Particle Physics in Germany

R-ECFA visit to Germany, Bonn, 2014

P. Schleper
Committee for Elementary Particle Physics (KET)
Science Case

Since last RECFA visit in 2007

Technological break through

• LHC accident, repair, great start
• Experiments got finished and perform better than expected, computing Grid works

Scientific break through

• Theoretical tools for higher order calculations
• Discovery of a Higgs
  Standard Model? Mass in SUSY range!
• Observation of Rare b-decays

Tensions & Phase transitions

• Higgs and top mass, neutrino properties
• High precision cosmology data, LHC searches, Rare b-decays, LHC/direct/indirect DM searches
  ➔ Bridge the gap between HEP and cosmology
  ➔ Phases and phase transitions of the universe

The best is yet to come:

• LHC upgrade, BELLE-II, DM, Cosmology

Phase transition of public awareness

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Organisation of Community

Astro-Particle

KAT

- Dark Matter
- Neutrinos w/o accelerators
- Cosmic rays
- Gamma astronomy
- Nuclear astrophysics
- Gravitational waves

See talk by C. Weinheimer

Particle Physics

KET

- LHC: ATLAS, CMS, LHCb
- Tevatron, HERA
- Belle-II
- Neutrinos @ accel, OPERA
- Fixed target experiments
- Theory, incl. math. Physics

This talk

Hadron & Nuclei

KHuK

- Heavy Ion, ALICE
- FAIR experiments
- Nuclear structure

See talk by J. Wessels

Mandate of KET

- Elected by all scientists
- Defines research strategy and priorities
- Represents community at funding agencies
- Public outreach

Accelerators

KfB

Accelerator R&D in all research areas particle, nuclear and photon science

See talk by Boine-Frankenheimer

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Particle Physics Institutes

Particle physics with accelerators:

Universities
- 25 Universities
- Mostly both theory and experiment
- ~ 80% of scientists

Helmholtz Centres
- DESY at Hamburg and Zeuthen
- KIT, Karlsruhe
- GSI, Darmstadt

Max-Planck Society
- MPI for Physics, München
- MPI for Nuclear Physics, Heidelberg

CERN

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Priorities of the German Community

Last update in December 2012

• input to European strategy process
• after LHC startup, Higgs discovery
• after proposal by the Japanese scientific community to host the ILC

1. LHC running and optimisation are of highest priority
2. High luminosity LHC and Phase-II detector upgrade
3. Linear e+e- collider: enthusiastic support for Japanese proposal, contribute actively to the realisation
4. Flavour physics with LHCb and Belle-II
5. Participation in further international projects, in particular neutrino physics, should be enabled
6. R&D on accelerator and detector technology
7. Theory, in particular related to experiments
8. Strong role of CERN and CERN council

Very much in line with the European Strategy for Particle Physics

• Strongly supported in Germany
Funding by federal Government (BMBF)

Verbundforschung
- Only accelerator related part is shown

Verbundforschung
- Backbone of University participation in large infrastructure, long time scales
- Matched by University funds
- Increase visible, but less than inflation
- 20% overhead as of 2012 to cover, major effort by BMBF to add this on top is much appreciated
- Level now at 21 M€ /year to be compared to 200 M€ /year for CERN budget
Funding

**BMBF**
- 20.3% of CERN budget, ~ 200 M€

**BMBF Verbundforschung**
- Project funding for Universities
- 3 years period until 2012: 51.3 M€
- 3 years period until 2015: 64.0 M€ now including 20% overhead
- Research-clusters (FSP) on ATLAS, CMS
- Gentner program for technical students

**Helmholtz**  
*see talk by J. Mnich*

**Alliance “Physics at the Terascale”**  
2 Helmholtz centres + 18 Unis + MPI  
26 M€, 2007-2014  
→ greatly enhanced collaboration between institutes in Germany
- **Computing boards** continue to coordinate all German LHC T1,2 centres and NAF
- **Accelerator and detector** projects are nuclei of the new “Matter and Technology” research area in Helmholtz
- Closely entangled LHC detector projects DESY/KIT/Universities
- **Schools for students, Phds and Postdocs** on particle physics are fully continued
Funding by German Science Foundation (DFG)

Hadron and Particle Physics

- Graduate schools
- Integrated research clusters
- Individual grants
- ...

