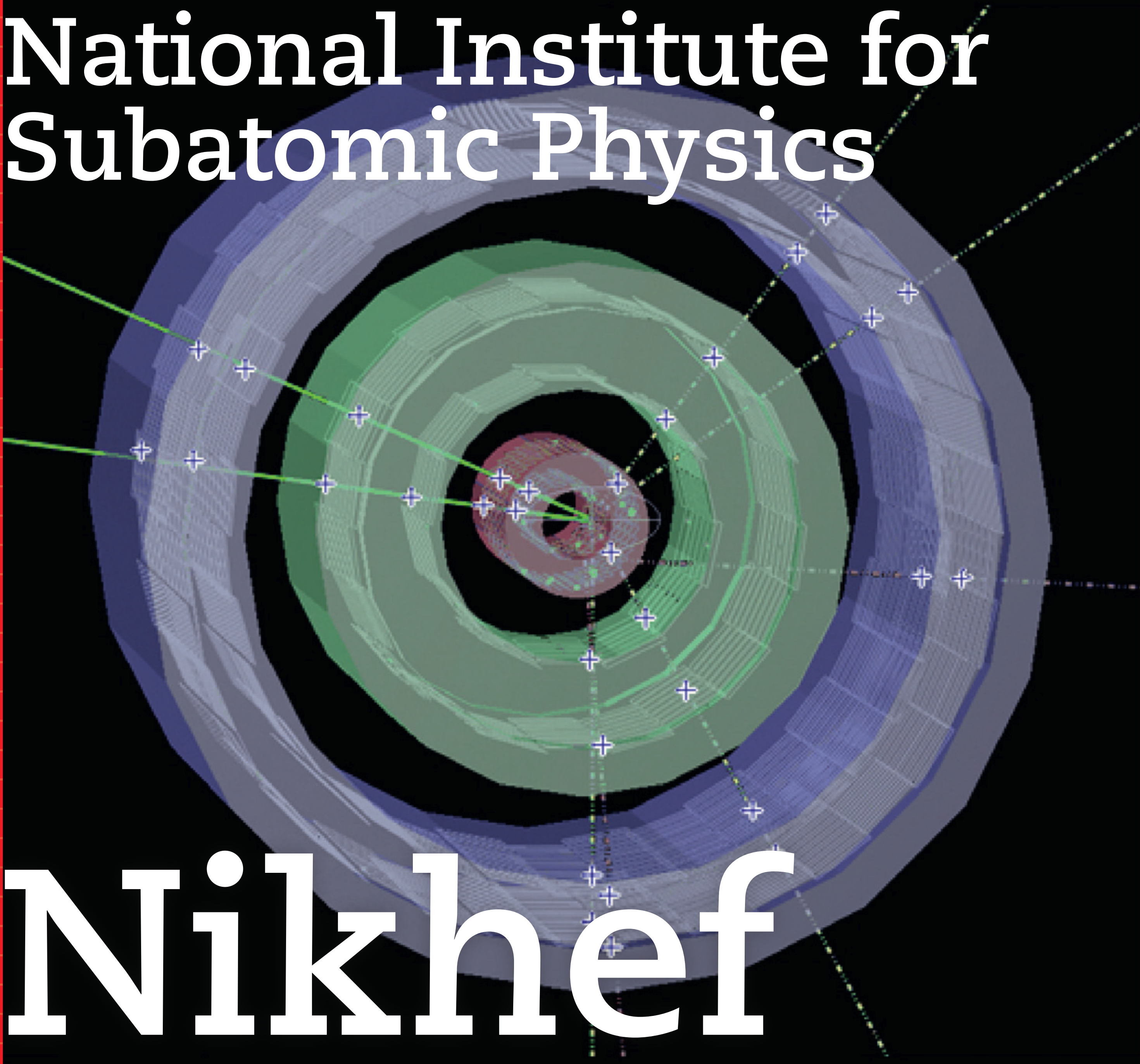
Annual Report
2008

National Institute for Subatomic Physics



Nikhef

NIKHEF

Annual Report 2008

National Institute for Subatomic Physics Nikhef

Colophon

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Cover: The first event in the ALICE detector after the LHC switch-on.

Nikhef is the National Institute for Subatomic Physics in the Netherlands, in which the Foundation for Fundamental Research on Matter (FOM), the University of Amsterdam, VU University Amsterdam, Radboud University Nijmegen and Utrecht University collaborate. Nikhef coordinates and supports most activities in experimental particle and astroparticle physics in the Netherlands.

Nikhef participates in experiments at the Large Hadron Collider at CERN, notably ATLAS, LHCb and ALICE. Astroparticle physics activities at Nikhef are threefold: the ANTARES neutrino telescope in the Mediterranean Sea; the Pierre Auger Observatory for cosmic rays, located in Argentina; and the Virgo gravitational wave interferometer in Italy. Detector R&D, design and construction of detectors and data analysis take place at the laboratory located at Science Park Amsterdam as well as at the participating universities. Nikhef has a theory group with both its own research programme and close contacts with the experimental groups.

Contents

Introduction

On Wednesday morning 10 September, 2008 at 10:15 protons circulated for the first time in the 28 kilometres circumference Large Hadron Collider (LHC). Marking decades of preparations! Worldwide millions of people watched (or tried to get access to) the live webcast from CERN. In Amsterdam, 41 journalists interviewed Nikhef physicists; some made it to the eight o'clock news; others made it to the front pages of the major national newspapers. The upshot of this media hype, inspired to a large extent by the possibility of mini black-hole creation in high-energy proton-proton collisions, is that finally many in the Netherlands are aware of the existence of CERN and in particular of the LHC start-up. In the days following 10 September major progress was made. The beams were captured by the radio-frequent acceleration fields which allowed the stored proton beam to circulate for many minutes (millions of turns) instead of a few hundred microseconds (few turns). This enabled accurate measurements of beam orbits which proved to be in excellent agreement with the simulations, demonstrating not only the detailed understanding of the accelerator but also the first-class quality of the beam diagnostics hardware and software. In parallel, all four LHC detectors (ALICE, ATLAS, CMS and LHCb) registered spectacular beam splashes which allowed the experimenters to verify many aspects of the detector hardware systems and the software event reconstruction packages. First results on detector alignment have already been achieved. With all this the LHC project appeared to be on track for a very smooth commissioning phase….

And then came 19 September, 10:19, a superconducting connection between magnets failed, causing an electric arc that ruptured a cooling pipe containing liquid helium. Several tons of helium escaped and the pressure release valves in the cryogenic vessel proved too small to prevent the pressure from rising. The

Auke-Pieter Colijn and Els Koffeman are the focus of attention at the LHC opening.

subsequent pressure wave rushing from magnet to magnet only came to a halt a few hundred meters away from the original incident, leaving in its wake 53 main dipoles damaged, thereby causing an abrupt end to the hitherto euphoric LHC commissioning. Since then, the CERN accelerator division has analysed the sequence of events leading to this accident in great detail and technicians and engineers are now frantically implementing early warning systems and additional pressure release valves to avoid a reoccurrence of this disaster. The LHC is expected to restart in the second half of 2009.

While a lot of attention went naturally to the start-up of LHC and its experiments, Nikhef's other line of research, astroparticle physics made major progress in 2008. On 30 May the last ANTARES detector line was deployed successfully, thereby completing the prototype neutrino telescope at the bottom of the Mediterranean Sea. After a few weeks of data taking, the eight years old 40 km long main cable installed at the bottom of the Mediterranean Sea connecting ANTARES to its shore station failed (at first the breakdown was attributed to a lizard which fried itself between the terminals of a transformer in the shore station …). This setback was overcome in a routine procedure first identifying the faulty cable segment and subsequently repairing it. Since then, ANTARES is running smoothly! In December the neutrino telescope community in the Netherlands received another boost with the granting of an 8.8 M€ investment fund for the construction of KM3NeT, the European project to build a next-generation neutrino telescope sufficiently large to be able to identify high-energy neutrino point sources (if they exist).

The AUGER cosmic-ray observatory in Argentina was completed in 2008 as well, at least as far as the installation of the water tanks (100% duty cycle) and fluorescence detectors (10% duty cycle) are concerned. Regretfully, I missed the inauguration ceremony to celebrate these events, because I boarded the wrong plane in Madrid. I expect to get another opportunity to travel to AUGER once we, together with our German and French colleagues, start to install the radio antenna array of twenty square kilometres that was designed to boost the duty cycle for simultaneous detection of cosmic-ray air-showers by two independent technologies from about 10% to 100%.

From the point of finances, 2008 was an excellent year. Apart from the already mentioned KM3NeT investment grant, both FOM and NWO granted Nikhef a budget increase because of the high marks attributed to the quality of Nikhef's research by the international committee that reviewed Nikhef in 2007. In addition, several Nikhef applicants received personal grants from NWO and one received the prestigious Starting Individual Research Grant (SIRG) from the EU.

As far as the LHC is concerned, 2009 promises to become almost that what I expected, albeit a bit too optimistic, a year ago from 2008: it will yield head-on proton-proton collisions. Initially at energies of 450 GeV onto 450 GeV and hopefully reaching 5 TeV onto 5 TeV by the end of 2009. Nikhef's three astroparticle physics endeavours, ANTARES, AUGER and Virgo, will take data in 2009. Mid 2009, the installation of the AMS-IX and BiG Grid related infrastructure should be completed and shortly afterwards the Dutch LHC Tier-1 grid compute facility should be in full swing!

Frank Linde

1

Reviews

1.1 LHC Start-up
remember those days in September

Christine Sutton (CERN)

At 10:28 on 10 September 2008, the first proton beam made the full 27 km journey around CERN's Large Hadron Collider (LHC), travelling in a clockwise direction. Cheers and applause filled the CERN Control Centre (CCC, see Fig. 1) as two spots appeared on the screen, indicating that the beam had completed the full circle, from injection at Point 2 round to the same point (see Fig. 2). The emotion was echoed around CERN where staff and users had been watching events unfold via screens in the main auditorium and elsewhere, as well as in the control rooms of the LHC experiments. Also keenly watching the action were some 250 journalists attending the event, many in the Globe of Science and Innovation.

It had taken the operations team in the CCC just less than an hour to allow the beam to progress carefully through the eight sectors of the machine, one at a time. Lyn Evans, LHC project leader, was more than satisfied: *"It was beyond my wildest dreams to get beam so quickly"*. In the afternoon, again taking about one hour for the complete journey sector-by-sector, the first anti-clockwise beam travelled all the way from injection at Point 7, finally making a total of two circuits.

It was a heady experience, which was followed by a few more days of steady progress, until a breakdown in a magnet inter-connection brought commissioning to an abrupt halt on 19 September. However, those few days have already demonstrated that, in Evans' words, *"the machine works beautifully"*.

The sight of first beam marked the end of a long journey for the LHC project, from the first proposals in 1984 to the final hardware commissioning during summer 2008. The LHC is unlike any other particle collider —it is truly its own prototype. It is the first to

Figure 1. The CERN Control Centre on 10 September 2008.

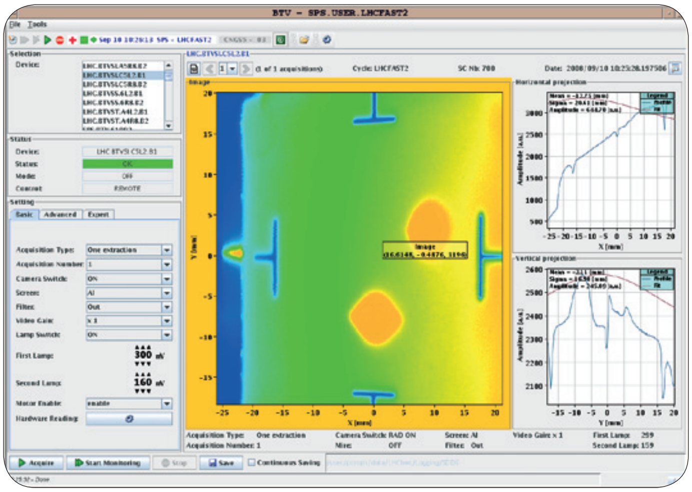


Figure 2. Beam spot of the injected LHC beam and of the beam that made one turn, on a screen near Point 2.

have two beams of particles travelling in opposite directions in separate channels within the same magnetic structure, and the first to operate with superfluid helium at a temperature of 1.9 K. Just 1.9 degrees above absolute zero, this very low temperature is required to reach the high magnetic-field strengths necessary to bend the beams at 7 TeV, the machine's future operating energy.

Starting up a machine like this is no simple matter. Commis–sioning is a long process that starts with the cooling down of each of the machine's eight sectors (see Fig. 3). This is followed by electrical testing of the 1600 superconducting magnet systems, and their individual powering to nominal operating current. Once these steps are completed, the powering together of all the circuits of each sector can begin. Only then can the eight independent sectors be powered up in unison to operate as a single machine.

There are around 1400 tests of varying complexity to be per-formed on each sector after it reaches 1.9 K. These include: electrical quality assurance to check that all the wiring is in place after the magnets have contracted during cool down; individual testing of protection systems; and power testing. After all these tests have been completed, the sectors are then handed over to the Operations Group to commence 'dry runs', where the ma-chine is run as it would be with the beam. There are also safety tests that must be done before the beam can circulate, to prevent people from being in the tunnel at the same time as the beam.

By the first week of April 2008 half of the LHC ring —between point 5 and point 1— was below room temperature, with sectors

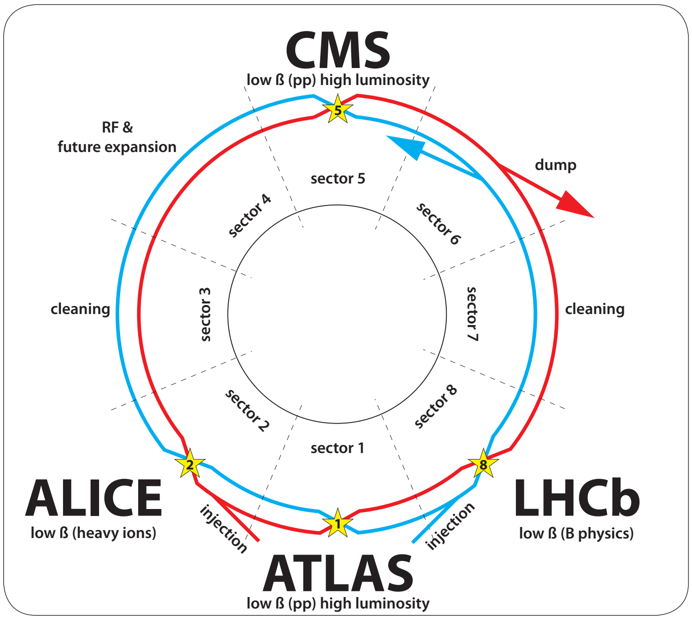


Figure 3. Schematic layout of the Large Hadron Collider (LHC) showing the eight main sectors. The red and blue curves indicate the clockwise and counterclockwise rotating proton beams. The four big experiments are located at the indicated crossing points.

5–6 and 7–8 fully cooled. Then, by the end of July, the whole machine was fully loaded with 130 tonnes of liquid helium for the first time. All eight sectors were at or close to the operating temperature of 1.9 K and the final commissioning of the hardware was progressing apace.

The next phase in the process was the synchronization of the LHC with the Super Proton Synchrotron (SPS) accelerator, which forms the last link in the LHC's injector chain. This was successfully achieved for the clockwise beam on the weekend beginning 8 August, when a single bunch of protons was taken down the transfer line from the SPS accelerator to the LHC. The anti-clockwise synchronization system was then tested successfully over the weekend of 22 August.

Finally, on 10 September, after preparing the SPS, the start-up procedure began promptly at 9:30. The plan was to send in the clockwise beam one bunch at a time and open up the LHC ring step by step. At each of the four points occupied by the LHC experiments (see Fig. 3), the beam would initially be stopped by closed collimators to allow corrections to be made, if necessary. The jaws of the collimators would then be opened to allow the subsequent beam shots to proceed through the detector and farther round the ring.

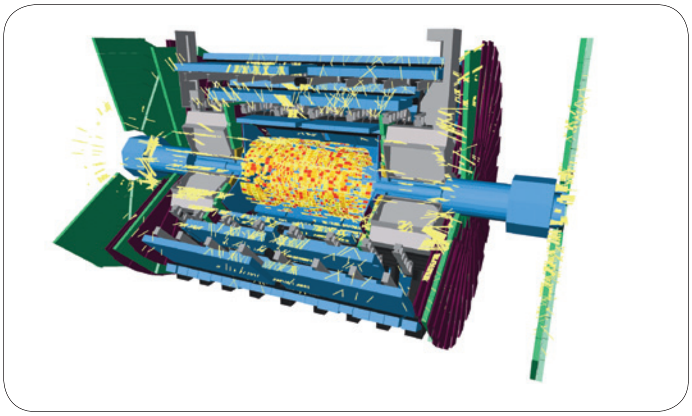


Figure 4. First beam induced event in the ATLAS detector.

The sequence worked like clockwork: beam to collimators, collimators open, beam to next collimators and so on. Each of the major LHC detectors —ALICE (Point 2), CMS (Point 5), LHCb (Point 8) and ATLAS (Point 1)— lit up in turn with the first beam-related particles as bunches in Beam 1 hit the nearby collimators, creating particle 'debris' (see Fig. 4). The procedure with the anticlockwise direction was almost as smooth, and it had made its first complete turn by 15:00.

Present in the crowd in the CCC during 10 September, were all the directors-general of CERN who had watched over the proposals, approval and construction of the LHC. Herwig Schopper (1981–1988) had overseen the construction of the LEP collider, with its 27 km tunnel that the LHC now occupies; Carlo Rubbia had been a tireless and inspirational advocate for the machine (1989–1993); Chris Llewellyn Smith (1994–1998) had conducted the hard negotiations that led to the project's approval in 1996; Luciano Maiani (1999–2003) was at the helm as major construction got under way; and Robert Aymar (2004-2008) had seen the project to its successful completion. The crowd (see Fig. 5) also included Giorgi Brianti, the 'father' of the machine with its unique twin-aperture, two-in-one magnet system.

Only very careful planning and preparatory work had made it possible for the Operations Team to be able to propose starting up the machine under the eyes of the world's media. Although common practice for the launch of space vehicles, for example, this was a 'first' in the world of particle physics —and not without additional stress for the operators. From 9:00 to 18:00 at CERN, regular live action from the CCC was broadcast by many TV channels. The journalists in the Globe were also able to attend a press conference in the afternoon, given by the current

Figure 5. CERN top brass in the LHC control room, foreground (left to right): Jos Engelen, Robert Aymar and Herwig Schopper; background (left to right): Chris Llewelyn Smith and Luciano Maiani.

director-general, Robert Aymar, together with Llewellyn Smith, Rubbia, Schopper, Brianti, Evans, and Jos Engelen, CERN's Chief Scientific Officer.

LHC inauguration

The LHC inauguration ceremony was a memorable experience for everyone who attended. On 21 October the SMA18 hall, which had previously served for the assembly of hundreds of superconducting magnet systems, was fitted out to welcome more than 1500 invited guests, including official delegations from CERN's member states, observer states and non-member states. *"The LHC is a marvel of modern technology, which would not have been possible without the continuous support of our member states,"* said the director-general, Robert Aymar, in his speech at the ceremony. *"This is an opportunity for me to thank them on behalf of the world's particle-physics community"*.

The ceremony officially marked the end of 24 years of conception, development, construction and assembly of the biggest and most sophisticated scientific tool in the world. After the LHC was proposed in 1984, it was 10 years before Council approved the project. *"Its construction has taken more than 14 years and there have been many challenges, which have all been overcome,"* said the LHC project leader, Lyn Evans, *"We are now looking forward to the start of the experimental programme, where new secrets of nature will undoubtedly be revealed"*.

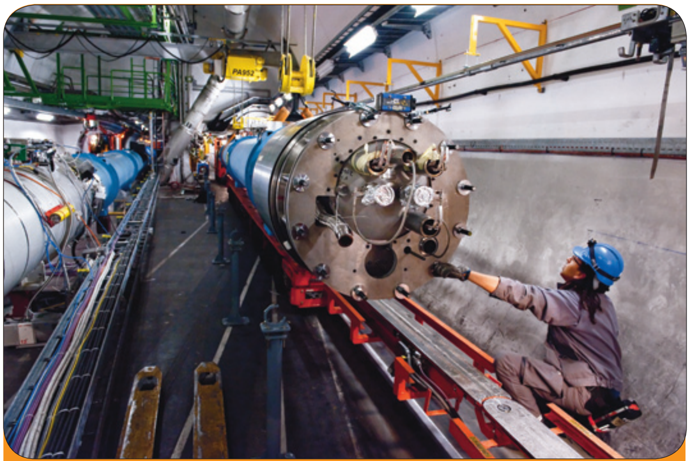


Figure 6. December 2008, a damaged LHC magnet is being removed from the ring for repair.

Incident at the LHC

On 19 September 2008, during powering tests of the main dipole (magnet) circuit in Sector 3–4 of the LHC, a fault occurred in the electrical bus connection in the region between two magnets, resulting in mechanical damage and release of helium from the magnet cold mass into the tunnel. Proper safety procedures were in force, the safety systems performed as expected, and no-one was put at risk.

In the following weeks, once the sector had been brought to room temperature, detailed investigations began, confirming the cause of the incident. CERN has published two reports based on these investigations and has confirmed that the accelerator will be restarted in 2009. These studies of the malfunction have allowed the LHC's engineers to identify means of preventing a similar incident from reoccurring in the future, and to design new protection systems for the machine.

In all, 53 magnets have to be removed from the affected zone in the tunnel for inspection and cleaning and/or repair (see Fig. 6). Of these, 39 will get a new 'cold mass' —the heart of the magnet— from the stock of spares. All magnets will undergo complete warm and cold testing before re-installation.

1.2 Nikhef and the World Wide Web

Willem van Leeuwen

The history of the World Wide Web (WWW) is well known. Its inventor Tim Berners-Lee formulated his proposal in 1989, two years later the web server at CERN became operational and the line mode browser was released for public use. The first years WWW did not become very popular due to the availability of systems like Gopher, archie and WAIS, which had a graphical user interface (GUI). In 1993 the first GUI's for WWW, Viola and X-Mosaic, became available and from that time the use of WWW grew spectacularly. Here I report my personal view on how Nikhef got involved in the WWW project and became the first web site in the Netherlands and one of the first web sites in the world.

The early days

In 1991 I worked in the computer department of Nikhef where I was responsible for user support and for the installation of the CERN software (written in FORTRAN and machine code) on Sun, Hewlett-Packard and Silicon Graphics computers, all running some version of the Unix operating system. In September that year there were two workshops in the USA that were useful for my daily work: a workshop on the CERN program libraries at the (now defunct) Superconducting Super Collider (SSC) near Dallas and the first workshop on the use of Unix in high-energy physics, called HEPiX, at Fermilab (FNAL) near Chicago. In both workshops Judy Richards of the computing division of CERN gave a presentation on WWW.

When in November 1991 the availability of a web browser was announced, I remembered the talks at SSC and FNAL and decided to install the browser on our central computer, a Sun 4/690. That failed miserably and this could have been the end of my involvement with WWW but fortunately I had access to an IBM

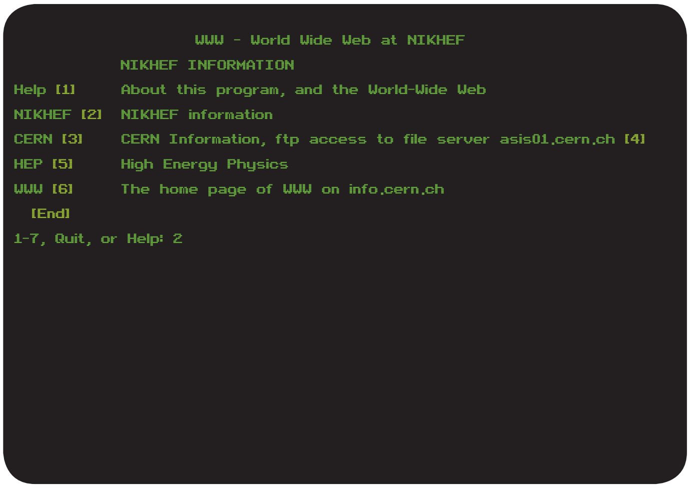


Figure 1.The first Nikhef web site.

RS/6000 running the AIX operating system and on that system the installation succeeded. I then looked into the source code of the browser to find the cause of the failure on the Sun. It turned out that the change of a number 80 into 79 made the browser work on Sun as well. This number 80 by the way had nothing to do with the port number which is now used by the web server but with the length of the line (remember: a punched card had 80 columns!). My first e-mail to Tim Berners-Lee was about this bug.

The first customers of the browser were the secretaries of Nikhef, they were now able to find the phone numbers of people at CERN without the help of physicists with an account on the CERN IBM computer. Even more enthusiastic was Karel Gaemers, then scientific director of Nikhef's High-Energy Physics section, because access to the SPIRES preprint database via WWW was much faster and easier than with the SPIRES user interface. SPIRES existed since the late 1960's at SLAC (Stanford Linear Accelerator, now SLAC National Accelerator Laboratory) as a database of particle physics literature and became in 1991 accessible via the web site of SLAC, the first web site in North America.

To appreciate the simplicity of working with WWW one has to realise the complexity of accessing files on another computer without WWW:

- One needs an account on that computer;
- One has to know the commands of the operating system of that computer;
- One has to understand the file system;
- If the information has to be accessed via a program like a database system one has to know the intricacies of that program.

As an example, for the installation of the CERN libraries at Nikhef I had to access the following CERN systems:

- The IBM 3090 running VM/CMS with a file system based on minidisks;
- A VAX running VAX/VMS with files contained in directories.

Needless to say that this was a cumbersome and time consuming task.

All necessary information is now conveniently stored in the web address or Uniform Resource Locator (URL) of the file; when a file has to be accessed via a program, the URL also contains the name of that program.

The next logical step was the installation of a web server at Nikhef. With the help of the local network gurus on February 1992 a web server was running on nic.nikhef.nl (nic: network information center). One of the first applications was the Nikhef telephone directory which could be searched using the *isindex* option. A more generic application was the world wide square root server which demonstrated the flexibility of what are now called CGI scripts. These applications were simple but they helped the CERN WWW team to overcome the skepticism at CERN. It showed that via WWW you can not only easily access documents on another computer, but also have that computer run programs for you and send the result. Early 1993 the web server had to be moved from nic.nikhef.nl to nikhefh.nikhef.nl. This meant the change of a lot of URL's. I therefore proposed our system manager to give nikhefh.nikhef.nl the alias www.nikhef.nl to make our URLs immune for future moves of the web server.

Propaganda fide

It took about two years for WWW to become popular. As stated above, there existed similar programs like Gopher, archie and WAIS, which all had a graphical user interface (GUI). There was at that time a WWW browser with a GUI, but that ran only on a not widely used NeXT computer on which WWW had been developed.

In 1993 I preached the WWW gospel at the Network Services Conference at Pisa and at Interop 1993 in Paris. There I stressed the beauty and the simplicity of the concept, based on one protocol HTTP and one markup language HTML and I demonstrated how easy it was to make scripts to be run on a web server. With the advent of X-Mosaic and Viola my mission became obsolete. The rest is history: nobody can now imagine a world without WWW.

What has changed?

The first web server at Nikhef has been developed with the line mode browser in mind. So no pictures, videos or sounds. The information was intended for physicists and technicians at Nikhef and at other high-energy physics institutes and contained practical information like phone numbers, e-mail addresses, Nikhef preprints and dissertations, documentation on ongoing projects, minutes of meetings and the like. The information was stored in plain files, written in HTML. Nowadays information and presentation are separated, information is stored via a content management system and tools are used to generate HTML. Moreover the Nikhef web site is now split in two sections:

- for Nikhef users;
- for people interested in Nikhef like students, schoolteachers, policy makers and industries.

Hebban olla vogala nestas hagunnan

This is the first sentence ever written in Dutch and means "All the birds started building nests". This sentence came into my mind when somebody asked me what the first Dutch text on the web was. I did not know the answer since most pages of the Nikhef web site were written in English. An exception were the pages I created from articles in the SARA Bulletin. SARA is the academic computer center in Amsterdam and the most useful articles were called *'Tips voor VM gebruikers'* (Hints for VM users). VM was the operating system of the IBM 3090 computer. Since it was hard to find a specific article I created an index of keywords with the Unix commands *mkey* and *inv*. The command *hunt* was then used to find the article(s). I used this tool for my work on the IBM but also to convince the SARA people of the usefulness of WWW.

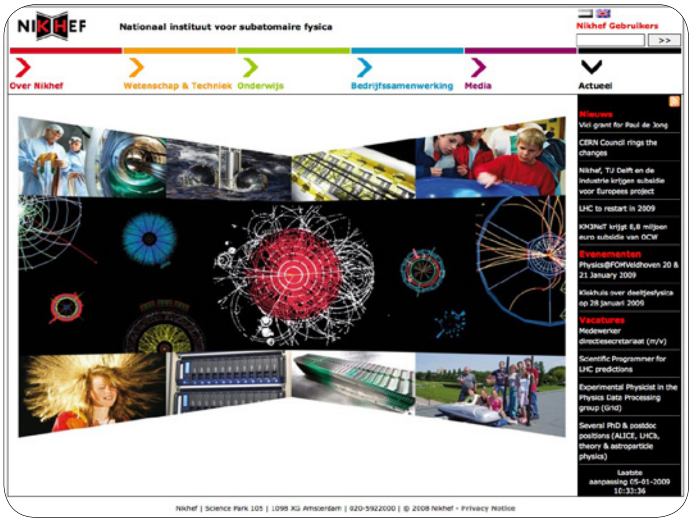


Figure 2. The present Nikhef web site.

Lessons I learned

- *Keep it simple*. This was easy in the early days of the web: With only the line mode browser available I did not have to bother about frames, pictures and the like. The Nikhef web site was primarily meant for physicists and was an intranet avant la lettre;
- *Divida et impera*. Use the information provided by secretaries, librarians, etc. Run cron jobs to translate their files into HTML;
- *Do not choose a program for its look and feel*. Gopher and WAIS had nice user interfaces but the concept of WWW is superior. In fact the Gopher and WAIS protocols were incorporated in WWW.

