Helmholtz Alliance – HA-101
Physics at the Terascale

Annual Report 2008

19th May 2009

Project Number	HA-101
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Coordinating Helmholtz Centre	DESY
Partners (enumeration)	DESY, FZ Karlsruhe, RWTH Aachen, HU Berlin, U. Bonn, TU Dortmund, TU Dresden, U. Freiburg, U. Gießen, U. Göttingen, U. Hamburg, U. Heidelberg, U. Karlsruhe, U. Mainz, LMU München, U. Rostock, U. Siegen, U. Würzburg, U. Wuppertal, MPI für Physik, München, U. Regensburg
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1 Summary: Project Development

The Helmholtz Alliance "Physics at the Terascale" (www.terascale.de) is a network comprising the Helmholtz Centres DESY and FZ Karlsruhe, 18 German universities and the MPI für Physik, München. It is part of the international research programme which investigates the structure of matter with accelerators at the highest energies, the LHC as well as a future linear e^+e^- collider. It develops structures and supports cooperations that go beyond single sites and experiments and connects theory and experiment. It enables a more effective use of existing funding structures in Germany such as the research groups ATLAS and CMS. Its aim is to collect the expertise and strengths of the participating institutes in Germany, in order to strengthen, also in the long-term, the international role of German particle physics. The Alliance has four scientific pillars: Physics Analysis, Grid Computing, Detector Development and Accelerator Physics.

After the successful start in July 2007, the Alliance structures were further developed and expanded in 2008. Investments were made in targeted infrastructure improvements at the partner institutes and were made available to all Alliance partners.

The heads of five "Young Investigator Groups (YIG)" were selected jointly by the Alliance and the host universities. Four of the positions were filled in the course of the year. Of the 20

internationally advertised advertised fellows, 17 (6 women) positions were filled with excellent young scientists. The "Equal Opportunity" Alliance funding was important for the filling of several of the positions.

The management structures in the Alliance have shown themselves to be very effective and have a established a new form of cooperation within Germany. Through monthly meeting of the Management Board it is possible to react quickly to developments and maintain the contact between the groups. The interactions between the Project Boards, that are directly responsible for four the pillars, the Management Board and the International Advisory Board work well.

Since the start of the Alliance two annual workshops have taken place, each with over 250 participants. A large number of well-received schools and smaller workshops have also taken place and will be detailed below.

After an appropriate change to the Alliance statutes, the University of Regensburg was accepted as an "Adjunct Partner" in October.

The Institute Assembly met during the Alliance annual workshop in November. The International Advisory Board met a few weeks later at DESY, Hamburg. In addition to the reports given on the progress of the Alliance, one of the Young Investigator Group heads discussed the Alliance from the viewpoint of the younger members. A first meeting of the Alliance fellows took place during the Annual workshop, where the representative of the YIGs and Fellows in the Physics Analysis Project Board was elected. In future about 2 meetings per year of the fellows are planned.

After extensive discussions within the management it was decided to more formally involve the flavour physics community in the Alliance. A letter explaining the Alliance position on this topic was sent to the management of the LHCb collaboration. As discussed below representatives from LHCb are now also members of the NAF Users Committee.

After several informal enquiries, a "Call for Proposals" for proposals was issued at the end of 2008, in order to investigate whether the Alliance could assist in the creation or maintenance of further permanent positions at the partner institutes. Two such proposals were submitted and will be evaluated early in 2009.

The "Weltmaschine" Exhibition in Berlin to coincide with the start of the LHC was a certainly a major highlight. Over 30000 visitors came to the exhibition that was supported by the Alliance.

2 Main Scientific Achievements

During the first half of the year both the ATLAS and CMS collaborations completed their detectors, installing the last components and finishing the cabling. As the year went on more and more components were included in tests of the data acquisition systems. By the start of LHC operation in September both detectors were ready to take data.

The start of the LHC machine on 10 September was a huge success. Remarkably both experiments were able to show event displays within a very short time. Events where the beam hit one of the flanges upstream of the experiments proved very useful for adjusting the timing of the detector components as well as providing tracks which traversed the detector horizontally for alignment purposes. These complement nicely the cosmic ray tracks, which are mostly vertical.

After the incident on 19 September, there were no further beams in the machine. However,

both ATLAS and CMS collected a large amount of data from cosmic ray events, which were used to align the detector as well as providing a long-term stress test of the data acquisition and processing systems.

Nice summaries of the LHC start-up and the performance of the two detectors can be found in the plenary talks given at the Spring German Physical Society Meeting in München:

- Martin Weber: Status des Large Hadron Colliders (LHC) und Inbetriebnahme des CMS-Experimentes
  www.etp.physik.uni-muenchen.de/dpg2009/talks/hv6_t6.1_mweber_DPG09_LHC_und_CMS.pdf
- Stefan Tapprogge: Status des ATLAS-Experiments und Erwartungen für Messungen am LHC mit ersten Daten
  www.etp.physik.uni-muenchen.de/dpg2009/talks/dpg09_st_atlas.pdf

During the shutdown that started at the end of the year further improvements to the components are planned and some weaknesses in the reliability of the detectors will be fixed. In February 2009 the CERN management issued a new plan for the LHC startup. First collisions are now expected in late 2009 and the machine will then run almost continuously (without a long winter shutdown) with the aim of collecting at least 100 pb^{-1} per experiment, so that first physics publications can be written.

The preparations for the next big project in particle physics, the linear collider, continued through 2008. The development of high-gradient superconducting acceleration modules was one of the key areas. DESY is the worldwide leading laboratory in this area. Together with partners from the Alliance progress was made on the systematic study of high gradient cavities, in particular through a program of optical inspection of cavities. In parallel the development of detectors for this future facility is ongoing. The Alliance is active in a few key technological areas, e.g. time projection chamber and hadron calorimeter. Through the Alliance the basis of this research in Germany could be significantly broadened. A main focus of the work in 2008 was the preparation of letters of intent for the experiments at the linear collider. The German community is mostly involved in one of the projects, the ILD detector. Also supported by the Alliance-financed infrastructure, German groups could make a big contribution to this document. Increasingly CERN is becoming active in this area as well. Close ties have been established with the relevant CERN groups, and the Alliance-based projects play an important role in this.