Restricted to non-BMBF projects
Smaller experiments, theory

20% success rate
Increasingly successful

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- Sonderforschungsbereiche
- Graduiertenkollegs
- Schwerpunktprogramme
- Forschergruppen
- Einzelförderung

Funding by German Science Foundation (DFG)

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Particle Physics Community

**KET Survey in 2013** includes Helmholtz, Max-Planck, Universities, CERN

- Most sites participate in BMBF research clusters (FSPs) or HGF-Alliance
- Successful in DFG and EU grants

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Third party funding

Number of postdocs and PhD students

- Total postdocs experiment: 261; total postdocs theory: 203;
- Total PhD students experiment: 474; total PhD students theory: 221

Postdocs & PhD students: 50 – 70% third party funding
Adding permanent scientists: 50% base funding, 50% third party funding
Manpower and Projects

Manpower:

incl. PhD students
• Experiment: 951
• Theory: 508

Focus on
• ATLAS & CMS (75%)
• b-Physics
• linear collider
• phenomenology

FTE per subject

- other theory subjects: 74
- mathem. physics, string theory: 116
- particle phenomenology: 318
- other experiments: 64
- linear collider preparation: 73
- double beta decay, neutrino mass: 32
- neutrino ph. without accelerators: 13
- neutrino ph. with accelerators: 8
- HERA: 24
- Belle / Belle II: 61
- LHCb: 43
- ATLAS, CMS, Tevatron: 635

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A particular strength:
Many young scientists

Employees in particle physics in Germany
total: 1475; total experiment: 939; total theory: 536
Women in science

- ~ 20% female students (was 10%)
- ~ 30% PhD students, Junior-Profs and YIG leaders (increasing)
- ~ 10% of permanent staff (up to now)
Number of permanent positions is limited

retirements within the next 5 years

• Experiment: 26
• Theory: 14
Tenure track mostly at Helmoltz Institutes
Number of JProfs and YIG leaders is 10 times smaller than number of postdocs
But similar to number of retirements within next 5 years
Typical career path: PhD → 1.Postdoc → 2.Postdoc → JProf/Yig → permanent
1/3 chance to get to the next career step up to JProf/Yig or permanent
Critical items

LHC experiments ➔ see talk by K. Desch
- Phase-II detector upgrades require extra funds on top of current BMBF / Helmholtz / MPI funding
- All 4 exp: 97 M€, + inflation + 20 % contingency: 125 M€, + 20 % overhead
- Proposal in 2013 to BMBF to add LHC Phase-II to national Roadmap of large infrastructure ➔ decision process initiated by BMBF with HGF and MPG!
- BMBF/HGF funding periods require decision this year to obtain funds until 2018
- LHC on the Roadmap is essential to obtain matching funds and long term support of research field by Universities.

LHC Computing ➔ see talk by Ch. Zeitnitz
- Investment degrading as of 2015 ➔ critical shortage in 2016
- 75% from Helmholtz: depends on successful application
- 25% from Universities: lack of short and long term means of application

Support of new projects
- Allow for limited funds for preparation of new major (LC, FCC?) and outstanding smaller projects.

Support of young scientists
- Harsh selection, few open positions in next 5 years
- Should enforce visibility and individual funding for best young scientists
Summary

Particle physics in Germany

- Highly dynamic field with results of major impact
- Much increased public recognition and fascination for fundamental physics, also due to LHC, Higgs, impact on cosmology

German contribution

Cornerstone of European particle physics

- Long term vision by all funding agencies
- Importance of close interconnection of Verbundforschung + Helmholtz + MPG
- Excellent integration in international community
- LHC: Excellence in both accelerator and detector contribution
- Major impact on LHC phenomenology, analysis and discovery(ies)
- Major contribution also to Belle-II detector

Critical items

- LHC detector Phase-II upgrade costs → German Roadmap
- LHC Computing at HGF and Universities
- New projects on major and on smaller scales
- Career path of young scientists
Backup

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Particle Physics Community

Percentage of foreign employees

- total experiment: 24%
- total theory: 40%

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