CUI THE HAMBURG CENTRE FOR ULTRAFAST IMAGING

The Hamburg Centre for Ultrafast Imaging

The Graduate Days 2014

Hamburg
Campus Bahrenfeld
March 10 – 12

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

DESY

EMBL

MAX-PLANCK-GESELLSCHAFT

European XFEL

Programme

Monday, March 10, 2014

8:30 Registration (CFEL, Bld. 99, Foyer)

9:30 **Dr. Fabrizio Dolcini**
Superconductivity in mesoscopic systems
(ZOQ, Bld. 90, Seminar room)

Prof. Frédéric Merkt
Molecular spectroscopy
(CFEL, Bld. 99, Seminar room I-II)

Prof. Horst Weller
Nanoparticles: From nucleation and growths to application and materials and life of sciences
(ILP, Bld. 69, Seminar room)

11:00 Coffee Break (ZOQ, ILP, CFEL)

11:15 **Dr. Fabrizio Dolcini**
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(ILP, Bld. 69, Seminar room)

12:30 Lunch (Desy-Canteen, Bld. 09)

14:00 **Prof. Louis Lyons**
Practical statistics
(ZOQ, Bld. 90, Seminar room)

Ms. Monica Schofield
Scientific writing and writing for funds
(CFEL, Bld. 99, Seminar room I-II)

Ms. Kerstin Kathy Meyer-Ross
Presentation skills
(ILP, Bld. 69, Seminar room)

15:30 Coffee Break (ZOQ, ILP, CFEL)

16:00 **Dr. Manfred Mark**
Ultracold physics in low dimensions
(ZOQ, Bld. 90, Seminar room)

Dr. Daniel Rolles
Gas phase molecules and FELs
(CFEL, Bld. 99, Seminar room I-II)

Dr. Michael Sprung and Dr. Leonard Müller
Modern methods of X-ray physics
(ILP, Bld. 69, Seminar room)

17:30 Free time

18:00 Industry event
Dr. Henning Fink and Dr. Ralf Behling
Industrial Innovation Management – Example Philips Hamburg
(CFEL, Bld. 99, Seminar rooms I-II-III)

19:00 Welcome reception (CFEL, Bld. 99, Foyer)

Tuesday, March 11, 2014

9:30 **Dr. Fabrizio Dolcini**
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(ZOQ, Bld. 90, Seminar room)

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(CFEL, Bld. 99, Seminar room IV, 01.111)

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17:30 Free time

18:00 Special colloquium
Prof. R. J. Dwayne Miller
The Centre for Ultrafast Imaging: From Atoms to Cells - Making Connections
(CFEL, Bld. 99, Seminar rooms I-II-III)

18:40 Science slam
Everything you always wanted to know about ultrafast imaging, but were afraid to ask
Moderation: Prof. C. Meier, Vice-Dean of the MIN-Faculty of the University of Hamburg
(CFEL, Bld. 99, Seminar rooms I-II-III)

19:40 Reception (CFEL, Bld. 99, Foyer)
Entertainment with the Greek music of the young band *Mousikorama*

Wednesday, March 12, 2014

9:30 **Dr. Fabrizio Dolcini**
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Prof. Frédéric Merkt
Molecular spectroscopy
(CFEL, Bld. 99, Seminar room I-II)

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17:30 End of the graduate days

Abstracts

Morning long courses (Mo-We, 9:30-12:30)

Superconductivity in mesoscopic systems: Dr. Fabrizio Dolcini (Politecnico di Torino, Italy)

The recent developments of nanotechnology have shown that a number of interesting transport properties arise in hybrid systems where superconductors are interfaced to nanostructures in the quantum coherence regime. The purpose of this course is to offer an introduction and an overview of superconductivity in nanostructures and mesoscopic systems: After a short survey about bulk Superconductivity, Mesoscopic Physics and Nanostructures, the method of Bogolubov-DeGennes (BdG) Equations for treating inhomogeneous superconductivity and hybrid systems will be presented. The phenomenon of Andreev reflection at the interface with the superconductor will be discussed, along with the current-voltage characteristics of a Normal Metal – Superconductor junction, within Blonder-Tinkham-Klapwijk Theory. Then, the BdG method shall be combined with the Scattering Matrix formalism to discuss the Josephson Effect in mesoscopic systems. In the last part of the course recent applications to the case of topological materials will also be discussed.

