Particle Theory in Germany

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Overview

1. Topics in Particle Theory
2. Institutions in Germany
3. Cooperation with DESY-TH and CERN-TH
4. Funding Situation of Particle Theory
5. The next generation: Situation of Junior Scientists

Topics in Particle Theory

- No strict borders between:
  - Nuclear Physics Theory
  - Astro-Particle Physics / Particle-Astrophysics
  - Mathematical Physics
  - Gravitation
  - Solid State / Condensed Matter Physics
- Cathegories have to be taken with a grain of salt

- Electroweak and QCD (EWK/QCD)
- Beyond the SM, e.g. SUSY (SUSY)
- Flavour Physics (including Neutrinos) FLAV
- Monte Carlo and Computer Algebra (MCCA)
- Lattice Gauge Theory (LGT)
- String Theory (ST)
- Mathematical Physics/Gravitation (MP/G)
- Particle-Astrophysics or Astro-Particlephysics, Cosmology (ASTRO)

Institutions in Germany

- New Group in Dresden
- New Group in Göttingen
- More than one group in some places

Topics an Places

- **Aachen:**
  3 Profs., 4 FTE Univ. 6 FTE other, 6 PhD
  FLAV, EWK/QCD, SUSY
- **Berlin: Humboldt Universität:**
  3 Profs., 5 FTE Univ. (2 Perm.), 5 FTE other, 8 PhD
  LGT, ST
- **Bielefeld:**
  6 Profs., 11 FTE, 10 PhD
  LGT, ASTRO
- **Bonn:**
  4 Profs., 7 FTE Univ. (1 Perm), 10 FTE other (incl. PhD)
  MP, SUSY, ASTRO

- **DESY Hamburg:**
  3 Profs., 26 FTE DESY (11 perm). 10 FTE other, 26 PhD. EWK/QCD, SUSY, ST, ASTRO
- **DESY Zeuthen:**
  1 Prof. (zusammen mit Uni Potsdam),
  14 FTE (6 Perm), 10 PhD.
  EWK/QCD, LGT
- **Dortmund:** 3 Profs., 5 FTE Univ. (1 Perm), 2 FTE other, 8 PhD. EWK/QCD, FLAV, ASTRO
- **Dresden:** 1 Prof. 1 FTE Univ., 2 PhD.
  EWK/QCD, SUSY, MCCA New Group
- **Freiburg:**
  1 Prof. 1 JProf., 3 FTE Univ., 1 FTE other
  SM/QCD, SUSY

- **Göttingen:**
  2 Profs., c.a. 2 FTE
  MP/G, EWK/QCD and/or SUSY
  New Group, initially funded by Helmholtz Alliance!
- **Hamburg: Universität:**
  4 Profs., 14 FTE, 17 PhD.
  MP/G, EWK/QCD, ST
- **Hannover:** 2 Profs., 1 FTE Univ., 2 FTE other, 3 PhD.
  MP/G, ST, SUSY
- **Heidelberg Uni:**
  3 Profs., 4 FTE Univ. 6 FTE other, 8 PhD.
  EWK/QCD, ST, ASTRO
- **Heidelberg MPIK:**
  2 Profs., 6 FTE., 8 PhD., (FLAV nu)

- **Jena:** 1 Prof., 2 FTE, 4 PhD., MP/G
- **Karlsruhe:**
  5 Profs., 6 FTE Uni. (1 Perm.), 13 FTE other, 17 PhD.
  FLAV, EWK/QCD, SUSY, MCCA
- **Leipzig:** 3 Profs., 3 FTE Univ., 3 FTE other, 8 PhD.
  MP/G, LGT
- **Mainz:**
  4 Profs., 3 FTE Univ. (1 Perm), 2 FTE other, 3PhD.
  FLAV, EWK/QCD, LGT
- **München: Ludwig Maximilian Universität:**
  4 Profs., 3 FTE Univ., 4 FTE other, 13 PhD.
  FLAV, ST

