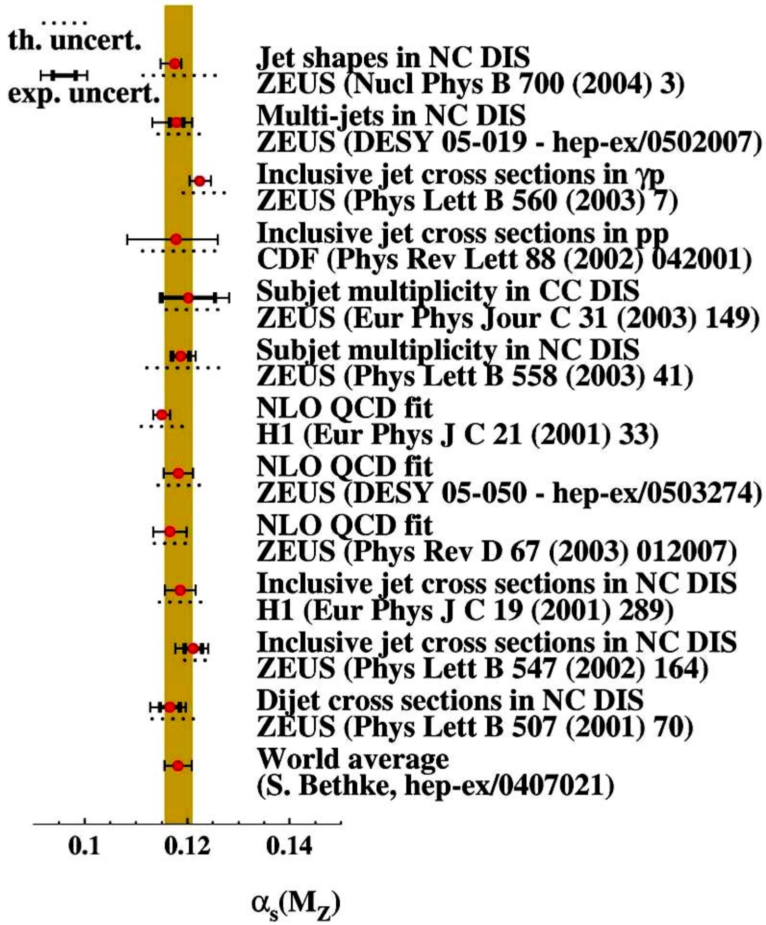


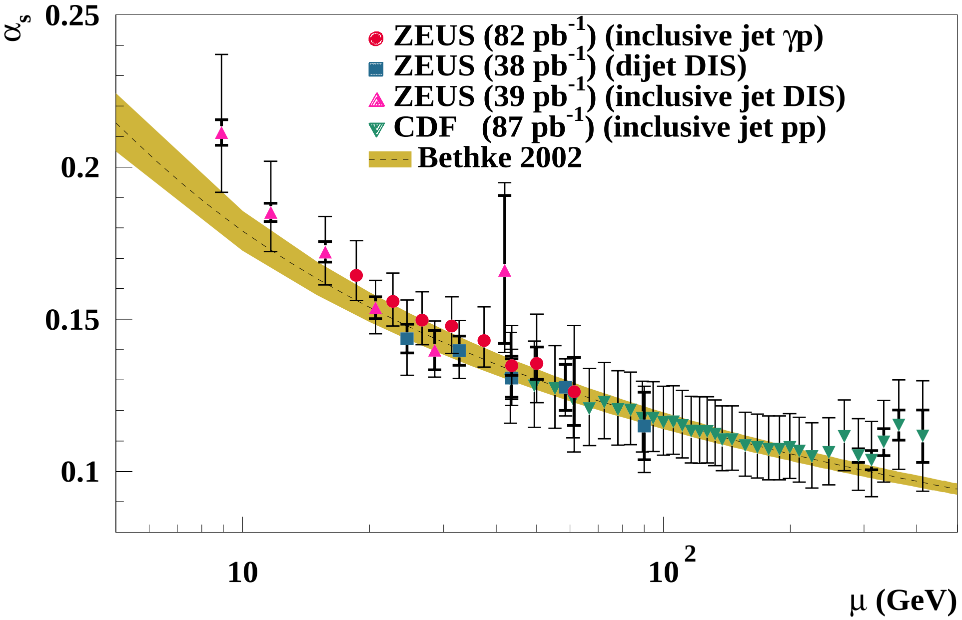
polarization 25-45%



- **HERA end mid-2007: ~700 pb^{-1}** totally, about equally e^+ and e^-