Molecular spectroscopy: Prof. Frédéric Merkt (Laboratory of Physical Chemistry, ETH Zürich, Switzerland)

Molecular spectroscopy is the main source of information on the structure and dynamics of molecules. Spectroscopic experiments can be carried out at frequencies ranging from the radio-wave to the X-Ray regions of the electromagnetic spectrum and provide information on all types of motion associated with electronic, vibrational, rotational and spin degrees of freedom. Molecular spectroscopy is also used in chemical analysis and remote sensing.

After a review of basic aspects of molecular quantum mechanics and of the interaction of radiation with matter, the lecture series will provide an overview of molecular spectroscopy with emphasis on the following topics:

(1) Selection rules, group theory and symmetry,
(2) Rotational, vibrational and electronic structure in molecules,
(3) Rotational, vibrational and electronic transitions in molecules,
(4) Molecular spectroscopy and dynamics,
(5) Experimental strategies, spectroscopic methods and instrumentation.

The lecture series will primarily focus on high-resolution spectroscopy, include general material taken from the recently published Handbook of High-Resolution Spectroscopy [1] and illustrates the main concepts with examples taken from the recent literature.

[1] Handbook of High-resolution Spectroscopy, Eds. M. Quack and F. Merkt, Wiley, Chichester, 2011.

Nanoparticles: From nucleation and growths to application and materials and life of sciences: Prof. Horst Weller (Fachbereich Chemie, Universität Hamburg, Germany)

The lectures will give an introduction to synthesis, properties and application of wet-chemically prepared nanocrystals. Focus is lead on semiconductor, metal and magnetic nanoparticles and we will discuss the influence of size, shape and surface functionalization on the physical properties. This includes basic principles of size quantization, plasmonics and the transition from ferro- to superparamagnetism. The second part of the lectures deals with basic concepts of how to make and stabilize such particles in solution. Special attention will be laid on the question how size, shape and surface chemistry of the particles can be controlled. Different mechanisms of particle growth will be discussed. Finally we will present current and future applications of such particles in materials and life sciences. This includes the use as biomarkers for molecular imaging, applications in display, lightning and photovoltaic technology as well as the utilization in modern catalysis.

Afternoon short courses (Mo-We, 14:00-15:30)

Practical statistics: Prof. Louis Lyons (Imperial College and University of Oxford, United Kingdom)

Because many experiments involve complicated and expensive apparatus, it is worth investing effort into analysing the data well. These lectures deal with practical problems that arise in the statistical analysis of data.
The emphasis will be on what the results mean, features to beware of, and trying to understand whether the results are sensible. They cover the determination of

parameters and their errors, and also comparing data with various models.

Lecture 1) Introduction (Monday March 10, 2014) The Introduction includes a reminder of several topics which should already be familiar from an undergraduate course, although we will look at some of these in a new light. We will need these concepts in later lectures. We will also discuss briefly the Bayesian and Frequentist approaches to the meaning of probability, and to determining parameters.

Topics:

- Introductory remarks:
    1. Probability and Statistics.
    2. Conditional probability.
    3. Statistical and systematic errors.
    4. Combining different sources of uncertainty
    5. Combining results. BLUE = Best Linear Unbiassed Estimate
    6. Binomial, Poisson and 1-D Gaussian, and relations between them
- What is probability? Bayes and Frequentist approaches

Lecture 2) Chi-squared (Tuesday March 11, 2014) Parameters can also be determined via the chi-squared approach. This is compared with the likelihood method. The main advantage of chi-squared is that it can also be used to provide a measure of 'goodness of fit' between the data and a theoretical prediction.

Topics:

- Basic idea.
- Error estimates.
- Several parameters
- Correlated errors on y.
- Errors on x and y.
- Goodness of fit. Degrees of freedom. Why assymptotic?
- Errors of first kind and second kind.
- The paradox
- Kinematic fits. Toy example.