Conclusion

It was great fun to be involved in the early development and use of WWW. I was convinced of its success but I never foresaw this to be that big.

1.3 What is 'The Grid'? and why is Nikhef working on it?

Jeff Templon

The Grid is a concept invented in the last decade of the 20th century. The inventors had a vision of a computer system like the electric power grid: plug into it and the power is 'just there'. You don't need an electric generator in your house to use electricity; with the Grid, you would not need a large computer in your house to do large computations.

In less than 10 years, Nikhef expertise in remote farm computing has been expanded and applied to drug discovery, archival of scans of medieval bibles, lattice quantum chromodynamics, atmospheric ozone depletion studies, and analysis of MRI brain scans. During the same period, the amount of storage and computational power in our grid site has increased onehundredfold, and Nikhef has become a world leader in the area of security in grid computing. This review describes what a computing grid is, and how Nikhef got involved with grid computing, starting from its roots in high-energy physics.

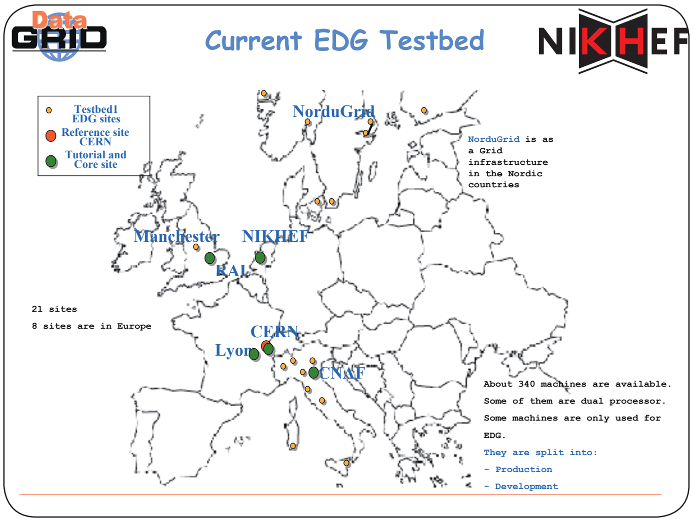


Figure 2. EDG testbed map showing five core partners (green) in 2002.

Early ideas

The Grid was meant to be an extension of the World Wide Web. The Web allows a user to access data located all over the world, as if these data were actually on her personal computer. On the Web, however, you can't do very much with these data, besides look at it, or download it to your personal computer for further processing. The vision of the Grid is to be able to specify not only what information you would like to see, but also how you would like it processed. Instead of downloading the data (gigabytes) and running your program (megabytes) over this data, you would "send the megabytes to the gigabytes".

In practice, using the Grid is not as simple as plugging in your lamp and turning it on (see box). However, much of the grid vision has been realised, and is being used daily by scientists all over the world. Because it was touted as the followup to the Web, Grid was a real hype and the term was adapted for many different uses.

In all cases, grid refers to a system of "more than one". The simplest case is "more than one computer", as in the case of 'campus grids', a cluster of computers supporting the research at a university. There are also grids in the sense of "more than one location"; banks often set up this type of grid, tying together computers at all their main locations; during the evenings, when employees are not using their workstations, large computations are run using the combined power of all these machines, spread over a wide area.

In both these examples, the computers were owned and operated by a single organisation: 'the bank' or 'the university'. Grids also exist which combine the computer power of various different organisations; this is a unique type of collaboration. And finally, one can have a grid in the sense of having various different groups of users, working on the same computers.

The Grid used in high-energy physics is the most ambitious type, combining each of the 'many' elements listed above. The computers are located at many different institutes and universities, in different countries, and being used (at the same time) by different groups. The high-energy physics grid contains many sites belonging to the pan-european research grid, so that there are a large number of different groups … not just collaborations that perform the high-energy experiments.

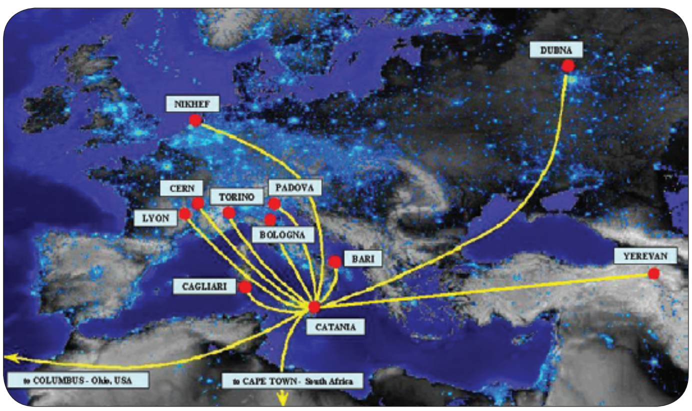


Figure 1. Nikhef's first Grid: ALIGRID, the earliest version of the grid for the ALICE experiment at CERN, autumn 2001.

Figure 3. LHC grid infrastructure in and around Europe, January 2007

How it works:
Consider a scientist who has to analyse data contained in one thousand files. These thousand files will not fit on her personal workstation, and even if they did, the analysis would take a year to complete. She decides to run the work *on the grid*. She applies to a grid project requesting access to its storage and computer resources.

The experiment that produces the data is modified so that the data are written directly onto the grid, via the *file transfer service* that can automatically recognise new data files when they are produced, and ships them to the appropriate storage location in the grid. Our scientist modifies her analysis program so that it analyses data from a single file instead of one thousand. She then uses a *grid submission* program to submit one thousand identical jobs, each of which analyses one of her thousand data files.

In order to prevent abuse of the grid system, users must authenticate themselves (prove who they are) by presenting a *certificate*, similar in spirit to the DigID system used by the '*Belastingdienst*' (Dutch tax service). This certificate is digitally *signed* by the grid project that granted her access, proving that she is authorised to use the grid.

If she is lucky, there is no congestion on the grid when she submits her work —grids can be rather like highways in that respect— all one thousand of her jobs will run simultaneously, giving her the answers in eight hours instead of a year. Admittedly, more programming was needed —it probably takes a week to adapt the problem to use the grid— but for large problems, this investment is repaid well: "invest a week, earn a year".

The European Data Grid
At the turn of the century, Nikhef was involved in a project for remote computing related to the DØ experiment at Fermilab in the USA. Three staff members were involved, and to do this remote computing, fifty standard PC workstations had just been installed at Nikhef, i.e. 'remote' from the Fermilab point of view. Grid computing was seen as a natural extension of this project, and one year later (2001) Nikhef was one of the five 'core partners' of the European Data Grid (EDG) project. In April of 2001, Nikhef also hosted the very first meeting of the Global Grid Forum, an organization that eventually became the Open Grid Forum, the key body responsible for standards development in grid computing.

The first year of the EDG project was spent in integration of various existing 'middleware' tools such as the Globus grid toolkit, together with a newly-developed workload management system, parts of which were developed at Nikhef, INFN (Italy), and CERN. 'Middleware' refers to the software that enables the grid operation; this software sits between (hence *middle*ware) the user's program and the remote grid systems. By the time of the first EDG official review (March 2002), it was possible for three different groups (high-energy physics, earth observation, and comparative genomics) to show examples of their computation workflows using computing and storage, distributed over five sites in Europe, in the Netherlands (Nikhef), Switzerland, England, France, and Italy. Some programs failed to complete correctly, resulting in the kudos from the reviewers, who were impressed that we had dared to show them the actual grid system in real time, rather than replaying a recorded demo!

By the end of the EDG project, the Nikhef grid site had expanded from ten machines to well over one hundred, the grid itself had expanded from the original five locations to over forty, and

Nikhef had made lasting contributions in the area of virtual organization management (how to organise groups of users on the grid), grid information systems (the 'central nervous system' of the grid), site management (how to automate management of hundreds of machines), and computer security for grid systems.

The LHC Computing Grid
At the end of the EDG project, when Nikhef made its computing infrastructure available to the LHC grid, it was the largest single site in that grid. The LHC Computing Grid (LCG) is a worldwide infrastructure being built to handle the computing and storage needed for the LHC experiments at CERN in Geneva, and the thousands of scientists in the world who will participate in the analysis of these data.

The LHC computing grid currently contains over 150 distinct sites, petabytes (one petabyte is one million gigabytes) of storage, and an estimated 100,000 processors. It runs on average a quarter million programs *each day*. Nikhef, together with partner institution SARA, runs one of eleven 'Tier-1' centers in the world. These Tier-1 centers are responsible for the bulk of the data storage in the LHC grid.

Enabling Grids for e-Science in Europe

This project (acronymn EGEE) is the European successor to the pioneering EDG project. The main objectives are to expand use of the grid to more groups of users (EDG had only three user communities), and to expand the scale of the grid, and transform it from a proof-of-concept testbed into a real infrastructure for scientific research in Europe. EGEE is now in its fifth year and has succeeded admirably in both goals. Over 300 institutes contribute computing and storage resources to the EGEE grid (including all of the European LHC sites). Thousands of users, belonging to over sixty active user communities, make use of the grid every week. About three-quarters of the activity on this grid comes from high-energy physics research. The remaining quarter comes from a wide range of research (listed in order of decreasing activity): life sciences, computational chemistry, astronomy, energy research, and earth sciences. Nikhef has made important contributions to EGEE in the areas of grid security software, in operational automation (such a large infrastructure cannot be operated without a high degree of automation), and in the technical leadership of the project.

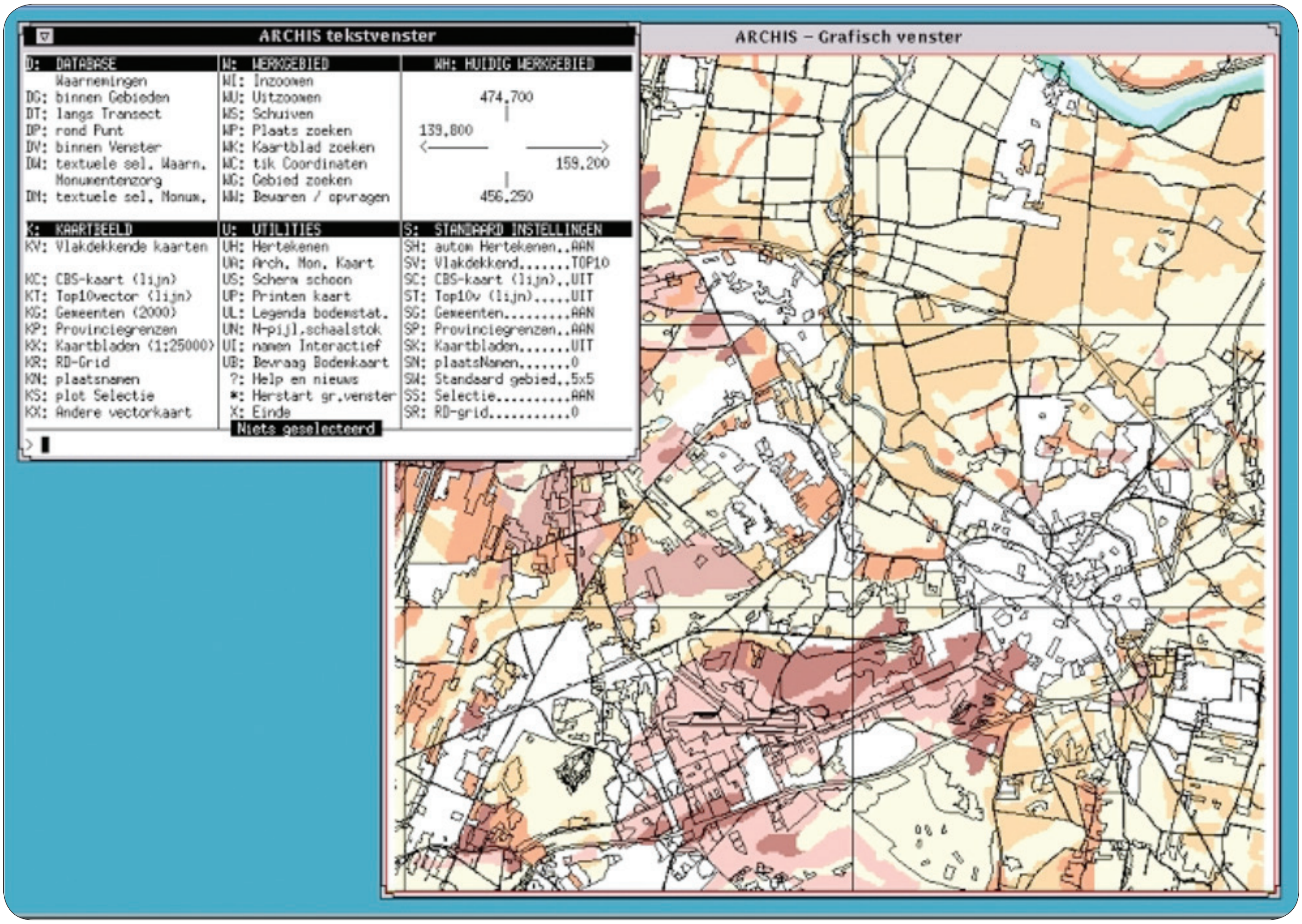


Figure 4. Example of archeological data being stored by DANS, one of the participants in BiG Grid.

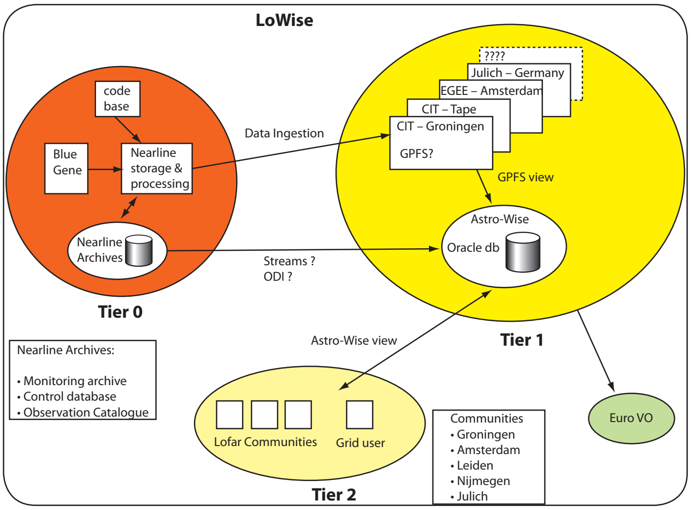


Figure 5. Early design for an archive facility for LOFAR. A BiG Grid technical focus group is currently making a detailed technical design report for the LOFAR archive. The estimated amount of data to be stored is two petabytes per year.

BiG Grid

The "BiG" in the name is the acronym for *Budget voor Investeringen in Grootschalige onderzoeksfaciliteiten*, (Budget for Investment in Large research facilities). There was a one-time call for proposals for such facilities in the Netherlands in late 2005; Nikhef, together with partners NCF (the Dutch national foundation for computer facilities) and NBIC (the Netherlands BioInformatics Centre) were awarded a 29 M€ grant to build and operate a Dutch national grid infrastructure, and to support Dutch scientists in their use of this infrastructure. This grant includes operation of the Dutch LHC Tier-1 site already mentioned, a distributed infrastructure for the life sciences in the Netherlands such as biobanking, genomics, and medical imaging, and a large amount of storage for the Dutch LOFAR experiment, the world's largest low-frequency radio telescope.

BiG Grid officially started in January 2007. This enabled Nikhef and SARA to start installing the large amounts of computers and storage servers needed for the LHC Tier-1 facility. The size of the Tier-1 facility expanded by a factor of five during 2008.

BiG Grid is the first step in the creation of a national computing infrastructure for scientific research. Nikhef is investing in this vision, supporting the view that such a system is the most cost-effective IT solution for the Netherlands scientific community; it also provides a splendid opportunity for multidisciplinary collaboration; Nikhef grid-computing staff are actively working with people from other fields in 'gridification' of their research computing. The group is now active in two of these projects. The first is the design of the LOFAR data archive, which will contain the scientific results of the LOFAR telescope and make these available to researchers in the Netherlands and later across the globe. The second involves a pilot project (in collaboration with SURFnet and the Max Planck Institute for Psycholinguistics in Nijmegen) that will make it possible for psycholinguistics researchers to safely connect to their grid infrastructures, even when located at an internet cafe (notorious for not being secure!).

Technology transfer

In the nineties, one of the side effects of the research activities at Nikhef was the beginning of what is now known as the Amsterdam Internet Exchange. We see a similar trend in grid computing at Nikhef: grids are core technologies for Nikhef research in high-energy physics, but we collaborate with Dutch industrial partners on use of the same technologies.

Two examples: firstly, we work with Logica in the Virtual Laboratory for e-Science (VL-e, and its proposed successor VLe++) to develop new techniques to analyse, and improve, the reliability of distributed systems. For us the distributed systems are computing grids, for Logica they are next-generation service-oriented business systems. Another partner is Philips Research in Eindhoven. This collaboration goes two ways: Philips is one of the core housing locations for BiG Grid, meaning high-energy physics computations relevant to Nikhef and CERN research, will be running at Philips in Eindhoven. Philips in turn has used the Grid facilities at Nikhef to do research on the next generation of SPECT scanners for medical imaging.

Challenges for the Future

Nikhef is investing in the grid-computing vision; one of our important tasks in the near future is to realise this vision. We work towards this realization via our participation in projects like the BiG Grid ones mentioned above. One of the biggest challenges is to improve the ease of use of the system; high-energy physicists are used to typing cryptic-looking commands in order to make something happen on a computer, other fields are more critical and have a strong preference for the drag-and-drop type interface.

Scaling the Dutch grid infrastructure to meet the demands of the LHC and LOFAR is also a challenge. We are taking the unfortunate delay in the LHC experiments, as an opportunity to improve the BiG Grid infrastructure. Acceptance of data from these large experiments is said to be like drinking water from a fire hose: "*we plan to be thirsty*".

1.4 Never lonely at the top
an interview with Jos Engelen

Karina Meerman

Chief Scientific Officer Jos Engelen is leaving CERN and moving back to the Netherlands to take up a position as Chairman of the Board of the Netherlands Organisation of Scientific Research (NWO). He will miss walking the Jura mountainside and is sad to leave good friends behind, but he will continue to be proud of and involved with the science generated at CERN.

For a lot of people, there is something mythical about CERN. Not only because smart people dug a tunnel 27 kilometres long so particles could collide in the hope of finding something that has never been found before, but also because it is the place where the world-wide web was invented. For Chief Scientific Officer Jos Engelen it was a familiar place to work. *"Years ago I wandered the halls of CERN as a post-doc and later as a visiting scientist. I passed the office where Tim Berners-Lee had just installed the first clickable browser."* He pauses and laughs. *"I could not have been interested less"*.

CERN's Chief Scientific Officer Jos Engelen.

Large Hadron Collider

Engelen is quiet-spoken and articulate. He is modest and carefully avoids taking credit for things that he feels should be attributed to the collective that is the engineers and physicists at CERN. History will know him as the director who gave new momentum to the ambitious project that is the Large Hadron Collider (LHC), but could not be there in his official capacity to witness the proper start, that had to be delayed due to a hardware error in the tunnel. *"Having to postpone the proper start of the LHC is professionally a bitter pill to swallow, but to quote the Dutch football player Johan Cruyff: 'every disadvantage has its advantage' and we have developed superior diagnostic tools thanks to the incident. I am 102% convinced that the real start in 2009 will be a real start."*

Will he be sad that the new start of the LHC will not fall under his responsibility? *"Not really. It is a collective success. In subatomic science, we are so used to cooperate because the matter is so complex. It is a requirement to work together. I will remain sufficiently committed to celebrate and be proud with the others."*

Work together

The kind of people that have to work together are all scientists and technical experts, for example in the field of super-conductivity, electronics, physics and measurement analysis. *"Before I joined CERN, I worked at Nikhef as a project director and that had the same structure of leadership. People who work with something as unique and valuable as the LHC are motivated by that fact alone. It is their project and their motivation is never a problem. The challenge lies in channelling their creativity."* It is said that organising highly intelligent people is like herding cats. It is similar to that? Engelen laughs: *"Yes, but I also have hard-core engineers who carry out quality controls and enforce procedures. Their way of working is almost bureaucratic. It is the purely creative scientists who refuse to be harnessed, but it has to be done up to a point, because there is no way a large project such as LHC is going to be realised otherwise."*

Organisation

The CERN organisation in Geneva has 2,500 employees, but the science community outside the building consists of some six to seven thousand users. They are as much a part of the programme as the people on the regular payroll are. *"They carry the experimental programme and I was responsible for that. Management implements the strategy that has been agreed with the laboratory's governance: what research projects will we work on, when will we do so. The departments carry out the work with the means they have been given. Management operates above the departments, rather than in the midst of them. This was a conscious decision. Our previous directorate was large and had some ten members, some who considered themselves*

Curriculum Vitae
Joseph Johannus Engelen (1950)

Physics study at Nijmegen University (presently Radboud University) starting September 1967, Doctoral Exam February 1973.
Research Appointment (20% for teaching) at Nijmegen University; Ph.D. February 1979 (Nijmegen University).
March 1979 -February 1985: CERN (the European Laboratory for Particle Physics - Geneva, Switzerland), Fellow and Staff Member.
March 1985 - present: Staff Physicist at NIKHEF, since 1987 Full Professor of Physics at the University of Amsterdam (on leave of absence since January 2004).
1 July 2001 - 31 December 2003: Director of NIKHEF, National Institute for Nuclear Physics and High Energy Physics (Amsterdam, The Netherlands).
1 January 2004 - 31 December 2008: Chief Scientific Officer (Scientific Director) and Deputy Director-General of CERN, the European Laboratory for Particle Physics (Geneva, Switzerland)
Member of various scientific advisory committees.
Member of the Council of FOM (Dutch national funding agency for physics research).
Chairman of the board of ASTRON, the Dutch institute for radio-astronomy in the Netherlands.
Corresponding member of the Royal Netherlands Academy of Arts and Sciences.

working foremen, others positioned themselves above the departments. There was an unbalance of energy that had led to a certain overspending at CERN. There is a smaller directorate now with consistent roles and it is very clear who minds the budgets."

Company life

Asked if he could ever function in business life, Engelen takes a moment's pause. *"I have asked myself this before and I find it hard to give you a well-wrought reply,"* says the scientist. *"But anecdotal? No. I would not find the right terms of employment. It is all too short term and there is nothing wrong with making money as a primary goal, but it just isn't in my blood. And from what I have seen of project management in businesses, I must admit I have not been floored with admiration. There is no envy on my part. Of course there are captains of industry with great talents, but I believe creative people are more interesting. A physicist who is really good at his work, does not fit into company life. A free brain is a primary condition of employment."*

So what has CERN brought Engelen's free brain? *"I have thought some on who I was on January 1st, 2004 and who I am now, at the end of 2008. Those are the dates I started at CERN and left, by the way, they are not New Year's resolutions. It is hard to remember who you were in the past, but to be able to follow the big projects, the progress, to be able to assist with financial impulses when required, setting and meeting milestones…. It has been very satisfying to be a part of great ambition. And also to be in the pleasant position to discuss new ideas with physics colleagues. The jobs at CERN are filled with high-quality people. The IT people who work at CERN are certainly the best there are in the world."* Not that the physicists are mediocre, but Engelen reckons that they are as good as any that work at the high quality institutes such as Lausanne and Nikhef. A hint of emotion slips into his voice when he says: *"At a personal level, my time at CERN has brought me some extraordinary friendships. People say it is lonely at the top. If there are problems, that is certainly the case, but I was never completely alone."*

Politicians

One gets used to working with brilliant people, says Engelen, until one arrives in a more mediocre environment. *"CERN is a truly international, European organisation that works. For that reason, many politicians come to visit. I have had lunch with Musharraf, president of Pakistan, for example. He was most interested in our R&D-model. But what I wanted to say, is that I have learned that politicians are just as varied as ordinary people: they can be stupid, smart, pleasant or horrible. They are so varied, there seems to be no template for them. We welcomed a European politician, whose hand I shook while she glanced over my shoulder and asked: 'Where are the journalists and photographers?' On the other hand, we have met politicians who were instantly enthusiastic about their country's participation and wanted to invest R&D funds immediately."*

Leaving

So how does it feel to go? To leave France and Switzerland and return to his home country? *"Every farewell is accompanied by a bit of sorrow. Certain contacts will become less frequent and I will miss the Jura mountains. It had become something of a hobby for my wife and I to walk the foothills. I will miss that. But I can continue to enjoy the science that CERN generates. My interest in that will remain. Moving back to the Netherlands, I have already had my first encounters with the traffic jams at rush hour. Maybe I will get used to public transport, maybe we will move house. I don't know, we will see what happens."*

2

Research

2.1 Physics at the TeV scale: ATLAS/DØ

Management: Prof. dr. S.C.M. Bentvelsen (PL),
Prof. dr. N. de Groot, dr. ir. P. de Jong
Running period: 1997–2015

DØ
In 2008, the operation of the DØ experiment at the Tevatron collider at Fermilab, as well as the operation of the collider itself, has improved further, leading to a total integrated luminosity of almost 5 fb^{-1} collected in Run II (was 3 fb^{-1} at the end of 2007). As a testimony of the maturity of the experiment, in terms of physics output, 2008 was the most productive year ever, with 46 papers submitted for publication.

Physics highlights include an improved performance of the Higgs boson search, leading to the exclusion of a Standard Model Higgs boson with a mass of approximately 170 GeV (combined with CDF); a determination of the top quark mass with an unprecedented precision of 1.2 GeV (combined with CDF); the establishment of a significant lifetime difference of the two eigenstates of the the B_s system; and the observation of the Ω_b baryon.

ATLAS
The year 2008 was an eventful one for the ATLAS experiment. It started off with a race against the clock in order to complete the full detector before the start of data taking. The national ATLAS meeting in April in Groesbeek was brimming with anticipation. Then there was the excitement of the LHC start-up and the first beams through ATLAS. This was followed by the deception of the incident in the accelerator that damaged the machine to such an extent that collisions are delayed by at least eight months. We have made the best of this situation by carefully analysing the data from beam splashes, where the LHC beam hits a collimator, leading to a very large number of tracks trough ATLAS (see Fig. 1). Also analysed were the more than 100 million cosmic events that have been collected by ATLAS. From this we have learned that the ATLAS detector is already functioning very well and is ready for data taking. The year ended on a high note when NWO announced in December that Paul de Jong has been awarded a NWO VICI grant to investigate supersymmetry at the ATLAS experiment.

In the ATLAS muon system, Nikhef is partly responsible for the Monitored Drift Tubes (MDT). Before the start-up 1088 of the 1150 modules of the MDTs have been installed, of which all but two were included in the read out chain. At present there are 1.7% dead channels in the MDT detector and we expect to recover most of these during the current shutdown. The position of the chambers has to be known to a precision of better than 40 μm. This is achieved through an optical alignment system of more than 12000 sensors of which 99.6% were operational. One Nikhef specific project has been the so-called twin-tubes, where we try to measure both x- and y-coordinates in the MDT system. First data indicate that this method is working well and can be used in the muon track reconstruction. Muons can be identified by the muon system alone or by taking a track in the ATLAS inner detector and linking that to a muon signature in the muon chambers or the calorimeters. We have been very active in the software development of the muon reconstruction and have made important contributions to all three of these methods. Cosmic data indicate that we find a muon signal in the MDT for almost every muon that traverses the detector. In 95% of the cases this track segment can be successfully linked to a track in the inner detector.

The ATLAS inner detector consists of three layers of silicon pixel detectors, four layers of silicion strip detectors (SCT) and 36 layers of transition radiation tracker (TRT). Nikhef has been responsible for the assembly of of one of the SCT endcaps. The SCT was completed in the month of January. A failure of the cooling system caused some delay in the commissioning, but the SCT was ready for first beam in September with 98% of the modules operational and has been taking cosmic data since. A total of seven million cosmic events have been collected with the inner detector. They have been used to align and calibrate the detector. A resolution of 45 μm on the transverse impact parameter has been achieved. This is already approaching the design resolution of 35 μm. One area of concern is a degradation of the signal from the optical read-out system. This issue will be investigated during the present shut-down.

In parallel with the completion and commissioning of the detector, the computing and analysis effort was going full steam ahead in 2008. ATLAS performed a final readiness for data test where a large number of physics events were simulated and shipped out to the Tier-1 computing sites with our Nikhef-SARA centre receiving over one terabyte of data per day. Using a software framework developed at Nikhef we were often able to analyse the data on the day they were supplied. In addition all physics groups presented their final sensitivity studies in a number of ATLAS physics notes.