Strong coupling α_s

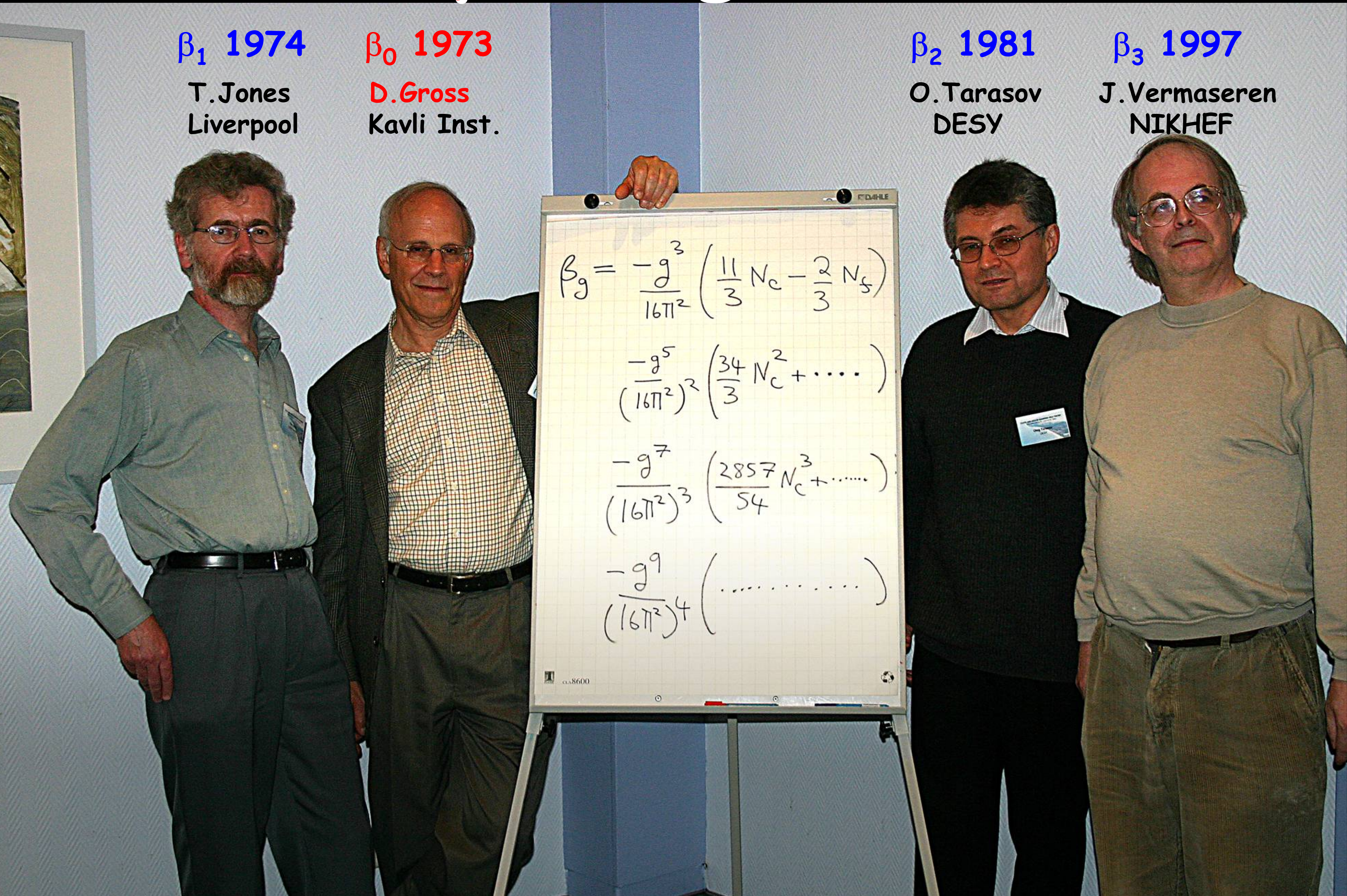




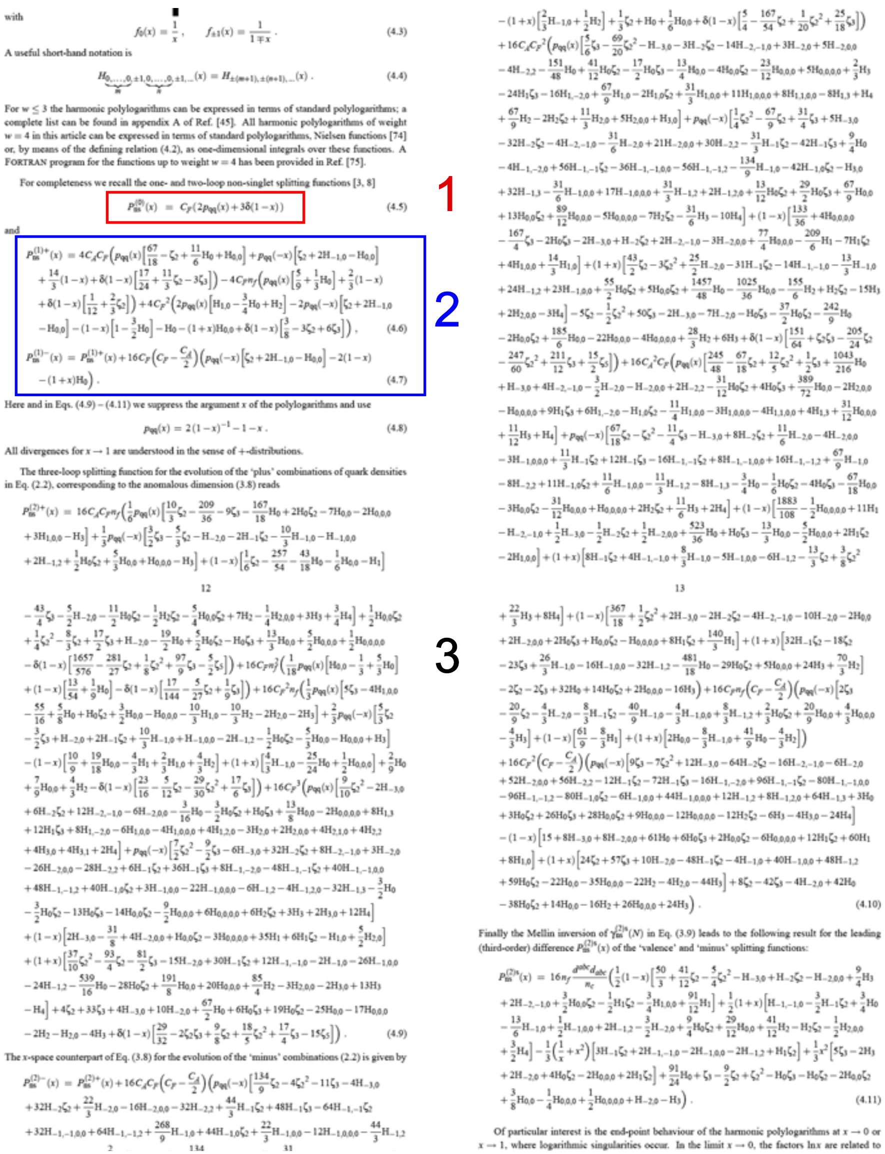
$\alpha_s (M_Z) = 0.1182 \pm 0.0027$

need ~1% precision
from theory !