- **München: Technische Universität:**
  3 Profs., 2 FTE Univ (1 Perm), 3 FTE other, 14 PhD.
  FLAV, EWK/QCD, SUSY, ASTRO
- **München: Werner Heisenberg Institut (MPG):**
  2 Profs., 21 FTE (8 Perm), 32 PhD.
  EWK/QCD, SUSY, ASTRO
- **Münster:**
  2 Profs. 3 FTE Univ., 3 FTE other, 12 PhD.
  LGT, SUSY
- **Regensburg:**
  1 Prof., 1 FTE Univ., 2 FTE other, 3PhD..
  FLAV, EWK/QCD

- **Siegen:**
  3 Profs, 4 FTE Univ. (2 Perm), 5 FTE other, 8 PhD.
  FLAV, SM/QCD, SUSY, MCCA
- **Würzburg:**
  2 Profs., 3 FTE Univ. (1 Perm), 8 FTE other, 8 PhD.
  FLAV, EWK/QCD, SUSY, MCCA
- **Wuppertal:**
  3 Profs., 3 FTE Univ. (1 Perm), 1 FTE other, 7 PhD.
  EWK/QCD, LGT

Total Numbers of Theorists in Germany

- Professors and senior staff: 67
- Permanent (senior) Scientists: 39 !
  only 14 at Universities
- Fixed Term positions
  funded from Universities: $\sim$ 95 FTE's
- Fixed Term Positions
  from other sources: $\sim$ 130 FTE's
- PhD Students: $\sim$ 240
- Strong Groups working on the LHC-related Topics
  EWK/QCD, SUSY, FLAV, MCCA

Cooperation with DESY-TH

- DESY remains the major national Lab in Germany
- Strong particle theory group
  - Currently very strong in ASTRO and cosmology
  - Successor of P. Zerwas:
    $\rightarrow$ Strong Group in Particle Phenomenology
- Remains a “Meeting place” for german theorists:
  e.g. DESY Theory workshop
- Will play a leading role within the Helmholtz alliance, also for theorists

Cooperation with CERN-TH

German theorists in CERN–TH:

- One Permanant Staff Member in ST
- One Permanent Staff Member in Heavy Ions
- One staff members (five years contracts)
- Four regular postdoctoral fellows
  $\longrightarrow$ 2 or 3 Postdocs per year
- Few externally paid Postdocs

$\longrightarrow$ Two out of nine permanent staff members

$\longrightarrow$ About 10 German Theorists out of (about) 160 CERN–TH members !

- Improvement through the new program of BMBF (fixed term fellows)

Funding Situation of Particle Theory

Main Sources of Support (on top of University Resources):

- Deutsche Forschungsgemeinschaft (DFG)
  - Sonderforschungsbereiche (Special Research Centers)
  - Graduiertenkollegs (Graduate Schools)
  - Schwerpunktprogramme (Special Research Programs)
  - Forschergruppe (Research Groups)
  - Normalverfahren (Individual Applications)
- Bundesministerium für Bildung u. Forschung (BMBF)
- Helmholtz Alliance
- European Community

Remarks:

- Very few DFG-Sonderforschungsbereiche due to strong BMBF Support in Experiment
  Recently a few exceptions
- BMBF Support only for theory directly related to a BMBF supported experiment.
- Main Source of Funding for Particle Theory is DFG
- Significant contribution of BMBF only in phenomenological theory

DFG Sonderforschungsbereiche

- **SFB-TR09**
  "Computergestützte Theoretische Teilchenphysik"
  Aachen, Karlsruhe, Berlin
  Computational Aspects of MCCA, EWK/QCD, LGT, FLAV (Theory only)
- **SFB 676**
  "Teilchen, Strings und frühes Universum: Struktur von Materie und Raum-Zeit"
  Hamburg
  Strong in ST, small experimental component

- **SFB-TR27**
  "Neutrinos and Beyond –Weakly Interacting Particles in Physics, Astrophysics and Cosmology"
  München, Heidelberg, Karlsruhe, Tübingen
  Mainly ASTRO and Neutrinos
- **SFB 647**
  "Raum - Zeit - Materie: Analytische und geometrische Strukturen"
  Berlin
  mathematical physics and strings
- Two applications are running ...
- Funding Volume approx 2 MEuro per year for a typical SFB

