TWEPP 2016 - Topical Workshop on Electronics for Particle Physics

(High Energy) Particle Physics in Germany

Activities, Organization and Perspectives

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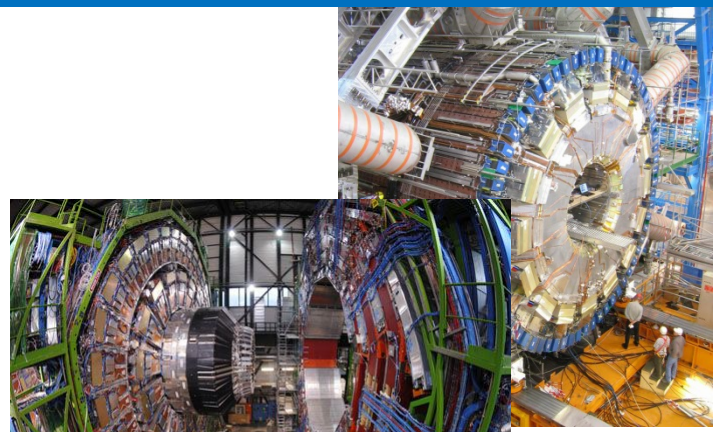
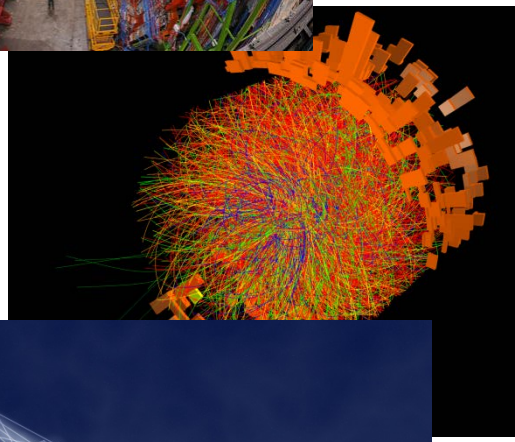
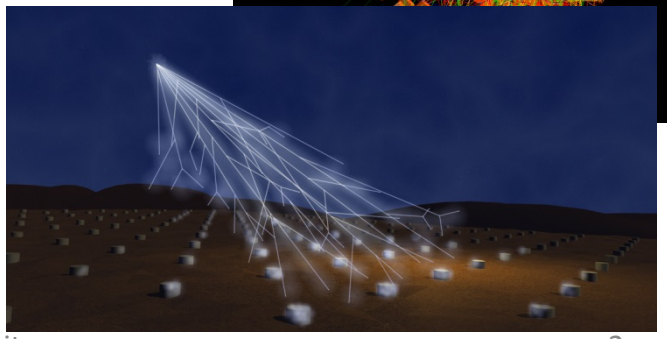
German Particle Physics Activities

- High energy physics (accelerator based)
  - LHC, flavour-physics, rare decays, dark matter, Neutrinos, …
- Astro particle physics
  - Cosmic Rays, Gamma rays, Neutrinos, …
- Hadron and Nuclear physics
  - Heavy Ions, dark matter, Neutrinos, nuclear structure, anti-matter, …
- Strong R&D in all areas
  - Detector and accelerator technology, electronics, computing