Loops+Legs 2004



QCD Perturbation Theory



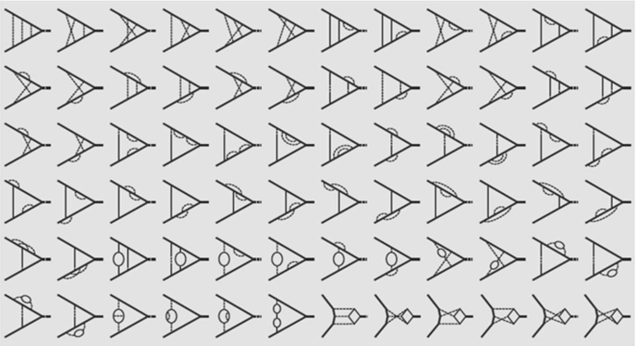
S. Moch et al., The QCD Splitting Functions At Three Loops, Nucl.Phys.Proc.Suppl.135:137-146,2004. hep-ph / 0403192 + 0404111

1-2-3 Loops:
Next-to-Next-to-Leading Order:

- splitting functions
- anomalous dimensions
- coefficient functions

~ 10.000 Feynman Diagrams :

	tree	1-loop	2-loop	3-loop
$q\gamma$	1	3	25	359
$g\gamma$		2	17	345
$h\gamma$			2	56
qW	1	3	32	589
$q\phi$		1	23	696
$g\phi$	1	8	218	6378
$h\phi$		1	33	1184
sum	3	18	350	9607

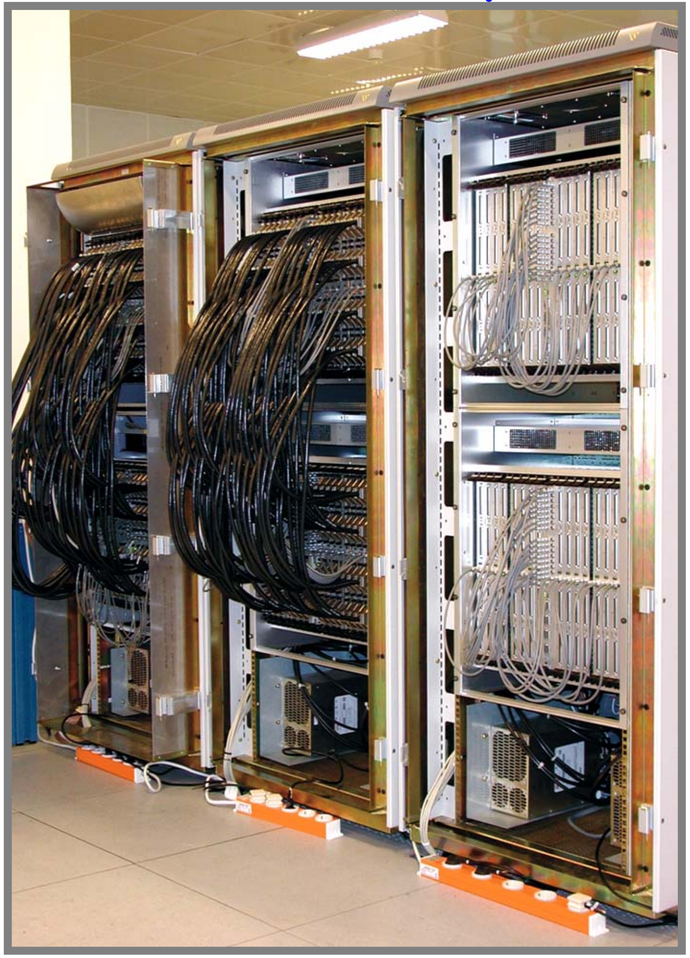


> 100.000 Integrals ...

M.Czakon, Kovalevskaya Preis 2004.

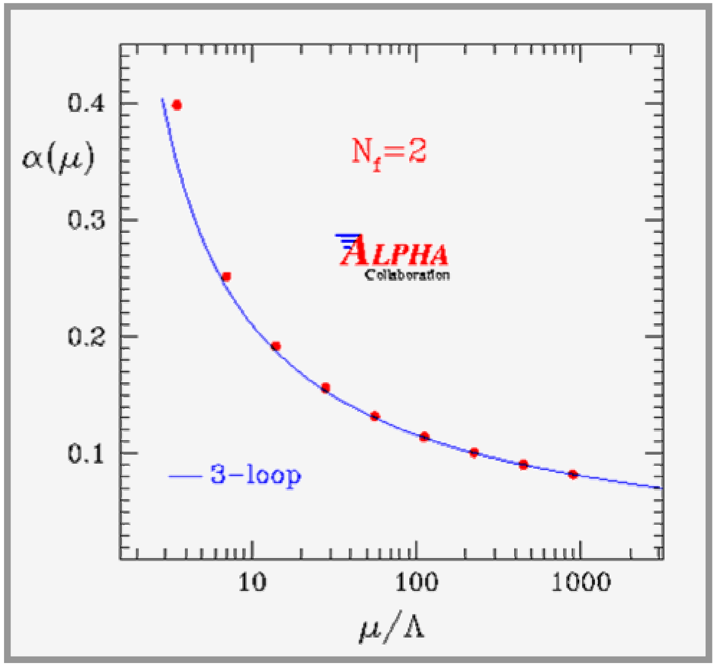
Lattice QCD

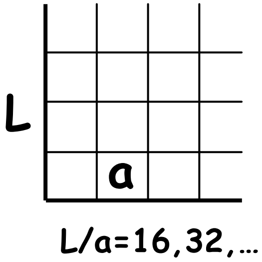
APE Lattice Computers



APENext at DESY Zeuthen
2005/6: 3 TFlops

- simulate QCD on a lattice :