Nikhef is active in three areas of physics analysis: top physics, supersymmetry (Susy) and Higgs searches. We have continued our traditional strength in the top group, where we provided the editor of the cross-section chapter of the top physics note as well as the overall editor of this note. We studied the impact of running at a lower energy of 10 TeV initially, the possibility to extract the *b* quark identification efficiency from data, the difference

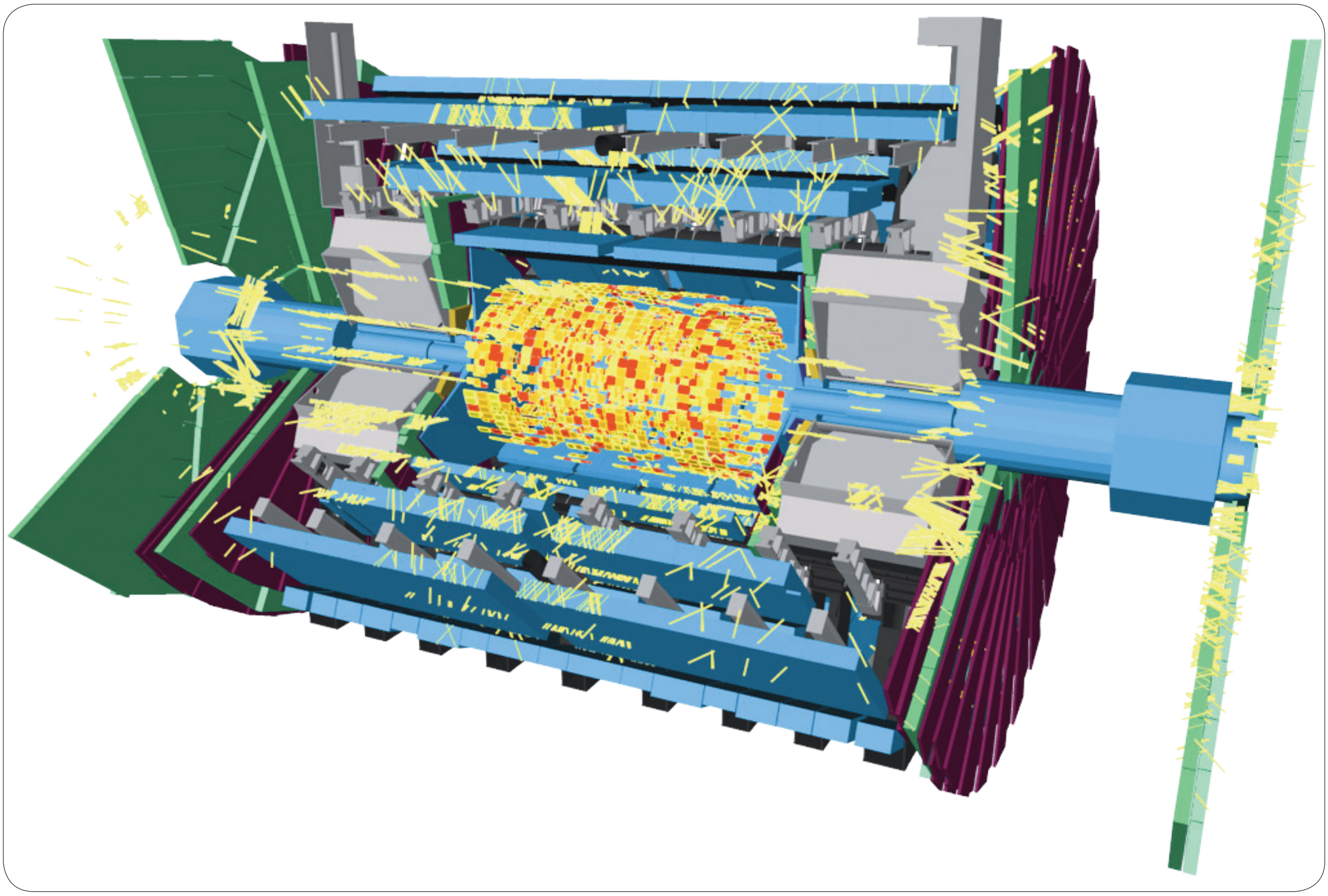


Figure 1. First collision tracks in the ATLAS detector. The beam is hitting a collimator placed just upstream of ATLAS and is producing a large number of muon tracks in the detector.

between Monte Carlo generators and the measurement of the W+ jets background on early data.

Our efforts in the Susy group have increased significantly since last year. We follow several paths to look for Susy signals in the top quark sample, since top will be the most important background for Susy. We use our expertise in the muon system to look for Susy in events with one or two muons and missing transverse energy. Finally, we are searching for Susy in decay modes that include a tau lepton, where we benefit from our knowledge of the tau trigger system. In the Susy group we have been one of the pioneers of data driven background estimation.

The Higgs analysis is the smallest of the Nikhef efforts. We demonstrated a way to improve by 10% the so-called golden channel, with a Higgs decaying to four leptons by making use of calorimeter information to identify muons. We contributed to the analysis of the vector boson fusion channel, again using data driven background estimates. We also studied the channel were the Higgs decays into two muons and two b quarks and looked at the alternative 'little Higgs' scenario.

We are looking towards 2009 with optimism and we are ready for data.

2.2 Physics with b-quarks: LHCb/BABAR

Management: Prof. dr. M.H.M. Merk (PL),
dr. A. Pellegrino
Running period: 1999–2014

The installation of the LHCb experiment at the LHC collider was completed in spring 2008. During the summer several subdetector systems were commissioned making use of cosmic muon rays that traverse the detector setup. At the same time the data acquisition system was tested with test-pulse and noise runs. Although the trigger and reconstruction algorithms were still being tuned, the detector was at the end of the summer ready to accept the first LHC data.

First LHC tracks in the Velo
The Vertex Locator (Velo) detector, located closely around an LHC interaction point, consists of 23 measurement stations of silicon detectors that are installed inside the vacuum system of the LHC. A photograph of the silicon detectors is shown in Fig. 1. After the LHC beams have been injected and stable operation is achieved, these detectors will be positioned by an automatic moving system at a distance of 8 mm from the beams with a reproducibility of 10 μm. To avoid radiation damage the detectors are cooled to –5°C with a binary phase CO_2 cooling system. A beam vacuum pressure of 3×10^{-9} mbar was obtained, well within the requirements of the LHC machine. Interlock procedures of the vacuum system and cooling were installed and the motion control system of the detectors was commissioned.

On 24 August the LHC injection system was tested by colliding protons on a beam absorber target. This beam dump provided an intense source of muons that traversed the LHCb detector and were detected with the Velo. Fig. 2 shows a reconstructed event with muon tracks traversing the Velo detector. The Scintillating Pad Detector of LHCb provided a central trigger for these events, and the signal timing between the subdetectors proved to be correct within one bunch crossing (25 ns). To capture the analogue detector signals close to their peaking value and to minimise the spillover effect, this timing is important for high efficiency and low noise detector operation. A fine tuning procedure is being developed by the Nikhef group.

In total 1400 tracks were observed in these LHC data runs. An examination of the fitted track sample demonstrates that the alignment of the silicon detectors, as obtained from survey measurements and beam tests, is understood to a precision of better than 10 μm. The design resolution of the detector is 5 μm, which can be obtained from a software alignment procedure using tracks produced in LHC collisions.

Cosmics in the Outer Tracker
The Outer Tracker (OT) detector serves to measure the momentum of charged particles after their deflection by the LHCb dipole magnet. The detector consists of 53760 drift tube straw detectors arranged in three stations of in total 24 measurement planes. The detector was installed in 2007 and has been commissioned in 2008 with cosmic ray muon tracks. These tracks traverse the LHCb pit where their passage is detected by the calorimeter and their trajectory reconstructed from the Outer Tracker planes. During the summer 200,000 of these cosmic muon events have been collected. An example of one of the triggered events is

Figure 1. Silicon detector measurement planes and the readout electronics of one half of the Vertex Locator detector. The photograph was taken in the laboratory prior to installation.

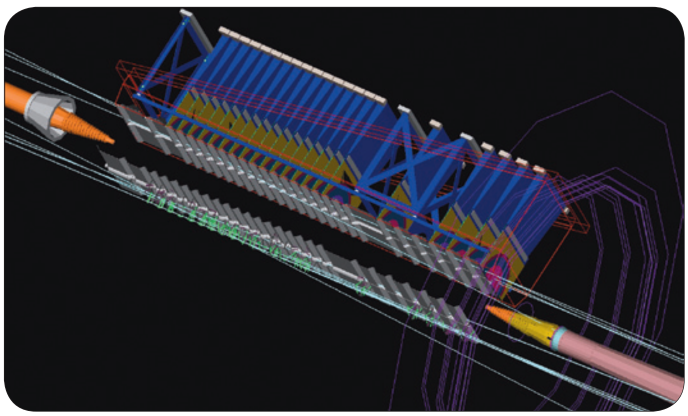


Figure 2. A view of muon tracks as they traverse the Velo detector. The reconstructed muons are the parallel white lines that run across the picture.

shown in Fig. 3. These events have been used to monitor the detector operation, to test the track reconstruction procedure, and to exercise the software algorithm to align the individual detector planes.

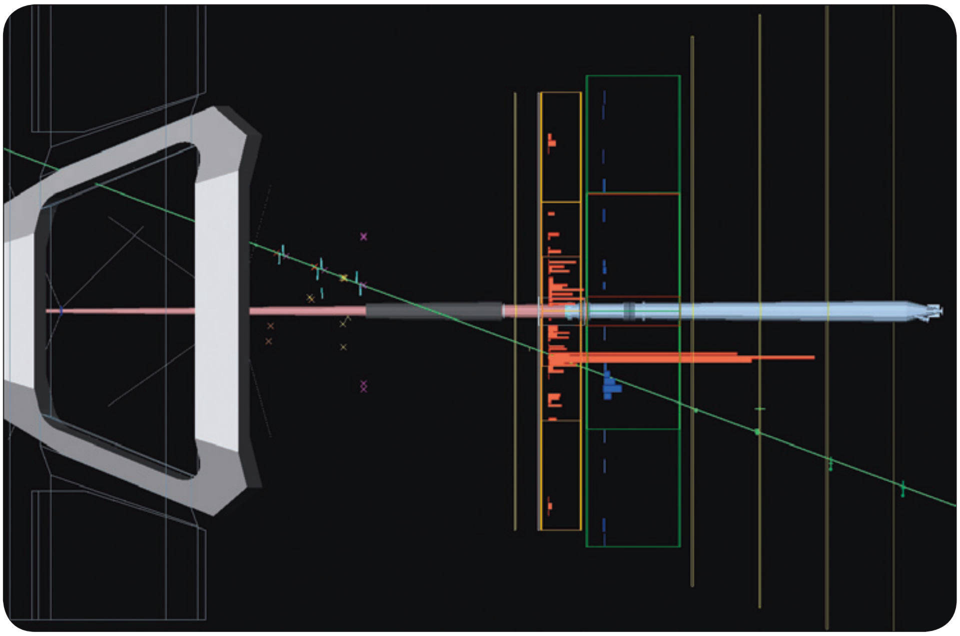


Figure 3. A view of a cosmic muon track that traverses the downstream part of the LHCb spectrometer. From left to right the picture shows the magnet yoke, the hits in the Outer Tracker (crosses and small blue lines), the energy depositions in the electromagnetic (red) and hadronic calorimeters (blue), and the muon chamber hits.

The collected track sample is subsequently used to study the drift time versus drift distance relations in the straw detectors. A complication arises due to the fact that the calorimeter trigger-time has insufficient resolution to provide a precise reference time of the traversing cosmic muon. A fitting method has been developed to determine this trigger-time using the observed hits of the track. Tracks of sufficient quality can be reconstructed to calibrate the relation between the observed drift time and the track position (the R-T relation) of the drift tubes.

Preparing the search for new physics

In LHCb, the search for new physics is performed by looking for CP violating effects that are inconsistent with Standard Model predictions, as well as by measuring observables in decays that are suppressed in the Standard Model: the so-called rare decays. In both cases the focus of the Nikhef group is on *B* decays into final states that consist of charged particles, in line with our hardware expertise in the construction of the Velo and OT detectors.

The decay channel $B_s \rightarrow J/\psi\phi$ has a clean experimental signature as its final state consists of two oppositely charged muons and two kaons that originate form a J/ψ particle and a ϕ particle, respectively. This decay provides a standard method to search for new physics that carries CP violation, as the Standard Model only predicts a very small CP asymmetry between the B_s and $\overline{B}_s$ decay rate into this final state. The fact that the B_s meson decays into a CP eigenstate with two particles of spin=1, implies that both the CP-even and CP-odd eigenstates are allowed to decay into this final state, but with different angular momentum. Analysis of the angular distribution is therefore required to disentangle the CP-even and CP-odd contributions to the decay. The Nikhef group has developed an intricate likelihood fitting method to describe the decay simultaneously in the time domain to observe CP violating oscillations, in the angular domain to disentangle CP-even and CP-odd contributions, and in the invariant mass domain to suppress possible backgrounds. Using this method the expected sensitivity to observe a CP-violating phase after 1 year of LHC running with nominal luminosity is 0.02 radian.

The rare decay channel $B \rightarrow K^*\mu^+\mu^-$ occurs in the Standard Model via a $b \rightarrow s$ penguin diagram. *B* meson decays of this type will be recognised by the presence of a muon pair with high transverse momentum in the detector as well as a kaon and pion forming a K^* resonance. An analysis of the angular distribution of the two final state muons can be used to study the Lorentz structure of the decay matrix element. The analysis method is worked out in a similar way as the $B_s \rightarrow J/\psi\phi$ decay, now studying the direction of the charged muons with respect to the K^* particle flight direction. A forward-backward asymmetry can be plotted as function of the invariant mass of the dimuon pair. It was established that the point at which the asymmetry becomes zero is a robust experimental observable, which in LHCb can be determined with an experimental precision of 0.7 GeV within one year of data taking. The measurement of this point will be compared to the Standard Model prediction, which is 2 GeV, and to predictions from Supersymmetry models that are significantly different.

2.3 Relativistic Heavy-Ion Physics: ALICE/STAR

Management: Prof. dr. Th. Peitzmann
Running period: 1998 - 2013

The main goal of the ALICE programme is to study the properties of strongly interacting matter at extreme temperatures and densities where a new form of matter, the quark gluon plasma, is produced. The strong interaction between the constituents of matter is on a microscopic level described by the theory of Quantum Chromo Dynamics (QCD). The ALICE programme aims to understand better two important and interesting properties of QCD, namely the phenomenon of confinement and the generation of mass by the strong interaction. Experimentally we create this novel state of strongly interacting matter by colliding heavy-ions at very high energy.

The Large Hadron Collider (LHC) will make heavy-ion collisions available at an unprecedented centre of mass energy of 5.5 TeV per nucleon, which is thirty times higher than currently available at the Relativistic Heavy Ion Collider (RHIC) in Brookhaven, USA. The Nikhef heavy-ion group participates in the STAR experiment at RHIC and in the ALICE experiment at the LHC.

In 2008 the main focus of the group was to prepare the Silicon Strip Detector (SSD) of the Inner Tracking System (ITS) for first collisions at the LHC.

During the first half of 2008 all SSD power supplies were delivered and from June onwards, after an upgrade of the cooling plant, the full detector remained almost continuously in operation. At the same time the innermost layers of the ITS became operational and provided a trigger that allowed to record cosmic rays traversing the whole ITS (see Fig. 1). The data obtained with this trigger are used for calibration and alignment. After removal of bad channels, dead modules and problematic ladders from the reconstruction only one noise hit was, on average, observed per module in 10.000 events. Most of the lost acceptance (14% of the active area) is due to ladders with bias problems. Here five out of 144 half-ladders have developed unrecoverable shorts, while another eight require more tests to understand the cause of their bias problems. After calibration it is found that the signal to noise ratio of SSD modules is typically 40, whereas the dE/dx resolution, obtained from matching the cluster charges recorded in the *p* and *n* sides of the detector, is about 6%.

The surveyed positions of the SSD sensors were verified by reconstructing a sample of straight cosmic-ray muon tracks. The mean deviation between the detector hits and the track position were found to be 50 μm, which is appreciably larger than the design resolution of 20 μm. This discrepancy is not surprising as no additional alignment has so far been included. The alignment with cosmics is in progress for the ITS internally and for the ITS relative to the TPC. An algorithm for the latter relative alignment has been developed at Nikhef.

Nikhef has also been active in fast reconstruction during data taking using the full ALICE reconstruction software. This so called 'prompt off line' tool has direct access to the raw data stored in the memory buffers of the data acquisition system and is a crucial element in guaranteeing the quality of data taking. For this purpose the prompt off line tool includes the event dis-

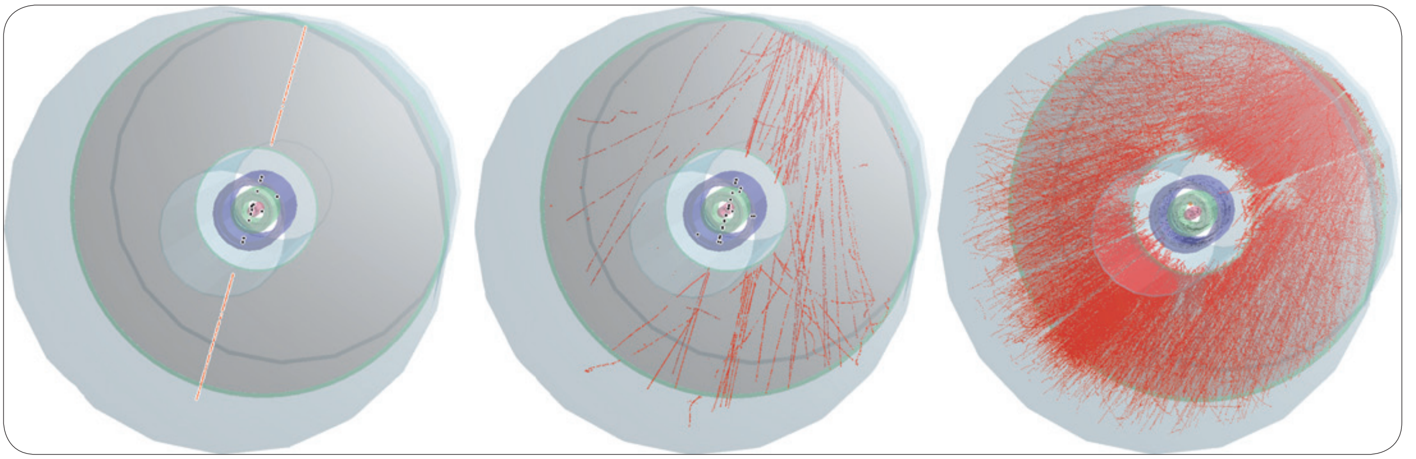


Figure 1. Cosmic-ray muon tracks recorded in the ALICE Time Projection Chamber and Inner Tracking System. The left figure shows a single track from typical events used for alignment and calibration. The figure in the middle shows a small cosmic shower while on the right a rare shower is shown with a large number of tracks.

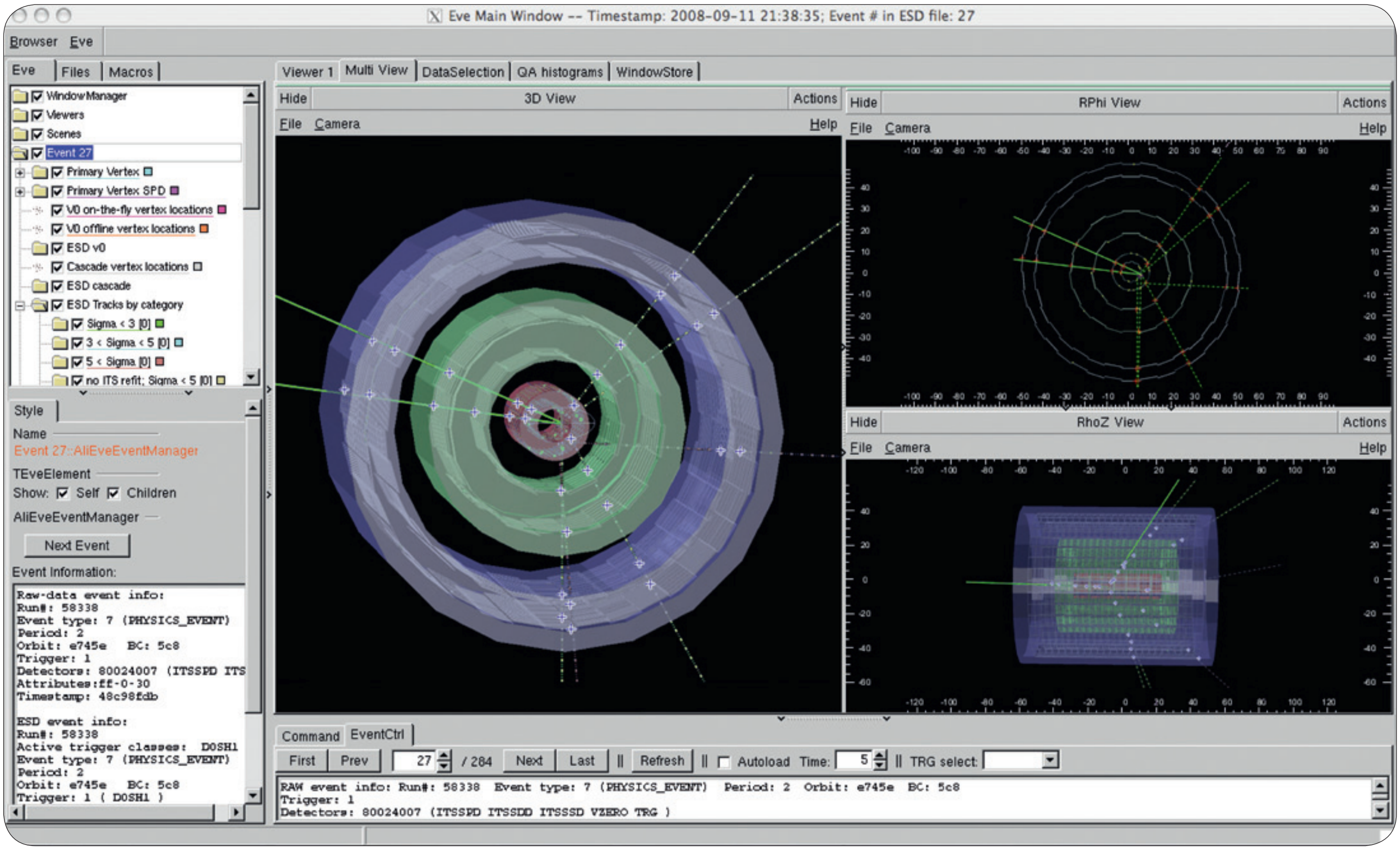


Figure 2. Prompt offline window showing a display of an interaction in the Inner Tracking System (ITS) of the ALICE detector observed during the LHC run in September 2008. The left display shows a 3D view of the ITS, the upper and lower right-hand displays show a projection transverse to and along the LHC beam axis, respectively.

play, the filling and monitoring of quality assurance histograms as well as tools to monitor the alignment and calibration as a function of time.

In Fig. 2 is shown an event display from the LHC run in September 2008. It shows views of the six layers of the ITS with hits caused by a collision of a particle in the inner layer when one of the beams was circulating in the LHC. The lines in this display correspond to the tracks reconstructed by the prompt offline tool that all point to a single vertex.

Apart from the hardware and on-line efforts the group is continuing the preparations for physics analysis of the upcoming proton-proton and heavy-ion collisions at the LHC.

2.4 Neutrino telescopes: ANTARES/KM3NeT

Management: Prof. dr. M. de Jong (PL),
dr. E. de Wolf
Running period: 2008–2013

The prime objective of ANTARES and KM3NeT is the scientific capitalisation of a new generation of telescopes. Unlike conventional ones, these telescopes will detect neutrinos and not light. The detection of neutrinos from the cosmos will break new ground in the study of various frontier questions in science such as those related to the origin of cosmic rays, the mechanism of astrophysical particle acceleration and the birth of relativistic jets. In May 2008, the ANTARES detector has been completed. In total, twelve lines have been deployed at the bottom of the Mediterranean sea equipped with 900 optical modules, the 'eyes' of the neutrino telescope. In addition, a designated line with deep-sea instrumentation for oceanographic research has been deployed and is operated in parallel. The instrumented volume of sea water amounts to about 0.05 km^3, which makes ANTARES the largest neutrino telescope in the Northern Hemisphere.

The ANTARES detector has good sky coverage, including the Galactic centre which is known to host many high-energy gamma ray sources. Some of these sources are expected to produce a large flux of neutrinos. A sky map of neutrinos observed with the first five lines of ANTARES during their operation in 2007 is shown in Fig. 1.

The number of detected neutrinos amounts to 104 and corresponds to about 20% of the statistics available today. With these first data, no evidence for a neutrino point source has been found. The black area in Fig. 1 corresponds to the part of the sky that remains invisible to ANTARES. Due to a background of muons produced by cosmic ray interactions in the atmosphere above the detector, the field of view of the telescope is limited to neutrinos from below the horizon. The Earth is thus used as a particle filter. The cosmic rays that are at the origin of this background consist primarily of high-energy protons. However, nuclei are believed to contribute to this background as well. A surprising feature of the ANTARES detector, discovered at Nikhef, is the capability to determine the contributions of different nuclei in cosmic rays. Fig. 2 shows the result of a preliminary analysis in which Bremsstrahlung showers, produced by high-energy cosmic rays, are identified and counted in the ANTARES detector. It demonstrates that the shower distributions for protons and iron,

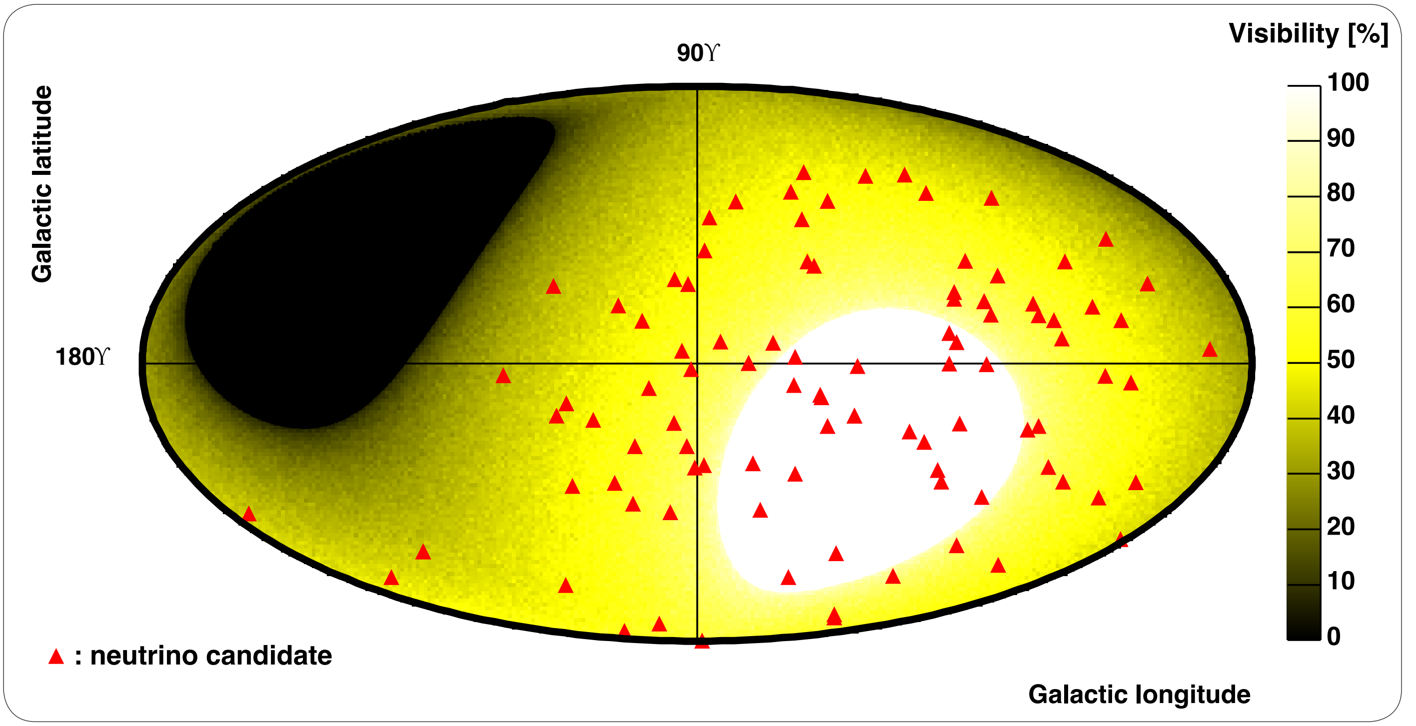


Figure 1: Neutrino sky map obtained with the first 5 lines of ANTARES in the year 2007. The horizontal line in the centre corresponds to the Galactic disk. The colour coding corresponds to the relative observation time (in units of percent).

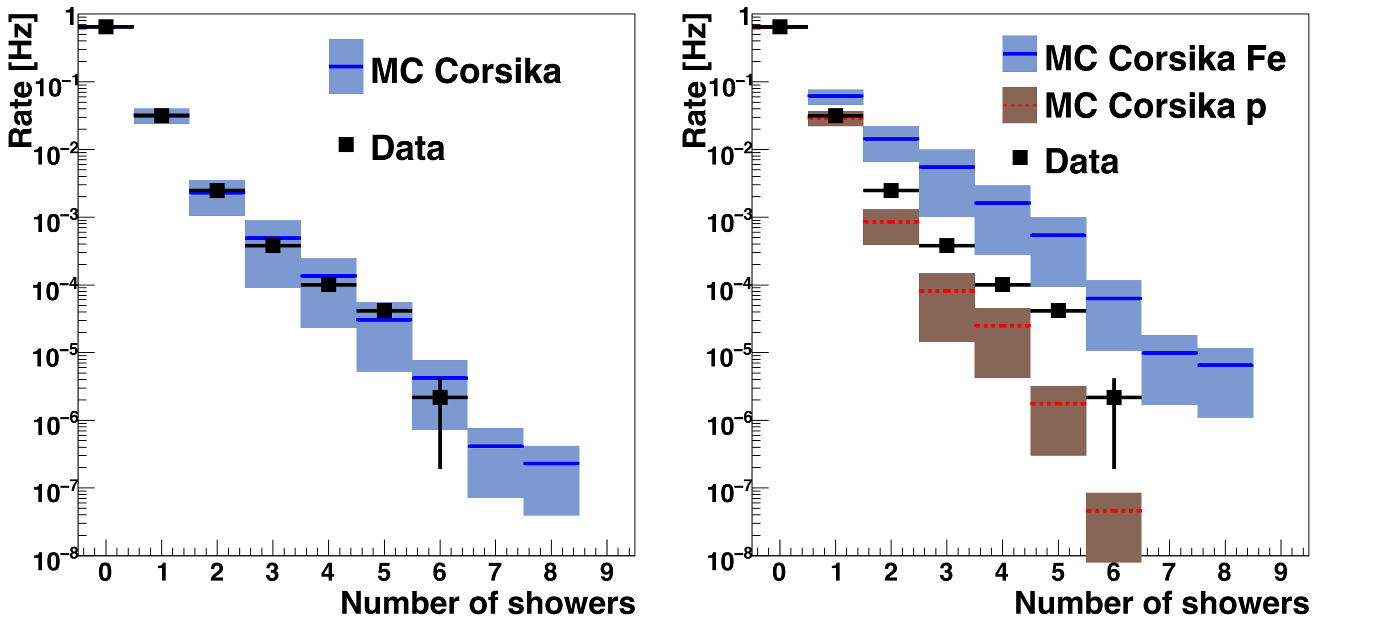


Figure 2: The observed event rate in ANTARES as a function of the number of Bremsstrahlung showers. The error bars on the data points correspond to the statistical uncertainty, and the coloured area around the Monte Carlo points correspond to the systematic uncertainty. The Monte Carlo simulation is based on the Corsika program and includes contributions from various nuclei. In the left plot, all contributions are added together. In the right plot, the contributions from protons and iron are shown separately (both renormalized).

for example, exhibit a measurably different shape.
As can be seen from Fig. 2, the data and Monte Carlo simulations are in good agreement. It can also be seen that the same data can be used to estimate the (relative) contributions from the different nuclei. The typical energy of the cosmic rays that produce detectable muons is relatively high due to the large depth of the detector (about 2.5 kilometre). With the full 12 line detector, it will be possible to determine the chemical composition of the cosmic rays around the 'knee' in the energy spectrum. It is believed that this knee is due to a change in the composition. With the data collected this year, a verification of this hypothesis is within reach.