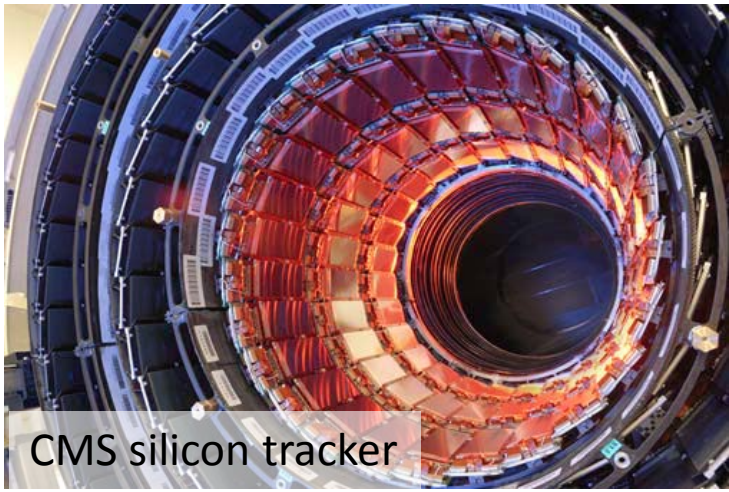


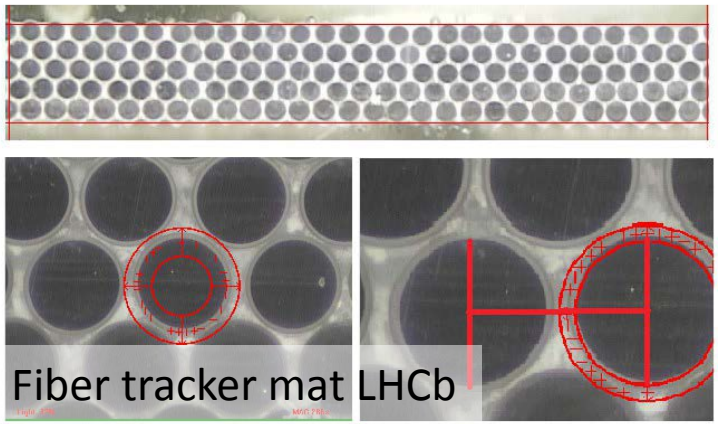
Experiments with German involvement

- High energy physics (accelerator based)
  - ATLAS, CMS, LHCb, ALICE, Belle II, NA62
- Astro-particle
  - AUGER, ICECube, HESS, MAGIC, CTA, KATRIN, GERDA, Double Chooz, JUNO, XENON
- Hadron physics and nuclear structure
  - ALICE, COMPASS
  - GSI/FAIR Experiments
  - Experiments at MAMI (Mainz) and ELSA (Bonn) accelerators
- And more …

Some Detector Technologies

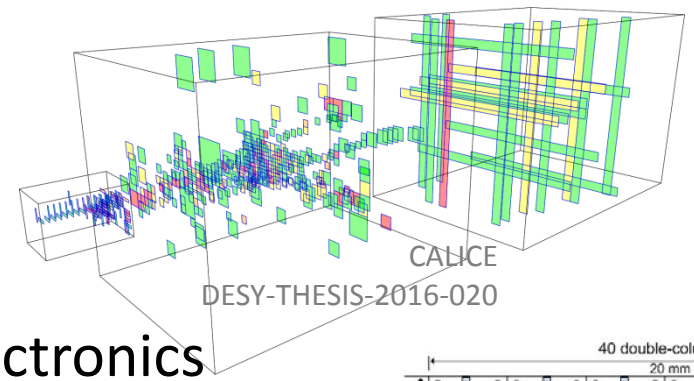
- Tracking detectors
  - Silicon based pixel detectors
    - ATLAS, CMS, Belle II
  - TPC technology
    - ALICE, ILD
  - Myon chambers
    - ATLAS, CMS
  - Scintillating Fiber Tracker
    - LHCb