- degrees of freedom:
  Color, Flavor, Quark Masses

$\delta\alpha_S/\alpha_S$ = 1% ok with expt.+ 3-loop

High Performance Computing

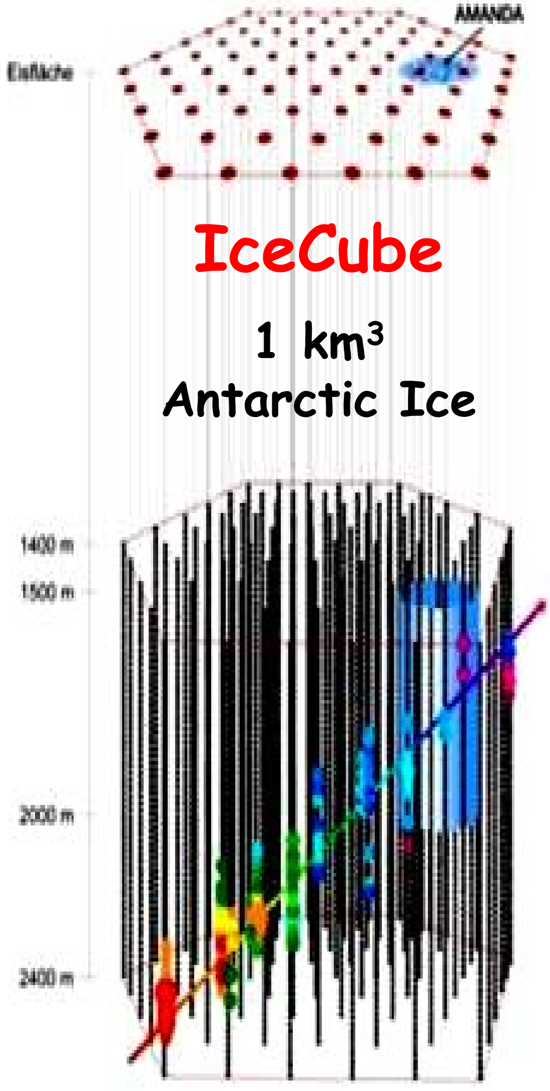
strategy group of Helmholtz institutes

DESY,GSI, AWI, DLR, FZJ, FZK

Ausbau des Supercomputing in der Helmholtz-Gemeinschaft und Positionierung im europäischen Forschungsraum

- needs of diff. communities:
  LQCD, astrophysics, biophysics, chemistry, climate
- FZJ-NIC → HGF-HPC → German → European ?
- general vs dedicated machines
- large vs topical centres

Neutrino Astro-Physics



Neutrino Astro-Physics

Amanda: many new results - sensitivity gets interesting

Search for Neutrino Point Sources

Select upgoing events: maximize ↑ν and minimize ↓μ

Optimize cuts in each declination band optimizing for $E^{-2...-3}$ signal spectrum

Sensitivity ~independent of direction

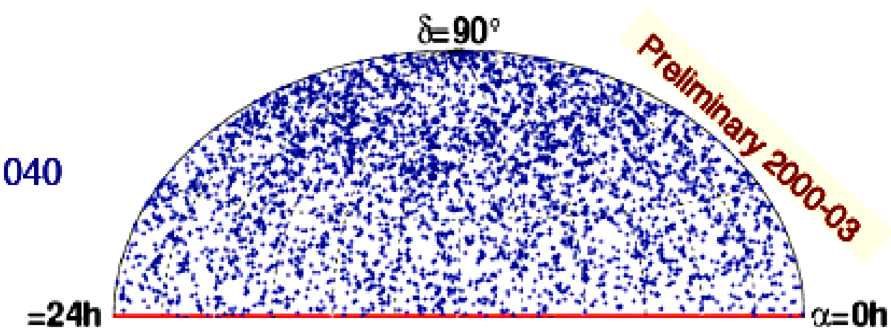
Published analyses:

– 1997 data

Astrophys.J. 583(2003)1040

– 2000 data

PRL 92(2004) 071102



New preliminary results with different strategies:

• 2000-01 and 2002 data

• 2000–03 data: 3370 evts in 807 days (sensitivity ~3 higher as 2000)

No clustering in skyplot observed →
No evidence for steady point sources
(measurement compatible with atmospheric ν's)

S Schlenstedt PRC Open Session, Oct 28, 2004 NuAstro 10

IceCube: Neutrino Astrophysics

First string deployed

2450 m deep in Antarctic ice
in January 05.

DOM Module Production

1300 of 60x80 = 4800 modules
assembled at DESY Zeuthen.