The operation of the ANTARES detector will continue until 2013. For the scientific exploitation, funding has already been secured through the approval of a new FOM research programme in 2007. A design study for large deep-sea infrastructure hosting a cubic kilometre scale neutrino telescope is ongoing. The infrastructure will be shared by other sciences, enabling continuous and long-term measurements in the area of oceanography, geophysics, and marine biological sciences. The design study —known as KM3NeT— is funded by the EU and will culminate in a Technical Design Report by the end of 2009. Together with NIOZ (*Royal Netherlands Institute for Sea Research, Texel*) and KVI (*Nuclear-physics Accelerator Institute, Groningen*), Nikhef has submitted a proposal for the construction of the future research infrastructure. In November 2008, Nikhef has received 8.8 M€ funding from NWO. The funding will cover the period from 2008 until 2015.

2.5 Search for Gravitational Waves: Virgo/LISA

Management: Prof. dr. ing. J.F.J. van den Brand

Virgo

The Virgo experiment for detecting gravitational waves coming from any part of the Universe, consists of a Michelson laser interferometer made of two orthogonal arms each being 3 kilometers long. Multiple reflections between mirrors located at the ends of each arm extend the effective optical length of each arm up to about 400 kilometers. Virgo is located within the site of EGO, the European Gravitational Observatory, near Pisa in Italy. The Virgo collaboration carried out in 2008 the interferometer upgrade programme, termed Virgo+. In this upgrade, the laser power was increased and thermal compensation systems installed. Nikhef took responsibility for the upgrade of front-end electronics for angular alignment of the various mirrors and the input-mode cleaner (IMC) upgrade. We will briefly discuss the latter.

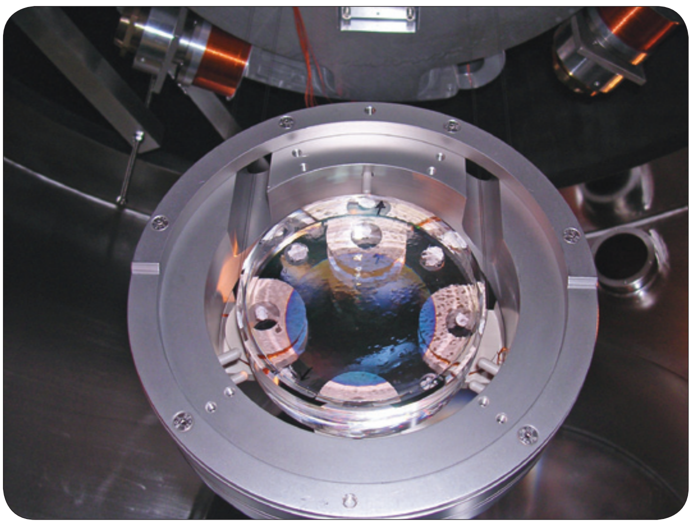
The IMC is a 144 m long high finesse triangular cavity that is used to filter out unwanted modes of the laser beam that is injected into the interferometer. Furthermore, the IMC is used as a first stage in the frequency stabilisation of the carrier wave. The end mirror of the IMC was suffering from low optical quality of both substrate and coating which led to significant scattering losses. In addition, the weight of the mirror and its reference mass was too small, making the system sensitive to radiation pressure effects resulting in control problems.

Nikhef has replaced the entire IMC end-mirror system. A heavier and better quality end-mirror, part of the suspension system (marionette) and reaction mass were installed. The new system is shown in Fig. 1. The various components were fabricated in mechanical workshops at Nikhef, the University of Amsterdam, VU University Amsterdam and the University of Rome – La Sapienza. The installation of this device took place in July 2008. Commissioning of the IMC was completed in August 2008 resulting in a beam transmission efficiency of 85% (compared to about 50% before the upgrade). Virgo+ installation has been finalised in September 2008, and commissioning of the improved interferometer has started. Our goal is to be operational again in the summer of 2009 and start our second science run, at the same time as the Laser Interferometer Gravitational-Wave Observatory (LIGO) in the USA starts its measurements with its upgraded detectors (called Enhanced LIGO).

Einstein Telescope

The Einstein Telescope (ET) (see Fig. 2) is a new infrastructure project that will bring Europe to the forefront of the field of gravitational wave astronomy. The realisation of ET will be an important step in our quest to understand the history and future of the Universe. Gravitation is the least understood fundamental force of nature. Challenges include discovery and exploitation of gravitational waves as a probe of the Universe, putting experimental constraints on the corresponding quantum (graviton) and the development of a quantum field theory of gravity.

In May 2008, ET received 3 M€ from the European Commission within the Seventh Framework Programme (FP7) to start a preliminary design study. This design study will define the speci-



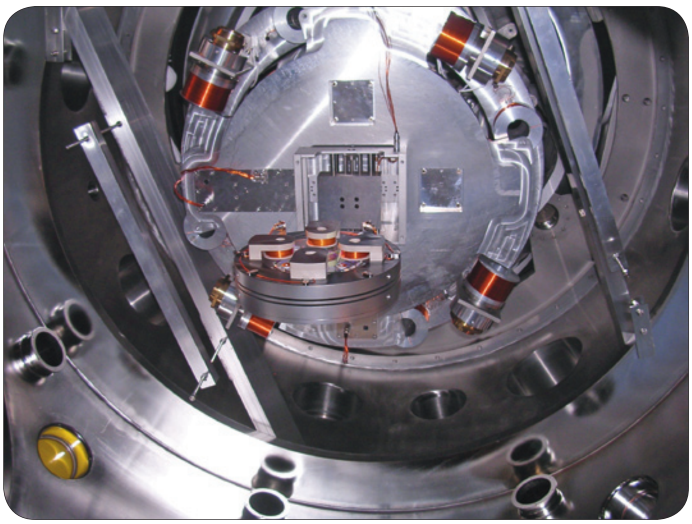


Figure 1. End-mirror of the input-mode cleaner of Virgo. The left picture shows the new 15 cm diameter mirror and the reaction mass for controlling the mirror position with magnetic forces. The right picture shows that mirror and reaction mass are suspended with wires from a so-called marionette.

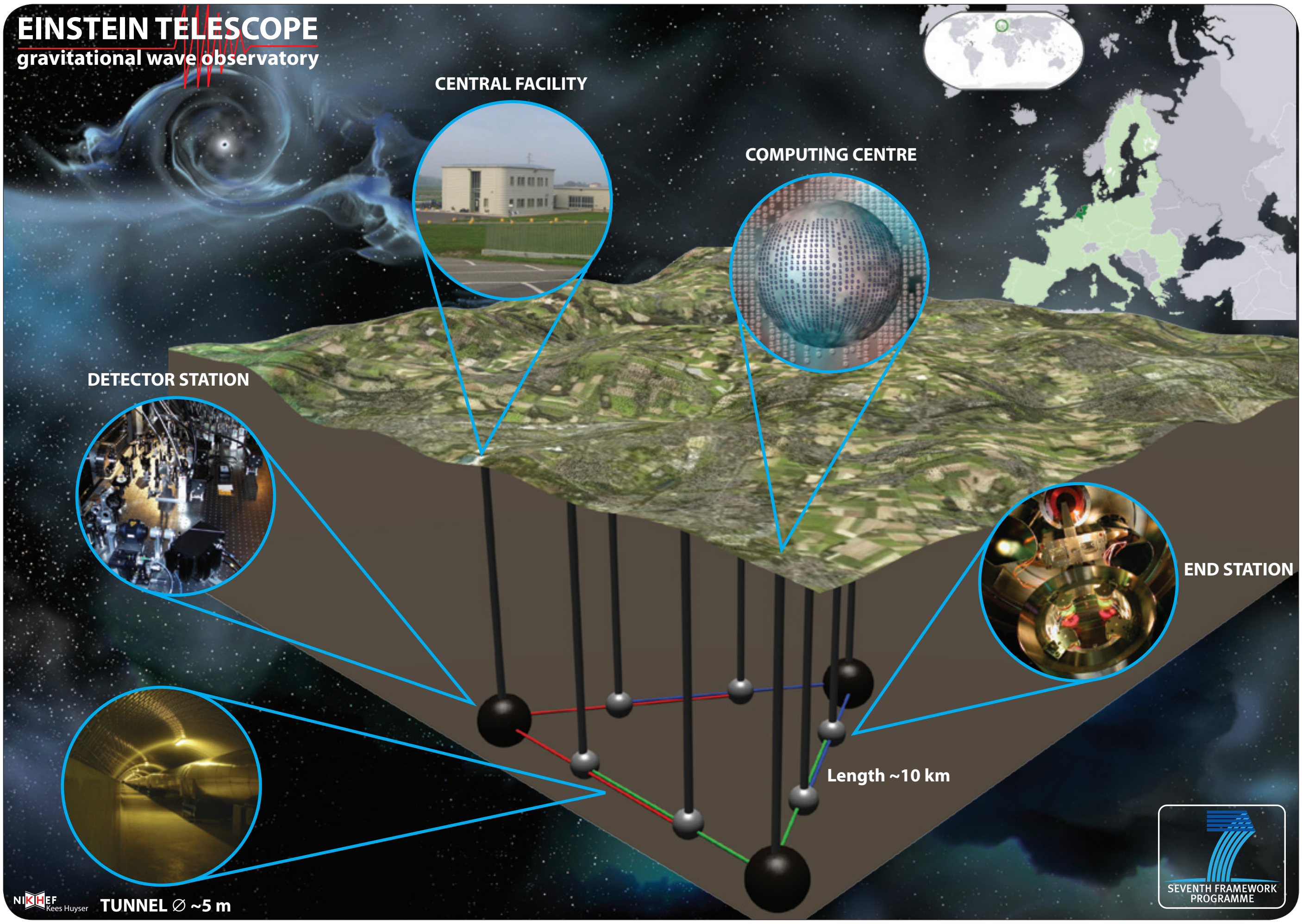


Figure 2. Conceptual diagram for the Einstein Telescope facility. Three interferometers with 10 km arms are placed underground to suppress micro-seismic noise. Optical components are placed in an ultra-high vacuum and cryogenic environment.

fications for the required site and infrastructure, the necessary technologies and the total budget needed, and can be considered an important step towards the third generation of gravitational-wave observatories. Nikhef leads the work package on site selection and infrastructure. These activities are carried out in close collaboration with geoscientists and industry.

After the completion of the design study and of a subsequent technical preparation phase, the construction of ET could begin once the second-generation observatories have started operating. The technology required for third generation detectors is being studied in several countries besides Europe, including the USA and Japan. All future third-generation detectors will need to perform joint observations, as is the case for current gravitational-wave experiments. ET is a multi-national project of eight European research institutes and is listed in the ASPERA Roadmap for Astroparticle Physics in Europe as one of the 'Magnificent Seven'.

2.6 Air-shower Array: AUGER

Management: dr. A. van den Berg (KVI, PL),
dr. C. Timmermans
Running period: 2008–2013

Nikhef is involved in hardware development, data acquisition, data reconstruction and data analysis of radio detection of cosmic rays at the Pierre Auger observatory in Malargüe, Argentina. The data set obtained by the Dutch operated setup is used by the whole collaboration for analysis.

Natural background and detector calibration
A good fraction of the natural radio signal background originates from synchrotron radiation of particles in the galactic magnetic field. Existing measurements of this galactic background have

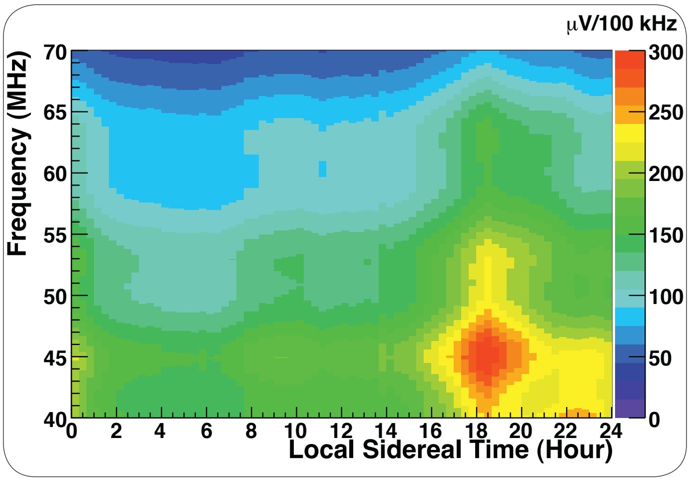


Figure 1. Simulation of the expected background as measured by a North-South oriented antenna due to extraterrestrial noise as a function of local sidereal time and frequency.

been used to calculate the expected field strength near our detector in the 10 to 100 MHz range. This field strength has been convoluted with the detector response, an example of which is shown in Fig. 1.

This simulation provides a qualitative understanding of the slight difference in the time structure of the noise measured in the East-West and North-South polarisations, including the until now unexplained secondary enhancement at 22:00 h local sidereal time (LST) that appears only in the North-South arm. The main bump at 18:00 LST occurs when the galactic center is overhead. The absolute level of our simulation is in agreement with the measured noise within a factor of about two. This

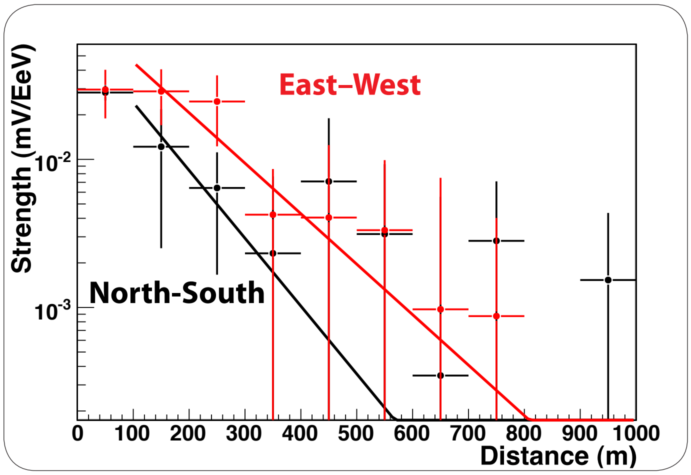


Figure 2. Measurement of the lateral distribution for the polarisations East-West and North-South, as indicated.

makes the galactic noise measurement an excellent candidate method to provide an absolute calibration of the detector gain.

The lateral distribution of the radio signal
The lateral distribution of the radio signal (the fall-off as a function of the distance to the centre of the shower) is of importance for understanding the emission mechanism, as well as for determining the spacing of detectors in a large array. Measurements from different antennas with similar characteristics are in good agreement with each other. Fig. 2 shows a set of measurements taken at an average energy of 0.8 EeV. An exponential function has been fitted to all measurements beyond 100 m from the shower core. The fall-off distance obtained is about 30% larger than expected from theory. It is also larger than previously determined fall-off distances at lower energies. From Fig. 2 it is clear that the signal from the East-West arm is on average larger than the North-South signal. This is consistent with the mechanism of geo-synchrotron radiation.

Hardware development
The installation of four solar powered wireless radio antennas in May marks the beginning of the Multiple Antenna experiment In Malargüe Argentina (MAXIMA). These detectors make use of a new digitizer, made by Nikhef, which allows for triggering on the antenna signal itself. The noise level of these new stations exceeds the natural background. However, the initial data are very useful for debugging the complete setup. The improved GPS timing resolution of less than 3 ns allows for an excellent reconstruction of the arrival direction of the radio signal. The angular resolution, obtained from locating a radio station, is about 1°.

2.7 Theory

Management: Prof. dr. E. Laenen
Running period: 2008–2013

As in other years, research in the Nikhef theory group, including that of the VU University Amsterdam and Radboud University Nijmegen partners, has been wide in reach. The LHC and new developments in astroparticle physics were a natural source of inspiration for a number of research efforts, but also investigations into the fundamentals of field and string theory have yielded interesting results.

Research highlights

In phenomenology, the last of the single top production modes, W+t, was added to the MC@NLO framework, requiring a treatment of the top pair production interference in an event generator context. Two methods were proposed and both were shown to work well. In addition, a Monte Carlo generator for Higgs boson production with multiple hard jets was developed. In Fig. 1 the distribution of the number of jets in this process from this generator is shown. The software is presently packaged up for an official release, but is already used by experimenters.

Golem95, a numerical program for one-loop tensor integrals with up to six external legs was completed and released, and promises to be an important tool for precise predictions of processes studied at LHC. In another project, the impact of NNLO corrections to weak boson fusion production of Higgs bosons was assessed.

By employing different unconventional points of view, clear insight was gained into new classes of 'subeikonal' terms in the perturbation expansion of scattering amplitudes.

There was also focus on the role of partonic transverse momenta, including the matching of low and high momentum regimes in cross sections, where the latter regime can be treated perturbatively. Furthermore, T-odd phenomena such as single spin asymmetries, some in combination with jet-jet correlations or prompt photon production, may provide new probes of the Higgs sector and of specific new physics beyond the Standard Model at the LHC.

In the arena of LHC heavy ion collisions, nonlinear gluon saturation effects were studied, yielding predictions for the transverse momenta of forward hadrons produced in these collisions.

In cosmology and related research, solutions of string theory that exhibit inflation were sought and found, but were not of the preferred hybrid type. Also, a very light dark matter candidate

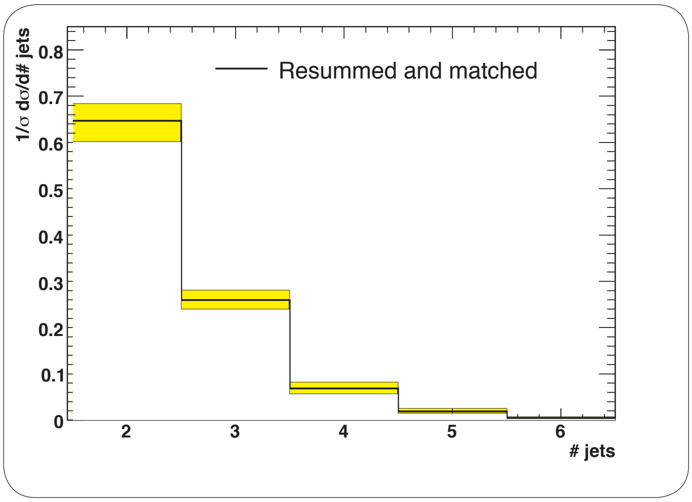


Figure 1. The calculated distribution of the number of hard jets in Higgs boson production via gluon-gluon fusion. Certain cuts on jet properties have been applied. The yellow areas represent uncertainties due to the variation of the renormalisation scale.

was confronted with known constraints, and found to be quite unlikely. In another study, the gravitational field of of a travelling light wave was explicitly constructed.

Exploration of a large class of string theory solutions, a subset of the so-called Landscape, showed that not 'everything goes'; certain classes of free fermion solutions gave no acceptable spectra. Neutrino sectors and non-supersymmetric solutions were also explored. The Landscape of string theory solutions is the subject of a lively debate, as clearly outlined in a review article by B. Schellekens. Statistical studies were carried out to assess the predictive power of string theory in the Landscape context. The understanding of and tools to use the mathematical symmetry structure of string theory in terms of superconformal algebras were extended.

On a more fundamental level, the vexing issue of whether to use path integral or operators in quantizing a field theory was carefully examined for theories with spontaneous symmetry breaking, and found to give different results. A solution to this uncomfortable situation was proposed. In a different study, subtle issues regarding symmetry preservation when quantizing a non-relativistic conformal field theory were investigated.

Other news

Nikhef postdoc Chris White was awarded a Marie Curie Fellowship for top quark physics at the LHC and the Utrecht/Nikhef AIO

Figure 2. Reiner de Adelhart Toorop (left) received the biannual Pieter Zeeman Award in Zierikzee, Zeeman's birthplace.

student Gerben Stavenga was given the prestigious Best Student Award at a recent conference in Erice, Italy. The PhD student Reinier de Adelhart Toorop won the UvA Pieter Zeeman award for his Master thesis (see Fig. 2).

The monthly Theory Meetings, a key element of the new FOM program "Theoretical Particle Physics in the Era of the LHC", have a consistent good attendance, and spawn spontaneously organised small discussion meetings. They ensure a regular and lively interaction among theorists from Dutch institutions, and with experimental colleagues. The national Seminar on Theoretical High-Energy Physics continues to be held at Nikhef and attracts excellent attendance. Outreach activities of the theory group include HiSPARC as well as giving presentations to high school students and other interested groups throughout the Netherlands.

Staff members of the group have been lecturing in the Nikhef topical lecture series and at the 2008 BND summer school, this in addition to teaching numerous courses at the universities.

2.8 Detector R&D: Gridpix Detectors

Management: dr. J.J.M. Timmermans

In 2008 the focus of the Nikhef R&D group was on the further development of gaseous and silicon detectors for charged particles and X-rays with pixelised readout at multi-gigabit per second rate.

Gridpix detectors

A gas-filled Gridpix detector for charged particles consists of a drift volume where these particles produce primary ionisation clusters (electrons) that drift towards a thin metallic grid mounted at a short distance (typically 50 μm) on a pixelised CMOS readout ASIC (Application Specific Integrated Circuit) that acts as anode. By applying a voltage difference of about 400 V between the grid and the anode, gas multiplication of the primary electrons by a factor of a few thousand occurs, and the resulting charge avalanche for each of the primary single electrons can be detected with good efficiency on single pixels of size 55×55 μm^2.

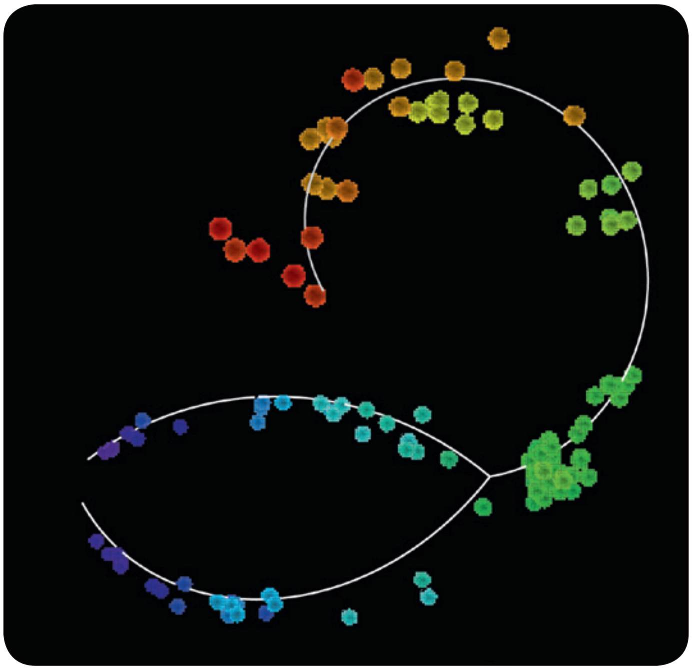


Figure 1. The image shows the tracks of an electron and an electron-positron pair resulting from the decay of a ^{24}Na nucleus, recorded with the DICE detector. The drift time, proportional to the perpendicular coordinate, is indicated with the color. Each hit pixel can be associated with a single electron, created along the path of the energetic particles.

Ingrid

Ingrid is a Gridpix detector in which the thin metallic grid is integrated with the CMOS chip through (wafer) post-processing. In 2008 several detectors with such a gas multiplication grid integrated on a Timepix chip have been constructed and operated with various gas mixtures. This had been made possible with the breakthrough in the autumn of 2007 of achieving sufficient protection against discharges by means of 15–20 μm thick amorphous silicon protection layers on the CMOS readout chip. In 2008 another high-resistive material Si_3N_4 (silicon nitride) has also successfully been applied in 7 μm thick protection layers. Another variant is the DICE ('Delft Internal Conversion Experiment') detector, which consists of a GridPix detector and a scintillation trigger detector placed in a permanent magnetic field. An example of an event taken with the DICE detector is shown in Fig. 1. The operation of all these detectors turned out to be very stable with only a single chip damaged by a discharge; this was expected under the quite extreme conditions of using a Xe/CO_2 (70/30) mixture and a voltage of –490 V on the grid. The performance of these detectors was measured at Nikhef with and without magnetic field applied using cosmic tracks and at CERN, Geneva, in a mixed pion/electron beam of up to 5 GeV from the PS. Systematic studies of efficiency, point resolution and ionization loss have shown that the detector performance is close to expectation. Further detailed measurements, with a variety of Ingrid detectors on 'dummy' anodes, were made on gas gain, energy resolution, number of primary electrons and ion backflow in 5.9 keV photon conversions from ^{55}Fe.

Gossip

Gossip is a GridPix detector with only a thin layer of gas covering the pixel chip. This gas layer is an alternative for Si sensors, now widely applied in tracking detectors. Gossip could withstand radiation better, and could be much lighter. The crucial feature of 'ageing' has been studied with some encouraging results. The application of Gossip in the ATLAS upgrade is under study. There is interest from small-angle scattering experiments FP420 at the LHC to include Gossip detectors.

Medipix and Relaxd

The Nikhef participation in the Medipix2/3 collaborations at CERN focuses on the development of detector units that can be tiled at each of the four sides of the system and can be read out at a multi-gigabit per second rate. To achieve a unit that can be tiled, work is done with the IMEC research centre in Leuven, Belgium, to move the read-out from the side of the chip through wire-bonds to the bottom of the chip by means of a ball-grid-array attached to the bond-pads at the front of the chip by through-silicon-vias. To minimise the area between the tiles, edge-less sensors have been designed by Canberra. The first devices have been made and tested. A significant reduction of the currently required area between the tiles can be achieved. The performance of the edge-pixels in the various configurations is under study. The multi-gigabit per second read-out is being developed in collaboration with PANalytical. The read-out channel has been established at the desired speed and full communication with the chip is being implemented in the on-board field-programmable gate array (FPGA). The whole system will be mounted in a cooling unit (shown in Fig. 2) to dissipate the generated power by both the medipix chips and the on-board FPGA.

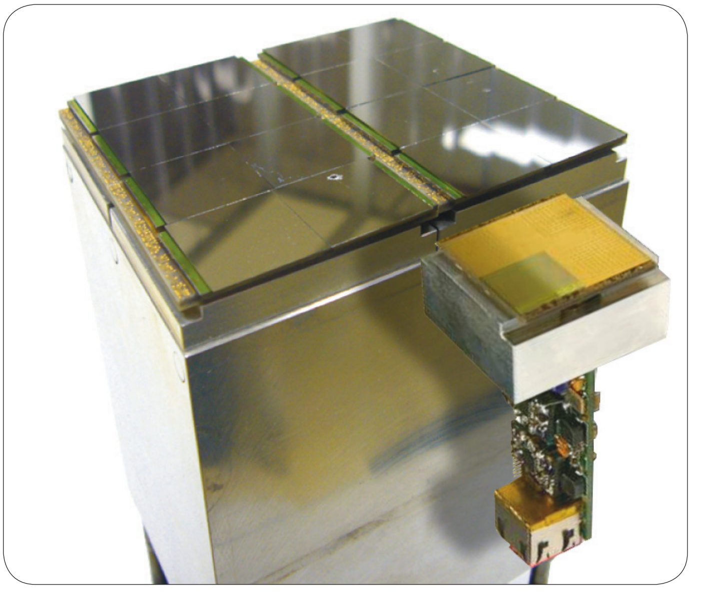


Figure 2. Relaxd cooling jig with four times 2×2 sensors and a single read out unit on the side. Each sensor measures 1.4 by 1.4 cm.

2.9 Grid Computing

Management: dr. J. Templon (PL),
ing. W. Heubers

Each year, the grid computing facilities at Nikhef grow larger and larger. This expansion is in large part enabled by the national grid infrastructure project, with the aptly chosen name BiG Grid. The project's mission is to create a national grid infrastructure serving a number of Dutch scientific communities, including high-energy physics.

With BiG Grid in its second year we have seen the grid facilities at Nikhef increase by 800 computing *cores* and by more than 300 TB of disk space. There has also been an increase in the number of grid communities that make use of the grid facilities at Nikhef, as envisaged in the BiG Grid project. In 2008 we have welcomed the KNMI, eNMR, Virgo and Life Science Grid communities at the Nikhef grid facilities.

The first of the BiG Grid engineering proposals is well under way, and concerns *Single Sign-On* technologies in a grid environment. This work is performed by a collaboration comprising researchers from Nikhef, Surfnet, and the Max Planck Institute for Psycholinguistics in Nijmegen. A further increase in both the hardware facilities, and in the number of grid communities using them, is expected over 2009. All of this is in line with the vision of the BiG Grid project, which aims to build, enable, and operate the Dutch LHC Tier-1 facility whilst at the same time helping new scientific communities to make use of the grid. The grid group has expanded during the last year from nine to twelve persons, as a direct result of the increased activity in both areas, and expects this expansion to continue in 2009.

BiG Grid is a project on e-science infrastructure deployment, supporting a wide range of sciences in the Netherlands, funded by the Dutch government for 29 M€. The project's principal partners are NCF, NBIC, and Nikhef.