Lecture 3) Do's and dont's with Likelihood functions (Wednesday March 12, 2014) The likelihood function provides a powerful method for determining a parameter and its uncertainty. An important feature is that it can deal with individual observations, rather than needing histograms. The method is explained with simple examples. Various possible pitfalls are also discussed.

Topics:

- Introduction to likelihood. Error estimate.
- Simple examples: (1) Breit Wigner (2) Lifetime
- Binned and unbinned likelihood
- Several parameters
- Common misapprehensions:
    1. Normalisation
    2. delta(lnL) = 1/2 rule and coverage
    3. Integrating the likelihood
    4. Unbinned L_max as goodness of fit?

Presentation skills: Ms. Kerstin Kathy Meyer-Ross (Hochschule für Technik und Wirtschaft, Dresden, Germany)

This talk helps students to improve their personal presentation skills. Topics are, among others: how to structure a presentation so that the audience can follow it easily, designing slides, making the best possible use of visual aids and technical equipment, dealing with interruptions, handling questions, keeping an eye on the time and the best way of finishing in a hurry, common mistakes, what to do when nervous, how to give proper feedback, etc. Furthermore, non-native speakers of English are given tips on spoken language and a number of phrases they can use e.g. for transition.

Scientific writing and writing for funds: Ms. Monica Schofield and Ms. Nina Stedman (TuTech Innovation GmbH, Hamburg, Germany)

Acquiring grants for research has become a very competitive business no longer simply dependent on putting forward purely scientific arguments. Interpreting the criteria set out by funding bodies and writing convincingly to make the case are essential skills needed to win funding and make a career as a researcher.

This workshop will equip early career researchers with core skills on how to prepare grant applications in programmes requiring these to be made in English, such as Horizon 2020. The three sessions will cover an introduction to research funding systems and how to write effectively and convincingly in English.

First session: A short introduction to grant acquisition (Monica Schofield, Monday March 10, 2014)

- Basic of public funded grants and funding sources
- Grant acquisition skills
- The process to get funded
- Where to get information
- What you need to start

Second session: Writing your grant proposal in English (Nina Stedman, Tuesday March 11, 2014)

- Understanding academic writing
- Understanding structure: writing your proposal narrative

Third session: The portfolio approach to grant writing (Nina Stedman, Wednesday March 12, 2014)

- How to enhance your message and sell your project
- How to built your portfolio of expressions for academic purposes

Afternoon short courses (Mo-We, 16:00-17:30)

Ultracold physics in low dimensions: Dr. Manfred Mark (Institute for Experimental Physics, Universität Innsbruck, Austria)

Part 1: Introduction and overview

We will start with a short theory review of low-dimensional physics, especially interacting bosons in 1D and the corresponding theoretical models (BEC in 1D, Luttinger liquid, 1D versus quasi-1D, confinement induced resonances (CIR), Fermionization, …). Then an overview over recent experimental investigations is given (Newtons Cradle, Prethermalization, Integrability breakdown, …).

Part 2: One-dimensional Bose-gases with tunable interactions

We will start with a stability analysis of Bose gases in 1D, showing decay measurements revealing the dependence of the three-body correlation function on the interaction strength. Then the observation of the CIR and their behaviour are discussed. Finally, measurements showing all different regimes in 1D, going from the non-interacting gas across the weakly interacting gas into the Tonks-gas and crossing the CIR into the super-Tonks-gas, are presented.

Part 3: One-dimensional Bose-gases in a lattice

We will start with a review of lattice physics, especially the Bose-Hubbard and sine-Gordon model. Then recent experiments are discussed: First, the observation of the superfluid-to-Mott-insulating phase in a 1D commensurate lattice, also called pinning transition, will be shown. Second, decay and revival of Bloch oscillations in 1D and the transition to the quantum chaotic regime are presented. Third, tunnelling dynamics after a quantum quench along the 1D chains and their relation to spin dynamics are addressed.