German theory groups have been active in 2008 in a wide array of particle physics research. An internationally leading role is played in precision calculations for LHC phenomenology, where a number of technically challenging calculations have been presented in the areas of top quark physics [1, 2], production and decay of weak gauge bosons [3, 4], and Higgs boson properties [5] and production rates [6]. These precision calculations are complemented by phenomenological investigations. Examples include the development of new tools and observables for Higgs boson properties [7], or for tests of supersymmetric models [8, 9, 10] and more general models of electroweak symmetry breaking [11]. Of particular importance for the analysis work within the Terascale Alliance is the development of Monte Carlo tools. In 2008 German groups have made major contributions to the multi-purpose Monte Carlo generator Herwig [12] and to improving the description of the complex hadronic final states at present colliders [13].

2.1 Milestones

The following table lists the milestones as specified in the proposal for 2008 and their status. It also includes those that were not reached in 2007. In these cases the date given in last years report is given in the first column.

Date	Work Package	Milestone	Status
Analysis			
06/2008	WP1	Fill majority of 07/2007 positions	OK
07/2008		Second call for Alliance fellowships and YIGs	10/2007[#1]
04/2008		Start of VTI seminar programme	05/2008
	WP3	Wiki pages available	10/2008
01/2008		Integration of LHC-D workshop series in the Alliance	OK
04/2008		Start of Alliance tutorials and workshops	OK
10/2008		Workshop on analysis techniques and Monte Carlo generators	OK
Grid Computing			
02/2008	WP1	Tier-2 centres operational with first batch of resources	OK
04/2008		NAF operational with first batch of resources	09/2008[#2]
12/2008		Easy to install dCache	OK
01/2008		Start of High Performance Network	OK
05/2008	WP3	Start of Grid training activities	OK
Detector Development			
01/2008	WP1	First 50% of additional positions for VLDT filled	08/2008
01/2008		First round of new infrastructures acquired	06/2008
Accelerator Physics			
12/2008	WP2	Optimisation of capture yield of undulator based positron source	OK
12/2008		Results from studies on beam based alignment techniques under realistic operating conditions	OK

[#1] It was decided very early in the Alliance to offer more fellowships than was written in the proposal. As a result all planned fellowships and YIGs, with the exception of the Accelerator YIG in Hamburg, have already been advertised in 2007 and nearly all are now filled.

[#2] The NAF was fully operational somewhat later than planned, but with substantially more resources due to the hardware funding from BMBF.

3 Physics Analysis

3.1 WP 1: Analysis Network

3.1.1 Analysis Working Groups

In 2008, Alliance Working Groups on "Central Jet Veto" (coord. Schumacher, Zeppenfeld), "Higgs production in association with heavy quarks" (coord. Harlander), "BSM parameter determination at the LHC" (coord. Desch, Dreiner, Krämer) and "m(tau-tau)" (coord. Kobel, Quast) have been formed. These groups consist of experimentalists from different institutions and collaborations and of theorists who collaborate on a specific topic and meet regularly.

3.1.2 Monte Carlo Group

The Monte Carlo group consists of a YIG in Karlsruhe, a tenure-track position in Wuppertal, both paid by the alliance, the Monte Carlo part of the analysis centre and contributions from several German universities. The group contributes to several Monte Carlo generators used by the community. In November 2008 a coordination meeting took place where all participating groups attended and reported on their work. As an outcome of the meeting a coordinated activity on loop corrections to automatic matrix element calculation is planned.

3.1.3 Virtual Theory Institute

The VTI has fostered collaboration between theorists at different institutions by providing travel support for mutual visits, specifically for a collaboration between the Universities of Hamburg and Mainz and between the University of Bonn and the MPI in Munich. The VTI has furthermore launched a successful series of "virtual seminars" broadcast through video-conference facilities. In 2008 three of these seminars were held - partially with renowned external speakers (H. Haber, C. Quigg) - and with about 50 participants from up to 10 institutes each time.

3.2 WP 2: Analysis Centre at DESY

3.2.1 The Analysis Centre Groups

The groups working on Monte Carlo generators and their development, on parton distribution functions and on statistics tools were formed shortly after the initial set-up of the Alliance.

While in the beginning the groups were exclusively staffed by DESY physicists, in the meantime at least the Statistics Tools and the Monte Carlo groups have attracted numerous colleagues from other Alliance institutes, underlining the network character of the Alliance.

The members of the groups (which meet on a regular basis) work on numerous projects, some connected to a specific experiment, but mostly experiment-independent or even purely phenomenological or theoretical in nature. In addition, the groups and their leading members are establishing positions as reference points, accepted for their knowledge and expertise and their good connections to the whole HEP community. In this respect, the manpower put (by DESY) into the groups proves very beneficial: in addition to the Analysis Centre leader, who took office in fall 2008, two positions are available for the Monte Carlo group and one for

the Statistics Tools group (one position was advertised at the end of 2008, the others will be advertised early in 2009).

Furthermore, the groups organised numerous schools and workshops and are contributing to the overall education of the Alliance members, see Section 3.3.

3.2.2 The Knowledge Database

A very specific project of the Analysis Centre aimed at increasing the flow of information, of enabling synergies and increasing the efficiency of collaborations between institutes and also across the experiment borders is the "Knowledge Database".

In the "Knowledge Database" information about activities of individuals and groups and about specific expertise will be stored, ready for retrieval by any Alliance member. Examples for questions that can be asked to the database are "Who is knowledgeable about electron identification in ATLAS in Germany?", "Who can help me with jet calibration in CMS?", "Who is the leader of tau activities in the Alliance?", etc.

The database is currently being filled with information provided by Alliance members upon request. It will be opened for the public once a certain critical mass of information is surpassed. For the future, it is foreseen to keep the database up-to-date either by updates from the Alliance members themselves or by the Analysis Centre that will stay in close contact with all institutes.

In addition, the web and Wiki pages of the Analysis Projects and the Analysis Centre provide important and up-to-date information on ongoing projects and activities.

3.3 WP 3: Training and Exchange

3.3.1 Schools and Workshops

In 2008, several schools and workshops have been organised, ranging from introductory tutorials aimed at master and PhD students to expert workshops on specific research topics. The schools have mainly been organised by the Analysis Centre with the input of numerous colleagues from other Alliance institutes, and have focused on Monte Carlo Generators, on Statistics Tools and on Parton Density Functions (PDF). All three events were very successful, attracting between 50 and 120 students who gave overall excellent feedback.

Since these initial events, a full programme of schools and workshops on various topics has both been planned and partially already organised. With the increasing experience in the Centre, the workshops and schools become more and more productive, which also shows in the feedback. It is foreseen to establish the planned program on a long-term basis and to organise all exercises, tutorials etc. as self-contained units that can also be followed off-line by any interested student or colleague.