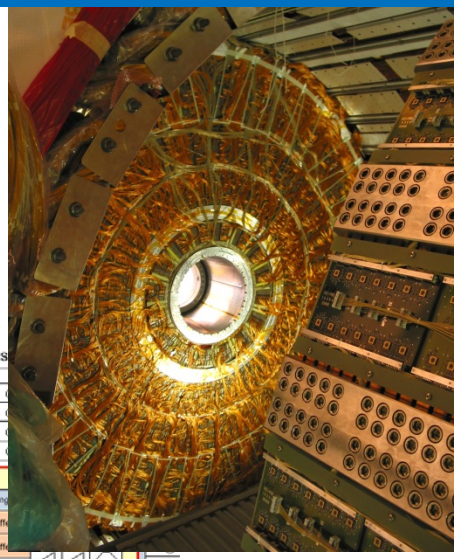

CMS silicon tracker

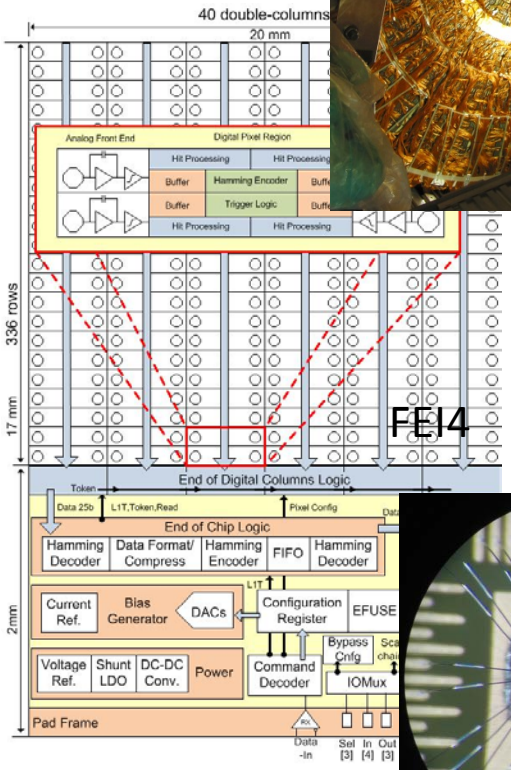

Fiber tracker mat LHCb

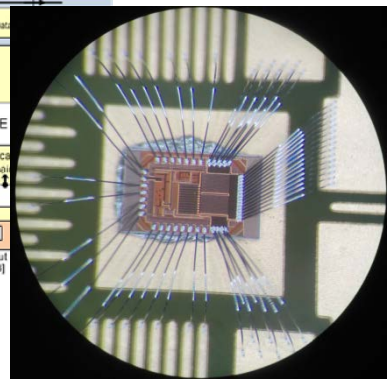
Some Detector Technologies (2)

- Calorimetry
  - ATLAS, CALICE
- Electronics
  - Radiation hard electronics
  - Front-End electronics
  - DAQ
  - Trigger
  - Detector monitoring and control
- And more …
- German groups cover the whole range of detector technologies









R&D for LHC Phase II Upgrades

- Tracking Upgrade of ATLAS, CMS and LHCb
  - Aachen, Berlin, Bonn, DESY, Dortmund, Freiburg, Göttingen, Hamburg, Heidelberg, Karlsruhe, MPI Munich, Siegen, Wuppertal
- Calorimeter electronics (ATLAS)
  - Dresden, MPI Munich
- Myon Systems electronics (ATLAS, CMS)
  - Aachen, Freiburg, Munich, MPI Munich, Heidelberg, Würzburg
- Trigger (ATLAS)
  - Heidelberg, Mainz, DESY, Heidelberg

Institutional Structure in Germany

- Universities in the 16 states
  - Teaching and research
- Centers of the Helmholtz Association
  - Research
  - 18 centers
  - 3 directly involved in particle physics
- Max Planck Institutes
  - Research
  - 83 institutes
  - 2 directly involved in particle physics
- International
  - CERN, LNGS, KEK …