One of the core activities of the group is the deployment and operation of the Dutch Tier-1 facility. The preparations for the start of the LHC generated a lot of activity in this area:

- the Combined Computing Readiness Challenge (CCRC08) took place in February, during which all experiments at CERN tried to simultaneously write simulated data to all of the LHC Tier-1 sites distributed across the globe. The first CCRC08 exercise was a success;
- A new configuration for the Dutch ATLAS 'cloud' was adopted and fine-tuned for the subsequent Full Dress Rehearsal 2 (FDR2) and second CCRC08 exercises;
- As Ganga has been promoted as an official grid job submission tool in ATLAS, efforts were made in 2008 to help ATLAS users at Nikhef to migrate their analysis works to Ganga;
- Two new LHC Tier-2 partners joined the Dutch ATLAS cloud this year: ULAKBIM from Turkey and Trinity College (Dublin) from Ireland; they are fully in production now. This brings the total number of Tier-2 partners in the cloud (*i.e.,* relying on the Dutch Tier-1) to eight (including six Russian sites).

In May, the EGEE-III project was launched, in which Nikhef is involved even more heavily than before, despite the fact that overall funding for the EGEE-III project is *less* than for its predecessor. In addition to the development of grid security middleware we are now also involved in software integration

TB	terabyte (10^{12} bytes)
KNMI	Dutch Royal Meteorological Institute
eNMR	e-Infrastructure project for Nuclear Magnetic Resonance in System Biology; the Dutch partner is the Bijvoet Center for Biomolecular Research at Utrecht University
Virgo	Gravitational-wave observatory located near Pisa, Italy
EGEE	Enabling Grids for e-Science in Europe, flagship European framework project on e-science infrastructures
LOFAR	Large-area low-frequency radio telescope, located in the north of the Netherlands
SARA	High-performance computing centre, located in Amsterdam, our partner in operating the Dutch Tier-1
NCF	Netherlands National Computing Facilities foundation
NBIC	Netherlands Bioinformatics Centre
Tier-1	A computing centre with a long-term commitment to store a large fraction of an experiment's data, and to provide sufficient computing power for processing these data

activities, similar to the work done for the still on-going Virtual Laboratory for e-Science (VL-e) project.

The challenge for the grid group next year will be to keep growing in a sustainable and controllable fashion. As 2009 will see the start-up of both the LHC at CERN and the LOFAR radio telescope, the amount of data that needs to be stored at SARA and Nikhef is expected to more than double. Ensuring that our present grid users are able to safely store and process their data at Nikhef remains one of our top priorities, whereas one of the other priorities —attracting new scientific research communities to the grid— will result in many new challenging grid research projects.

3

Output

3.1 Publications

ATLAS/DØ

ATLAS Collaboration:

Z. Aad (*et al.*); S. Bentvelsen, G.J. Bobbink, R. de Boer, H. Boterenbrood, G. Brouwer, E.J. Buis, J.J.F. Buskop, A.P. Colijn, R. Dankers, C. Daum, B. van Eijk, J. Ennes, F. Filthaut, M. Gosselink, H. van der Graaf, H. Groenstege, N. de Groot, F. Hartjes, R.G.G. Hart, P.J. Hendriks, N.P. Hessey, E. Jansen, P.P.M. Jansweijer, P. de Jong, G. Kieft, P.F. Klok, S. Klous, P. Kluit, A.C. Koenig, F. Koetsveld, E. Koffeman, A. Koutsman, E. van der Kraaij,W. Liebig, M. Limper, F. Linde, G. Luijckx, C.A. Magrath, G. Massaro, A. Muijs, S.J.M. Peeters, A. Reichold, P. Rewiersma, M. Rijpstra, R.C. Scholte, H.W. Schuijlenburg, J. Snuverink, C.J.W.P. Timmermans, W. Verkerke, J.C. Vermeulen, M. Vreeswijk, I. van Vulpen, P. Werneke, T. Wijnen

The ATLAS Experiment at the CERN Large Hadron Collider
J. Instr. **3** (2008) S08003

I. Riu (*et al.*), G. Kieft, J. Vermeulen
Integration of the trigger and data acquisition systems in ATLAS
IEEE Trans. Nucl. Sci. **55** (2008) 112

H.P. Beck (*et al.*), G. Kieft, S. Klous, J. Vermeulen
Performance of the final event builder for the ATLAS experiment
IEEE Trans. Nucl. Sci. **55** (2008) 176

D.E. Baynham (*et al.*), J. Buskop
ATLAS End Cap Toroid final integration, test and installation
IEEE Trans. Appl. Superconductivity **18** (2008) 391

A. Abdesselam (*et al.*), A.P. Colijn, N.P. Hessey, P. de Jong, M. Limper, C.A. Magrath
The data acquisition and calibration system for the ATLAS Semiconductor Tracker
J. Instr. **3** (2008) P01003

A. Abdesselam (*et al.*), A.-P. Colijn
The detector control system of the ATLAS SemiConductor Tracker during macro-assembly and integration
J. Instr. **3** (2008) P02007

A. Abdesselam (*et al.*), H. Band, E. Berbee, R. Buis, J. Buskop, A.-P. Colijn, C. Duisters, G. Gorfine, F.G. Hartjes, N.P. Hessey, J. Homma, B. John, P. de Jong, E. Koffeman, H. Kok, A. Korporaal, E. van der Kraaij, W. Kuilman, R. Leguyt, M. Limper, G.H. Magrath, A.J.M. Muijs, M. van Overbeeke, A. Rietmeijer, A. Rovenkamp, H. Schuijlenburg, C. Snippe
Engineering for the ATLAS SemiConductor Tracker (SCT) End-cap
J. Instr. **3** (2008) P05002

A. Barriuso Poy (*et al.*), H.J. Boterenbrood
The detector control system of the ATLAS experiment
J. Instr. **3** (2008) P05006

A. Attree (*et al.*), N.P. Hessey, E. van der Kraaij, P. Werneke
The evaporative cooling system for the ATLAS inner detector
J. Instr. **3** (2008) P07003

E. Abat (*et al.*), A.-P. Colijn, N.P. Hessey, P. de Jong, P. Kluit, E. Koffeman, E. van der Kraaij, W. Liebig, M. Limper, C.A. Magrath, P. Werneke
Combined performance tests before installation of the ATLAS Semiconductor and Transition Radiation Tracking Detectors
J. Instr. **3** (2008) P08003

Y. Arai (*et al.*), H. Boterenbrood, P.P.M. Jansweijer, J.C. Vermeulen, A.C. Koenig, T.A.M. Wijnen
ATLAS Muon Drift Tube Electronics
J. Instr. **3** (2008) P09001

A. Ahmad (*et al.*), G. Gorfine, W. Liebig
Alignment of the Pixel and SCT Modules for the 2004 ATLAS Combined Test Beam
J. Instr. **3** (2008) P09004

A. Abdesselam (*et al.*), A.-P. Colijn, F.G. Hartjes, N.P. Hessey, P. de Jong, E. Koffeman, E. van der Kraaij, M. Limper, C.A. Magrath, A.J.M. Muijs, P. Werneke
The integration and engineering of the ATLAS SemiConductor Tracker Barrel
J. Instr. **3** (2008) P10006

R. Cranfield (*et al.*), G. Kieft, J. Vermeulen
Technical report : The ATLAS ROBIN
J. Instr. **3** (2008) T01002

M. Abolins (*et al.*), G. Kieft, S. Klous, J.C. Vermeulen
Integration of the trigger and data acquisition systems in ATLAS
J.Phys.:Conf.Series **119** (2008) 022001

T. Fonseca-Martin (*et al.*), G. Kieft, J. Vermeulen
Event reconstruction algorithms for the ATLAS trigger
J.Phys.:Conf.Series **119** (2008) 022022

T. Cornelissen (*et al.*), W. Liebig, M. Limper
The global χ^2 track fitter in ATLAS
J.Phys.:Conf.Series **119** (2008) 032013

T. Cornelissen *(et al.)*, W. Liebig
The new ATLAS track reconstruction (NEWT)
J.Phys.:Conf.Series **119** (2008) 032014

C. Adorisio *(et al.)*, M. Barisonzi, G. Bobbink, H. Boterenbrood, N. van Eldik, H. van der Graaf, H. Groenstege, R. Hart, A. König, F. Linde, J. Vermeulen, P. Werneke, T. Wijnen, M. Woudstra
System test of the ATLAS muon spectrometer in the H8 beam at the CERN SPS
Nucl. Instr. Meth. **A 593** (2008) 232

M. Arnaud *(et al.)*, G. Bobbink, P. Ennes, H. Groenstege, R. Hart
Commissioning of the magnetic field in the ATLAS muon spectrometer
Nucl. Phys. B (Proc. Suppl.) **177-178** (2008) 265

M. Antonelli *(et al.)*, N. van Eldik, P. Kluit
In-Situ determination of the performance of the ATLAS muon spectrometer
Nucl. Phys. B (Proc. Suppl.) **177-178** (2008) 326

DØ Collaboration:
V.M. Abazov *(et al.)*; M. Anăstăsoaie, L.S. Ancu, P.J. van den Berg, K. Bos, S. Caron, B. van Eijk, F. Filthaut, C.F. Galea, J.G. Hegeman, P. Houben, P. de Jong, S.J. de Jong, M.H. Kirby, W.M. van Leeuwen, N.A. Naumann, M. Vreeswijk
Search for W' bosons decaying to an electron and a neutrino with the DØ detector
Phys. Rev. Lett. **100** (2008) 031804

Model-independent measurement of the W-Boson helicity in top-quark decays at DØ
Phys. Rev. Lett. **100** (2008) 062004

Observation and properties of the orbitally excited B^*_{s2} meson
Phys. Rev. Lett. **100** (2008) 082002

Search for Randall-Sundrum gravitons with 1 fb^{-1} of data from $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **100** (2008) 091802

Search for flavor-changing-neutral-current D meson decays
Phys. Rev. Lett. **100** (2008) 101801

Measurement of the shape of the Boson-Transverse momentum distribution in $p\bar{p}\rightarrow Z/\gamma^*\rightarrow e^+e^- +X$ events produced at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **100** (2008) 102002

Search for ZZ and $Z\gamma^*$ production in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV and limits on anomalous ZZZ and $ZZ\gamma^*$ couplings
Phys. Rev. Lett. **100** (2008) 131801

Measurement of the forward-backward charge asymmetry in top-quark pair production
Phys. Rev. Lett. **100** (2008) 142002

Simultaneous measurement of the ratio $B(t\rightarrow Wb)/B(t\rightarrow Wq)$ and the top quark pair production cross section with the DØ detector at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **100** (2008) 192003

Measurement of the $t\bar{t}$ production cross section in $p\bar{p}$ collisions at $\sqrt{s}$= 1.96 TeV
Phys. Rev. Lett. **100** (2008) 192004

Study of direct CP violation in $B^+\rightarrow J/\psi K^\pm(\pi^\pm)$ decays
Phys. Rev. Lett. **100** (2008) 211802

Search for W' boson resonances decaying to a top quark and a bottom quark
Phys. Rev. Lett. **100** (2008) 211803

Search for scalar neutrino superpartners in $e^+\mu$ final states in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **100** (2008) 241803

First study of the radiation-amplitude zero in $W\gamma$ production and limits on anomalous $WW\gamma$ couplings at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **100** (2008) 241805

Search for large extra dimensions via single photon plus missing energy final states at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **101** (2008) 011601

Observation of the B_c meson in the exclusive decay $B_c\rightarrow J/\Psi\ \pi$
Phys. Rev. Lett. **101** (2008) 012001

Search for decay of a fermiophobic Higgs boson $h_f\rightarrow\gamma\gamma$ with the DØ detector at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **101** (2008) 051801

Measurement of the inclusive jet cross section in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **101** (2008) 062001

Search for pair production of doubly-charged Higgs bosons in the $H^{++}H^{--} \rightarrow \mu^+\mu^+\mu^-\mu^-$ final state
Phys. Rev. Lett. **101** (2008) 071803

Search for Higgs bosons decaying to τ pairs in $p\bar{p}$ collisions with the DØ detector
Phys. Rev. Lett. **101** (2008) 071804

Search for long-lived particles decaying into electron or photon pairs with the DØ detector
Phys. Rev. Lett. **101** (2008) 111802

Observation of ZZ Production in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **101** (2008) 171803

Precise measurement of the top-quark mass from lepton+jets events
Phys. Rev. Lett. **101** (2008) 182001

Measurement of the polarization of the Υ(1S) and Υ(2S) states in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **101** (2008) 182004

Measurement of the Forward-Backward charge asymmetry and extraction of $\sin^2\theta^{eff}_W$ in $p\bar{p} \rightarrow Z/\gamma^* + X \rightarrow e^+e^- + X$ events produced at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **101** (2008) 191801

Measurement of the electron charge asymmetry in $p\bar{p} \rightarrow W + X \rightarrow e\,\nu + X$ events at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **101** (2008) 211801

Search for neutral Higgs bosons in multi-b-jet events in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. 101 (2008) 221802

Observation of the doubly strange b baryon Ω_b^-
Phys. Rev. Lett. **101** (2008) 232002

Search for third generation scalar leptoquarks decaying into τb
Phys. Rev. Lett. **101** (2008) 241802

A search for the standard model Higgs boson in the missing energy and acoplanar b-jet topology at $\sqrt{s}$=1.96 TeV
Phys. Rev. Lett. **101** (2008) 251802

Measurement of the muon charge asymmetry from W boson decays
Phys. Rev. D **77** (2008) 011106

Search for excited electrons in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Rev. D **77** (2008) 091102

Evidence for production of single top quarks
Phys. Rev. D **78** (2008) 012005

$ZZ \rightarrow l^+l^-\nu\bar{\nu}$ production in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Rev. D **78** (2008) 072002

Search for the lightest scalar top quark in events with two leptons in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Lett. **B 659** (2008) 500

Search for supersymmetry in di-photon final states at $\sqrt{s}$=1.96 TeV
Phys. Lett. **B 659** (2008) 856

Search for squarks and gluinos in events with jets and missing transverse energy using 2.1 fb^{-1} of collision data at $\sqrt{s}$=1.96 TeV
Phys. Lett. **B 660** (2008) 449

A combined search for the standard model Higgs boson at $\sqrt{s}$=1.96 TeV
Phys. Lett. **B 663** (2008) 26

Search for scalar top quarks in the acoplanar charm jets and missing transverse energy final state in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Lett. **B 665** (2008) 1

Measurement of the ratio of the $p\bar{p} \rightarrow$W+c-jet cross section to the inclusive $p\bar{p} \rightarrow$W+jets cross section
Phys. Lett. **B 666** (2008) 23

Measurement of the differential cross-section for the production of an isolated photon with associated jet in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Lett. **B 666** (2008) 435

Search for scalar leptoquarks and T-odd quarks in the acoplanar jet topology using 2.5 fb^{-1} of $p\bar{p}$ collision data at $\sqrt{s}$= 1.96 TeV
Phys. Lett. **B 668** (2008) 357

Search for $t\bar{t}$ resonances in the lepton plus jets final state in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Lett. **B 668** (2008) 98

Measurement of differential Z/γ^*+jet+X cross sections in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Phys. Lett. **B 669** (2008) 278

J.G. Hegeman
Inclusive jet production at the Tevatron using the DØ experiment
J.Phys.:Conf.Series **110** (2008) 022018

LHCb/BABAR

LHCb Collaboration:
A. Augusto Alves (*et al.*); J. Amoraal, G. van Apeldoorn, N. van Bakel, H. Band, T.S. Bauer, A. Berkien, M. van Beuzekom, E. Bos, J. van den Brand, Ch. Bron, H.J. Bulten, L. Ceelie, M. Doets, R. van der Eijk, J.-P. Fransen, P. de Groen, V. Gromov, R. Hierck, J. Homma, B. Hommels, W. Hoogland, E. Jans, F. Jansen, L. Jansen, M. Jaspers, M. de Jong, A.P. Kaan, T. Ketel, S. Klous, B. Koene, J. Koopstra, J. Kos, M. Kraan, F. Kroes, J. Langedijk, A. van Lysebetten, B. M'charek, M. Merk, S. Mos, F. Mul, B. Munneke, J. Palacios, A. Papadelis, A. Pellegrino, O. van der Petten, T. du Pree, G. Raven, E. Roeland, W. Ruckstuhl, A. Schimmel, H. Schuijlenburg, E. Simioni, T. Sluijk, J. Spelt, J. Stolte, H. Terrier, N. Tuning, P. Vankov, J. Verkooyen, B. Verlaat, W. Vink, H. de Vries, L. Wiggers, G. Ybeles Smit, N. Zaitsev, M. Zupan, A. Zwart

The LHCb Detector at the LHC
J. Instr. **3** (2008) S08005

LHCb Outer Tracker Collaboration: H. Terrier
Performance of the outer tracker detector of LHCb
J.Phys.:Conf.Series **110** (2008) 092031

Raja Nandakumar (*et al.*), B. M'Charek
The LHCb computing data challenge DC06
J. Phys. : Conf. Series **119** (2008) 072023

M. Gersabeck (*et al.*), M. van Beuzekom, E. Jans, T.J Ketel, A. Keune, A. Papadelis, A. Vanlysebetten, T.W. Versloot, H. de Vries
Performance of the LHCb vertex detector alignment algorithm determined with beam test data
Nucl. Instr. Meth. **A 596** (2008) 154

LHCb VELO Collaboration: M.G. van Beuzekom
Status and prospects of the LHCb vertex locator
Nucl. Instr. Meth. **A 596** (2008) 21

BABAR Collaboration:
B. Aubert (*et al.*); M.A. Baak, G. Raven, H.L. Snoek

Exclusive branching-fraction measurements of semileptonic τ decays into three charged hadrons, into $\phi\pi^-\nu_\tau$, and into $\phi K^-\nu_\tau$
Phys. Rev. Lett. **100** (2008) 011801

Observation of the semileptonic decays $B\to D^*\tau^-\bar{\nu}_\tau$ and evidence for $B\to D\tau^-\bar{\nu}_\tau$
Phys. Rev. Lett. **100** (2008) 021801

Measurement of the absolute branching fraction of D^0K^+
Phys. Rev. Lett. **100** (2008) 051802

Observation of $B^+a(1260)K^0$ and $B^0a(1260)K^+$
Phys. Rev. Lett. **100** (2008) 051803

Search for CP violation in the decays $D^0\to K^-K^+$ and $D^0\to\pi^-\pi^+$
Phys. Rev. Lett. **100** (2008) 061803

Search for lepton flavor violating decays $\tau^\pm\to l^\pm\omega$
Phys. Rev. Lett. **100** (2008) 071802

Observation of $B^0\to K^{*0}\bar{K}^{*0}$ and Search for $B^0\to K^0K^{*0}$
Phys. Rev. Lett. **100** (2008) 081801

Search for CPT and Lorentz violation in B^0-$\bar{B}^0$ oscillations with dilepton events
Phys. Rev. Lett. **100** (2008) 131802

Measurement of the branching fractions of exclusive $\bar{B}\to D^{(*)}(\pi)l^-\bar{\nu}_l$ decays in events with a fully reconstructed B-meson
Phys. Rev. Lett. **100** (2008) 151802

Measurements of partial branching fractions for $\bar{B}\to X_u l\bar{\nu}$ and determination of $|V_{ub}|$
Phys. Rev. Lett. **100** (2008) 171802

Observation of Tree-Level B decays with $s\bar{s}$ production from gluon radiation
Phys. Rev. Lett. **100** (2008) 171803

Measurement of the Decay $B^-\to D^-e^-\bar{\nu}_e$
Phys. Rev. Lett. **100** (2008) 231803

Evidence for CP violation in $B^0\to J/\Psi\,\pi^0$ decays
Phys. Rev. Lett. **101** (2008) 021801

Observation of the bottomonium ground state in the decay $\Upsilon(3S)\to\gamma\eta_b$
Phys. Rev. Lett. **101** (2008) 071801

Measurements of $B\to\pi, \eta, \eta' l\nu_l$ branching fractions and determination of $|V_{ub}|$ with semileptonically tagged B-mesons
Phys. Rev. Lett. **101** (2008) 081801

Observation of Y(3940)→J/ψ ω in B→J/ψ ω K at BABAR
Phys. Rev. Lett. **101** (2008) 082001

Study of B-meson decays with excited η and η' mesons
Phys. Rev. Lett. **101** (2008) 091801

Observation and polarization measurements of $B^{\pm}\to\phi K_1^{\pm}$ and $B^{\pm}\to\phi K_2^{*\pm}$
Phys. Rev. Lett. **101** (2008) 161801

Measurement of the CP asymmetry in b→sγ using a sum of exclusive final states
Phys. Rev. Lett. **101** (2008) 171804

Searches for B-meson decays to φφ, φρ, φf^0(980), and f^0(980)f^0(980) final states
Phys. Rev. Lett. **101** (2008) 201801

Measurement of the branching fractions of $\overline{B}\to D^{**}l^-\overline{\nu}_l$ decays in events tagged by a fully reconstructed B-meson
Phys. Rev. Lett. **101** (2008) 261802

Search for the rare charmless hadronic decay $B^+\to a_0^+\pi^0$
Phys. Rev. **D 77** (2008) 011101

Study of resonances in exclusive B decays to $\overline{D}^{(*)}D^{(*)}K$
Phys. Rev. **D 77** (2008) 011102

Search for the decays $B^0\to e^+e^-\gamma$ and $B^0\to\mu^+\mu^-\gamma$
Phys. Rev. **D 77** (2008) 011104

Search for $B^+\to\tau^+\nu$ decays with hadronic B tags
Phys. Rev. **D 77** (2008) 011107

Study of excited charm-strange baryons with evidence for new baryons $\Xi_c(3055)^+$ and $\Xi_c(3123)^+$
Phys. Rev. **D 77** (2008) 012002

Measurement of the CP-violating asymmetries in $B^0\to K_s^0\pi^0$ and of the branching fraction $B^0\to K^0\pi^0$
Phys. Rev. **D 77** (2008) 012003

Study of $\overline{B}\to\Xi_c\overline{\Lambda}_c^-$ and $\overline{B}\to\Lambda_c^+\overline{\Lambda}_c^-\overline{K}$ decays at BABAR
Phys. Rev. **D 77** (2008) 031101

Determination of the form factors for the decay $B^0\to D^{*-}l^+\nu_l$ and of the CKM matrix element $|V_{cb}|$
Phys. Rev. **D 77** (2008) 032002

Search for decays of B^0 mesons into e^+e^-, $\mu^+\mu^-$ and $e^{\pm}\mu^{\mp}$ final states
Phys. Rev. **D 77** (2008) 032007

Measurement of the $B\to X_s\gamma$ branching fraction and photon energy spectrum using the recoil method
Phys. Rev. **D 77** (2008) 051103

Time-dependent Dalitz plot analysis of $B^0\to D^{\mp}K^0\pi^{\pm}$ decays
Phys. Rev. **D 77** (2008) 071102

Searches for the decays $B^0\to l^{\pm}\tau^{\mp}$ and $B^+\to l^+\nu$ (l = e,μ) using hadronic tag reconstruction
Phys. Rev. **D 77** (2008) 091104

Measurements of $e^+e^-\to K^+K^-\eta$, $K^+K^-\pi^0$, and $K_s^0K^{\pm}\pi^{\mp}$ cross sections using initial state radiation events
Phys. Rev. **D 77** (2008) 092002

Improved measurement of CP observables in $B^{\pm}\to D^0_{CP}K^{\pm}$ decays
Phys. Rev. **D 77** (2008) 111102

Study of B→X(3872)K, with $X(3872)\to J/\psi\pi^+\pi^-$
Phys. Rev. **D 77** (2008) 1111101

Measurement of the $\tau^-\to\eta\pi^-\pi^+\pi^-\nu_\tau$ branching fraction and a search for a second-class current in the $\tau^-\to\eta'(958)\pi^-\nu_\tau$ decay
Phys. Rev. **D 77** (2008) 112002

Measurement of time-dependent CP asymmetry in $B^0\to K_s^0\pi^0\gamma$ decays
Phys. Rev. **D 778** (2008) 071102

Measurement of the mass difference $m(B^0)$-$m(B^+)$
Phys. Rev. **D 78** (2008) 011103

Observation of $B^+\to b_1^+K^0$ and search for B-meson decays to $b_1^0K^0$ and $b_1\pi^0$
Phys. Rev. **D 78** (2008) 011104

Measurement of D^0-$\overline{D}^0$ mixing using the ratio of lifetimes for the decays $D^0\to K^-\pi^+$, K^-K^+, and $\pi^-\pi^+$
Phys. Rev. **D 78** (2008) 011105

Observation of $B^+\to\eta\rho^+$ and search for B^0 decays to η'η, $\eta\pi^0$, $\eta'\pi^0$, and $\omega\pi^0$
Phys. Rev. **D 78** (2008) 011107

Evidence for direct CP violation from Dalitz-plot analysis of $B\to K^{\pm}\pi^{\mp}\pi^{\pm}$
Phys. Rev. **D 78** (2008) 012004

Study of B-meson decays to $\eta_c K^{(*)}$, $\eta_c(2S)K^{(*)}$, and $\eta_c \gamma K^{(*)}$
Phys. Rev. **D 78** (2008) 012006

Measurement of the branching fractions of the rare decays $B^0 \to D_s^{(*)+}\pi^-$, $B^0 \to D_s^{(*)+}\rho^-$, and $B^0 \to D_s^{(*)-}K^{(*)+}$
Phys. Rev. **D 78** (2008) 032005

Measurement of the spin of the $\Xi(1530)$ resonance
Phys. Rev. **D 78** (2008) 034008

Improved measurement of the CKM angle γ in $B^\mp \to D^{(*)}K^{(*)\mp}$ decays with a Dalitz plot analysis of D decays to $K_s^0\pi^+\pi^-$ and $K_s^0K^+K^-$
Phys. Rev. **D 78** (2008) 034023

Study of the decay $D_s^+ \to K^+K^-e^+\nu_e$
Phys. Rev. **D 78** (2008) 051101

Search for CP violation in neutral D meson Cabibbo-suppressed three-body decays
Phys. Rev. **D 78** (2008) 051102

Search for $B^0 \to K^{*+}K^{*-}$
Phys. Rev. **D 78** (2008) 051103

Dalitz plot analysis of the decay $B^0(\overline{B}^0) \to K^\pm\pi^\mp\pi^0$
Phys. Rev. **D 78** (2008) 052005

Measurement of the branching fractions of the radiative charm decays $D^0 \to \overline{K}{}^{*0}\gamma$ and $D^0 \to \phi\gamma$
Phys. Rev. **D 78** (2008) 071101

Observation of $e^+e^- \rho^+\rho^-$ near $\sqrt{s}$=10.58 GeV
Phys. Rev. **D 78** (2008) 071103

Measurement of the branching fraction, polarization, and CP asymmetries in $B^0 \to \rho^0\rho^0$ decay, and implications for the CKM angle α
Phys. Rev. **D 78** (2008) 071104

Observation of $B^0 \to \chi_{c0}K^{*0}$ and evidence for $B^+ \to \chi_{c0}K^{*+}$
Phys. Rev. **D 78** (2008) 091101

Search for the highly suppressed decays $B^- \to K^+\pi^-\pi^-$ and $B^- \to K^-K^-\pi^+$
Phys. Rev. **D 78** (2008) 091102

Measurement of ratios of branching fractions and CP-violating asymmetries of $B^\pm \to D^*K^\pm$ decays
Phys. Rev. **D 78** (2008) 092002

Time-dependent and time-integrated angular analysis of $B \to \phi K_s\pi^0$ and $B \to \phi K^+\pi^-$
Phys. Rev. **D 78** (2008) 092008

Measurements of branching fractions for $B^+ \to \rho^+\gamma$, $B^0 \to \rho^0\gamma$, and $B^0 \to \omega\gamma$
Phys. Rev. **D 78** (2008) 112001

Study of hadronic transitions between Υ states and observation of $\Upsilon(4S) \to \eta\Upsilon(1S)$ decay
Phys. Rev. **D 78** (2008) 112002

Measurements of $B(\overline{B}^0 \to \Lambda_c + \overline{p})$ and $B(B^- \to \Lambda_c + \overline{p}\pi^-)$ and studies of $\Lambda_c + \pi^-$ resonances
Phys. Rev. **D 78** (2008) 112003

ALICE/STAR

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The ALICE experiment at the CERN LHC
J. Instr. **3** (2008) S08002

STAR Collaboration:
B.I. Abelev (*et al.*); Y. Bai, F. Benedosso, M. Botje, E. Braidot, O. Grebenyuk, N. van der Kolk, M. van Leeuwen, A. Mischke, T. Peitzmann, M.J. Russcher, R. Snellings

Longitudinal double-spin asymmetry for inclusive jet production in p-vector +p-vector collisions at $\sqrt{s}$=200 GeV
Phys. Rev. Lett. **100** (2008) 232003

Forward neutral-pion transverse single-spin asymmetries in p+p collisions at $\sqrt{s}$=200 GeV
Phys. Rev. Lett. **101** (2008) 222001

System-size independence of directed flow measured at the BNL relativistic heavy-ion collider
Phys. Rev. Lett. **101** (2008) 252301

ρ^0 photoproduction in ultraperipheral relativistic heavy ion collisions at $\sqrt{s_{NN}}$=200 GeV
Phys. Rev. **C 77** (2008) 034910

Enhanced strange baryon production in Au+Au collisions compared to p+p at $\sqrt{s_{NN}}$=200 GeV
Phys. Rev. **C 77** (2008) 044908

Centrality dependence of charged hadron and strange hadron elliptic flow from $\sqrt{s_{NN}}$=200 GeV Au+Au collisions
Phys. Rev. **C 77** (2008) 054901

Spin alignment measurements of the K^{*}(892) and ϕ(1020) vector mesons in heavy ion collisions at $\sqrt{s_{NN}}$=200 GeV
Phys. Rev. **C 77** (2008) 061902

Hadronic resonance production in d+Au collisions at $\sqrt{s_{NN}}$=200 GeV measured at the BNL relativistic heavy ion collider
Phys. Rev. **C 78** (2008) 044906

