

Beschleunigerphysik in Deutschland

Hans Weise / DESY KET Jahresversammlung 2007, Bad Honnef, 23./24. Oktober 2007

Komitee für ElementarTeilchenphysik (KET)



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Accelerator Physics at German Universities



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All these universities offer lectures on

- Accelerator Physics, Part I or Part II; typ. 1.5 hours per week
- occasionally add. lectures on special topics
- in some cases special courses (one full week instead of the weekly lecture)

In average approx.

- 20 PhDs per year (typ. 29 years old) and
- 20 Diplomas per year (typ. 25 years old);
 Darmstadt, Frankfurt and Hamburg have
 60% of these students.

| Simulations | 35% |
|------------------------|-----|
| Beam Diagnostics | 20% |
| Accelerator Physics | 15% |
| Accelerator Technology | 15% |
| Sources | 10% |
| Others | 5% |

Accelerator Physics at the S-DALINAC



Nuclear Physics Accelerator Physics Infrared-FEL (typ. 2 Diss. & 4 Dipl. per year)

Beam Dynamics at the S-DALINAC

Channeling Radiation

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Transverse phase space Tomography

A Gun for Polarized Electrons at the S-DALINAC

HF-Resonators for Beam Intensity and Position Measuring at the S-DALINAC

Field Emission Studies in a Superconducting Cavity of the S-DALINAC

Prototype of a New Up- and Downconverter Unit for the S-DALINAC

Compton Scattering Experiments to Determine the Polarizability of the Proton and the Deuteron at the S-DALINAC

Improvements of the S-DALINAC Gamma Source

Pulse Length Measurements at the S-DALINAC Using a Compact Auto Correlator



Theory of Electromagnetic Fields



Theory of Electromagnetic Fields Wake fields, RF structures (typ. 4 Diss. per year)

Wake field simulations 2D und 3D

Dispersion free wake field simulations Wake field integration for accelerators

Wake field simulations using the Boundary-Element-Methode

Design and simulation of the polarized S-DALINAC source

Design of a chopper and buncher resonator for the S-DALINAC

Impact of fabrication tolerances on the mode distribution in accelerating structures

PIC-Code Simulations

Propagation of synchrotron radiation (calc. for the X-FEL)

Impedance simulation for ion beams in kicker structures

Design of pickups and kickers for stochastic cooling of ion beams

Welcome to TEMF

IAP Accelerator R&D



Institute for Applied Physics Accel.structures (mainly ions) (typ. 3 Diss. / 3 Dipl. per year)

Ion beams in space charge lenses

Barrier-Buckets at the GSI-ESR

Linear Coupling and Nonlinearities in Hadron Circ.Accel

Design and Construction of a Finger **Drift Tube Accelerator**

Development of an IH-DTL Injector for the Heidelberg Cancer Therapy Project

New Post-RFQ Accelerating Structures

Study of **beam funneling**

Investigations towards a High Current RFQ for Neutron Production

Extraction/Transport of H- beams

Ion beam cooling using an RFQ



MAMI and ANKA



Institute for **Nuclear Physics** MAMI orientated (typ. 1 Diss. / 2 Dipl. per year) Beam dynamics at MAMI C Transverse beam profiles

Spin management at the MAMI accelerator cascade

Effizient source for spin polarized electrons

NEA-Photo cathodes





Application of Synchrotron Radiation ANKA orientated (max. 1 Diss. / 2 Dipl. per year) study of single- and multi-

Shimming of superconducting undulators

Energy calibration for ANKA

Stupakov limit for stable / instable emission of CSR

Single Bunch Source and bunch effects in the CSR-Production



ELSA and **DELTA**



Physics Institute Source & beams & diagn. ELSA orientated (typ. 2 Diss. / 2 Dipl. per year)

GaAs source

Acc. of **polarized beams**

Fast bipolar correctors

Beam diagnostics (I < 1nA

Compton backsc. based polarimetry - Laser-Wire

Collective instabilities





Center for Synchrotron Radiation DELTA orientated (typ. 2 Diss. / 4 Dipl. per year) Design of the **booster synchrotron** BODO

Undulator design / FEL

Beam diagnostics and orbit studies

Field emitter in RF resonators



Hamburg University and FLASH / XFEL



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Institute for Experimental Physics FLASH / XFEL / ILC & Diagn. (typ. 4 Diss. / 2 Dipl. per year)

Coherent synchrotron radiation (CSR) meas. at FLASH

Laser induced energy modulation at FLASH

Performance and limitations of L-band **rf waveguides**

IR Undulator + Spectroscopy

Start-to-End Simulations



Machine safety system for high beam currents at FLASH and the XFEL

A BPM with large horizontal aperture for use in dispersive magnetic chicanes

Optical fibers for laser synchronization at the 10 fs level over long distances

Availability / reliability studies for FLASH and the XFEL

Phase space tomography at FLASH + Diagnostics at XFEL

Long. phase space diagnostics / slice emittance measurements at PITZ

Optical master oscillator for FLASH



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Deutsche Forschungsgemeinschaft ÐFG

Research Training Group



01.10.1997 - 30.09.2006

University training program established for a specific time period to support young researchers in their pursuit of a

professores & 1 leading scientist

46 scholarships & 51 Research Trainees

Professor Dr. Dr. h.c. mult. Achim Richter

in total approx. 110 Physicists & Engineers

72% of the 29 PhDs (30.09.2006) became PostDoc at BESSY, CERN, DESY, GSI,

(eq. 2-3 per year over 9 years)

Excellent example of a well coordinated education / training of young accelerator scientists and engineers.