Institutions in Germany

- 29 Universities
  - Base funding: states
- 3 Helmholtz centers
  - DESY
    - Hamburg, Zeuthen
  - KIT, GSI
  - Funding: 90% federal funds, 10% states
- 2 Max Planck Institutes
  - Munich, Heidelberg
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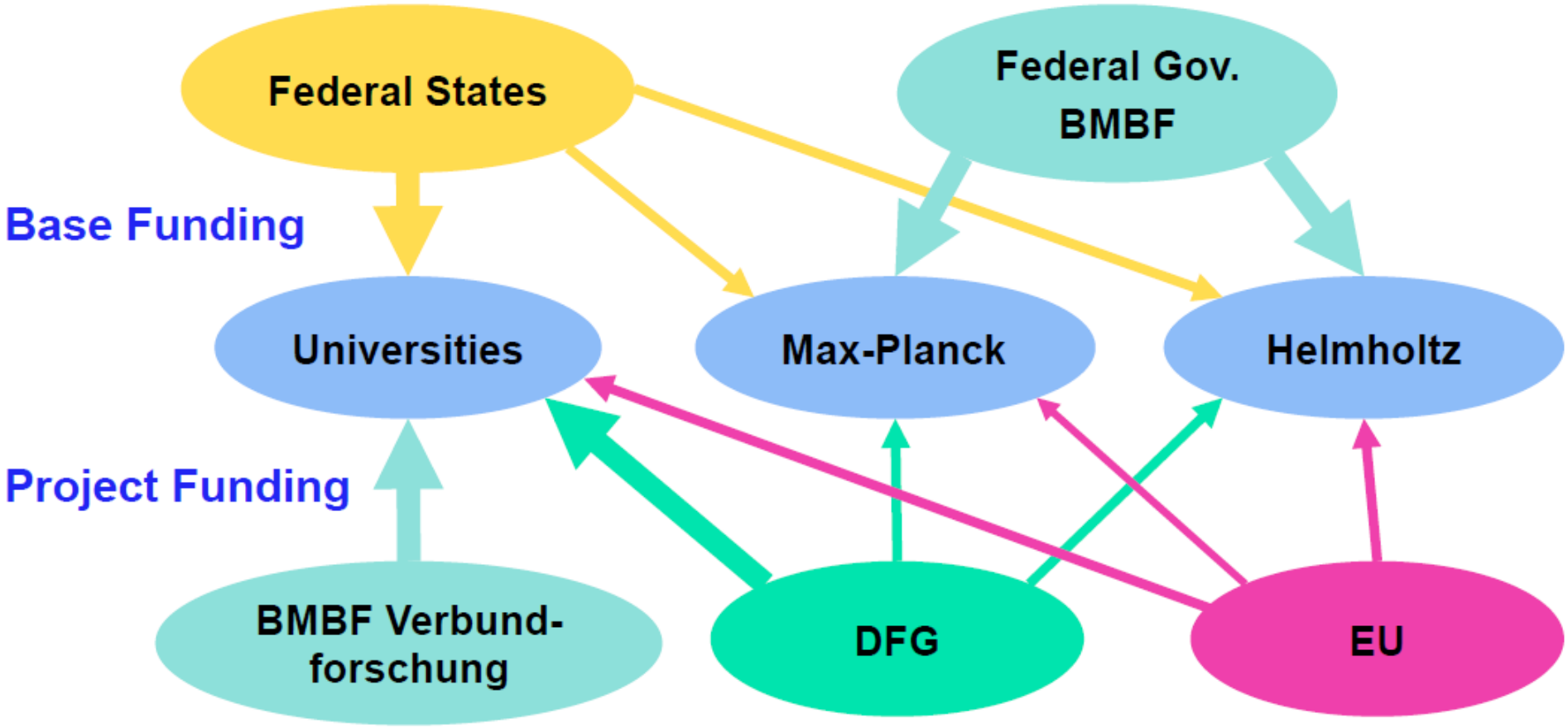
Diverse Research Funding

- 16 States
  - provide base funding for University groups
    - Funding of permanent positions
    - Technical personnel
    - Office and laboratory space and equipment
    - Workshops
  - Funding to Max Planck institutes and Helmholtz centers
- Federal government
  - Direct contribution to CERN (20% of the budget)
  - Funding of Max Planck institutes and Helmholtz centers
  - Project based funding for University groups
    - German Science Foundation (DFG)
    - Projects which are in the “national interest” (e.g. CERN exp., KEK exp., CTA, Auger …)