also: simulation, reconstruction, analysis

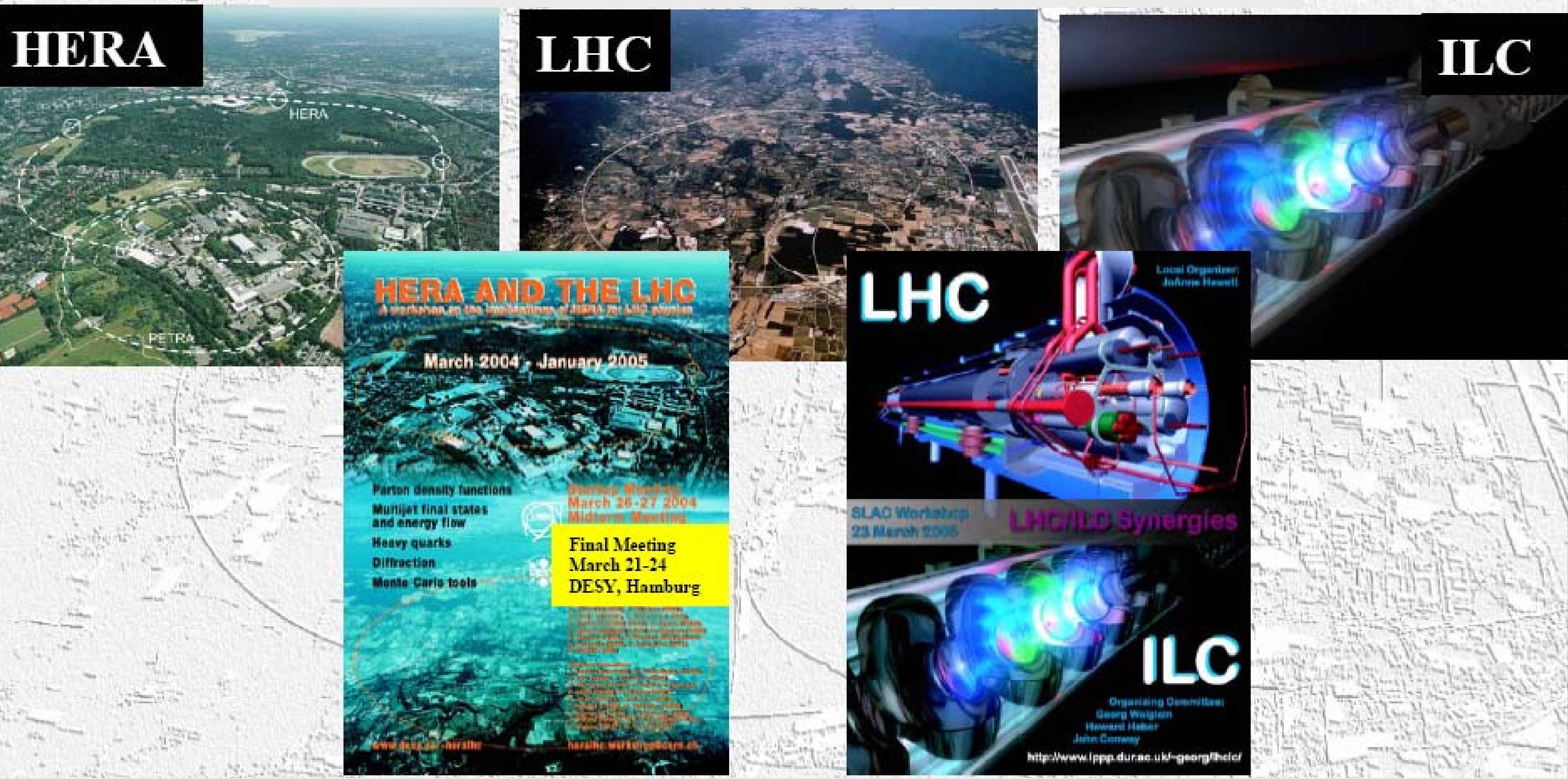
ILC: Global Design Initiative

~220 participants

from all 3 regions

mostly accelerator experts

HERA-LHC-ILC



DESY participation at the LHC:
the bridge from HERA to the ILC
DESY-CERN contacts start

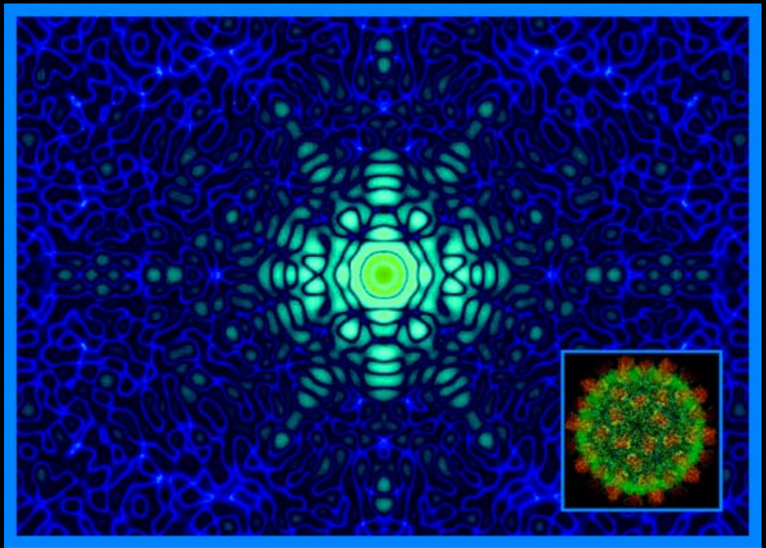
Synchrotron Radiation

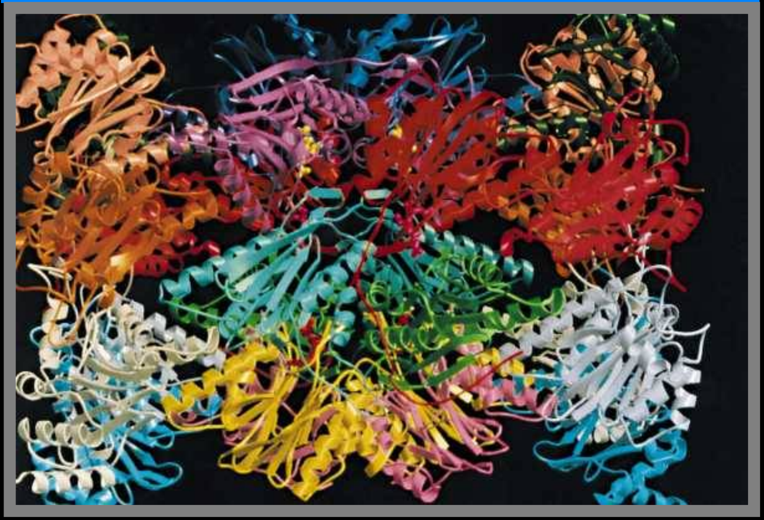
use different features of laser in

- Atomic and molecular physics
- Biology
- Chemistry
- Material science
- High field and plasma physics

to produce

- movies of chemical reactions
- real-time studies of formation of condensed matter
- imaging of bio-molecules with atomic resolution