NA49 Collaboration:
C. Alt *(et al.)*; M. Botje, M. van Leeuwen, A. Mischke

Pion and kaon production in central Pb+Pb collisions at 20A and 30A GeV: Evidence for the onset of deconfinement
Phys. Rev. **C 77** (2008) 024903

High transverse momentum hadron spectra at $\sqrt{s_{NN}}$=17.3 GeV in Pb+Pb and p+p collisions
Phys. Rev. **C 77** (2008) 034906

Bose-Einstein correlations of $\pi^-\pi^-$ pairs in central Pb+Pb collisions at 20A,30A,40A,80A, and 158A GeV
Phys. Rev. **C 77** (2008) 064908

Energy dependence of multiplicity fluctuations in heavy ion collisions at 20A to 158A GeV
Phys. Rev. **C 78** (2008) 034914

Energy dependence of Λ and Ξ production in central Pb+Pb collisions at 20A,30A,40A,80A, and 158A GeV measured at the CERN Super Proton Synchrotron
Phys. Rev. **C 78** (2008) 034918

Energy dependence of ϕ meson production in central Pb+Pb collisions at $\sqrt{s_{NN}}$=6 to 17 GeV
Phys. Rev. C 78 (2008) 044907

WA98 Collaboration:
M.M. Aggarwal *(et al.)*; N.J.A.M. van Eijndhoven, F.J.M. Geurts, R. Kamermans, T. Peitzmann, E.C. van der Pijll

Suppression of high-p_T neutral pion production in central Pb+Pb collisions at $\sqrt{s_{NN}}$=17.3 GeV relative to p+C and p+Pb collisions
Phys. Rev. Lett. **100** (2008) 242301

ANTARES/KM3NeT

ANTARES:
M. Bouwhuis
GRB satellite triggers for neutrino telescopes
Astronomische Nachrichten **329** (2008) 334

P. Kooijman
Status of the ANTARES neutrino telescope
J.Phys.:Conf.Series **110** (2008) 062013

S. Mangano
Algorithm for muon electromagnetic shower reconstruction
Nucl. Instr. Meth. **A 588** (2008) 107

KM3NeT:
E. de Wolf
KM3NeT, a new generation neutrino telescope
Nucl. Instr. Meth. **A 588** (2008) 86

Virgo/LISA

Virgo Collaboration:
B. Abbott *(et al.)*; F. Acernese *(et al.)*, Th.S. Bauer, J.F.J. van den Brand, S. van der Putten

Lock acquisition of the Virgo gravitational wave detector
Astropart. Phys. **30** (2008) 29

In-vacuum optical isolation changes by heating in a Faraday isolator
Appl.Optics **47** (2008) 5853

Status of Virgo
Class. Quantum Grav. **25** (2008) 114045

Astrophysically triggered searches for gravitational waves: status and prospects
Class. Quantum Grav. **25** (2008) 114051

Virgo status
Class. Quantum Grav. **25** (2008) 184001

Noise studies during the first Virgo science run and after
Class. Quantum Grav. **25** (2008) 184003

First joint gravitational wave search by the AURIGA-EXPLORER-NAUTILUS-Virgo Collaboration
Class. Quantum Grav. **25** (2008) 205007

Search for gravitational waves associated with GRB 050915a using the Virgo detector
Class. Quantum Grav. **25** (2008) 225001

Data acquisition system of the Virgo gravitational waves interferometric detector
IEEE Trans. Nucl. Sci. **55** (2008) 225

The Virgo 3 km interferometer for gravitational wave detection
J. Opt. A: Pure Appl. Opt. **10** (2008) 0640096

The status of Virgo
J.Phys.:Conf.Series **110** (2008) 062025

Virgo: a large interferometer for gravitational wave detection started its first scientific run
J. Phys. : Conf. Series **120** (2008) 032007

AURIGA Collaboration: M.B. Bignotto *(et al.)*, Th.S. Bauer, J.F.J. van den Brand, S. van der Putten

A cross-correlation method to search for gravitational wave bursts with AURIGA and Virgo
Class. Quantum Grav. **25** (2008) 114046

AUGER

Pierre Auger Collaboration:
J. Abraham *(et al.)*; J. Coppens, S. Harmsma, S.J. de Jong, C. Timmermans

Correlation of the highest-energy cosmic rays with the positions of nearby active galactic nuclei
Astropart. Phys. **29** (2008) 188

Upper limit on the cosmic-ray photon flux above 10^{19} eV using the surface detector of the Pierre Auger Observatory
Astropart. Phys. **29** (2008) 243

Upper limit on the diffuse flux of ultrahigh energy tau neutrinos from the Pierre Auger Observatory
Phys. Rev. Lett. **100** (2008) 211101

Observation of the suppression of the flux of cosmic rays above $4{\times}10^{19}$ eV
Phys. Rev. Lett. **101** (2008) 061101

Theory

F. Gmeiner, F. Witt
Calibrations and T-duality
Commun. Math. Phys. **283** (2008) 543

Ph. Brax *(et al.)*, M. Postma
D-term uplifted racetrack inflation
J. Cosmol. Astropart. Phys. **01** (2008) 008

F. Gmeiner, C. D. White
Dirac-Born-Infeld inflation using a one-parameter family of throat geometries
J. Cosmol. Astropart. Phys. **02** (2008) 012

Ph. Brax, S.C. Davis, M. Postma
The robustness of n_s less than or similar to 0.95 in racetrack inflation
J. Cosmol. Astropart. Phys. **02** (2008) 020

S.C. Davis, M. Postma
Supergravity chaotic inflation and moduli stabilization
J. Cosmol. Astropart. Phys. **03** (2008) 015

S.C. Davis, M. Postma
Successfully combining SUGRA hybrid inflation and moduli stabilization
J. Cosmol. Astropart. Phys. **04** (2008) 022

Ph. Brax *(et al.)*, M. Postma
Racetrack inflation with matter fields and cosmic strings
J. Cosmol. Astropart. Phys. **07** (2008) 018

E. Kiritsis, B. Schellekens, M. Tsulaia
Discriminating MSSM families in (free-field) Gepner orientifolds
J. High Energy Phys. **10** (2008) 106

S. Frixione, E. Laenen, P. Motylinski, C. White, B. R. Webber
Single-top hadroproduction in association with a W boson
J. High Energy Phys. **7** (2008) 07029

F. Gmeiner, G. Honecker
Millions of standard models on $\mathbb{Z}_6'$?
J. High Energy Phys. **7** (2008) 07052

A. Bacchetta, D. Boer, M. Diehl, P. J. Mulders
Matches and mismatches in the descriptions of semi-inclusive processes at low and high transverse momentum
J. High Energy Phys. **8** (2008) 023

N. Armesto *(et al.)*, D. Boer, A. Utermann, E. Wessels, I. Kraus
Heavy-ion collisions at the LHC - Last call for predictions
J. Phys. **G 35** (2008) 054001

B. Gato-Rivera
The Adapted Ordering Method for Lie Algebras and superalgebras and their generalizations
J. Phys. **A 41** (2008) 0452016

A. Vogt, S. Moch, M. Rogal, J.A.M. Vermaseren
Towards the NNLO evolution of polarised parton distributions
Nucl. Phys. B (Proc. Suppl.) **183** (2008) 155

J.A.M. Vermaseren
The FORM project
Nucl. Phys. B (Proc. Suppl.) **183** (2008) 19

Y. Yamamoto, Th.A. Rijken
S=–2 hypernuclei based on the ESC04 model
Nucl. Phys. **A 804** (2008) 139

Th.A. Rijken, Y. Yamamoto
Recent soft-core baryon-baryon interactions
Nucl. Phys. **A 804** (2008) 51

M.O. de Kok, J.W. van Holten
The fate of conformal symmetry in the non-linear Schrödinger theory
Nucl. Phys. **B 803** (2008) 363

M.O. de Kok, J.W. van Holten
The role of conformal symmetry in the Jackiw-Pi model
Nucl. Phys. **B 805** (2008) 545

D. Boer
Angular dependences in inclusive two-hadron production at BELLE
Nucl. Phys. **B 806** (2008) 23

K. Itonaga *(et al.)*, Th.A. Rijken
Role of the axial vector a_1-meson exchange in hypernuclear nonmesonic weak decays
Phys. Rev. **C 77** (2008) 044605

E. Hiyama *(et al.)*, Th. A. Rijken
Light Ξ hypernuclei in four-body cluster models
Phys. Rev. **C 78** (2008) 054316

M.M. Meijer, J. Smith, W.L. van Neerven
Helicity amplitudes for charmonium production in hadron-hadron and photon-hadron collisions
Phys. Rev. **D 77** (2008) 034014

R. V. Hardlander, J. Vollinga, M. M. Weber
Gluon-induced weak boson fusion
Phys. Rev. **D 77** (2008) 053010

L.P. Gamberg, A. Mukherjee, P.J. Mulders
Spectral analysis of gluonic pole matrix elements for fragmentation
Phys. Rev. **D 77** (2008) 114026

J.R Andersen, C.D. White
New framework for multijet predictions and its application to Higgs boson production at the Large Hadron Collider
Phys. Rev. **D 78** (2008) 051501

D. Boer, J. K. Boomsma
Spontaneous CP violation in the strong interaction at $\theta=\pi$
Phys. Rev. **D 78** (2008) 054027

E. Laenen, L. Magnea, G. Stavenga
On next-to-eikonal corrections to threshold resummation for the Drell-Yan and DIS cross sections
Phys. Lett. **B 669** (2008) 173

A.N. Schellekens
The emperor's last clothes? Overlooking the string theory landscape
Rep. Prog. Phys. **71** (2008) 072201

Detector R&D

V.M. Blanco Carballo *(et al.)*, M. Chefdeville, H. van der Graaf, J. Timmermans
A radiation imaging detector made by postprocessing a standard CMOS chip
IEEE Electr. Dev. Lett. **29** (2008) 585

V.M. Blanco Carballo *(et al.)*, M. Chefdeville, H. van der Graaf, F. Hartjes, J. Timmermans, J.L. Visschers
Pulse height fluctuations of integrated micromegas detectors
Nucl. Instr. Meth. **A 591** (2008) 147

Z. Vykydal (*et al.*), J.L. Visschers
The RELAXd project: Development of four-side tilable photon-counting imagers
Nucl. Instr. Meth. **A 591** (2008) 241

Grid Computing

D. Groep, M. Helm, J. Jensen, M. Sova, S. Rea, R. Karlsen-Masur, U. Epting, M. Jones
Grid Certificate Profile
Community Practice GFD.125, OGF Document Series, the Open Grid Forum, Joliet, Illinois, USA

Nairz, A. (*et al.*), K. Bos
ATLAS computing system commissioning: real-time data processing and distribution tests
J.Phys.:Conf.Series **110** (2008) 092019

I. Sfiligoi (*et al.*), O. Koeroo, G. Venekamp, D. Groep
Addressing the pilot security problem with gLExec
J.Phys.:Conf.Series **119** (2008) 052029

D. Groep, O. Koeroo, G. Venekamp
gLExec: gluing grid computing to the Unix world
J.Phys.:Conf.Series **119** (2008) 062032

HERA

HERMES Collaboration:
A. Airapetian (*et al.*); H.P. Blok, M. Demey, J. Dreschler, L. Lapikás, P. van der Nat, A. Reischl, G. van der Steenhoven, J.J.M. Steijger

Evidence for a transverse single-spin asymmetry in leptoproduction of $\pi^+\pi^-$ pairs
J. High Energy Phys. **6** (2008) 017

Measurement of azimuthal asymmetries with respect to both beam charge and transverse target polarization in exclusive electroproduction of real photons
J. High Energy Phys. **6** (2008) 066

Cross sections for hard exclusive electroproduction of π^+ mesons on a hydrogen target
Phys. Lett. **B 659** (2008) 486

Measurement of parton distributions of strange quarks in the nucleon from charged-kaon production in deep-inelastic scattering on the deuteron
Phys. Lett. **B 666** (2008) 446

C. Baumgarten (*et al.*), H. Kolster
First measurement of the hydrogen spin-exchange collision cross-section in the low temperature region
Eur. Phys. J. **D 48** (2008) 343

ZEUS Collaboration:
S.V. Chekanov (*et al.*); G. Grigorescu, A. Keramidas, E. Koffeman, P. Kooijman, A. Pellegrino, H. Tiecke, M. Vazquez, L. Wiggers

Diffractive photoproduction of dijets in ep collisions at HERA
Eur. Phys. J. **C 55** (2008) 177

Energy dependence of the charged multiplicity in deep inelastic scattering at HERA
J. High Energy Phys. **6** (2008) 061

Three- and four-jet final states in photoproduction at HERA
Nucl. Phys. **B 792** (2008) 1

Deep inelastic inclusive and diffractive scattering at Q^2 values from 25 to 320 GeV^2 with the ZEUS forward plug calorimeter
Nucl. Phys. **B 800** (2008) 1

Inclusive $K^0_sK^0_s$ resonance production in ep collisions at HERA
Phys. Rev. Lett. **101** (2008) 112003

Multijet cross sections in charged current $e^{\pm}p$ scattering at HERA
Phys. Rev. **D 78** (2008) 032004

Beauty photoproduction using decays into electrons at HERA
Phys. Rev. **D 78** (2008) 072001

LEP

DELPHI Collaboration:
J. Abdallah (*et al.*); H.M. Blom, P. van Dam, P. Kluit, J. Montenegro, M. Mulders, D. Reid, J. Timmermans

Higgs boson searches in CP-conserving and CP-violating MSSM scenarios with the DELPHI detector
Eur. Phys. J. **C 54** (2008) 1-35 erratum **56** (2008) 165

Study of W-boson polarisations and triple gauge boson couplings in the reaction $e^+e^-\rightarrow W^+W^-$ at LEP 2
Eur. Phys. J. **C 54** (2008) 345

Measurement of the mass and width of the W boson in e^+e^- collisions at $\sqrt{s}$=161-209 GeV
Eur. Phys. J. **C 55** (2008) 001

Study of b-quark mass effects in multijet topologies with the DELPHI detector at LEP
Eur. Phys. J. **C 55** (2008) 525

Observation of the muon inner bremsstrahlung at LEP1
Eur. Phys. J. **C 57** (2008) 499

Di-jet production in $\gamma\gamma$ collisions at LEP2
Eur. Phys. J. **C 58** (2008) 531

Measurement of the τ lepton polarisation at LEP2
Phys. Lett. **B 659** (2008) 65

L3 Collaboration:
P. Achard *(et al.)*; S.V. Baldew, G.J. Bobbink, M. Dierckxsens, F. Filthaut, H. Groenstege, P. de Jong, W. Kittel, A.C. Koenig, E. Kok, J. Kuijpers, F.L. Linde, W.J. Metzger, A. van Mil, A.J.M. Muijs, T. Novak, B. Petersen, A. Rojkov, D.J. Schotanus, C. Timmermans, H. Verkooijen, R.T. van de Walle, Q. Wang, R. van Wijk, A.N.M. Zwart

Study of the solar anisotropy of cosmic ray primaries of about 200 GeV energy with the L3+C muon detector
Astron. Astrophys. **488** (2008) 1093

Miscellaneous
D.G. Middleton *(et al.)*, P. Barneo, H.P. Blok, W.H.A. Hesselink, E. Jans, L. Lapikás, H. de Vries, B. Zihlmann
^{3}He(e,e'pp) and ^{3}He(e,e'pn) reactions at AmPS and MAMI
Few-Body Systems **44** (2008) 171

V.I. Klyukhin *(et al.)*, F. Linde, M. Mulders
Measurement of the CMS Magnetic Field
IEEE Trans. Appl. Superconductivity **18** (2008) 395

H.P. Blok, V. Tvaskis
Charged pion form factor between Q^2=0.60 and 2.45 GeV^2. I. Measurements of the cross section for the ^{1}H(e,e'π^+)n reaction
Phys. Rev. **C 78** (2008) 045202

G.M. Huber *(et al.)*, H.P. Blok, V. Tvaskis
Charged pion form factor between Q^2=0.60 and 2.45 GeV^2. II. Determination of, and results for, the pion form factor
Phys. Rev. **C 78** (2008) 045203

R. Subedi *(et al.)*, E. Jans
Probing cold dense nuclear matter
Science **320** (2008) 1476

CHORUS Collaboration:
E. Eskut *(et al.)*; A. Kayis-Topaksu *(et al.)*, M.G. van Beuzekom, R. van Dantzig, M. de Jong, J. Konijn , O. Melzer, R.G.C. Oldeman, E. Pesen, C.A.F.J. van der Poel, J.L. Visschers
Final results on $\nu_\mu \rightarrow \nu_\tau$ oscillation from the CHORUS experiment
Nucl. Phys. **B 793** (2008) 326

Leading order analysis of neutrino induced dimuon events in the CHORUS experiment
Nucl. Phys. **B 798** (2008) 1

3.2 Theses

Ytsen Ronald de Boer
Measurement of single W boson production in ep scattering
Universiteit Twente, 10 January, 2008
Promotor: B. van Eijk
Copromotor: C. Diaconu

Patrick Motylinski
Single top production aspects of perturbative QCD
Universiteit van Amsterdam, 25 January, 2008
Promotor: E.L.M.P. Laenen

Carmen Miruna Anăstăsoaie
A search for $W^{\pm}H \to \nu_{\mu} bb$ production at the Tevatron
Radboud Universiteit Nijmegen, 6 February, 2008
Promotor: S.J. de Jong
Copromotor: F. Filthaut

Ronald Bruijn
The ANTARES Neutrino Telescope: Performance studies and analysis of first data
Universiteit van Amsterdam, 19 March, 2008
Promotores: P.M. Kooijman, M. de Jong

Joana Montenegro Ferreira
Measurement of the W mass using semi-leptonic events at LEP
Radboud Universiteit Nijmegen, 20 March, 2008
Promotor: N. de Groot
Copromotor: J. Timmermans

Tiberiu Gabriel Grigorescu
Measurement of charm production in deep inelastic scattering at HERA II
Universiteit van Amsterdam, 28 March, 2008
Promotores: E. Koffeman, P. Kooijman

Martinus Johannes Russcher
Direct photon measurement in proton-proton and deuteron-gold collisions
Universiteit Utrecht, 15 April, 2008
Promotor: T. Peitzmann
Copromotor: A. Mischke

Emanuele Lorenzo Simili
Elliptic flow measurements at ALICE
Universiteit Utrecht, 16 June, 2008
Promotor: R. Kamermans
Copromotor: P.G. Kuijer

Cristina Florina Galea
Measurement of $\sigma(p\overline{p} \to Z)\cdot Br(Z \to \tau^{+}\tau^{-})$ and search for Higgs bosons decaying to $\tau^{+}\tau^{-}$ at $\sqrt{s}$=1.96 TeV
Radboud Universiteit Nijmegen, 25 June, 2008
Promotor: S.J. de Jong

Mark Okker de Kok
Broken symmetries in field theory
Universiteit Leiden, 26 June, 2008
Promotores: P.J. van Baal, J.W. van Holten
Copromotor: F. Bruckmann

Tamás Novák
Bose-Einstein Correlations in $e^{+}e^{-}$ Annihilation
Radboud Universiteit Nijmegen, 4 September, 2008
Promotores: E.W. Kittel, T. Csörgő
Copromotor: W.J. Metzger

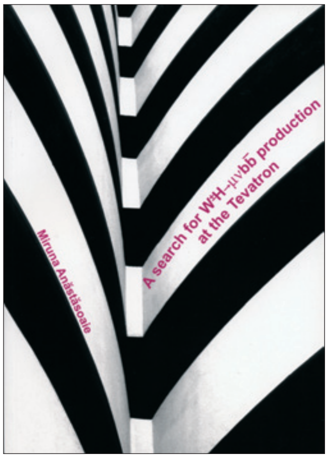
Qin Wang
Inter-string Bose-Einstein Correlations in Hadronic Z Decays using the L3 Detector at LEP
Radboud Universiteit Nijmegen, 4 September, 2008
Promotor: E.W. Kittel
Copromotor: W.J. Metzger

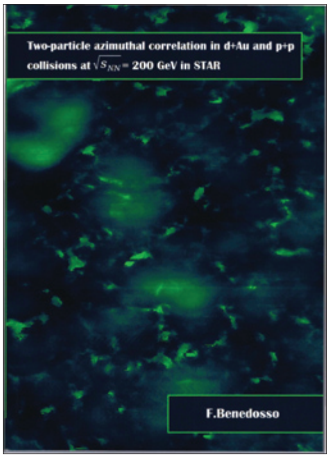
Federica Benedosso
Two particle azimuthal correlation in d+Au and p+p collision at $\sqrt{s_{NN}}$=200 GeV in STAR
Universiteit Utrecht, 8 September, 2008
Promotor: T. Peitzmann
Copromotor: A. Mischke

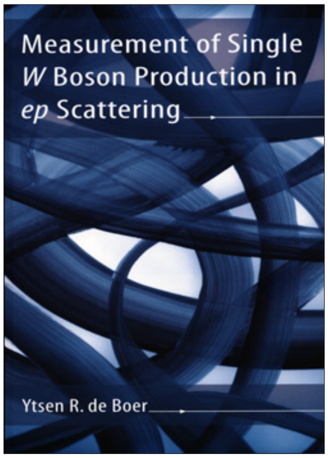
Jeroen Dreschler
Transverse target-spin asymmetry in exclusive electroproduction of ρ^{0} mesons
Vrije Universiteit Amsterdam, 7 October, 2008
Promotor: G. van der Steenhoven
Copromotor: H.P. Blok

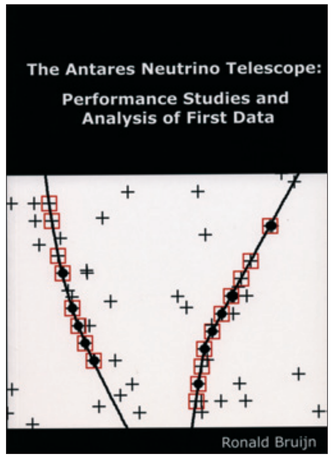
Peter Hristoforov Vankov
Study of the B-meson lifetime and the performance of the outer tracker at LHCb
Vrije Universiteit Amsterdam, 5 November, 2008
Promotor: J.F.J. van den Brand
Copromotor: A. Pellegrino, H.G. Raven

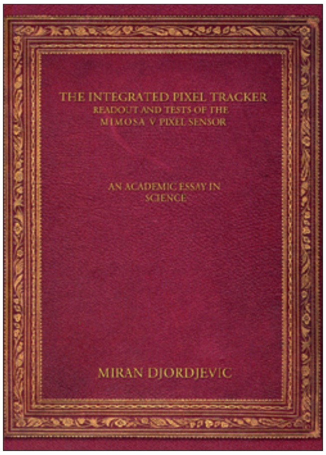
Miran Djordjevic
The Integrated Pixel Tracker: readout and tests of the MIMOSA V pixel sensor
Radboud Universiteit Nijmegen, 26 November, 2008
Promotor: S.J. de Jong

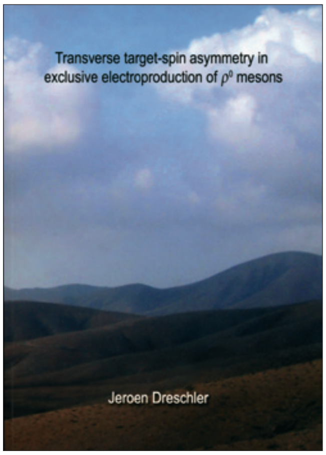

A search for $WH \to \mu\nu b\bar{b}$ production
at the Tevatron
Miruna Anăstăsoaie

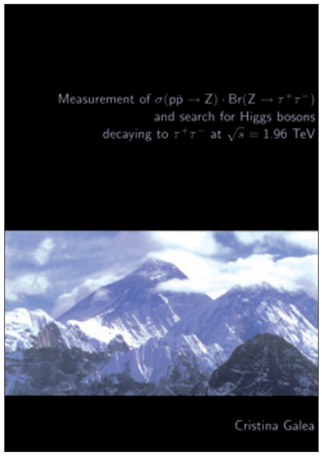

Two-particle azimuthal correlation in d+Au and p+p collisions at $\sqrt{s_{NN}}$ = 200 GeV in STAR
F.Benedosso

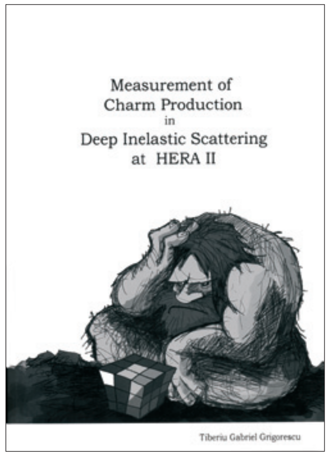

Measurement of Single W Boson Production in ep Scattering
Ytsen R. de Boer

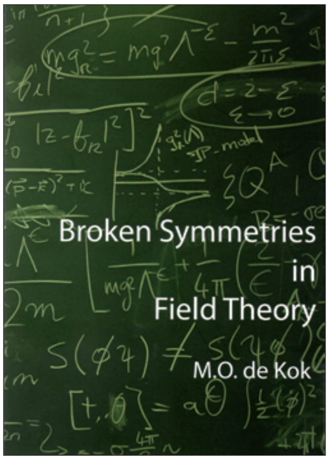

The Antares Neutrino Telescope:
Performance Studies and Analysis of First Data
Ronald Bruijn

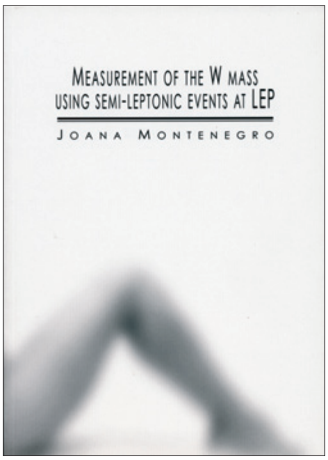

THE INTEGRATED PIXEL TRACKER
READOUT AND TESTS OF THE MIMOSA V PIXEL SENSOR
AN ACADEMIC ESSAY IN SCIENCE
MIRAN DJORDJEVIC

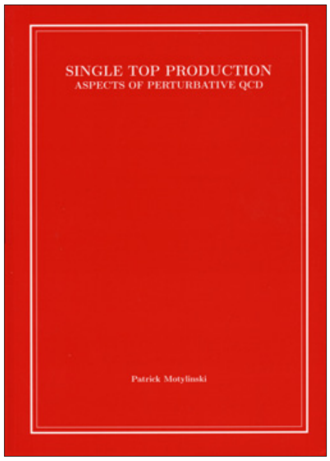

Transverse target-spin asymmetry in exclusive electroproduction of ρ^0 mesons
Jeroen Dreschler

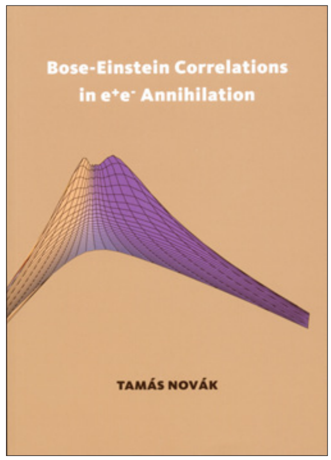

Measurement of $\sigma(p\bar{p} \to Z) \cdot Br(Z \to \tau^+\tau^-)$
and search for Higgs bosons
decaying to $\tau^+\tau^-$ at $\sqrt{s}$ = 1.96 TeV
Cristina Galea

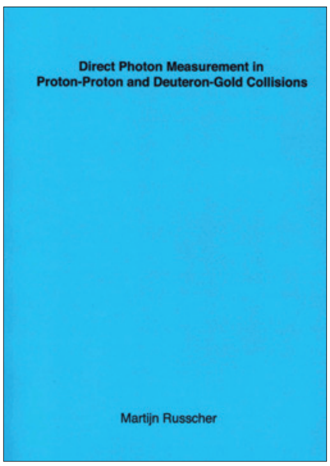

Measurement of
Charm Production
in
Deep Inelastic Scattering
at HERA II
Tiberiu Gabriel Grigorescu

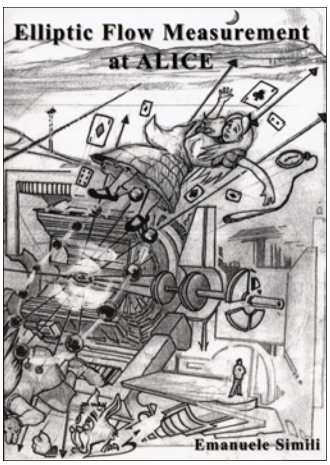

Broken Symmetries
in
Field Theory
M.O. de Kok

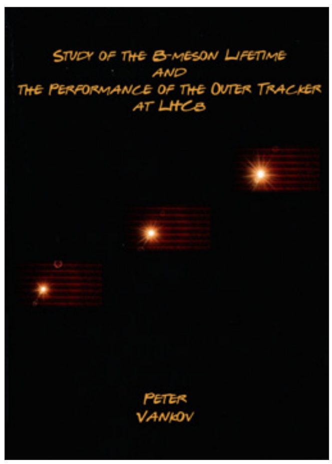

Measurement of the W mass
using semi-leptonic events at LEP
Joana Montenegro


SINGLE TOP PRODUCTION
ASPECTS OF PERTURBATIVE QCD
Patrick Motylinski


Bose-Einstein Correlations
in e^+e^- Annihilation
TAMÁS NOVÁK


Direct Photon Measurement in
Proton-Proton and Deuteron-Gold Collisions
Martijn Russcher


Elliptic Flow Measurement
at ALICE
Emanuele Simili


Study of the B-meson lifetime
and
the performance of the Outer Tracker
at LHCb
Peter Vankov


Inter-string Bose-Einstein Correlations
in Hadronic Z Decays using the L3 Detector at LEP
Qin Wang

3.3 Talks

ATLAS/DØ

Ancu, L., Searches for the SM Higgs Boson at Tevatron, NNV Najaarsvergadering, Lunteren, The Netherlands, 7 November, 2008