Research Funding



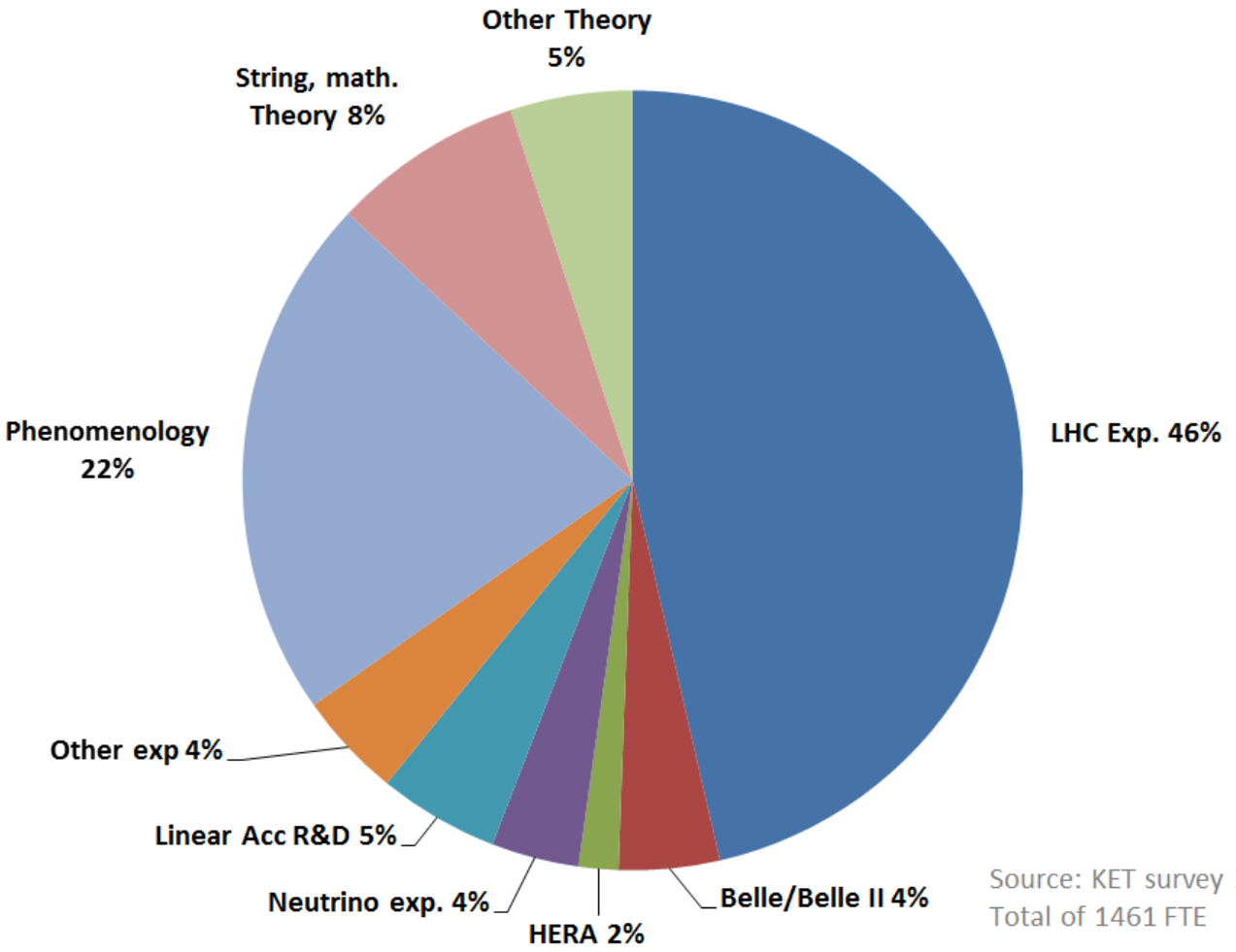
Scientists in HEP

Theory and experiment

- 129 Professors
- 192 permanent scientists
- 40 young investigator group leaders
- 463 postdocs
- 695 PhD students (25% non-German)

Source: KET survey in 2013

HEP Work Subjects (experiment and theory)



Source: KET survey 2013
Total of 1461 FTE

Self-Organization

- Elected committees of certain communities
  - HEP: Komitee für Teilchenphysik (KET)
  - Astro particle physics: Komitee für Astroteilchenphysik (KAT)
  - Hadron and nuclear physics: Komitee für Hadronen und Kerne (KHuK)
  - Accelerator: Komitee für Beschleuniger (KfB)
- Committees represent the communities in different national and international bodies
- Provides a body to discuss strategies and solve common problems