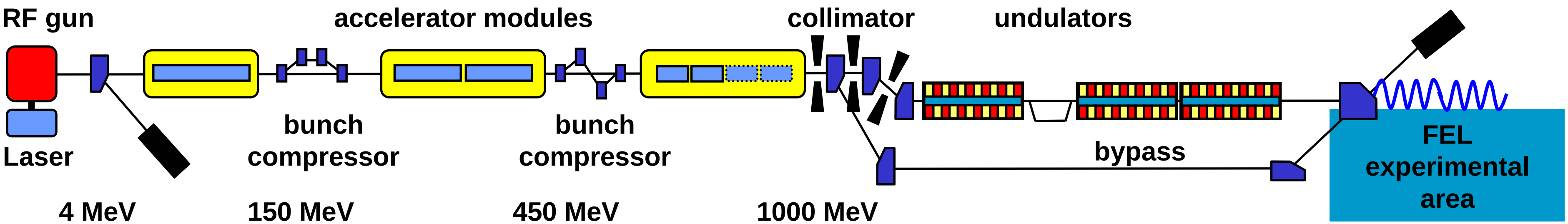




VUV-FEL

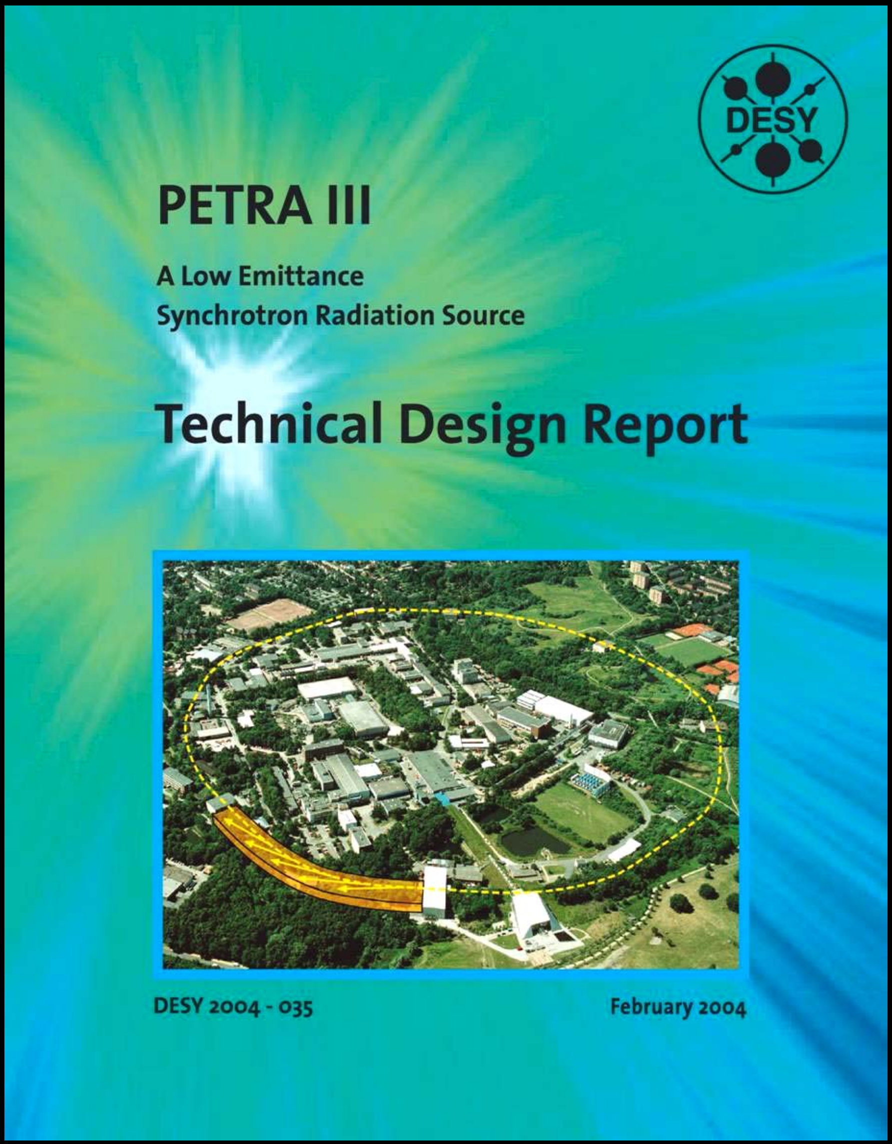
VUV-FEL

2005: start of user running E = 250-1000 MeV λ = 24-6 nm



Wire scanner: 7 stations in undulator region built in Zeuthen
Gun: optimized in Zeuthen - good emittance