Most of these events take place at DESY, as the necessary infrastructure – seminar rooms, hostel, secretarial support, computing support – is available there throughout the year. It is often difficult to find enough space at universities during the semester.

With the WE-Heraeus-seminar "Physics at the Terascale" a further very successful training event with renowned national and international speakers has been organised at the Physikzentrum Bad Honnef.

Expert workshops on all aspects of Terascale physics were held in 2008 (Higgs physics, BSM physics, QCD and electroweak physics, Top quark physics), bringing together theorists and experimentalists from both ATLAS and CMS as well as the ILC community.

4 Grid Computing

4.1 Tier-2

Participating institutes	RWTH Aachen, DESY, U. Freiburg, U. Göttingen, LMU München, MPI München, Wuppertal

During the first months of 2008, the initial installation of the computing hardware in the Tier-2 centres at DESY and the Universities Aachen, Freiburg, Munich and Wuppertal was completed. For the Göttingen Tier-2, the equivalent of one FTE was converted to investment, and used to augment the computing resources available at the newly established Tier-2 in Göttingen. All sites contributed successfully to the service and data challenges conducted by the LHC collaborations in order to prepare for the initial data taking at the LHC. When the LHC had its first circulating beams on 10 September 2008, both ATLAS and CMS transferred data to the Tier-1 at GridKa. After the LHC incident on 19 September, which prevented further operation with beam, the experiments continued data-taking with cosmic-ray events at high rates, and transferred and processed data at GridKa and the Tier-2 centres. All German grid sites demonstrated good performance during this initial phase of data-taking of the LHC experiments.

4.2 National Analysis Facility (NAF)

At DESY, the hardware and initial services of the National Analysis Facility were deployed. Funding for the hardware could be obtained from the Federal Ministry of Education and Research (BMBF), thus freeing the financial resources foreseen in the original planning. To properly consider the needs of the users, a NAF Users Committee (NUC), consisting of two members per experiment (initially ATLAS and CMS) and two members from DESY IT was formed. Later in 2008, the LHCb experiment and groups working on development for the ILC also joined. The NUC coordinates resource usage at the NAF, helps in defining the special NAF services which enable efficient analysis work by physicists, and – most importantly – ensures close collaboration between the computing teams of the experiments, the grid projects and DESY as the resource and service provider. The chair of the NUC is an associated member of the Grid Project Board.

4.3 Grid Development Projects

Participating institutes	RWTH Aachen, DESY, U. Freiburg, U. Göttingen, U. Karlsruhe, FZ Karlsruhe, LMU München

An initial workshop on the Grid projects pursued within the Alliance (National Analysis Facility (NAF) at DESY, wide-area Networking, virtualisation, Grid storage, monitoring) took place in Karlsruhe on 21-22 February. As the prime goal of this workshop, status and plans of all projects were presented by the partners. While positions in the computing area were still being

filled, initial progress on some of the projects had already been made in Diploma, Master or PhD theses. During the course of 2008, working groups formed on Grid storage (Aachen, DESY, Karlsruhe, Munich) and site monitoring (Aachen, DESY, Göttingen, Karlsruhe). The virtualisation project has been pursued by Karlsruhe. A first proposal for improved wide-area networking between all partner institutes had been prepared by a group consisting of experts from DESY, GridKa and DFN. A high-bandwidth connection of all Tier-2 sites with GridKa was considered most important. For smaller Grid sites at universities (Tier-3), the existing internet connections will probably be sufficient to ensure appropriate connectivity to a nearby Tier-2 site; special cases may be considered if the available resources allow for it – this issue was postponed to a later workshop.

4.4 Training

During the February Workshop, it had been agreed that dedicated presentations and tutorials should be arranged at the annual computing school at GridKa. There were dedicated courses for Grid site managers and Grid users by members of the Alliance Grid projects on the installation and operation of the dCache grid storage, and the deployment of Grid services in virtual machines. These courses were complemented by a tutorial on the usage of the National Analysis Facility at DESY and a presentation on the concept of meta-monitoring to improve the reliability of services at Grid sites.

5 Detector Development

Dr. F. Sefkow replaced Dr. T. Behnke in the detector project board.

5.1 WP 1: Virtual Laboratory for Detector Technologies

Participating institutes	RWTH Aachen, U. Bonn, DESY, U. Hamburg, U. Heidelberg, U. Karlsruhe

5.1.1 WP1.1 Electronics System Development

The task of this work package is to make expensive and service-intensive infrastructure available to partners of the Alliance and to enable the community as a whole to make more significant and long-lasting contributions to future projects in the framework of physics at the Terascale.

Electronics system development relies on two kinds of expensive and service intensive infrastructures: state-of-the-art and up-to-date software packages for CAE (in particular layout, synthesis and simulation) and test facilities for electronics systems (in particular high-speed and low-noise capability).

VLDT Node Heidelberg

The Heidelberg node has successfully finished the set-up of software and laboratory work places according to the proposal. Ten additional workplaces for chip-design and simulation have been installed. The software can be accessed remotely from any partner institute in the Alliance.

Web-based introductions and personal training by lab staff are being offered. The node has also initiated a membership to the US based MOSIS program for chip production, so that this facility is available to Alliance members as well. Five laboratory workbenches have been set up featuring very high speed data serial data sources and analysis facilities. This investment is of crucial importance for the massive future use of serial data transmission in practically all LHC upgrade and other future particle physics projects.

Low-noise measurement facilities have also been acquired. A clean-room cell for handling of chips, sensors and wafers has been installed in the Kirchhoff-Institute of Physics and is available in particular for chip / wafer handling, bonding, testing and packaging.

Two full time engineers are now financed through the Alliance. The hiring of external engineers has so far not been successful due to the non-competitive salaries compared to industry. The search and evaluation process is being continued.

VLDT Node Bonn

In 2008 the VLDT Bonn has continued the extension of its chip design infrastructure. The two positions for chip design engineers could be filled (Dr. Ing. A. Kruth, since September 2008, T. Hemperek, since April 2008). Also the chip designers' office was enlarged providing now 9 Cadence workstations (7 permanent + 2 for external guests) and additional support for external users working via remote login. The available chip-design tools from Cadence and Mentor Graphics were extended with the Synopsys tool suit and MunEDA software to support advanced digital design flow and multi-parameter analogue circuit optimisation. New design kits have been installed to access state-of-the-art technologies (90 nm technology, 3D integration) for high performance digital and mixed-mode designs.