Gas-phase molecules and FELs: Dr. Daniel Rolles (Desy, Hamburg, Germany)

Free-Electron Lasers provide ultra-intense, few-femtosecond, fully spatially coherent light pulses in the vacuum-ultraviolet and X-ray regime which open up new experimental possibilities in molecular physics including the study of multi-photon processes in the X-ray regime, femtosecond time-resolved studies of photochemical reactions, and various molecular imaging applications. This lecture will start with a general introduction into the photoionization of atoms and molecules, followed by a brief introduction into the principles of a Free-Electron Laser and some typical electron and ion spectroscopy techniques used in FEL applications. I will then discuss several examples of current FEL research on molecules including multi-photon ionization of molecules, femtosecond pump-probe experiments, and X-ray and photoelectron diffraction of aligned molecules.

Modern methods of X-ray physics: Dr. Michael Sprung and Dr. Leonard Müller (Desy, Hamburg, Germany)

The advent of third generation synchrotron light sources and later free-electron laser (FEL) sources has revolutionized X-ray scattering methods for condensed matter research in many ways. In the first two lectures, basic concepts of x-ray scattering will be introduced. New coherence-based experimental methods, that become possible only by using modern third generation synchrotron radiation facilities, will be highlighted. Main emphasize will be on coherent diffraction imaging (CDI) approaches and x-ray photon correlation spectroscopy (XPCS). The first group of techniques recreates an object from its diffraction signal on nanometer length scales and the later technique allows to measure dynamical behavior on nanometer length scales, e.g. diffusion coefficients in complex liquids. The third lecture will focus on soft x-ray scattering at FEL sources. FELs allow to access dynamics on femtosecond time scales, which is demonstrated on the basis of resonant magnetic scattering and imaging experiments on magnetic domain systems. The holographic method to image magnetic domain systems will be discussed in detail.

Practical information

Location

Campus Bahrenfeld
Notkestraße 85 (Main Entrance)/Luruper Chaussee 149 (Side Entrance)

- Center for Free Electron Laser Science (CFEL), Building 99
- Zentrum für Optische Quantentechnologien (ZOQ), Building 90
- Institut für Laserphysik (ILP), Building 69

Seminar room IV (01.111) in CFEL is located on the first floor. The other rooms are located on the ground floor.

Contact

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Luruper Chaussee 149
22761 Hamburg
Phone: +49-40-8998-6504
E-mail: anegrett@physnet.uni-hamburg.de

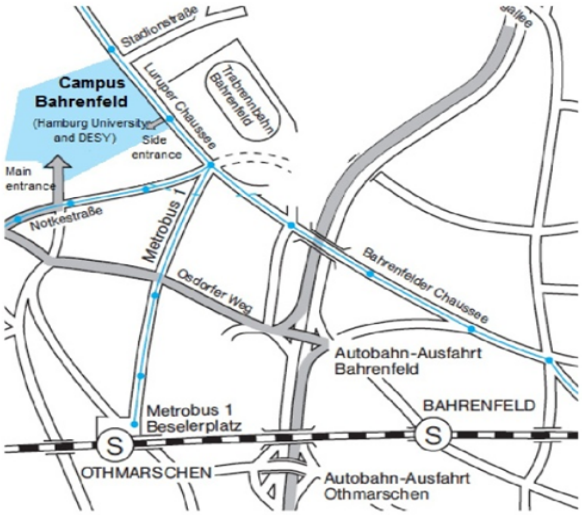
Registration

The registration to the graduate days takes place on Monday March 10, 2014, in the foyer of the CFEL (Bld. 99) from 08:30 to 09:30. All registered participants and invited speakers will be provided with a badge and three meal vouchers.

Lunch and group photo

The common lunches will take place at the Desy-canteen (Bld. 09) from 12:45 to 14:00.
A group photo of all participants of the graduate days as well as of the invited speakers is scheduled for Tuesday March 11, 2014, at 12:40. All participants meet in front of the entrance of ZOQ (Bld. 90).