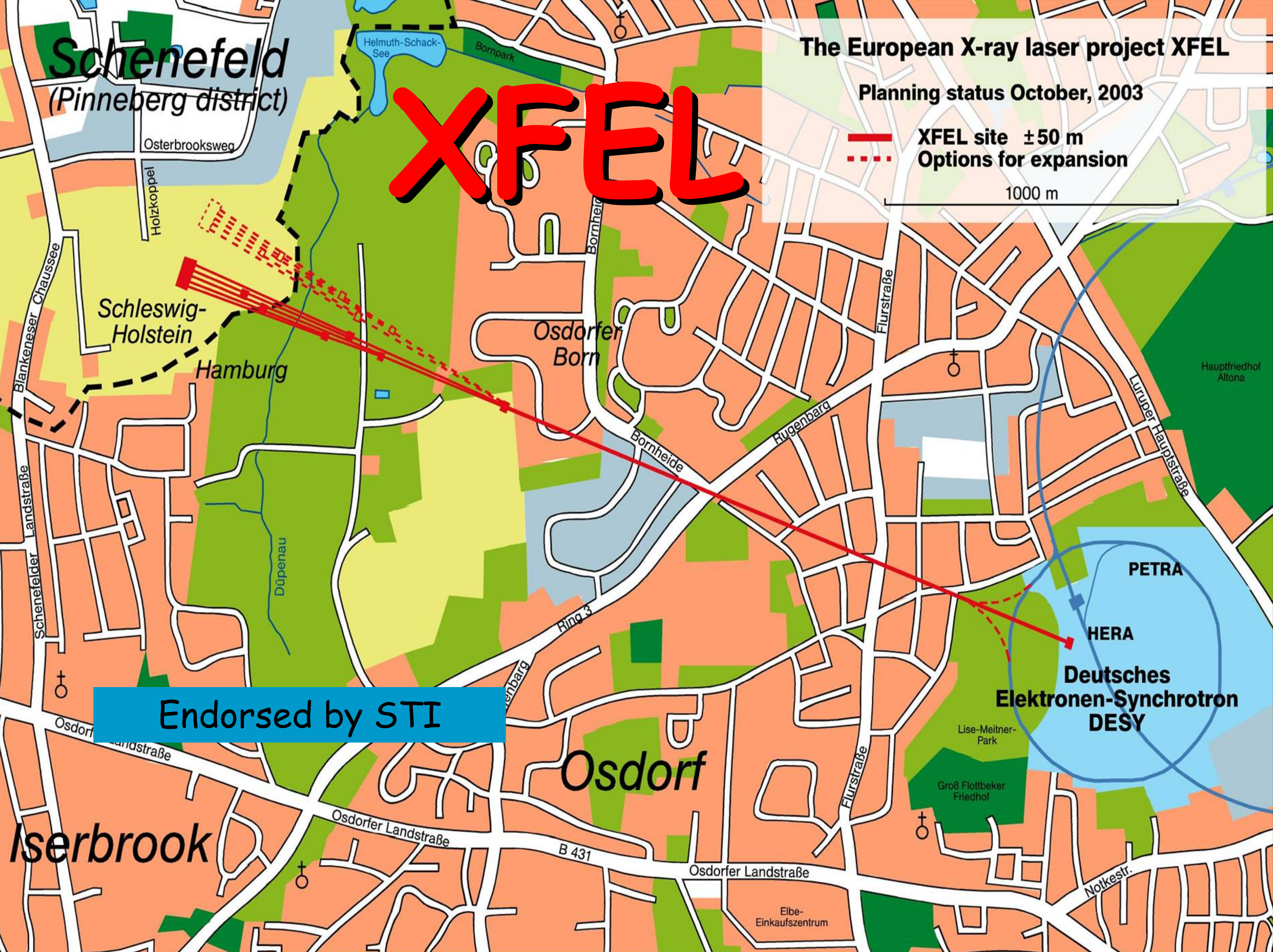
PETRA III



super-brilliant
Synchrotron
Light Source

25.11.2004:
134 M€ allocated by BMBF,
German Ministery of Science

July 2007:
take over PETRA from HERA


XFEL
The European X-ray laser project XFEL
Planning status October, 2003
XFEL site ±50 m
Options for expansion
1000 m
Endorsed by STI
Schenefeld
(Pinneberg district)
Osterbrooksweg
Holzkoppel
Helmuth-Schack-See
Bornpark
Schleswig-Holstein
Hamburg
Blankeneser Chaussee
Schenefelder Landstraße
Düpenau
Osdorfer Born
Bornheide
Rugenbarg
Ring 3
Flurstraße
Luruper Hauptstraße
Hauptfriedhof Altona
PETRA
HERA
Deutsches
Elektronen-Synchrotron
DESY
Lise-Meitner-Park
Groß Flottbeker Friedhof
Osdorf
Iserbrook
Osdorfer Landstraße
B 431
Notkestr.
Elbe-Einkaufszentrum

European XFEL

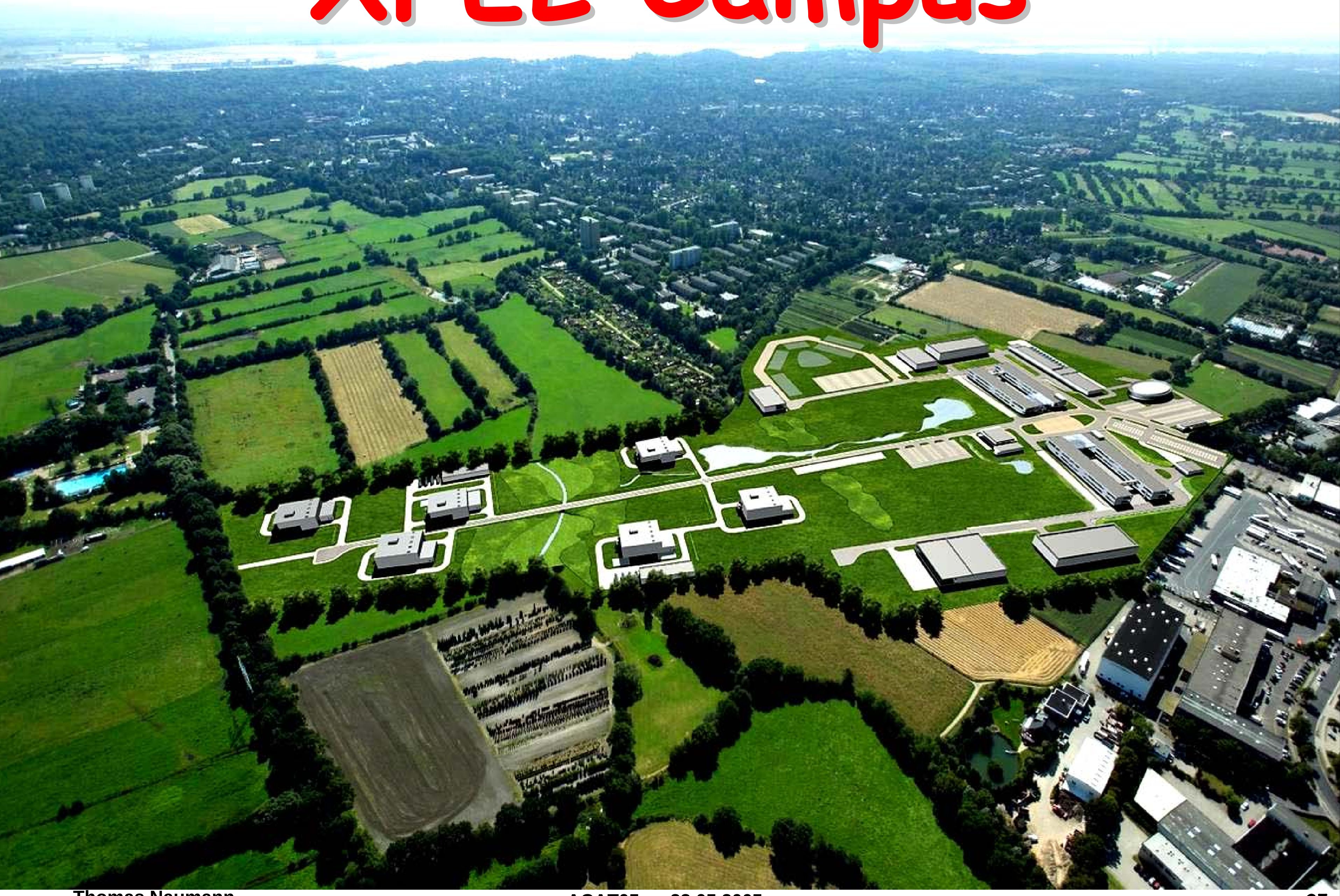
- **Feb. 2003:** German govt.: XFEL as European project
  Cost: 684 M€ (2000)
  50% Federal govt.
  + ~10% from Länder HH + Schleswig-Holstein
  + ~40% from European Partners

- **Mar. 2005: MoU** for project preparation **signed by** 10 EU countries:
  CH, DE, DK, ES, F, GR, IT, PL, UK, SE

- **Jan. 2005:**
  Interim Report of Scientific and Technical Issues Working Group on European XFEL Lab in Hamburg
  Cost incl. R&D, escalation to 2012, contingency:
  908 M€