Priorities of the German HEP Community (2012)

1. Best possible utilization of the scientific potential of the LHC
2. Upgrade the LHC and the experiments for the higher energy and collision rate
3. Contribute actively to the realization of an international linear accelerator as the next big particle physics project
4. Push forward international precision experiments in the area of b-Meson physics
5. Participate in other international projects, especially in the area of Neutrino physics
6. Develop new accelerator and detector concepts
7. Strong theory program ro support the experimental projects

Priorities of the German HEP Community (2012)

The European Strategy for Particle Physics
Update 2013

Preamble

Since the adoption of the European Strategy for Particle Physics in 2006, the field has made impressive progress in the pursuit of its core mission, elucidating the laws of nature at the most fundamental level. A giant leap, the discovery of the Higgs boson, has been accompanied by many experimental results confirming the Standard Model beyond the previously explored energy scales. These results raise further questions on the origin of elementary particle masses and on the role of the Higgs boson in the more fundamental theory underlying the Standard Model, which may involve additional particles to be discovered around the TeV scale. Significant progress is being made towards solving long-standing puzzles such as the matter-antimatter asymmetry of the Universe and the nature of the mysterious dark matter. The observation of a new type of neutrino oscillation has opened the way for future investigations of matter-antimatter asymmetry in the neutrino sector. Intriguing prospects are emerging for experiments at the overlap with astroparticle physics and cosmology. Against the backdrop of dramatic developments in our understanding of the science landscape, Europe is updating its Strategy for Particle Physics in order to define the community's direction for the coming years and to prepare for the long-term future of the field.

Update of the Priorities of the German Particle Physics Community

- Determine the interest of the German community within next 2 years
  - What are the next big projects to participate in?
  - Which physics topics are of interest to the community?
  - What is the German strategy for the next decade(s)?
- Topics of workshop series
  - e^+e^--Colliders (May 2016)
  - Neutrinos (early 2017)
  - non-Collider Experiments (2017)
  - Hadron Colliders (2018)
- Most workshops target HEP, Astro particle, Hadron and nuclear physics community
- Final Summary workshop will yield a priority list of topics
- Input to next European strategy discussion ~2019
- This is especially of interest for young scientists!

KE a

Max- 16

1. The phy om M_Z up to the TeV and in fact requiri chine.[i]

2. The ILC kshop.[ii] It is current erefore this project, cussed to be hosted esult of this worksh

3. FCC-ee, ell cover the low-ene d thus be comple

4. CLIC ha han the ILC. CLIC R& RN projects, based 2019/2020 Europe

Conclusions of the

KET Workshop on Future e^+e^- Colliders[a]

Max-Planck-Institut für Physik Munich, May 2-3, 2016

1. The physics case for a future e^+e^- collider, covering energies from M_Z up to the TeV regime, is regarded to be very strong, justifying (and in fact requiring) the timely construction and operation of such a machine.[i]

2. The ILC meets all the requirements discussed at this workshop.[ii] It is currently the only project in a mature technical state. Therefore this project, as proposed by the international community and discussed to be hosted in Japan, should be realised with urgency. As the result of this workshop, this project receives our strongest support.[iii]

3. FCC-ee, as a possible first stage of FCC-hh, and CEPC could well cover the low-energy part of the e^+e^- physics case, and would thus be complementary to the ILC.[iv]

4. CLIC has the potential to reach significantly higher energies than the ILC. CLIC R&D should be continued until a decision on future CERN projects, based on further LHC results and in the context of the 2019/2020 European Strategy, will be made.

Summary

- German particle physics groups are heavily involved in a multitude of experiments
- Substantial contributions to experiments
  - detector/electronics R&D
  - Construction
  - Data analysis
  - theoretical support
- Funding is a complex matter in Germany (institutional an project based)
- Direction of future German participations is under discussion right now
- Technological developments will remain an important pillar of particle physics in Germany