The current chip design activity is focused on the upgrade of the ATLAS pixel detector and the development of a digital read-out chip for DEPFET pixels. The Bonn group is responsible for: upgrade of the ATLAS pixel chip (FE-I4) in collaboration with CPPM, LBNL, Genua and NIKHEF; implementation of ATLAS pixel prototype chip in 3D technology (FE-TC4-proto1) in collaboration with CPPM, and LBNL; integrated detector control chip for ATLAS upgrade (DCS). The development is led by the Wuppertal group; data processing chip for DEPFET pixel detectors (DHP) in collaboration with Univ. of Barcelona and MPI Munich.

To support testing and characterisation of these and other chips, dedicated prototype data acquisition (DAQ) systems have been developed, which are all based on a common framework of software and hardware library elements.

5.1.2 WP 1.2 Sensors: Materials, Design and Characterisation

VLDT Node Hamburg

The Hamburg site of the VLDT provides general services of chip characterisation and simulation, and makes irradiation facilities available.

A multi-channel TCT (Transient Current Technique) system has been put into operation, with three lasers with different absorption lengths, focusing of the laser light to 2 µm and detailed SPICE simulations. It has been used to measure pulse shapes and lifetimes of charge carriers in highly radiation damaged epitactic silicon sensors for the SLHC and to study the plasma-effect in silicon.

The facility is now ready to be used by external partners. First projects centred around the SLHC are starting.

At the DORIS electron ring, an "X-ray Irradiation Facility" for 10 keV photons and dose rates between 0.5 and 150 kGy/s has been put into operation. The set-up has been used by a group from the HLL-Munich, the DESY XFEL detector group and the Hamburg group.

A key area of expertise in Hamburg is the study of damage mechanism in silicon sensors. Expertise for sensor simulation using the program ISE-TCAD has been acquired. The development of a programme to simulate the pulse shape in segmented, radiation damaged Si-sensors is in progress, though slightly delayed relative to the proposal.

VLDT Node Karlsruhe

Karlsruhe provides to the Alliance an irradiation facility, which allows to reach high dose-rates of hadronic radiation in a short time, and an X-ray irradiation facility. Both are in heavy demand from Alliance partners. Irradiations at the proton irradiation facility were performed for Freiburg, HLL München and Karlsruhe using a total of 53.4 hours of beam time. The X-ray irradiation facility was used for a total of 514 hours of irradiation time by HLL München, Heidelberg and Darmstadt

A new probe station is being developed, which is aimed towards cold measurements after irradiation and optical quality control. Irradiation procedure and dosimetry is established. One technical support person was added to the staff at Karlsruhe, who supports Alliance members in their work at the facility.

Currently the TCT setup is being refurbished. IR laser, focusing optics and attenuators will be added.

5.1.3 WP1.3 Detector Systems: Development, Infrastructure and Testing

VLDT Node DESY

The VLDT site DESY provides detector development infrastructure such as superconducting magnets and test-beams, and offers engineering support.

The test-beams were shut down for the first 8 months of the year, due to work on the accelerator complex. This limited the service to users, but the time was used for a general refurbishment of all beam-lines, e.g. with improved vacuum. Two of them are equipped with silicon telescopes for precision reference tracking.

In the remainder of the year, the beams were used by German and international groups. The biggest single project was the start of a series of tests of a large prototype for a time projection chamber (TPC) at the ILC, where, within an international collaboration, university groups from Bonn, Freiburg, Hamburg, Mainz, Rostock and Siegen participated.

The DESY node was strengthened by the addition of two engineers in February 2008. They played a central role in the engineering support of the TPC test experiment. The high-field magnet infrastructure was also heavily used throughout 2008 by groups from DESY and from other Alliance partners.

Test-Beam Infrastructure ELSA at Bonn

Plans to build and maintain a dedicated test beam area at the ELSA storage ring in Bonn have been finalised. A region for a new beam-line has been identified and the calculations for the necessary beam dump and the electron optics for beam extraction have been started.

5.2 WP 2: Detector R&D Projects

5.2.1 WP2.1 Tracking Detectors for the ILC

Participating institutes and group leaders	RWTH Aachen (A. Stahl), U. Bonn (K. Desch), DESY (T. Behnke), U. Mainz (S. Tapprogge), U. Rostock (H. Schröder), U. Siegen (I. Fleck)

In 2008 one of the main activities was the preparation for the data-taking with the large prototype TPC at the DESY test-beam. The beam test stand at DESY was able to accommodate data taking with several different read-out concepts.

Aachen has started to build a transportable gas system which is able to mix several gases and can analyse the gas mixture with a built-in gas chromatograph. As this system can be transported easily it will be made available for the use at the other partner institutes.

In a collaboration between Bonn and DESY, a simulation, digitisation, reconstruction and analysis package for TPC development, called Marlin-TPC, has been developed and has been made available for the use of other groups as well.

At Bonn the installation of the infrastructure for the testing of Timepix chips has been finalised. A gas system, including a gas chromatograph, is operational. Infrastructure for test-beams with ELSA, such as a clean room and a trigger system, is in preparation. Another activity in Bonn was the construction of a read-out module for the large prototype TPC at DESY using Timepix chips. This module will go into the test-beam in June 2009.

Mainz is developing a FPGA based read-out system for the Timepix chip. This system will be adopted to the requirements of particle physics operation rather than imaging and in addition will increase the read-out speed. The read-out system will be tested with the Timepix module at Bonn.

In Siegen the infrastructure for a TPC, including a gas system and a high voltage system for up to three GEMs, has been installed. In addition the high voltage system and the high voltage slow control for the large prototype TPC at DESY is under development.

The main activity of the Rostock group is the development of 640 channels of TPC readout electronics based on charge-to-time conversion and time-to-digital conversion. 20 front-end cards of type "Barcelona" were manufactured for this. The mechanical support of the Barcelona and pitch adapter boards on the Large Prototype TPC was developed with engineering support from the Alliance. The Alliance helped also by granting access to the DESY electronics and mechanical production facilities.

Spending: Most institutes could not spend all of the requested funds in 2008, mainly due to problems with hiring qualified personal. In the meantime nearly all of the position could be filled. Most investment funds were spent in 2008. The remaining funds were deferred to 2009 and will be used for their original purpose.

5.2.2 WP 2.2: Calorimetry at the ILC

Participating institutes	DESY, TU Dresden, U. Heidelberg, MPI München, U. Wuppertal

The experimental groups at DESY, the Universities of Heidelberg and Wuppertal, and MPI München play a strong role in the development of a highly-segmented analogue imaging hadron calorimeter (AHCAL) for a future linear collider. The calorimeter is based on a sampling structure with scintillating tiles individually read out using Silicon Photo-Multipliers (SiPM). The work is done in the framework of the international CALICE collaboration.