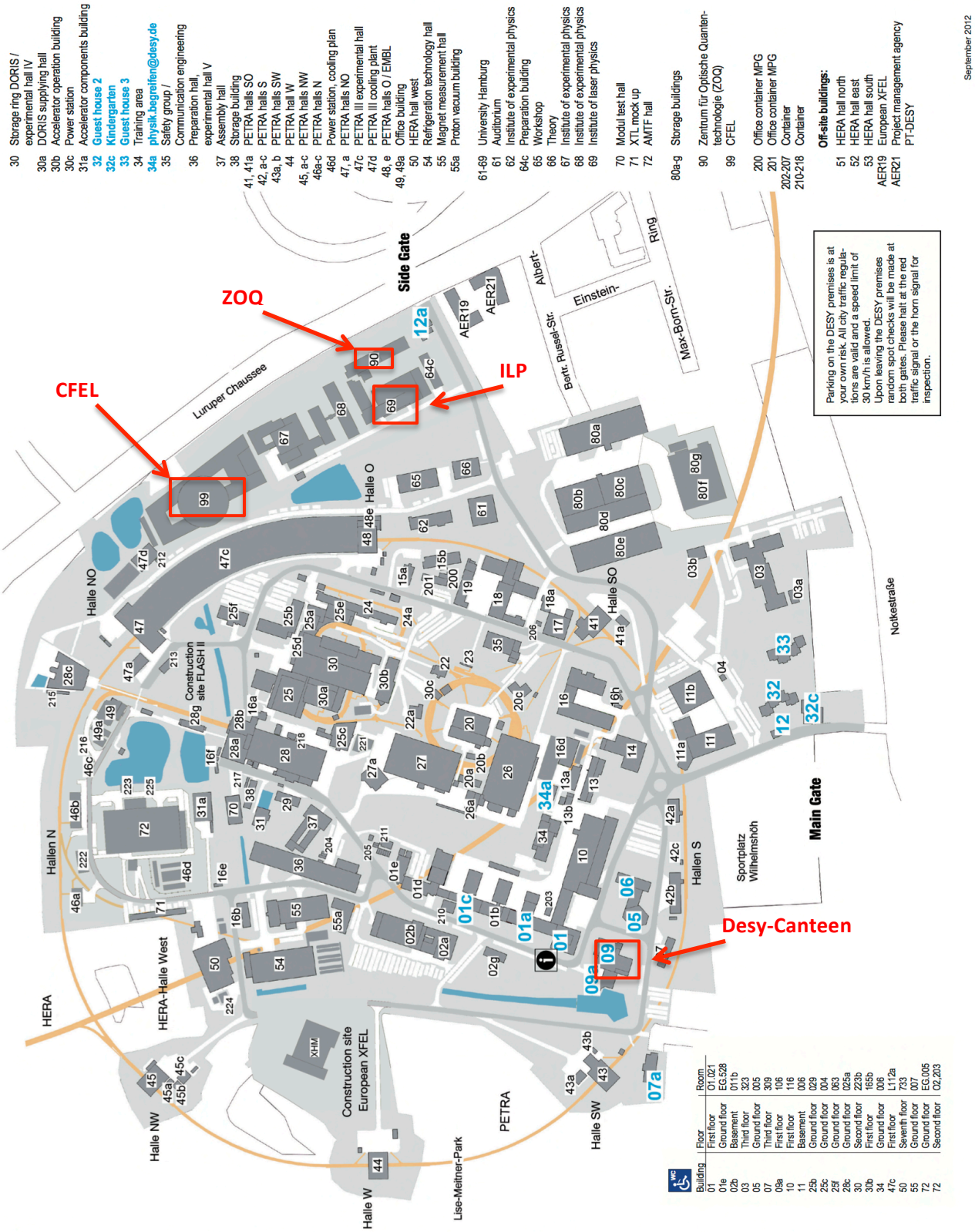
Directions



By train: to Hamburg-Altona station, then continue by taxi (travelling time about 15 minutes) or take a bus (see below).
By bus: To reach the side gate (recommended), take bus line 2 (direction Schenefeld Mitte) from Altona train station and get off at "Luruper Chaussee/DESY", travelling time about 20 minutes.
From train station "S-Bahn Othmarschen", take bus line 1 (direction "Schenefelder Holt") directly to the main entrance of the campus (bus stop "Zum Hünengrab/DESY"), travelling time about 25 minutes.
By plane: The campus can be reached from Hamburg airport by taxi in about 30 minutes. Alternatively, take suburban train S1 to Altona or Othmarschen (about 40 minutes, direct train) and a bus from there (see above).