DFG Graduiertenkollegs

- **GRK 570** Mainz
  "Eichtheorien - experimentelle Tests und theoretische Grundlagen"
- **GRK 570** Hamburg
  "Zukünftige Entwicklungen in der Teilchenphysik"
- **GRK 729**: Aachen
  "Elementarteilchenphysik an der TeV-Skala"
- **GRK 742**: Karlsruhe
  "Hochenergiephysik und Teilchenastrophysik"
- **GRK 881:** Bielefeld, Orsay
  "Quantenfelder und stark wechselwirkende Materie"

- **GRK 1054:** München
  "Teilchenphysik im Energiebereich neuer Phänomene"
- **GRK 1102:** Freiburg
  "Physik an Hadron-Beschleunigern"
- **GRK 1147:** Würzburg
  "Theoretische Astrophysik und Teilchenphysik"
- Usually a mix of Theory and Experiment
- About 10 to 20 PhD Fellowships per Graduate School

BMBF Funding in Particle Theory

BMBF Theorie-Verbund: Begleitende theoretische Untersuchungen zu den Experimenten an den Großgeräten der Teilchenphysik

Theoretical Investigations related to the large experiments in particle physics

- Cooperation between nine Institutions
- Phenomenology closely related to BMBF funded experiments
- In total 16 FTE's and travel funds
- www.bmbf-thvb.physik.uni-siegen.de

Theory in the Helmholtz Alliance

- Focus on new structures
- Focus on Interaction between Theory and Experiment
- Long term effects
- Some new theory professorships
  - Berlin (Humboldt Univ.) (JProf.)
  - Göttingen (JProf., early replacement of a MP/G)
- Tenure track positions at Karlsruhe and Siegen

EU Funding in Particle Theory

EU-RTN Networks in the sixth framework

- *FLAVIANET: Flavour Physics*
  (Karlsruhe, Aachen, DESY HH, Siegen, TU München)
- *Constituents, Fundamental Forces and Symmetries of the Universe*
  (München)
- *The Quest For Unification: Theory Confronts Experiment*
  (Bonn, Hamburg)
- *The European Superstring Theory Network*
  (München, Hamburg)

- HEPTOOLS: Tools and precision calculations for Physics discoveries at colliders (DESY, MPI München)
- MCNET: Monte Carlo Event Generators for High Energy Particle Physics (Karlsruhe)

Situation of Junior Scientists

Funding for outstanding young investigators:

- Emmy Noether Programme of DFG (ENG)
- Young Investigator Groups in the Helmholtz Alliance (YIG HA)
- HGF Young Investigator Groups (HGF YIG)
- Junior-Professorships (JP)
- Heisenberg Fellowship Programme of DFG (HF)
- Others (e.g. Kovalevskaja Fellowships of Humboldt, Marie Curie (EU))

- **Uni Hamburg:**
  1 HGF YIG (EWK/QCD) and 1 ENG (MP/G)
- **Karlsruhe:**
  1 YIG HA (MCCA) and 1 HF (EWK/QCD)
- **Würzburg:**
  1 ENG (EWK.QCD) and 1 other (Neutrinos)
- **DESY Hamburg:**
  2 JP (EWK/QCD), 1 YIG HA (ASTRO), 1 other (ST)
- **Freiburg:** 1 JP (SUSY)
- 11 Positions ... (Possibly incomplete)
- Expect an increase due to appointments of Helmholtz Alliance and Excellence Initative

- Sufficient number of fixed term postdoc positions
- Still too few Tenured Scientists Positions at the Universities ("wissenschaftlicher Mittelbau"),

  (permanent positions at a level below a proferssorship)
- Transition to tenure should
  - more transparent / straightforward
  - happen earlier
- Young scientists are going into particle physics and take the (theory) challenge

Summary

- Total Funding is sufficient
- Many (and new) sources of support
- Funding from the Universities still not satisfactory (funding for the Univerities from the “Länder”)
- Situation of young scientists:
  - Sufficient number of fixed term positions
  - Transitions to tenure ... ?
- Total manpower is sufficient to take the (theory part of) the LHC challenge