The group in Wuppertal has taken over the responsibility to develop a robust and scalable calibration system. Calibration of each channel is required to correct for temperature and voltage variations, and is done utilising LEDs. During 2008 a test stand, funded by the Alliance, has been set up to optimise the position of the calibration LED. The actual measurements will take place in 2009. In order to read out the SiPM a simplified DAQ system has been developed. This DAQ allows the signals from 18 SiPMs to be read out via a USB interface.

The focus of the Heidelberg group is the characterisation of SiPMs and development of SiPM read-out electronics and the analysis of test-beam data. A test laboratory has been set up for the measurement of relevant SiPM parameters like gain, dark rate, noise, cross-talk and photon detection efficiencies. With this set-up new devices are studied with respect to their potential use in calorimetry or other fields of application. Concerning electronics, the group has started to work on an improved amplification concept optimised for SiPM read-out. This is done in close collaboration with LAL Orsay. This work will strongly benefit from the Heidelberg VLDT node.

The focus at DESY is on electronics integration, mechanical structures, technical support for large test-beam campaigns and analysis software. In summer 2008 the test-beam installation was successfully relocated from CERN to Fermilab, where it will be operated for several years, using different options for the electromagnetic and the hadronic calorimeter.

The development of a scalable and compact prototype is the logical next step. Again DESY focuses here on electronics system integration and the handling of heavy mechanical structures.

The group at the MPI München is focusing on SiPM characterisation and analysis of the test-beam data.

Groups at DESY Zeuthen and the University of Dresden are involved in the development of forward calorimeters for the ILC, especially the read-out electronics. Dresden has started to evaluate the Advanced Telecommunications Computing Architecture (ATCA) as baseline for a read-out technology.

5.2.3 WP 2.3: Trigger Developments for the SLHC

Participating institutes and group leaders	U. Heidelberg (K. Meier), U. Mainz (S. Tapprogge)
Partners outside of the Alliance	Argonne National Laboratory, Birmingham, Cambridge, Michigan State University, Queen Mary College London, Rutherford Appleton Laboratory and Stockholm

In order to improve the flexibility of the level-1 calorimeter trigger of ATLAS, the efforts of the Mainz group focus initially on the development of a topological trigger for the first level

(phase 1), with the aim of an enlarged efficiency for the selection of specific final states, while being able at the same time to increase the rejection of background processes. In order to achieve this, a significantly larger amount of information has to be extracted from the present system of digital trigger processors, be combined in a dedicated processing unit (where selection criteria such as acoplanarity of jets and calculation of invariant masses of trigger objects can be performed) and the result be submitted to the final decision unit (central trigger processor).

Thanks to the funding by the Terascale alliance, the group has been able to improve the infrastructure for the developments of fast digital electronics by the purchase of the sampling scope with 30 GHz differential TDR head. The initial developments of first conceptual prototypes have been profiting also from the purchase of Xilinx development boards (containing a Virtex5 family FPGA).

First steps towards the development of a versatile generic digital processor module to be deployed for a phase 2 upgrade have been made.

The group in Heidelberg is actively involved in the level-1 calorimeter trigger upgrade for the SLHC. The work is funded by the BMBF and uses the infrastructure of the local detector node supported by the Alliance. The development concentrates on the trigger front-end, in particular the analogue-to-digital conversion, digital preprocessing and serialisation of the output data. The work is structured into 3 phases. During phase 0 (group internal phase) the initial preprocessor system will be equipped with state-of-the-art FPGA processors and new ADC chips. Phase 1 will be in line with the first phase of the ATLAS upgrade. A possible replacement of the copper-based LVDS links to the trigger processors by fibre optics with higher bandwidth is currently under consideration. Finally, the group is a member of the upgrade project for the tile-calorimeter front-end electronics where a major part of the preprocessing will eventually move to the detector location. With the current time scales of the upgrade (phase 0: 2010, phase 1: 2012, phase 2: 2017) the ongoing work concentrates on phase 0.

5.2.4 WP 2.4: Radiation-Hard Silicon Sensors for the SLHC

Participating institutes and group leaders	U. Hamburg (R. Klanner), U. Karlsruhe (T. Müller)

The development of radiation-hard silicon sensors will be done within the frame of the Central European Consortium (CEC) "R&D project to develop materials, technologies and simulations for silicon sensor modules at intermediate and large radii of a new CMS tracker for SLHC". The CEC is administrated by Doris Eckstein (HH) and Frank Hartmann (Ka). The Consortium combines the effort of the following institutes: Aachen, DESY, Hamburg, Karlsruhe, Santander, Warsaw, Vienna and Vilnius.

Activities in Hamburg:

The Hamburg group has performed simulations for different sensor layouts and contributed to the design of test structures and to the detailed planning of the irradiation and measurement campaigns. The order to Hamamatsu, done jointly with CERN, is unfortunately delayed.

The micro- and macroscopic studies of radiation damage in different silicon materials have been continued. The work on epitactic silicon is close to completion. At high fields an amplification process has been observed, which has already been reported by another group. Detailed

investigations are ongoing, to find out if this effect could be used for the fabrication of radiation-hard silicon sensors.

The multi-TCT set-up has been used for measurements of the plasma effect in silicon, relevant for the use of silicon pixel sensors at the XFEL. The data have shown to be important to tune the parameters used in the simulation of the pulse shape which is made at the WIAS (Weierstraß-Institut, Berlin).

Detailed micro- and macroscopic measurements of the radiation damage of 10 keV photons for doses between 1 kGy and 1 GGy have been performed. The density of stable and mobile oxide charges and the density and position in the band-gap of the interface states has been determined. An annealing effect at high doses has been found which so far is not understood.

Activities in Karlsruhe:

Silicon strip sensors fabricated at HIP from n-type magnetic Chochralzki material have been tested and irradiated up to fluences of $2.9 \cdot 10^{15}$ n/cm. Modules were built in Karlsruhe consisting of these sensors and CMS tracker read-out electronics based on the APV25. With these modules a beam test has been conducted, which showed that these modules can be operated at 600 V after $1.6 \cdot 10^{15}$ n/cm. They show a signal of about 7500 electrons at 600 V and the resolution was measured to be below the binary resolution of 14.4 µm for these 50 µm pitch sensors. A fluence of $1.6 \cdot 10^{15}$ n/cm corresponds to a distance of 15 cm from the interaction point and thus represents the radiation environment inside the pixel regime. This demonstrates the possible usage of n-type MCz silicon for the silicon strip tracker upgrade for SLHC. Apart from carrying out irradiations and sensor characterisations in Karlsruhe, the investigation of MCz strip modules was the main topic as written in the proposal. This has been successfully achieved. Efforts continue to find the best possible solution for a silicon tracker at the SLHC.