The New Doctoral Program at CERN



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CERN Doctoral Student Programme

At present 85 students CERN supervisor plus university teacher Technically orientated (no experimental nuclear or high energy physics topics like analysis of...) 2-3 years at CERN; PhD at home university So far only very few German students

BMBF Doctoral Student Programme (Wolfgang Gentner Program)

Approx. 20 students per year over 3 years

Same conditions as CERN program. Goal: increase number of German CERN employees

KET Helmholtz-Alliance & Accelerator Physics

www.terascale.de



RT4: Accelerator Physics

Research Topics: RT1: Physics Analysis RT2: Grid Computing RT3: Detector Technologies The Strategic Helmholtz Alliance 'Physics at the Terascale' forms a structured network comprising 17 universities, 2 Helmholtz institutes and 1 Max Planck Institute. The Alliance will act as a tool for a more effective collaboration, in particular between experimentalists and theorists.

- Offer lectures
- Young investigator group at DESY (equiv. Junior Prof. incl. 1 PD and 1 PhD Student) for 5 years

Main emphasis:

High gradient Cavities and/or beam diagnostics

Job Advertisement and Candidates

Deutsches Elektronen-Synchrotron Particle and Accelerator Physics



Deutsches Elektronen-Synchrotron

Hochfrequenztechni

DESY is one of the leading accelerator centres worldwide. The Laboratory's main research areas comprise a broad

program of photon synchrotron sources lasers, and research i physics.

For analysis of HERA LHC, and for the prepa ILC (accelerator and ex

DESY Fellowships

at Hamburg and Zeutl completed their Ph.D. v their application incluc (curriculum vitae, list degree). They should a to be sent to the person The DESY Fellowships the possibility for prolo DESY ist eines der weltweit führenden Beschleunigerzentren. Die Schwerpunkte der Forschung umfassen ein breites Programm der Photonenwissenschaft, inklusive Bau, Betrieb und Nutzung von Synchrotron-Lichtquellen und von Röntgenlasern, sowie der Forschung im Bereich der Elementarteilchen- und Astroteilchenphysik. Die Forschung bei DESY basiert auf dem Zusammenwirken von Photonenwissenschaft, Teilchen- und Beschleunigerphysik. 3000 Forscher aus aller Welt nutzen die Beschleunigeranlagen von DESY.

Die Gruppe -MHF-p- ist verantwortlich für Entwicklung, Aufbau und Betrieb der Hochfrequenzsenderanlagen der Protonenringbeschleuniger und der supraleitenden Linearbeschleuniger. Für unseren Hamburger Standort suchen wir zum nächstmöglichen Termin eine/-n

Diplom-Ingenieur/-in (FH) Fachrichtung Elektrotechnik

Sie werden sich an der Konzeption und Detailauslegung der Hochfrequenzsenderanlagen (1.3GHz, 10MW, 1.5ms, 10Hz) für den geplanten europäischen Freie-Elektronen Röntgenlaser XFEL beteiligen. Dazu gehören insbesondere die detailierte Auslegung und Spezifikation der einzelnen Komponenten, deren Beschaffung, Test und Inbetriebnahme und die Erstellung von Gefährdungsanalysen und Arbeitsanweisungen. Zudem werden Sie sich an der Modernisierung der bestehenden Senderanlagen des FLASH VUV-FEL beteiligen. Since a few years **only very few German candidates** apply for open positions in accelerator physics and technology. This is true for CERN and DESY. Obviously we still have **not a sufficient number of young scientists or are not attractive.**

Possible reasons / findings:

- can we offer a career at research institutes? ('so far, at the end, normally we could / can find a permanent position for all excellent, strongly engaged, young scientists')
- with the actual forms of funding (typ. project related) we offer non-permanent positions for specialists; candidates are difficult to find
- the job definition becomes less important ('if I have to accept a time limited contract then I better check income, evaluate leisure time facilities, search for international atmosphere, i.e. go to industry, to the U.S., to CERN, PSI...')

We (as a Community) Should ...

We should support **university programs**.

We should strengthen the relation between research institutes and universities.

Good examples like the *Graduiertenkolleg* exist.

Helmholtz-Allianz and CERN Doctorate Programme are a good starting point.

Nevertheless, we should **improve the education of accelerator physicists & engineers** in order to get more candidates when offering positions.

While searching experts for project-orientated tasks we should not forget educating all-round accelerator physicists.

The perfect candidate has

- a broad education in physics
- a diploma in accelerator related physics / technology
- managed his own little project (PhD) with experience in supervising eng./ techn. or young students
- seen more than one laboratory or worked in an international collaboration

KET Conclusion or The Way to Go

At present research institutions see approx. 50% out of 20 German PhD per year.

Research institutes (CERN, DESY, GSI, ...also smaller institutes) can offer approx. 20 PostDoc and 5 -10 permanent positions per year in total.

Consequence: more than 50% of the PostDocs are Non-German (fine...)

good candidates for permanent positions (i.e. groupand/or project leader)are difficult to find;

we have to educate more 'perfect candidates' (see previous slide)

Large projects like FAIR, XFEL, (ILC) need to include students.

Smaller and small projects at universities need sufficient support.

Special programs are more than welcome.

Improved communication can help strengthening the cooperation between university teachers and supervisors at research institutes.



Many Thanks for Providing Information and for Detailed Discussion

| DESY |
|-------------------|
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| |

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