Bentvelsen, S., Het ATLAS Experiment, University of Amsterdam Highlights college, Amsterdam, The Netherlands, 20 February, 2008

Speciale Relativiteit, University of Amsterdam Mastercourse, Amsterdam, The Netherlands, 20 March, 2008

Elementaire deeltjes en de Large Hadron Collider, Cool Science Lezing - Studium Generale, Erasmus University, Rotterdam, The Netherlands, 8 April, 2008

Getting ATLAS & the LHC ready for physics, Colloquium SRON, Utrecht, The Netherlands, 9 April, 2008

Speciale Relativiteit, Stedelijk Gymnasium Amersfoort, Amersfoort, The Netherlands, 16 May, 2008

LHC physics at ATLAS and CMS, Lectures for the BND school, Texel, The Netherlands, 24 September, 2008

De Oerknal in het laboratorium, Stichting Weer- en Sterrenkunde Eemsmond, Appingedam, The Netherlands, 8 October, 2008

The Big Bang in the Laboratory, Colloquium Eindhoven University of Technology, Eindhoven, The Netherlands, 30 October, 2008

Op zoek naar nieuwe materie: het ATLAS project, Vereniging Mensa Nederland, Elspeet, The Netherlands, November 1, 2008

Waarom zijn planeten rond?, Nemo Klokhuis vragendag, NEMO, Amsterdam, The Netherlands, 9 November, 2008

De oerknal in het laboratorium, Chemische Kring Midden Nederland, de Kruythof , Utrecht, The Netherlands, 18 November, 2008

Bobbink, G.J., Status of the ATLAS muon spectrometer, Bonn University, Bonn, Germany, 24 January, 2008

Consonni, M., Prospects for SUSY Discovery and Measurements with the ATLAS Detector at the LHC, International Conf. on Particles and Nuclei (PANIC08), Eilat, Israël, 11 November, 2008

Eijk, B. van, Elementaire Deeltjes in het Standaard Model en…?, Masterclass - Nikhef, Amsterdam, The Netherlands, 13 & 14 March, 2008

Het Higgs-deeltje, Groningen University, Groningen, The Netherlands, 17 March, 2008

HiSPARC: ‘Business as usual’ of Uitdaging?, ESERO: Netwerk Ruimtevaart en Sterrekunde - NEMO, Amsterdam, The Netherlands, 8 April, 2008

Going beyond the Standard Model, LHC Symposium, University of Twente, Enschede, The Netherlands, 17 October, 2008

De kunst van de (a)symmetrie, Qua Art Qua Science, University of Twente, Enschede, The Netherlands, 16 November, 2008

Het Higgs deeltje en the lightness of being, Sterrenwacht Enschede, Enschede, The Netherlands, 25 November, 2008

Filthaut, F., The Solar Neutrino Puzzle, honourscollege Eindhoven University of Technology, Eindhoven, The Netherlands, 7 April, 2008

Tevatron Searches for Higgs Bosons beyond the Standard Model, Hadron Collider Physics symposium, Galena, IL, USA, 28 May, 2008

Computers bij fysische experimenten, Eindhoven University of Technology, Eindhoven, The Netherlands, 5 November, 2008

Groot, N. de, Completing and cracking the Standard Model with the LHC, Physics colloquium, Utrecht, The Netherlands, 29 October, 2008

Nobel Colloquium, Physics colloquium, Utrecht, The Netherlands, 12 December, 2008

Hegeman, J.G., Jet energy scale calibration at DØ, XIII International Conf. on Calorimetry in High Energy Physics (CALOR08), Pavia, Italy, 27 May, 2008

Hessey, N.P., Overview and Electronics Needs of ATLAS and CMS High Luminosity Upgrades, TWEPP-08 Topical Workshop on Electronics for Particle Physics, Naxos, Greece, 18 September, 2008

Detector Upgrades for sLHC, Physics at LHC 2008, Split, Croatia, 4 October, 2008

Experiments' view of LHC Upgrade, CARE-HHH Workshop 2008 - Scenarios for the LHC upgrade and FAIR, Chavannes-de-Bogis, Switzerland, 24 November, 2008

Igonkina, O.B., Calorimetry triggering in ATLAS, The International Conf. on Calorimetry in High Energy Physics, Pavia, Italy, 28 May, 2008

Jansen, E., Event visualization in ATLAS, NNV Najaarsvergadering, Lunteren, The Netherlands, 7 November, 2008

Jong, P.J. de, Top Physics at the LHC, Heavy Quarks and Leptons 2008, Melbourne, Australia, 5 June, 2008

Status of ATLAS and Prospects for Supersymmetry Searches in CMS and ATLAS, SUSY 2008, Seoul, South Korea, 16 June, 2008

Learning to walk: preparations for supersymmetry searches in ATLAS, Universität Göttingen, Göttingen, Germany, 12 December, 2008

Koffeman, E.N., GOSSIP tracker, LHeC workshop, Divonne, France, 9 February, 2008

LHC is rond, Nikhef, Amsterdam, The Netherlands, 10 September, 2008

LHC is rond, RUG, Groningen, The Netherlands, 18 September, 2008

Natuurkunde studeren, Hogeschool INHolland, Alkmaar, The Netherlands, 8 December, 2008

Magrath, C., SCT Commissioning, Topical Workshop in Electronics for Particle Physicists, Naxos, Greece, 19 September, 2008

Resende, B., Alignment and Monitoring of ATLAS Muon Spectrometer, 2008 IEEE Nuclear Science Symposium, Dresden, Germany, 21 October, 2008

Svoisky, P., Tau Lepton Identification and Searches for Higgs with Taus at DØ, 10^{th} International Workshop on Tau Lepton Physics (Tau08), Novosibirsk, Russia, 25 September, 2008

Verkerke, W., Top quark pair cross-section measurement at ATLAS, Physics at the LHC, Split, Croatia, 2 October, 2008

Vreeswijk, M., A Studio Classroom Course on Electromagnetism, AMSTEL seminar - University of Amsterdam, Amsterdam, The Netherlands, 17 January, 2008

Vulpen, I.B. van, De LHC is rond, NEMO, Amsterdam, The Netherlands, 12 October, 2008

Preparing for (new) physics during the first LHC runs, Demokritos Institute of Physics, Athens, Greece, 18 June, 2008

LHCb/BABAR

Merk, M.H.M., Flavour Physics with LHCb, Theory Seminar University of Groningen, Groningen, The Netherlands, 31 March, 2008

The LHCb Physics Programme, CERN Theory Institute: Flavour as a window to New Physics at the LHC - Plenary talk, Geneva, Switzerland, 26 May, 2008

Serra, N.S., Beyond the 3SM generation at the LHC era, CERN, Geneva, Switzerland, 4 September, 2008

Terrier, H., Installation and Commissioning of a High-Efficiency and High-Resolution Straw Tube Tracker for the LHCb Experiment, 2008 Nuclear Science Symposium, Dresden, Germany, 20 October, 2008

Verlaat, B.A., CO2 cooling for the LHCb-Velo experiment at CERN, 8th IIF/IIR Gustav Lorentzen Conf. on Natural Working Fluids, Copenhagen, Denmark, 9 September, 2008

ALICE/STAR

Snellings, R.J.M., Collective motion in PbPb collisions at the LHC, Workshop on Hot & Dense Matter in the RHIC-LHC Era, Tata Institute of Fundamental Research, Mumbai, India, 14 February, 2008

Signatures of incomplete thermalization, Heavy Ion Forum, Geneva, Switzerland, 31 March, 2008

Anisotropic Flow, American Chemical Society, New Orleans, USA, 7 April, 2008

Experimental results of heavy-ion collisions, Strong and Electroweak Matter, University of Amsterdam, Amsterdam, The Netherlands, 26 August, 2008

Recent Results from heavy-ion collisions, Quark Confinement and the Hadron Spectrum, Mainz, Germany, 1 September, 2008

Parton Collectivity: from RHIC to the LHC, Strange Quark Matter, Beijing, China, 8 October, 2008

Anisotropic Flow: from RHIC to the LHC, The 2nd Asian Triangle Heavy Ion Conf., Tsukuba, Japan, 14 October, 2008

Anisotropic Flow: from RHIC to the LHC, RANP 2008, Rio de Janeiro, Brazil, 5 November, 2008

Kolk, N. van der, Flow analysis methods in ALICE, Event plane from LYZ, Confinement 8, Mainz, Germany, 4 September, 2008

ANTARES/KM3NeT

Bouwhuis, M., First results from the ANTARES neutrino telescope, Radboud University, Nijmegen, The Netherlands, 3 October, 2008

Lim, G.M.A., Searching for dark matter with the ANTARES neutrino telescope, TEVPA 2008 Conf., Beijing, China, 23 September, 2008

Presani, E., ANTARES completed: first selected results, NOW2008, Otranto, Italy, 7 September, 2008

Wolf, E. de, A new generation neutrino telescope, 10th Astroparticle Physics Symposium, Amsterdam, The Netherlands, March 5, 2008

From ANTARES to KM3NeT, Colloquium Uppsala universitet, Uppsala, Sweden, 10 June, 2008

A next generation neutrino telescope, TEVPA 2008 Conf., Beijing, China, 23 September, 2008

Wijnker, G.P.J.C., ANTARES: status and data, Non-thermal hadronic processes in galactic sources workshop, Heidelberg, Germany, 15 January, 2008

Virgo/LISA

Brand, J.F.J. van den, Search for gravitational waves, University of Amsterdam, Amsterdam, The Netherlands, 15 April, 2008

Search for gravitational waves, University of Groningen, Groningen, The Netherlands, 17 April, 2008

Einstein Telescope: Site identification, Gravitational Wave Advanced Detector Workshop (GWADW), Elba, Italy, 14 May, 2008

Einstein Telescope: search for gravity waves, COB Workshop Einstein Telescoop, Amsterdam, The Netherlands, 9 October, 2008

Einstein Telescope: WP1 - Site selection and infrastructure, ET-ILIAS Gravitational Wave Analysis joint meeting, Cascina, Italy, 25 November, 2008

Optical systems for future gravitational wave interferom-eters, ASPERA R&D meets industry event, Amsterdam, The Netherlands, 28 November, 2008

AUGER

Coppens, J.M.S., Observation of Radio Signals from Air Showers at the Pierre Auger Observatory, ARENA 2008 Conf., Rome, Italy, 25 June, 2008

Schoorlemmer, H., Radio detection of cosmic rays: Testing detec-tor simulation with galatic background, NNV Najaarsvergadering, Lunteren, The Netherlands, 7 November, 2008

Timmermans, C., The birth of Charged Particle Astrophysics, FYSICA 2008, Nijmegen, The Netherlands, 18 April, 2008

Recent Results from the Pierre Auger Observatory, Nikhef, Amsterdam, The Netherlands, 1 October, 2008

Het Pierre Auger Experiment, HiSPARC Docentendag, Nikhef, Amsterdam, The Netherlands, 27 October, 2008

Theory

Filthaut, F., Beyond the Standard Model Higgs Searches, THEP Colloquium, Radboud University Nijmegen, Nijmegen, The Netherlands, 19 June, 2008

Gmeiner, F., The SYZ-formulation of mirror symmetry, Freie Universität Berlin, Berlin, Germany, 11 February, 2008

DBI inflation in a class of throat geometries, Universidad de Santiago de Compostela, Santiago de Compostela, Spain, 6 March, 2008

Deformed throats and DBI inflation, XX Workshop Beyond the Standard Model, Bad Honnef, Germany, 10 March, 2008

Correlations in the Landscape, Workshop on String Phenomenology and Dynamical Vacuum Selection, Liverpool, United Kingdom, 27 March, 2008

Millions of Standard Models on Z6'?, CERN TH Institute on String Phenomenology, Geneva, Switzerland, 7 August, 2008

Millions of Standard Models on Z6'?, Ludwig-Maximilian Universität München, Munich, Germany, 25 September, 2008

Particle Physics and the String Landscape, DESY, Hamburg, Germany, 28 November, 2008

Statistical analysis of a subset of the string theory landscape, ICHEP 2008, Philadelphia, USA, 30 July, 2008

Holten, J.W. van, Theoretical Astroparticle Physics in the Netherlands, ASPERA Meeting, University of Oxford, Oxford, United Kingdom, 17 March, 2008

Relativistic Epicycles, Dutch Astrophysics Days, Leuven, Belgium, 26 March, 2008

Academic Lecture on Cosmology I, Nikhef, Amsterdam, The Netherlands, 15 May, 2008

Academic Lecture on Cosmology II, Nikhef, Amsterdam, The Netherlands, 22 May, 2008

Non-relativistic Conformal Field Theory, Universität Heidelberg , Heidelberg, Germany, 12 June, 2008

The gravitational field of a light-wave, Universität Heidelberg , Heidelberg, Germany, 13 June, 2008

HiSPARC, Da Vinci College, Leiden, The Netherlands, 30 September, 2008

Kosmologie, een geschiedenis van licht en donker, Astron. Genootschap Metius, Alkmaar, The Netherlands, 31 October, 2008

Non-relativistic Conformal Field Theory, Universität Freiburg , Freiburg, Germany, 6 November, 2008

Kessel, M. van, The Path Integral Approach to Spontaneous Symmetry Breaking, THEP Colloquium, Nijmegen, The Netherlands, 12 June, 2008

The Path Integral Approach to Spontaneous Symmetry Breaking, THEP Colloquium, Nijmegen, The Netherlands, 18 September, 2008

Kleiss, R.H.P., Relativiteitstheorie, Canisiuscollege, Nijmegen, The Netherlands, 11 January, 2008

Antimaterie, Vereniging Vesta, Oostzaan, The Netherlands, 21 February, 2008

Tijd en Ruimte van Elementaire Deeltjes, Studium Generale University of Twente, Enschede, The Netherlands, 12 February, 2008

Tijd en Ruimte, Montessori College, Nijmegen, The Netherlands, 7 March, 2008

Tijd en Ruimte, Dendron College, Horst, The Netherlands, 8 April, 2008

Relativiteitstheorie, Overbetuwe College, Nijmegen, The Netherlands, 17 April, 2008

Relativiteitstheorie, Marie Curie Symposium, Radboud University Nijmegen, Nijmegen, The Netherlands, 24 May, 2008

Het Higgs boson, Science Cafe, Enschede, The Netherlands, 10 December, 2008

Laenen, E., Developments in QCD and generators, XVI International Workshop on Deep-Inelastic Scattering, London, United Kingdom, 9 April, 2008

Top quark in theory, Hadron Collider Physics Symposium 2008, Galena, IL, USA, 27 May, 2008

Resummation, State University of New York, Buffalo, NY, USA, 6 August, 2008

QCD, Lectures for the BND school, Texel, The Netherlands, 22 September, 2008

Het Standaard Model: theorie van bijna alles, Leidsche Flesch lunchlezing, Leiden, The Netherlands, 26 November, 2008

Wat gaan we zien met de LHC?, Utrechts Natuurkundig Gezelschap, Utrecht, The Netherlands, 9 December, 2008

The 2008 Nobel Prize in Physics, Colloquium Utrecht University, Utrecht, The Netherlands, 12 December, 2008

Top quark physics at the LHC, RWTH Aachen University, Aachen, Germany, 16 December, 2008

Malamos, Y., The O.P.P. method, THEP Colloquium, Nijmegen, The Netherlands, 24 January, 2008

The OPP method: reduction to scalar integrals, DRSTP PhD-Day, Utrecht, The Netherlands, 25 April, 2008

Mulders, P.J., Non-collinearity in high energy processes, Xth Workshop on High Energy Physics Phenomenology, Chennai, India, 5 January, 2008

Single spin asymmetries and gluonic pole matrix elements, DIS2008, London, United Kingdom, 8 April, 2008

T-odd phenomena in QCD, National Seminar Theoretical High Energy Physics, Amsterdam, The Netherlands, 11 April, 2008

Nonuniversality of Transverse Momentum Dependent Parton Distribution Functions, Workshop on GPD's and Transversity, Trento, Italy, 10 June, 2008

Universality of T-odd phenomena, Transversity workshop, Beijing, China, 1 July, 2008

T-odd phenomena in QCD, Lightcone 2008, Mulhouse, France, 8 July, 2008

Link dependence in TMD distribution and fragmentation functions, Workshop on Strangeness Polarization in semi-inclusive and exclusive Lambda production, Trento, Italy, 30 October, 2008

Niessen, I., Supersymmetry, THEP Colloquium, Nijmegen, The Netherlands, 6 March, 2008

Supersymmetric Phenomenology in the mSUGRA Parameter Space, THEP Colloquium, Nijmegen, The Netherlands, 21 August, 2008

Oord, G. van den, Camorra: the CAravaglios-MORetti Recursive Algorithm tool, THEP Colloquium, Radboud University Nijmegen, Nijmegen, The Netherlands, 3 November, 2008

Reiter, T., With Automation towards the Four b-Jet Rate at NLO in QCD, 5th Vienna Central European Seminar on Particle Physics and QFT, Vienna, Austria, 28 November, 2008

Schellekens, A.N., The RCFT Orientifold Landschap, Università Tor Vergata, Rome, Italy, 22 February, 2008

Free Fermion Orientifolds, Workshop String Phenomenology and Vacuum Selection, Liverpool, United Kingdom, 28 March, 2008

Non-supersymmetric Gepner Orientifolds, String Phenomenology 2008, Philadelphia, USA, 29 May, 2008

Topics in RCFT Orientifolds, CERN Phenomenology workshop, Geneva, Switzerland, 12 August, 2008

RCFT Orientifolds, Institut d'été, Ecole Normale Superieure, Paris, France, 3 September, 2008

Wagenaar, J.W., Dirac's Contraint Analysis and Quantization Procedure, THEP Colloquium, Nijmegen, The Netherlands, 19 March, 2008

Pion-Nucleon Scattering in Kadyshevsky Formalism, THEP Colloquium, Nijmegen, The Netherlands, 4 September, 2008

Pion-Nucleon Scattering in Kadyshevsky Formalism, Tokyo Institute of Technology, Tokyo, Japan, 9 November, 2008

White, C.D., Estimating multiple hard jet final states in Higgs production, DIS08, London, United Kingdom, 9 April, 2008

Single top production in the Wt mode with MC@NLO, DIS08, London, United Kingdom, 9 April, 2008

Estimating hard multijet final states in QCD, University of Liverpool - Department of Mathematics, Liverpool, United Kingdom, 30 April, 2008

Single top physics with MC@NLO, University of Liverpool - Department of Physics, Liverpool, United Kingdom, 1 May, 2008

A new framework for estimating multijet final states, HERA-LHC meeting, CERN, Geneva, Switzerland, 27 May, 2008

Single top production in the Wt mode with MC@NLO, HERA-LHC meeting, CERN, Geneva, Switzerland, 27 May, 2008

Small x resummation: the Thorne-White approach, HERA-LHC meeting, CERN, Geneva, Switzerland, May 27, 2008

The effect of small x resummations on global parton fits, Small x meeting, Crete, Greece, 1 July, 2008

Small x resummation - an overview, International Symposium on Multiparticle Dynamics, Hamburg, Germany, 1 September, 2008

Detector R&D

Chefdeville, M.A., Energy resolution and ion backflow in InGrid, Nikhef, Amsterdam, The Netherlands, 16 April, 2008

Graaf, H. van der, The application of opto-electronical alignment systems in gravitational experiments, Inst. Phys. Nucl. Orsay, Student Seminar, Orsay, France, 24 January, 2008

Gaseous Detectors: History, Status and Future, CERN Student Seminar, Geneva, Switzerland, 13 March, 2008

New Developments in Gaseous Tracking and Imaging Detectors, IWORID2008, Helsinki, Finland, 1 July, 2008

Novel Gas-based Detection Techniques, PSD8, University of Glasgow, Glasgow, Scotland, UK, 1 September, 2008

Some thoughts on charging-up effects, RD51 Workshop, Inst. Henri Poincare, Paris, France, 14 October, 2008

GridPix/Gossip for ATLAS SCT Upgrade, ILC, CLIC, IEEE-NSS Conf., MPGD Workshop, Dresden, Germany, 18 October, 2008

A New Generation of Gaseous Tracking and Imaging Detectors, Seminar: Brookhaven BNL, Upton, NY, USA, USA, 27 October, 2008

A New Generation of Gaseous Tracking and Imaging Detectors, Seminar: Massachusetts Institute of Technology, Cambridge, MA, USA, 28 October, 2008

A New Generation of Gaseous Tracking and Imaging Detectors, Seminar: SLAC National Accelerator Laboratory, Menlo Park, CA USA, 29 October, 2008

A New Generation of Gaseous Tracking and Imaging Detectors, Seminar: Lawrence Berkeley National Laboratory, Berkeley, CA, USA, 30 October, 2008

A New Generation of Gaseous Tracking and Imaging Detectors, Seminar: Fermi National Accelerator Laboratory, Batavia, IL, USA, 31 October, 2008

A New Generation of Gaseous Tracking and Imaging Detectors, Seminar: University College of London, London, United Kingdom, 28 November, 2008

A new generation of gaseous tracking and imaging detectors, University of Manchester, Manchester, United Kingdom, 7 December, 2008

New results of GridPix TPCs, Fourth Symposium on Large TPCs, Paris, France, 18 December, 2008

Grid Computing

Groep, D.L., The EUGridPMA, EUGridPMA Plenary Meeting, Amsterdam, The Netherlands, 15 January, 2008

gLExec and Operating System compatibility, EGEE JRA1 All Hands, Amsterdam, The Netherlands, 21 February, 2008

The OGF Security Area, OGF22, Boston, MA, USA, 25 February, 2008

Grid Computing and Site Infrastructures, Gastcollege SNE Master University of Amsterdam, Amsterdam, The Netherlands, 9 March, 2008

Grid: Data Delen op Wereldschaal, Gastlezing Ondernemers-vereniging Wormerveer Krommenie, Wormerveer, The Netherlands, 9 May, 2008

The VL-e Scaling and Validation Programme in 2009 and beyond, VL-e workshop, Amsterdam, The Netherlands, 29 May, 2008

The OGF Security Area, OGF24, Singapore, Singapore, 15 September, 2008

gLExec and the SCAS, EGEE'08, Istanbul, Turkey, 25 September, 2008

The EUGridPMA, 14th EUGridPMA meeting, Lisbon, Portugal, 7 October, 2008

Issues with the Certificate Revocation List, 14th EUGridPMA meeting, Lisbon, Portugal, 7 October, 2008

Testing GFD.125 compliance, 14th EUGridPMA meeting, Lisbon, Portugal, 7 October, 2008

Infrastructure in 2009 and beyond, VL-e Workshop, Amsterdam, The Netherlands, 28 October, 2008

The EUGridPMA, 6th TAGPMA Plenary Meeting, La Plata, Argentina, 4 November, 2008

The Classic Authentication Profile, 6th TAGPMA Plenary Meeting, La Plata, Argentina, 4 November, 2008

Credential Management and Portals: towards new concepts, 6th TAGPMA Plenary Meeting, La Plata, Argentina, 4 November, 2008

CVE-2008-0166: Lessons Learned, 6th TAGPMA Plenary Meeting, La Plata, Argentina, 4 November, 2008

Grid Authentication and Security, GridForum Tutorial, Utrecht, The Netherlands, 13 November, 2008

Grid Computing: enabling scientific collaboration in Europe and beyond, Belnet Networking Conf., Brussels, Belgium, 28 November, 2008

The Profiles of the International Grid Trust Federation, 2nd NetherNordic SLCS workshop, Stockholm, Sweden, 16 December, 2008

Keijser, J.J., Hardware upgrade and new VL-e software in PoC R3, Nikhef, Amsterdam, The Netherlands, 29 October, 2008

Koeroo, O.A., SAML2-XACML2 Profile document status report, Middleware Security Group Meeting at CNAF-INFN, Amsterdam, The Netherlands, 27 March, 2008

Technical status SCAS, EGEE'08, Amsterdam, The Netherlands, 25 September, 2008

Lee, H., The AMAAthena Ganga module, Nikhef, Amsterdam, The Netherlands, 3 July, 2008

Ganga and the ATLAS analysis tools, Nikhef, Amsterdam, The Netherlands, 12 September, 2008

Rijn, A.J. van, EGEE: providing a production grid infrastructure for collaborative science., KNMI, De Bilt, The Netherlands, 9 May, 2008

The BiG Grid project, Academic Medical Center, Amsterdam, The Netherlands, 10 June, 2008

Starink, R., Nikhef status, Quattor Workshop, INFN-CNAF, Bologna, Italy, 17 March, 2008

The LSC/Virgo joint meeting was organised by Nikhef in September 2008; the plenary sessions took place in the 19th century church 'De Duif'.

The new AII and the upgrade process, Quattor Workshop, INFN-CNAF, Bologna, Italy, 17 March, 2008

Communication between sites and experiments, CCRC'08 F2F Meeting, CERN, Geneva, Swiss, 1 April, 2008

Status Update Nikhef, Quattor Workshop, Nikhef, Amsterdam, The Netherlands, 27 October, 2008

An Introduction to Nagios, EGEE'08 Conf., Istanbul, Turkey, 24 September, 2008

Suerink, T.C.H., Quatview, Quattor Workshop, Nikhef, Amsterdam, The Netherlands, 28 October, 2008

Templon, J.A., ERT, Glue, and Scheduling : present and future, EGEE'08, Istanbul, Turkey, 25 September, 2008

Miscellaneous

Decowski, M.P., The Era of Massive Neutrinos, FYSICA 2008, Nijmegen, The Netherlands, 19 April, 2008

KamLAND Neutrino Oscillation Results and Solar Future, Neutrino 2008, Christchurch, New Zealand, 26 May, 2008

Going back to the Source: Neutrinos from Reactors, the Earth and the Sun, 2008 APS Division of Nuclear Physics Meeting, Oakland, CA, USA, 24 October, 2008

Eijk, B. van, Nobelprijs fysica 2008, University of Twente, Enschede, The Netherlands, 17 October, 2008

De zoektocht naar het Higgs-boson, Science Cafe Enschede, Enschede, The Netherlands, 10 December, 2008

Graaf, H. van der, Complexity Theory in Development: a Physicists View, Workshop 'Understanding Development Better', MDF/ViceVersa/ISS, Ede, The Netherlands, 27 August, 2008

Linde, F.L., Universe' smallest constituents meet World's largest scientific instrument, ASML, Veldhoven, The Netherlands, 14 February, 2008

Mastercourse "Nieuwe Natuurkunde, Elementaire Deeltjes & Kosmische Straling, Nikhef, Amsterdam, The Netherlands, 20 March, 2008

Het Standaard Model, Studium Generale, Delft, The Netherlands, 9 April, 2008

Antimaterie, DIES studentenvereniging scheikunde, Utrecht, The Netherlands, 26 May, 2008

Wakker worden kinderlezing "Waar komt de bliksem vandaan?", NEMO sciencemuseum, Amsterdam, The Netherlands, 26 June, 2008

Fokke, Sukke, Huub & het Standaard Model, FOM bureau, Utrecht, The Netherlands, 9 July, 2008

Universe' smallest constituents meet World's largest scientific instrument, PANalytical, Almelo, The Netherlands, 12 September, 2008

Kleinst Kleiner Klein - Groot Groter Grootst, Amsterdam, The Netherlands, 21 September, 2008

Large Hadron Collider: micro deeltjes – giga experimenten, Vliegende Hollanders (platform beta techniek), Amsterdam, The Netherlands, 11 November, 2008

Winterlezing "Hooggespannen verwachtingen", Zaandams lyceum, Zaandam, The Netherlands, 8 December, 2008

Metzger, W.J., Recent L3 results (and questions) on BEC at LEP, XXXVIII International Symposium on Multiparticle Dynamics, DESY, Hamburg, Germany, 17 September, 2008

Snippe, Q.H.C., A Constitutive Model for the Superplastic Material ALNOVI-1 Including Leak Risk Information, International Conf. on Metal Forming 2008, Krakow, Poland, 24 September, 2008

Verlaat, B.A., Controlling a 2-phase CO_2 loop using a 2-phase accumulator, The 22nd International Congress of Refrigeration, Beijing, China, 23 August, 2007

CO_2 Cooling for HEP experiments, TWEPP-2008, Topical Workshop on Electronics for Particle Physics, Naxos, Greece, 18 September, 2008

CO_2 cooling experiences in the LHCb Velo Thermal Control System, LHC Engineering Forum: Experiences from cooling systems for LHC detectors, CERN, Geneva, Switzerland, 30 October, 2008

3.4 Jamboree

By the end of each year Nikhef physicists and technicians gather in an Annual Meeting traditionally called Jamboree. In the meeting reports are given about the status of Nikhef's various programmes and projects, while young students and postdocs get the opportunity to present their work for a broader audience. It was unfortunate that, due to the incident in September, the LHC experiments could not present their first data but they showed convincingly that they are ready to receive first LHC collisions in 2009. Also the astroparticle physics experiments presented nice progress in data taking and analysis.

This Jamboree was marked by lively discussions because the organisers had scheduled 10 minute time slots for this at the end of each session and had asked the group leaders and session conveners to kick-start the discussion. The meeting was concluded by film director Jan van den Berg (Theater Adhoc), who told how he fell in love with neutrinos and showed us fragments of his film about the Higgs boson, and by a summary of Nikhef director Frank Linde.