Within the CEC collaboration, the main focus of R&D is on strip sensors, especially on sensors with short strip length (2.5 cm) and their connectability to read-out electronics. To benefit from this collaboration towards radiation-hard silicon sensors for the SLHC the proposed collaboration with the Paul Scherrer Institute (CH) to develop a prototype pixel detector was abandoned.

Test structures proposed and designed by the CEC are implemented in a wafer submission of CMS, which will test several materials, thicknesses and implantations. In total 144 wafers will be produced. A test program and irradiation scenarios have been developed.

The device simulation package Synopsis T-CAD Tools has been made available and first steps of studying the concept of short strip sensor layout were taken. Layouts of new test structures and sensors can be produced in GDSII format for easy exchange with producers like CNN Barcelona and ITE Warsaw.

In summer 2009 p-type MCz strip sensors from the same manufacturer will be investigated in a test-beam at CERN. Karlsruhe will perform the irradiations and participate in the beam test and the analysis. Connection schemes and module layouts are being developed and assisted by device simulations. Prototype sensors including pitch adapters and/or 2-4 short strips will be fabricated and investigated. A huge systematic study of sensor properties will be performed when the CMS wafer submission is received.

5.2.5 WP 2.5: Luminosity and Forward Detectors for LHC

Participating institutes and group leaders	HU Berlin (T. Lohse), DESY(T. Haas, K.H. Hiller) and U. Gießen (M. Düren)
Partners outside of the Alliance	CERN, LIP Lisbon, Orsay, Prague

The focus of WP 2.5 was on the development of the ALFA Roman Pot detector of scintillating fibres for the absolute calibration of the luminosity at the ATLAS experiment using elastic pp scattering. During the reporting period the R&D phase for the production of high-precision titanium substrates, the assembly of double-layered scintillating fibre on these substrates and the manufacturing of scintillating tiles for trigger purposes was achieved. A test stand for the quality control and calibration of multi-anode photomultipliers to which the fibres are connected was built. Two complete ALFA prototype detectors were assembled and the performance of the final prototype was verified in a test-beam. The resources provided by the Alliance were sufficient to complete the R&D phase and to launch the production phase for the entire ALFA system. For the completion of the series production a third-party funding application was submitted by HU Berlin and U. Gießen. Beyond the luminosity topic the design phase has started for the development of new detectors in the forward region of ATLAS to explore diffractive physics at the LHC.

6 Accelerator Physics

Participating institutes	DESY, U. Bonn, TU Dortmund, U. Hamburg and U. Wuppertal

The accelerator group launched a school for accelerator physics in spring 2008. Some 35 participants from Alliance-affiliated institutes and also from universities abroad listened to lectures covering the current range of activities in HEP accelerators. Key to the success of the school was the hands-on class that enabled the students to design their own accelerator according to the topics presented in the lectures.

Lectures by DESY physicists on accelerator topics were given in Göttingen and included relevant aspects of controls theory.

6.1 Bonn

The HGF-related activities in Bonn mainly concentrated on three subjects: continuation of the set-up of the laser optics and detector electronics of the Compton polarimeter, simulation of beam optics, construction and set-up of the single bunch injection system and investigation and optimisation of the beam optics of a new external electron beam-line at the stretcher ring ELSA, dedicated to detector tests.

6.1.1 Compton Polarimeter

A new two-beam solid state disk laser system delivering 2x20 W green laser light ($\lambda = 515$ nm) has been purchased and installed. In order to focus the photon beams into the interaction region located in a defocusing quadrupole magnet 15 m away from the laser system, a dedicated

optical transfer line was set-up on the laser-bench in the accelerator tunnel. An analyser box was developed and installed behind the interaction region The relevant elements of this box are mounted on translation stages, which will allow a scanning operation mode of the polarimeter to measure the phase-space parameters of the electron beam. The read-out of the silicon strip detector was developed and set up successfully. The commissioning of a prototype was started at the end of the year.

6.1.2 Single-Bunch Injector

The installation of a new thermionic triode gun, a 500 MHz sub-harmonic prebuncher and a 3 GHz travelling wave buncher at the existing LINAC I has been started. Dedicated electronics for single- and long-pulse generation has been manufactured and is ready for installation. The complete overhaul of the LINAC modulator has been finished recently. Detailed optics simulations of the beam transfer to the booster synchrotron including an energy compression system were performed. The necessary modifications of the existing transfer line are under construction. The existing energy compressor will be upgraded by the installation of an improved 20-cell travelling-wave constant impedance structure operated in $\pi/2$-mode.

6.1.3 New test-beam area

Detailed simulations of the beam optics of a new external electron beam-line were performed in view of a variable adjustment of beam parameters over a considerably large range. Using a set-up of four quadrupole magnets and one deflecting dipole magnet the beam size in the test area can be varied from 1 mm to 7 mm rms radius. All elements (including extraction septa) are in house and ready for installation.

6.2 DESY

6.2.1 Superconducting RF Cavities

There has been very good progress in recognising the surface features in the existing SRF cavities that are being examined at DESY. Since August 2008 the prototype of a high-resolution camera system that was developed at KEK and Kyoto University is available at DESY. It allows inspection of the inner surface of cavities with a level of detail that was not accessible up to now. Up to now 26 cavities have been inspected.

The camera is intended to be used both as a research instrument in the laboratory, to investigate the defects that limit the accelerating gradient, as well as a step in the quality assurance for cavity mass production. First matches have been found in several cavities between the locations of the breakdown of the superconductivity (quench) and areas detected as hot-spots in a thermometry measurement. In parallel the system is being optimised in collaboration with colleagues at KEK and Kyoto University in order to improve the accuracy and reach a completely automated inspection process.

6.3 Dortmund

S. Khan has left the University of Hamburg and now holds the chair of accelerator physics at the TU Dortmund. The accelerator group at Dortmund formally joined the accelerator activities of the Terascale Alliance. Currently there are no funds dedicated to this activity.