The Hamburg Centre for Ultrafast Imaging

The Graduate Days 2014



Building	Floor	Room
01	First floor	01.021
01e	Ground floor	EG.528
02b	Basement	011b
03	Third floor	323
05	Ground floor	005
07	Third floor	309
09a	First floor	106
10	First floor	116
11	Basement	006
25b	Ground floor	029
25c	Ground floor	004
25f	Ground floor	063
28c	Ground floor	025a
30	Second floor	223b
30b	First floor	165b
34	Ground floor	006
47c	First floor	L112a
50	Seventh floor	733
55	Ground floor	007
72	Ground floor	EG.005
72	Second floor	02.203

September 2012

Laboratory 1 01-01e
Directorate 01
Press and public relations 01
Company medical officer 01a
Library 01d
Laboratory 2a, Theory 02a
Computer Centre, UCO 02b
Laboratory 02g
Laboratory 3 03
Caretaker 03a
Storage building 03b
Gas station 04
Auditorium, entrance building 6 05
Administration building, **Guest services 06**
Administration building 07
Guest house 8 07a
Cafeteria, Bank 09
Bistro 09a
Workshop 10
Purchasing department 11
Central warehouse 11a
Cable hall 11b
Gate lodge Notkestraße 12
(main gate)
Gate lodge Luruper Chaussee 12a
(side gate)
Liquifying plant 13
Gas cylinder building 13a
Helium container building 13b
Vacuum laboratory 14
Office building 15a, b
Power station 16
10 kV main station 16a, b
Cooling plant DESY II 16d
Filter network switchyard 16e
Emergency power switch facility 16f
Storage building 16h
Heating plant 17
Maintenance building 18, 18a
Carpenters' building 19
Synchrotron building 20
Filtering hall 20a
10 kV substation 5a 20b
Power house DESY 20c
Vacuum engineering 22
Laboratory of the Universities of Hamburg and Lübeck 22a
LINAC I 23
LINAC II 24
PIA 24a
HASYLAB laboratory 25
EMBL 25a
HASYLAB laboratory 1, MPG 25b
HASYLAB X-ray wiggler hall, HZG / GFZ 25c
HASYLAB laboratory 4 25d
HASYLAB laboratory 5 25e
HASYLAB laboratory 2 25f
LINAC III / experimental hall I 26
FLA laboratory 26a
Experimental hall II 27
Testing area 27a
TTF / experimental hall III 28
Cryogenic hall 28a
FLASH tunnel 28b
FLASH experimental hall 28c
FLASH laser hut 28g
Iron removal plant 29

30 Storage ring DORIS / experimental hall IV
30a DORIS supplying hall
30b Accelerator operation building
30c Power station
31a Accelerator components building
32 Guest house 2
32c Kindergarten
33 Guest house 3
34 Training area
34a physik.begreifen@desy.de
35 Safety group / Communication engineering
36 Preparation hall, experimental hall V
37 Assembly hall
38 Storage building
41, 41a PETRA halls SO
42, a-c PETRA halls S
43a, b PETRA halls SW
44 PETRA hall W
45, a-c PETRA halls NW
46a-c PETRA halls N
46d Power station, cooling plan
47, a PETRA halls NO
47c PETRA III experimental hall
47d PETRA III cooling plant
48, e PETRA halls O / EMBL
49, 49a Office building
50 HERA hall west
54 Refrigeration technology hall
55 Magnet measurement hall
55a Proton vacuum building
61-69 University Hamburg
61 Auditorium
62 Institute of experimental physics
64c Preparation building
65 Workshop
66 Theory
67 Institute of experimental physics
68 Institute of experimental physics
69 Institute of laser physics
70 Modul test hall
71 XTL mock up
72 AMTF hall
80a-g Storage buildings
90 Zentrum für Optische Quantentechnologie (ZOQ)
99 CFEL
200 Office container MPG
201 Office container MPG
202-207 Container
210-218 Container

Off-site buildings:
51 HERA hall north
52 HERA hall east
53 HERA hall south
AER19 European XFEL
AER21 Project management agency
PT-DESY