- **May 2005:** Start of Plan Approval Procedure

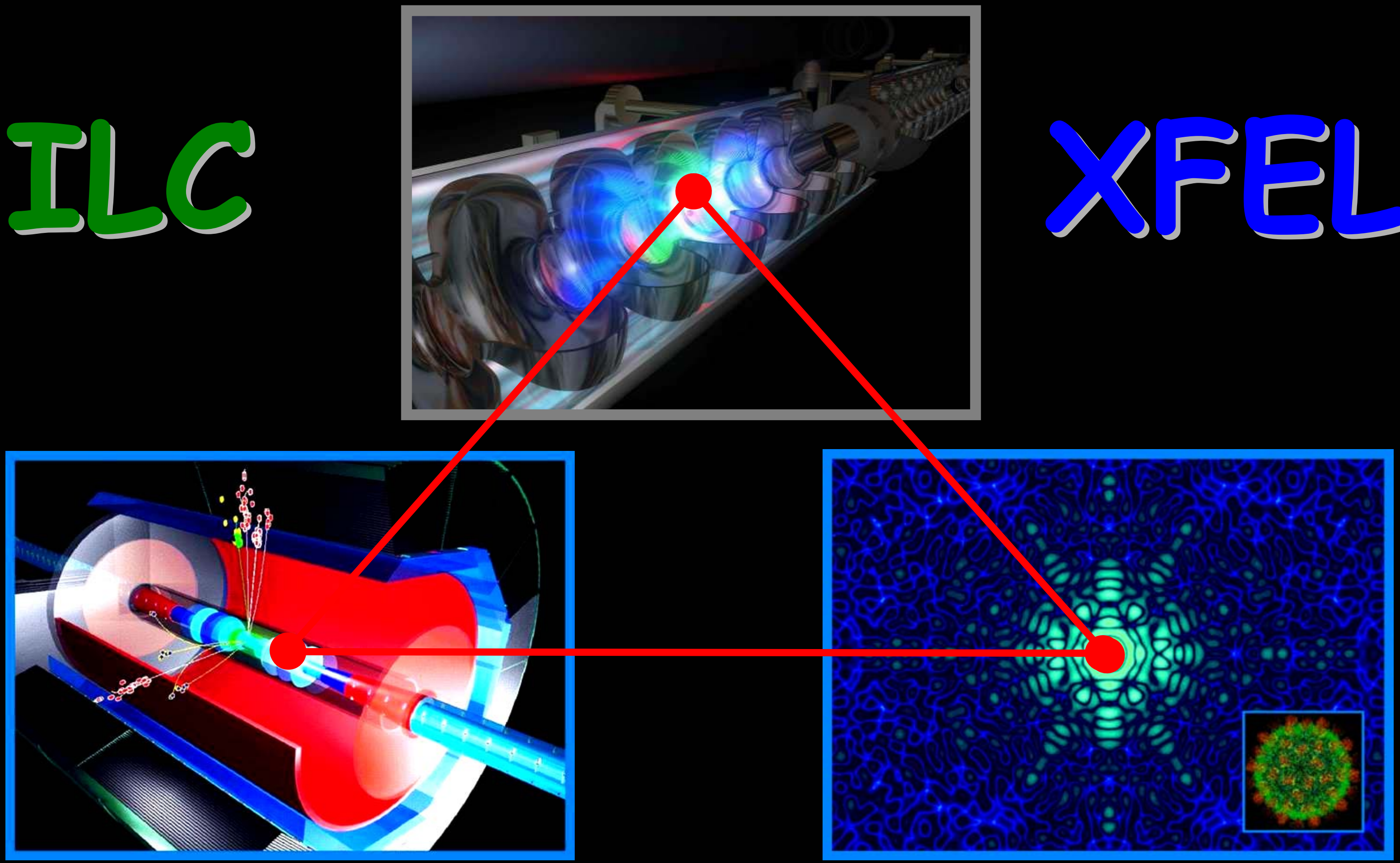
XFEL Campus



Synergy

ILC

XFEL



industrial cavity production

operate+commission VUV-FEL and XFEL

ACAT 05

Start	Monday, May 23	Tuesday, May 24	Wednesday, May 25	Thursday, May 26	Friday, May 27
09:00	Registration	Plenary Session Georgeot, Bertrand	Plenary Session Ramacher, Ulrich	Plenary Session Buchberger, Bruno	Summaries Brun, Rene Kiesling, Christian
10:00	Registration	Coffee break	Coffee break	Coffee break	Summaries Brun, Rene Kiesling, Christian
10:30	Registration	Parallel Sessions	Parallel Sessions	Parallel Sessions	Coffee break
11:00	Opening Naumann, Thomas	Parallel Sessions	Parallel Sessions	Parallel Sessions	Summaries Fujimoto, Junpei
11:30	Plenary Session Vermaseren, Jozef	Parallel Sessions	Parallel Sessions	Parallel Sessions	Summaries Fujimoto, Junpei
11:45	Plenary Session Vermaseren, Jozef	Parallel Sessions	Parallel Sessions	Parallel Sessions	Conference Closing Perret-Gallix, Denis
12:00	Plenary Session Vermaseren, Jozef	Parallel Sessions	Parallel Sessions	Parallel Sessions	Conference Closing Perret-Gallix, Denis
12:30	Lunch break	Lunch break	Lunch break	Lunch break	Lunch break
14:00	Parallel Sessions		Parallel Sessions	Parallel Sessions	
14:30	Parallel Sessions		Parallel Sessions	Parallel Sessions	
15:00	Parallel Sessions		Parallel Sessions	Parallel Sessions	
15:30	Coffee break		Coffee break	Coffee break	
16:00	Parallel Sessions		Parallel Sessions	Invited Talk Brandt, Siegmund	
16:30	Parallel Sessions		Parallel Sessions	Invited Talk Brandt, Siegmund	
17:00	Parallel Sessions		Parallel Sessions		
17:30					
18:00					
18:30					
19:00					
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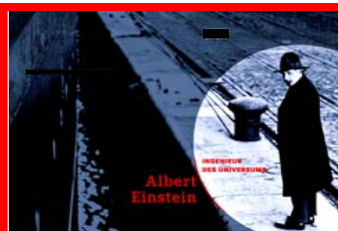
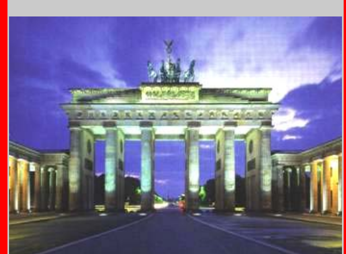
20:00					
21:00					
22:00					



Berlin



LOC/IAC

Trip + Banquet

Welcome

Physics in Berlin

- talk by S.Brandt, Thursday 16 h
- World Year of Physics: Einstein exposition

Kronprinzenpalais
Unter den Linden

Ratskeller Köpenick
Thursday 17.30-22.30 h

Captain of Köpenick

Future of ACAT

IAC meeting

Wednesday
19 h

at
Königliches
Schloßrestaurant
in the
Kavalierhäuser
of
Schloß
Königs Wusterhausen