As one of the directors of the Centre for Synchrotron Radiation (DELTA), he plans to combine the electron beam of the 1.5 GeV DELTA storage ring with femtosecond laser pulses. This activity includes the generation of ultra-short radiation pulses in the VUV and THz regime, laser-based beam diagnostics (electro-optical sampling, the optical-replica method pioneered at DESY, laser wires and others) as well as preparatory experiments for novel acceleration schemes such as inverse free-electron lasers.

6.4 Hamburg

The activities in Hamburg were largely defined by the activities of S. Khan before his departure to Dortmund. The work concentrated on the characterisation of the profile of the short bunches at FLASH. Laser induced energy modulation was used to diagnose the bunch dimensions in the longitudinal direction at FLASH. A two-dimensional longitudinal-transverse correlation in an electron beam by laser-electron interactions has been observed.

The position of S. Khan will be filled again to support the ongoing activities, which are currently supported by J. Rossbach.

6.5 Wuppertal

6.5.1 Research in High-Gradient Superconducting RF Cavities

This activity was launched in January 2009.

6.5.2 Optimisation of Electron and Positron Sources

By means of focused UV-VIS illumination of cathodes in the FESM, a slight shift of the field emission current to lower fields was observed. The systematic investigation of the PEFE process requires monochromatic light sources and energy spectroscopy of the field emitted electrons. Therefore, a new UHV system with a prechamber as load lock and for sputtering of samples is under construction. After some modifications to an existing UHV chamber a base vacuum pressure below 10^{-6} Pa has been obtained in the main chamber without excessive heating. The hemispherical electron energy analyser was previously used for Auger spectroscopy and will be adapted to the fully designed extraction system. The transfer device for samples and anodes is installed in the load lock already, and the fabrication of the other interior parts will be completed soon. The assembly and commissioning of the PEFE system should be finished in the first half of 2009, and first experimental results on emission currents as function of electric fields and laser illumination are expected in the second half of 2009.

7 Backbone Activities

7.1 Interim Professorships

The substitute for scientific manager continues to be funded via this scheme. The term of the ATLAS physics coordinator finished in September. Funding for the conveners of the ATLAS Standard Model group (S. Tapprogge) and the CMS Jets and Missing E_T group (P. Schleper) was applied for and approved.

7.2 International Networking

The visit of Takeshi Matsuda from KEK to DESY in 2008 was supported by the Alliance. He helped in the organisation and data-taking of the TPC test-beam done together with DESY, U. Hamburg, U. Siegen, U. Bonn and U. Freiburg

In Spring 2009 Prof. Julia Thom from Cornell University, USA will visit RWTH Aachen for 6 months to work on the CMS experiment. Part of her costs are funded by the Alliance. During the time there she will also visit partner institutes. Prof. Jan Timmermanns from NIKHEF Netherlands will visit DESY to work on the TPC project for the ILC. This visit is also partially funded by the Alliance.

7.3 Equal Opportunities

As mentioned in the previous report, the dual career support was successfully used for the fellows in Bonn and Würzburg. The Karlsruhe fellow also applied for and received support for his partner through this mechanism.

7.4 Outreach

A clear media highlight of the year was the startup of the LHC on 10 September. The successful circulation of the first beams was headline news on all the major television channels and in the newspapers. The LHC incident on 19 September was also widely reported in the press.

The Alliance was heavily involved in the very successful exhibition "Weltmaschine" held in the "U-Bahn Bundestag" in Berlin in October and November. In addition to the work of the "LHC Communicator", K. Voss, many members of the Alliance contributed their time and expertise as guides. From the comments we received, the idea of having active (young) scientists to guide the general public around the exhibition was one of the keys to its success and very much appreciated by all the visitors.

Articles on the Alliance appeared in Physik Journal and a longer article was written for the May issue of the CERN Courier.

Communication between the partners in such a large Alliance continues to be a challenge. Both the Scientific Manager (I. Brock) and the Head of the Analysis Centre (T. Schörner-Sadenius) visited almost all of the partners in 2008. Such personal meetings are very important in addition to the regular email exchanges, as they provide the opportunity for more general and informal discussions than can take place during regular meetings. Similar visits for 2009 are also planned.

A Wiki system provides a means for more members of the Alliance to contribute to the distribution of information within and outside the Alliance. A Wiki framework was set up in cooperation with the DESY IT department and is now being used by several groups.

Many Alliance partners participated in the particle physics Master Classes that are organised world-wide each year. The Alliance is also supporting the creation of a Master Class using LHC rather than LEP events.

There are also many activities involving Alliance members and schools, ranging from lectures and physics days to visits to schools (e.g. "rent a scientist").

The Alliance issued a statement supporting the SCOAP3 initiative. It was also agreed that in general, KET, as the body of elected particle-physics representatives, is the correct body in future for such political statements.

8 Personnel

Personnel funded by the Helmholtz grant:

	Male	Female
PhD students	8	2
Scientists	20	8
Technical personnel	7	3

Other personnel involved in the Helmholtz Alliance projects in 2008:

	Male	Female
Diplom/Master students	93	21
PhD students	168	39
Post-docs	143	31
Senior scientists	93	8
Technical personnel	77	6

The heads of four Young Investigator Groups took up their appointments in the course of the year: U. Karlsruhe, TU Dresden, HU Berlin and U. Wuppertal. The position in Göttingen has not yet been filled, as the three short-listed candidates finally took other offers. The start of the YIG in Hamburg was delayed further, mainly due to the move of S. Kahn from Hamburg to Dortmund. The position will be advertised in Spring 2009.

The tenure-track position in Wuppertal was filled. The one in Siegen will be advertised again in 2009, as also here the short-listed candidates finally decided to take up other offers.

9 Publications

The complete list of Alliance-related publications is attached to this report. In total there were 199 papers published in refereed journals, 116 conference proceedings, 80 preprints and 15 other publications.

10 Dissertations and Habilitations

34 (2 female) PhD theses on Alliance-related topics were completed in 2008. There were 3 habilitations.

11 Awards

Kevin Kröninger from Göttingen was awarded the Otto-Hahn Medal. Su-Jung Park (now at Göttingen) received a thesis prize from the University of Rochester, USA;

12 New Cooperations and Activities

Most of the new cooperations and activities within the Alliance are detailed in the sections on Physics Analysis, Grid Computing, Detector Development and Accelerator Physics.

Alliance funding was important in the successful involvement in the CEC (Central European Consortium) project "R&D project to develop materials, technologies and simulations for silicon sensor modules at intermediate and large radii of a new CMS tracker for SLHC" and the major involvement in the development of the new front-end pixel chip for ATLAS, FE-I4.

The Alliance functioned as a "Joint Research Unit" with DESY as the JRU Coordinator in the FP7 proposal on detector R&D.

With the move of S. Kahn from Hamburg to Dortmund, Dortmund is now joining the accelerator physics activities within the Alliance.

In addition to the support for the GridKa school, the Alliance will sponsor the CERN Physics School and the CERN School of Computing in 2009, as both of them will take place in Germany.

Selected other cooperations reported to the management:

- RWTH Aachen is cooperating with the PH-ESE Group at CERN on the development of a radiation-hard DC-DC converter;
- groups from Aachen and Bonn are cooperating on the topic of powering for SLHC detectors;
- the Berlin YIG is integrated in SFB-TR09 "Computational Particle Physics" (Aachen–Berlin–Karlsruhe) and is an Associated member of the EU network: Marie Curie Research Training Network, MRTN-CT-2006-035505, Tools and Precision Calculations for Physics Discoveries at Colliders (HEPTOOLS);
- HU Berlin, DESY Zeuthen and TU Dresden were awarded a joint graduate school GK1504;
- the NAF is officially participating in the "Atlas Tier3 Task Force";
- in Göttingen, the setup and running of GoeGrid involves cooperation with MediGrid, TextGrid, GWDG and the Institut für theoretische Physik in Göttingen.

13 Teaching

As mentioned above, the Alliance organised schools on Monte Carlo, Statistics and Parton Density Functions. The high attendance and success of the schools shows that the Alliance clearly fills a need within the whole particle physics community. These activities will be continued and expanded further in 2009.

Almost all the universities have regular lecture courses on experimental and particle physics that are not listed in this report. As the YIG in Göttingen had not yet been filled P. Uwer held a lecture course on theoretical particle physics there in summer term 2008.

The lecture series on "Physics of Particle Accelerators" was again held in Göttingen summer 2008. As a result both BSc and Diploma students have started theses in this area.

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27 February 2009

Minutes
Helmholtz Alliance: Physics at the Terascale
Second meeting of International Advisory Board
5 December 2008

Present: Kors Bos, Jim Brau, Brian Foster, Dieter Schlatter(chair), Bernhard Spaan (by phone), James Stirling (by phone), Tejinder Virdee (by phone), Sakue Yamada (by phone)

Excused: Peter Jenni

Agenda
9:00 - 12:30

Peter Mättig (U. Wuppertal)	Introduction, present status and plans for 2009 of the Alliance
Ian Brock (U. Bonn)	Review of HGFA positions
Arno Strässner (TU Dresden)	Feedback on Young Investigator Programme
Ariane Frey (MPI Munich)	Detector Development Status
Eckhard Elsen (DESY)	Accelerator Physics Developments
A. Schulze (HGF)	Plans for mid-term review of Helmholtz Association

Meeting with Management
Closed Session

General:

The IAB is pleased to see that the Alliance is very lively with many activities in place. One can already see an important impact on the HEP community in Germany, with an increase of the collective spirit among the particle physicists. DESY has assumed an important and central new role as part of a national network.

- Most positions are filled, and the few missing ones reflect that there is a competing market and that it is sometimes difficult to attract good people on short term posts. We expect the last Young Investigator position to be filled soon.
  International hiring, a good practice, is high for fellows but somewhat low for detector positions.
- The series of specialized schools is impressive (5 within the first 18 months) and the good attendance is proof that it is needed. We value the long-term benefit for the community of these schools very highly and resources should be secured such that this program can continue in the future.
  The purpose of the schools is to provide post-graduate education in particle physics and accelerators. These are regional schools in addition to international schools such as the ones organized by CERN. It might still be good practice to allow some non-German enrolment.
- The concept for a Virtual Laboratory for Detector Technology (VLTD), which provides key services through a network of institutes, has started to work and it is a very efficient way to bundle expertise at different locations effectively. We expect that the missing appointments should be filled soon.
- The Analysis Centre @ Desy, to cover subjects of common interest and which require a certain amount of infrastructure, is now in place. We expect to see a positive impact on the analysis of LHC data in the years to come.

- Being close to the mid term of the duration of the Alliance and the fact that several sub-projects are of a long term nature, ways to sustain those activities need to be found, in particular for the support based at DESY and FZK of programs of the Alliance. The Board is pleased to see that the HGFA management is well aware of this difficult situation and has started to explore possibilities for the future. Plans on how to secure projects which will last longer than 2012 should be presented and discussed at the next IAB meeting.
- The board was informed that the Helmholtz Gemeinschaft plans to review the Alliance during 2009 and is setting up an evaluation panel for early 2010. We took note that about 2 members of the IAB should be part of this panel.

Detailed comments

Detector R&D

The detector development is structured through a network of a Virtual Laboratory for infrastructure (3 work packages) and through specific R&D projects for linear collider detectors (2 WPs) and SLHC (3 WPs).

The VLTD comprises seven University groups and DESY. The WPs are mostly on infrastructure and general support for detector development. This organisation is an efficient use of the resources of the Alliance. However, the infrastructure will require support and funding beyond the duration of the Alliance.

The well focused R&D projects put the participating groups in an excellent position to prepare detector systems for future accelerator projects. This should enable them to become strong partners in the international collaborations once the SLHC or a Linear Collider gets approved as project. Unfortunately, this may not happen before the end of 2012 and again, extension of funding of these R&D projects may be needed.

Accelerators

The small amount of resources of the Alliance reserved for accelerator research is used to stimulate awareness within the particle physics community for the need of accelerator research at the universities. The goals are:

- Promote teaching of accelerator basics at universities.
- Stimulate common approaches and common use of equipment by university groups. First example is the polarimeter experiment at ELSA/Bonn.
- Introduce an accelerator school in Germany. The first was successfully organized in 2008, the next one will be in 2009.

Long term Future

The Alliance has targeted strategic projects to strengthen the German HEP groups within the large international collaborations of particle physics.
The expertise and research infrastructure which is built up by the Alliance is centered around the exploitation of the LHC and the development of detectors at future accelerators (SLHC or Linear Collider). These activities will go well beyond the duration of the Alliance and to find ways of funding beyond 2012 is crucial. The Helmholtz Centers DESY and KFZ, already partners of the Alliance are ideal places to carry on with some of the infrastructure and support, provided they receive adequate extra funding.
The management of the Alliance has also started to explore options on how to sustain the new structures created by the Alliance and we are looking forward to discussions on this important topic at the next IAB meeting by the end of 2009.

1 Journal Articles

Alliance acknowledgement in references [64] [118] [122] [130] [131] [36] [114] [130]

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