Monday 15 December, 2008

09:25	Introduction (Jeff Templon)
09:50	Detector Alignment with Tracks (Wouter Hulsbergen)
10:10	Searching for New Physics in Rare B-Decays (Nicola Serra)
10:30	Sci-Fi in J/ΨΦ (Tristan du Pree)
10:50	Discussion (Frank Filthaut, Marcel Merk)
11:20	Theory in 2008 (Eric Laenen)
11:35	Exponential scattering amplitudes (Gerben Stavenga)
11:50	T-odd phenomena in QCD scattering processes (Piet Mulders)
12:05	Statistics in the Landscape (Florian Gmeiner)
12:20	Discussion (Michiel Botje, Eric Laenen)
13:45	Introduction to ATLAS (Stan Bentvelsen)
13:50	Status of SCT and the first signals (Els Koffeman)
14:05	Real data from the muon spectrometer (Bernardo Resende)
14:20	Strategies toward first data analysis (Pamela Ferrari)
14:35	Search for Susy (Alex Koutsman)
14:50	Highlights of physics results of DØ (Peter Svoisky)
15:05	Top Physics Results of DØ (Jeroen Hegeman)
15:20	Discussion (Piet Mulders, Stan Bentvelsen)
15:50	CO_2 cooling for HEP detectors (Bart Verlaat)
16:10	Superplastic deformation - Leak or no leak? (Corijn Snippe)
16:30	VLSI Circuit Design (Ruud Kluit)
16:50	Discussion (Jo Van Den Brand, Frank Linde, Eric Heine, Rob Klöpping)

Tuesday 16 December, 2008

09:15	ANTARES: first results (Maarten de Jong)
09:40	KM3NeT: status and perspectives (Els de Wolf)
09:55	Status of the Pierre Auger Observatory (Charles Timmermans)
10:05	Observation of Radio Signals from Air Showers at the Pierre Auger Observatory (Jose Coppens)
10:25	Status of the gravitational wave programme (Jo van den Brand)
10:40	Calculating gravitational waves from a black hole system: method and results (Gideon Koekoek)
10:55	Discussion (Peter Kluit, Maarten de Jong, Jo van den Brand, Charles Timmermans)
11:25	ALICE Introduction (Raimond Snellings)
11:40	SSD status and commissioning with cosmics (Marco van Leeuwen)
12:05	ALICE alignment, calibration & monitoring (Mikolaj Krzewicki)
12:20	DØ and D^* measurement potential in ALICE (Christian Ivan)
12:35	Discussion (Jos Steijger, Raimond Snellings)
14:00	Grid Computing: Introduction (Jeff Templon)
14:05	BiG Grid Update (Jan Just Keijser)
14:25	Grid Operations (Ronald Starink)
14:45	Overview of Detector R&D at Nikhef (Jan Timmermans)
14:50	Medipix, RelaxD and beyond… (Jan Visschers)
15:10	Results of and plans for new tracking detectors (Harry van der Graaf)
15:30	Discussion (Marcel Vreeswijk, Jan Timmermans, Jeff Templon)
16:00	A subatomic love story (aka a high energy love story) (Jan van den Berg)
16:30	Jamboree Summary (Frank Linde)

3.5 Awards & Grants

NWO Vernieuwingsimpuls
In 2008 three Vidi grants were awarded to Nikhef related research. To Ruth Britto, for her proposal on *"Symmetry in quantum physics"*, to Aart Heijboer for his research on neutrinos, *"Messengers from the Universe"*, and to André Mischke, for his work on the quark-gluon plasma. Each year the Netherlands Organisation for Scientific Research (NWO) awards Vidi grants to promising researchers. The Vidi grants (up to 600 k€) enable young excellent postdocs —who have developed innovative ideas— to start a research group.

Paul de Jong was one of the 30 outstanding scientists who won a Vici grant in December 2008 with his proposal *"Between Bottom and Top: supersymmetry searches with flavor"*. He will receive 1.25 M€, over a period of five years to set up his own research group.

Dutch grants
SenterNovem, an agency of the Dutch Ministry of Economic Affairs, awarded two proposals:
- KM3NeT, Maarten de Jong, 8.8 M€;
- Hidralon, Jan Visschers, 2 M€.

European Grants
This year a new European competition started: the European Research Council (ERC) grants. André Mischke was successful with his ERC proposal for research on the quark gluon plasma at the ALICE detector.

André Mischke (right) and other Award winners at the ceremony for the Nuclear Physics A — Young Scientist Award.

Several proposals for funding by the European Union received grants:
- SLHC, Preparatory Phase study, Nigel Hessey, 64 k€;
- KM3NeT, Preparatory Phase study, Els de Wolf, 448 k€;
- EGEE-III, Enabling grid for E-sciencE, Jeff Templon, 677 k€;
- TOP@LHC, Marie Curie Fellowship, Chris White, 112 k€;
- PAD, detector R&D network, Els Koffeman, 424 k€;
- ET, Einstein Telescope Preparatory Phase study, Jo van den Brand, 229 k€.

Young Scientists
André Mischke also received the Nuclear Physics A — Young Scientist Award for his oral presentations at the 'Quark Matter Conference', which is the most relevant conference in the field. The award ceremony was held in India early 2008.

The Nikhef Theory Group was quite successful this year. PhD student Gerben Stavenga was awarded twice: he won the prestigious Best PhD Student Award at the 'Homage to Sidney Coleman' conference in Erice, September 2008, as well as the Sidney Coleman Prize.

In October 2008 PhD student Reiner de Adelhart Toorop received the biannual Pieter Zeeman Award for his master thesis on work he did in the theory group. He received the award in Zierikzee, where the Pieter Zeeman Foundation is located.

4 Nikhef & Society

4.1 Communication

The general focus of the 2008 communication activities was on the LHC start–up. The live LHC start–up press conference held on 10 September was more successful than any of us had expected. Physics on prime time news is quite rare, almost as rare as TV crews filming at Nikhef. Thanks to all participating staff (and the LHC technicians) the media were very satisfied. A second highlight for the Communications Department was the launch of the new web site late October. The novel design as well as the incorporation of new ‘users’ pages were positively welcomed, though there is still some fine–tuning left to do.

Rather than the Communications Department, the Nikhef staff is the most important portal for the general public. Therefore, in 2008 a training on how to deal with the media was offered to them. We are still working on a reader with several frequently asked questions and possible answers, as well as some successful metaphors that can be used to clarify the underlying physics. Although these outreach activities cost the Nikhef staff quite some time, in return they will positively influence Nikhef’s visibility, funding and human capital influx.

Nikhef & the media

In 2008 a total of ten press releases were published. The release about the LHC start–up was the most frequently quoted, because we organised a live press conference as well, in close collaboration with CERN. Around thirty reporters subscribed, and two even visited CERN. On the day, many more reporters phoned to get hold of more information and to talk to an expert for live commentary. The coverage proved to be enormous. It was encouraging to see physics on prime time TV news that night as well as on a lot of radio shows and in nearly every newspaper. The media clearly enjoyed the young enthusiastic scientists explaining their passion! The workshop ‘how to deal with the media’ indeed proved to be very useful. In the Nikhef entrance hall recent articles on Nikhef related topics are available for reading.

Dutch TV news would like to understand what’s happening…

Doing physics while the whole world is looking over your shoulder…

Throughout the year, we continuously deal with special media requests on science and technology. For instance, one reporter went to the inauguration of the Pierre Auger Observatory. ATLAS project leader Stan Bentvelsen is blogging for the Volkskrant on his LHC work. Theatre Adhoc is working on a Higgs documentary. They have been filming at CERN and are almost ready to start editing the material.

Nikhef & the public

The Open Day is part of the National Science Month, and was organised together with the other institutes at the Science Park. It is the best way for family, friends and neighbours to get to know Nikhef and the work we do. Around 1350 visitors were welcomed on 18 October, 2008. All activities were concentrated at and also near Nikhef this year, which created a cosy atmosphere.

All visitors start in the Nikhef main hall, which was filled with a lot of exhibition material for the LHC start events, and is presently transformed slowly into an exhibition of (astro)particle physics. We renewed the CERN view in the ceiling with an LHC illustration, including future events, to be displayed on big screens. A large print of the ATLAS detector was placed inside as well as outside the building. This was proven very useful for the press conference (as background on television). We will continue reorganising and updating the various exhibitions in the Nikhef hall.

Nikhef staff gave lectures at several public science events, as well as at schools or science associations in the country, at special re-

Ivo van Vulpen lecturing at 'Kennis op zondag' (Science on Sunday). Even Nobel laureate Gerard 't Hooft is fascinated…

Stan Bentvelsen at the 'Klokhuis Vragendag' (Klokhuis Question Day).

quest. This is highly appreciated by the public, a good experience for the scientists and is an important tool for Nikhef's visibility. The events 'Kennis op Zondag' (Science on Sunday) as well as the 'Klokhuis vragendag' (Klokhuis Question Day) are examples of such events where Nikhef staff voluntarily participate.

Dutch visits abroad

On 10 September a few reporters visited CERN to attend the press conference; many others visited Nikhef simultaneously. During the LHC inauguration on 21 October a delegation of the Dutch government, funding agencies and Nikhef represented the Netherlands. At the very successful CERN open day in April, Nikhef contributed by supplying guides. At that day, Dutch visitors were welcomed at CERN, both on the first day for family and friends and on the second day for the general public. Queues were formed early in the morning as many wanted to see a glimpse of the immense LHC project. In hindsight that was the first clue that the LHC start–up is really popular with the general public and media.

In November the Pierre Auger Observatory was inaugurated. A Dutch delegation of Nikhef, FOM and NWO representatives as well as a reporter travelled to Argentina to see the site for themselves and to enjoy an interesting start–up programme.

Communication tools

We continued implementing the novel Nikhef 'look' at the institute. Stationary, web site and brochures are being published in the same Nikhef style. The astroparticle physics flyer was the first example, a pilot, and is now available in Dutch and English. A new general flyer about Nikhef was released at the open day (in Dutch). This transformation is an ongoing process. We do hope that the entire Nikhef staff will start using the new style as well!

Last but not least, by the end of October the new web site was launched. The English translations are still under construction as well as several internal pages. Like Nikhef itself the web site is a dynamical entity to which new pages, both in Dutch and English, are continuously added. The part for users will serve internal communication purposes. There is also some space for personal requests ('prikbord'). A web committee was installed to coordinate the input by the Nikhef staff, and meets every two months.

Collaboration on Communication

Nikhef collaborates in several (inter)national communication networks, to share ideas and coordinate science communication. The LHC start–up was the main topic in all particle physics networks in 2008.

In 2007 the CERN Council established a communications network, the European Particle Physics Communication Network (EPPCN). In 2008 this network collaborated on the LHC start–up and the distribution and the production of translations of CERN brochures and discussed about the CERN communication strategy.

The InterAction Collaboration, communicators from laboratories worldwide, who's goal is to improve strategic particle physics communication, held a meeting at Nikhef in April, 2008.
The main agenda items were the start–up of the LHC, (inter) national communication and the coordination of press releases. Further subjects included communication on the International Linear Collider, and on photon, nuclear and neutrino physics.

The ATLAS outreach committee published the ATLAS book in 2008, a very glossy edition on the daily work of the ATLAS collaboration with lots of photos. Nikhef contributed to the book as well. The ATLAS collaboration further made a major effort to contribute to the CERN open day in April, just before the LHC tunnel was closed for final tests of the accelerator ring. Thousands of people were guided along the ATLAS instrumentation on that day. At the press conference on 10 September, live discussion time was provided for in the LHC Control Room.

ASPERA presented the European Astroparticle physics roadmap on 29 September in Brussels to the European physicists and the world. The second day of the workshop marked the start of a world-wide coordination in astroparticle physics research. The proposal to the European Committee to continue ASPERA for another three years was approved by the referees and negotiations for the new contract have been started.

4.2 Education

Nikhef considers it as its task to encourage the interaction between high school students and science. The institute facilitates and participates in several activities for students. HiSPARC, the project for high school students on cosmic rays, developed some new tools and activities to keep the students motivated. In 2008 the Nikhef module on particle physics was finalised and is now available online.

High schools @ Nikhef

Each year almost 200 students visit Nikhef, either with their entire class during a school visit, or individually for the master class. The European master class on Particle Physics was held on 13 and 14 March, and 50 students attended this event. Both days ended with a live video conference with other institutes in Europe and CERN. A few young scientists 'to-be' even came back for a second time.

Quite a number of requests to lecture outside Nikhef were posted, especially around March and September. In addition, ten high–school students performed their research project at Nikhef under the guidance of Nikhef staff members. This year this included a 'profielwerkstuk' on a non–physics subject: women in science.

Techniek Toernooi 2008

On 5 June, 2008 the fourth edition of the 'Techniek Toernooi' took place in the 'Nederlands Openluchtmuseum' in Arnhem, Netherlands. About thousand children in the age group between four and twelve year, participated in this tournament and showed their technical and scientific skills. The organisation devised eight different challenges for them, two for each age category. During the year, under supervision of their science teacher the children invented solutions for these challenges and tried them out at school. The best team represented the school at the tournament in Arnhem, where a jury of professors from Dutch universities selected the national winners. With nine members of the jury Nikhef was well represented in this yearly science event where the world of the universities meets the world of the primary schools.

The youngest children made a bridge of only a few sheets of paper spanning a gap of 35 cm. The best bridge could bear a weight of 37 kg before it collapsed. This was more than the pilot bridges build by university students could bear. For the older children the water rocket was popular as always. Within an hour, more than 120 rockets were launched of which the winner, using its parachute, landed only after 90 s. The photographs show children and jury engaged in two other challenges: a long spinning top.

'Techniek Ternooi': Nikhef jury member is closely watching…

The high quality of the work of the children impressed the jury. They awarded prizes not only for the technical performance but also for creative and original solutions. The winning teams were awarded with technical kits for children, with a special sculpture for the teachers and with a money cheque to be spent on material for technical lessons.

The 'Techniek Toernooi' is an initiative of the Dutch Physical Society to promote science education for young children. In order to allow more children to participate, next year regional satellite tournaments will be organized prior to the national tournament in Arnhem.

HiSPARC

Since 2002, a growing number of high school students and their teachers are participating in the HiSPARC (High School Project on Astrophysics Research with Cosmics) project. Students build their own cosmic-ray detector based on scintillator technology, install the detector on the roof of their school, link the data-acquisition system to the internet and submit data around the clock. The data are collected at two locations in large databases, which are freely accessible through the internet. This way, students can have access not only to the data of their own detector, but also analyse coincidences with measurements at other schools. The aim is to identify large area cosmic ray showers. These are a direct indication for the interaction of extremely high energy cosmic rays penetrating the earth's atmosphere with atomic nuclei in the upper air layers.

Presently, about eighty HiSPARC stations are operational (three abroad) and provide input for educational and scientific studies. Schools are organised in clusters around scientific institutes and universities. Furthermore, via the international collaboration EuroCosmics several stations in other countries are linked (Denmark, the UK, and even from Sudan and Vietnam data are submitted). The EuroCosmics collaboration joins the efforts of around fifteen countries.

The following Dutch regions are involved (in alphabetical order):
- Amsterdam (with Nikhef, the Free University and the University of Amsterdam as knowledge bases);
- Eindhoven (Technical University Eindhoven);
- Groningen (KVI and University of Groningen);
- Leiden (University of Leiden);
- Nijmegen (the Radboud University);
- Twente (Technical University Twente);
- Utrecht (University of Utrecht).

In 2008, a dense network of six stations was installed in the Watergraafsmeer, Amsterdam, in order to be able to take a closer look at details of the data by a PhD student. Once a year, a student symposium is organised at which the students present their results in the form of oral presentations and/or posters. In addition, each year, the plenary session offers a key-note speaker (previous years for example Nobel prize winner prof. Martinus Veltman and Royal Netherlands Academy of Arts and Sciences chairman prof. Robbert Dijkgraaf). Over a thousand students have been involved since 2002.

As of September 2008, a FOM financed program has started providing high school (physics) teachers the opportunity to participate in modern research during one day per week. At present six teachers are involved in studying various aspects of cosmic rays: data analysis, lab. tests, hardware calibration etc. These so-called LIOs (Leraren In Onderzoek) have been given one day off from their regular teaching duties. One teacher is collaborating with scientists at the KVI in Groningen, two are stationed at the Radboud University in Nijmegen, while three are working at Nikhef in Amsterdam. Regular meetings are held to discuss progress, exchange information and to focus on physics issues.

Master of Science in Particle and Astroparticle Physics

The Master's programme in Particle and Astroparticle Physics is unique in the Netherlands. The programme is firmly embedded in the research of Nikhef and is jointly offered by all partners of Nikhef. Officially, the master programme is registered as a MSc program at the University of Amsterdam (UvA) and the VU University Amsterdam. Students from Utrecht University and Twente University take part in most of the courses, although they graduate in a different programme at their home universities. For students from the Radboud University, the geographical distance between Nijmegen and Amsterdam makes it inefficient to take part in the full programme of courses, although they are allowed to do so.

Currently, almost thirty students are engaged in the programme, among them four students that follow a three-year 'double master' programme, in which they combine the programme with that of another master, i.e. Theoretical Physics of the UvA, Astronomy and Astrophysics of the UvA and Astronomy and Instrumentation of Delft University.

Internationalisation of the programme is strived for and indeed slowly increasing. One of the students acquired in 2008 a prestigious Huygens Grant and is currently at New York University for a research project. Another one acquired an Erasmus Grant and is at Stockholm University to follow courses. Of the first year students two are from Greece, while two Dutch students are preparing for a period abroad, at New York University and McGill University in Montreal, respectively.

Since the start of the programme in 2002, the percentage of female students that enrolled was around 30%. Also this year 33% of the first year students are female. This percentage is unusually high for the Netherlands. On average this is 15-20% in physics.

Although the full programme of the master Particle and Astroparticle Physics is aimed at a career in physics research, it also offers the option to focus the second year of the programme on other science professions. Of the students that graduated this year, two accepted a PhD position at Nikhef and three outside the Netherlands (France, Zurich, New York). One student started a career as physics teacher at a high school in the Netherlands and another student has chosen to focus the second year of his programme on science policy and management.

Research school subatomic physics (OSAF)

The research school for subatomic physics organises each year academic training courses (Topical Lectures) and, in collaboration with Belgian and German research groups, a summer school (BND Summer school) for PhD students. Throughout the year, the members of the research school's board organise one to two interviews ('C3 gesprekken') with each PhD student and his/her promotor and thesis advisor to monitor and evaluate the progress of his/her research project and his/her participation in the Topical Lectures and the BND summer school.

The 2008 BND summer school was organised by Prof.dr. René Kamermans from the Utrecht University and dr. Michiel Botje from Nikhef. It was held from 15 to 26 September in holiday centre 'de Krim' on the island of Texel and hosted 42 participants (13 Belgian, 24 Dutch and 5 German). This year's edition was devoted to strong interaction physics with lecture series on Quantum Field Theory (10 h), Quantum Chromo Dynamics (8 h), lattice QCD (4 h), Physics beyond the Standard Model (4 h), heavy-ion physics (4 h) and astroparticle physics (4 h). In addition, there were lectures on event generators (4 h), analysis methods (6 h), calorimetry (4 h) and proton–proton physics at the LHC (4 h). Six hours were devoted to eleven short presentations by the students on their thesis work. The organisation of these sessions in the style of a mini–conference was left entirely in the hands of the students themselves. The school was very well appreciated by the participants, also due to the nice weather, a social programme including a golf course and an entertaining evening lecture held by Prof.dr. Herman Ridderinkhof of the Royal Netherlands Institute for Sea Research (NIOZ).

Teaching the Master of Science programme at Nikhef.

As usual, also in 2008 three Topical Lectures were organised: in March the topic was Feynman calculus. The subject of the June lectures was astroparticle physics and in December accelerator physics was on the menu. The typical attendance of the Topical Lectures was 20–25 PhD students during the morning sessions (lectures) and 15–20 PhD students during the afternoon sessions (exercises).

Regarding administrative matters: 77 PhD students were enrolled in December 2008 and 14 PhD students graduated in 2008. Prof.dr. Nicolo de Groot from the Radboud University Nijmegen is secretary and the Radboud University is 'penvoerder' of the school.

4.3 Knowledge transfer

Press release, 8 December, 2008

Nikhef, TU Delft and industry receive European grant for project

Nikhef has, together with four other partners, obtained a subsidy from SenterNovem (a funding department of the Dutch Ministry of Economic Affairs) for the European research programme Hidralon. Over the next 15 months, two million Euro in subsidies will be assigned to the Dutch partners. The Hidralon project aims to improve high resolution X-ray imagers, based on CMOS chip technology, for a wide range of applications, including medical imaging. An advantage is that less radiation is necessary for imaging and that there will be less noise interfering with the recording.

Hidralon is an Eureka-Catrene project for which the Eureka label has already been granted by the European Union in Brussels. There are 16 partners from France, Germany, Hungary, Israel and the Netherlands. The total project costs within the Netherlands are 15.3 million Euro over three years. The first phase of 15 months will cost 5.4 million Euro. In addition to the now awarded subsidy, the partners themselves will furnish the remaining 3.4 million Euro.

The aim of Hidralon is to improve existing CMOS imagers to a level above the capabilities of the older CCD technology. This will have applications in the entertainment and broadcasting sectors, the automotive industry and in medical X-ray imaging. The Dutch partners are active in these sectors. They are Grass Valley Nederland BV from Breda, Philips Healthcare Nederland BV from Best, two faculties of the Technical University Delft and the FOM institute Nikhef Amsterdam. KlaasJan Damstra of Grass Valley will be the project leader of Hidralon.

Together with CERN in Geneva, Nikhef has been active for years in the development of hybrid pixel detectors. These detectors consist of a CMOS chip in which every pixel contains a signal processor with hundreds of transistors. A separate sensor chip is mounted on top and the combination forms a hybrid pixel detector.

“Our detectors cannot only see elementary particles, but also individual X-ray photons. This makes it possible to We can look straight through a pocket watch and see the gears move. Chips such as these could also very be useful in astronomy; thanks to the absence of thermal noise you should be able to observe extremely faint objects,” says Jan Visschers of Nikhef. “It is very rewarding to see that technology developed for subatomic physics is also relevant for society and that this fact now gets its recognition via this grant.

Nikhef, together with Philips Healthcare, will focus on hybrid pixel detectors for bio-medical applications. Here CMOS imagers are combined with a high-Z sensor layer, in which X-ray photons are directly converted into electrical signals. Nikhef will focus on the study of edge effects that become important when an X-ray imager is built from several smaller modules. The read-out via a Gigabit Ethernet serial connection will also be a part of the Nikhef research effort within Hidralon.

4.4 Memberships*

ASPERA Governing Board
F. Linde

ASPERA – Joint secretariat
R. van der Meer

Astroparticle Physics European Coordination (ApPEC)
P. Kooijman (peer review committee),
F. Linde (steering committee)

Board of Computer Algebra Nederland
J. Vermaseren

BiG Grid Executive Team
D. Groep, J. Templon

CERN Contact Commissie
S. Bentvelsen, S. de Jong (secretary), R. Kamermans, R. Kleiss
F. Linde, M. Merk, Th. Peitzmann

CERN Large Hadron Collider Committee
S. de Jong

CERN SPS Committee
P. Kooijman

Committee for Astroparticle Physics in the Netherlands (CAN)
J. van den Brand, M. de Jong, S. de Jong, F. Linde, R. van der Meer (secretary), P. Mulders, E. de Wolf

Computing Resources Scrutiny Group (LCG, C-RRB advisory group)
D. Groep

DESY, Hamburg – Program Review Committee
J. Timmermans

Deutsche Physikalische Gesellschaft Hadronen Physik – Scientific Advisory Committee
J. Koch

Dutch Research School Theoretical Physics – Educational Board
P. Mulders (chair), E. Laenen

EGEE Technical Management Board
J. Templon

* *as of 31 December 2008.*

European Committee for Future Accelerators (ECFA)
S. de Jong, M. Merk, F. Linde (restricted ECFA), Th. Peitzmann

European Particle Physics Communication Network, EPPCN
G. Bobbink , G. Zegers

European Particle Physics Outreach Group
G. Zegers

European Physical Society Physics Education Board
E. de Wolf

European Physical Society High Energy Physics Board
B. van Eijk

European Physics Journal – Scientific Advisory Committee
P. Mulders

European Policy Management Authority for Grid Authentication in e-Science (EUGridPMA)
D. Groep (chair)

European Science Foundation – Physical and Engineering Sciences Unit
R. Kamermans

FOM Board
J. Engelen, S. de Jong

FOM – Adviescommissie FOM/v programma
E. de Wolf (chair)

FOM network Theoretical High Energy Physics
E. Laenen (chair)

Gesellschaft für Schwerionenforschung, Darmstadt – Program Advisory Committee
Th. Peitzmann

GridKa Overview Board, Karlsruhe
K. Bos

Helmholtz-Alliance for Physics at the Terascale – International Advisory Board
K. Bos

International Grid Trust Federation
D. Groep (chair)

InterActions
A. van den Bergen
G. Zegers

KVI, Groningen – Scientific Advisory Committee (WAC)
P. Mulders

Laboratori Nazionali del Gran Sasso, L'Aquila – Scientific Committee
F. Linde

Laboratori Nazionali di Frascati, Frascati – Scientific Committee
F. Linde

Laboratoire de l'Accélérateur Linéaire, Orsay – Scientific committee
F. Linde

Nederlands Tijdschrift voor Natuurkunde – Redactie
S. de Jong

Nederlandse Natuurkundige Vereniging (NNV) – Board
P. Mulders (secretary), E. de Wolf

NNV – Sectie H
P. Kluit, E. Koffeman

NNV – Sectie Onderwijs en Communicatie
S. de Jong (vice chair)

Nuclear Physics European Collaboration Committee (NuPECC)
Th. Peitzmann

Onderzoekschool Subatomaire Fysica – Onderwijscommissie
Th. Bauer, S. Bentvelsen, J. van den Brand, T. van Egdom (personnel), B. van Eijk, N. de Groot (chair), S. de Jong, J. Koch, E. Koffeman, E. Laenen, F. Linde, M. Merk, P. Mulders, Th. Peitzmann, E. Schram-Post (secretary)

Open Grid Forum, Standards Function Security Area
D. Groep (director)

Platform Beta en Techniek – ambassadeur
F. Linde, E. de Wolf

Programme Committee of the First workshop on Security, Trust and Privacy in Grid Environments (STPC 2008)/The 8th IEEE International Symposium on Cluster Computing and the Grid (CCGRID2008) May 2008
D. Groep

Scientific Advisory Committee van de International Workshop on Radiation Imaging Detectors
J. Visschers

Stichting Conferenties en Zomerscholen over de Kernfysica (StCZK)
S. de Jong, P. Mulders

Stichting Hoge-Energie Fysica
J. van den Brand, R. Kleiss, F. Linde (chair), Th. Peitzmann, A. van Rijn (treasurer)

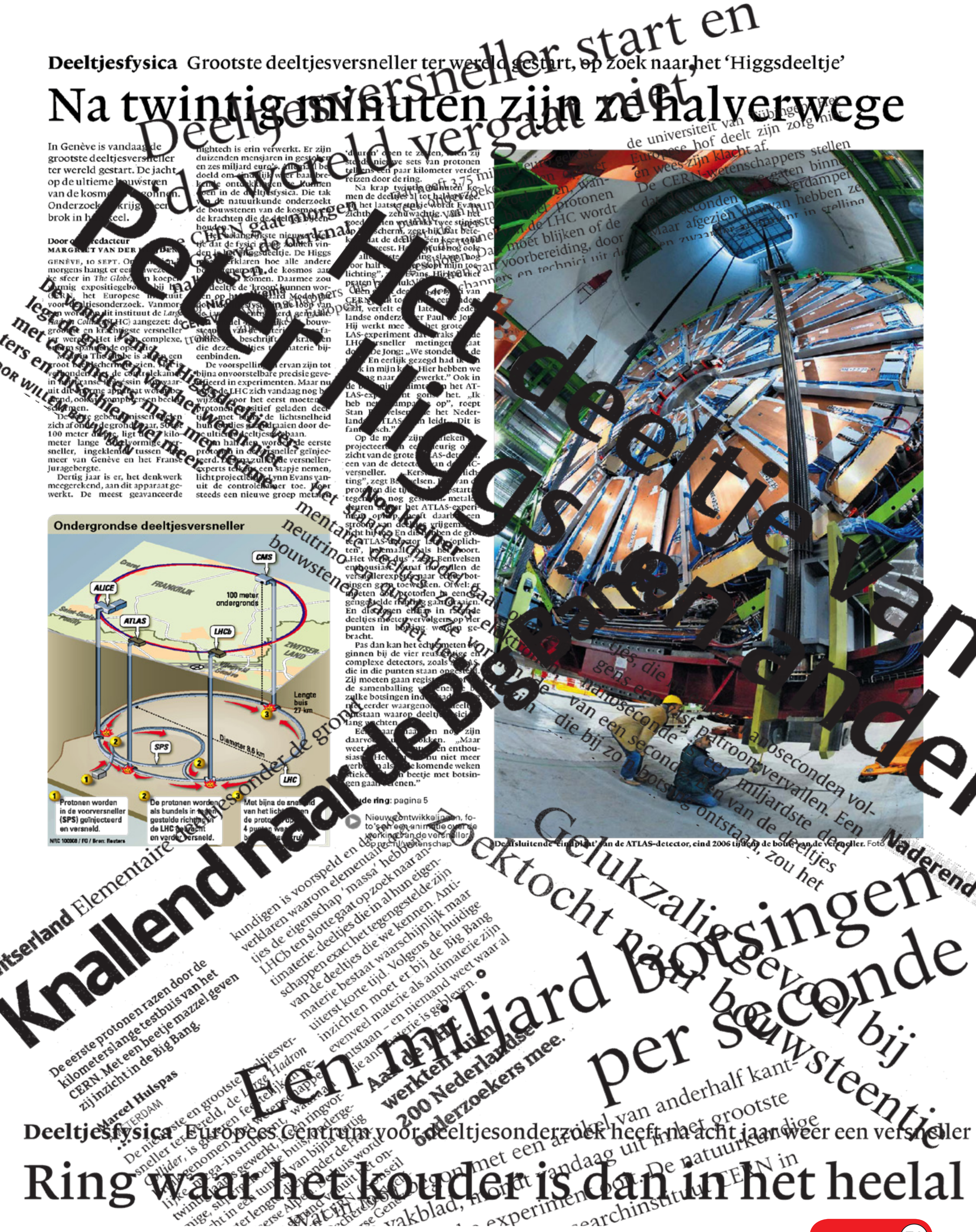
Stichting Industriële Toepassing van Supergeleiding
B. van Eijk

Techniek Toernooi 2008
E. de Wolf

TJNAF – Program Advisory Committee
P. Mulders

Vereniging Gridforum Nederland
A. van Rijn (treasurer)

Worldwide LHC Computing Grid Management Board
J. Templon

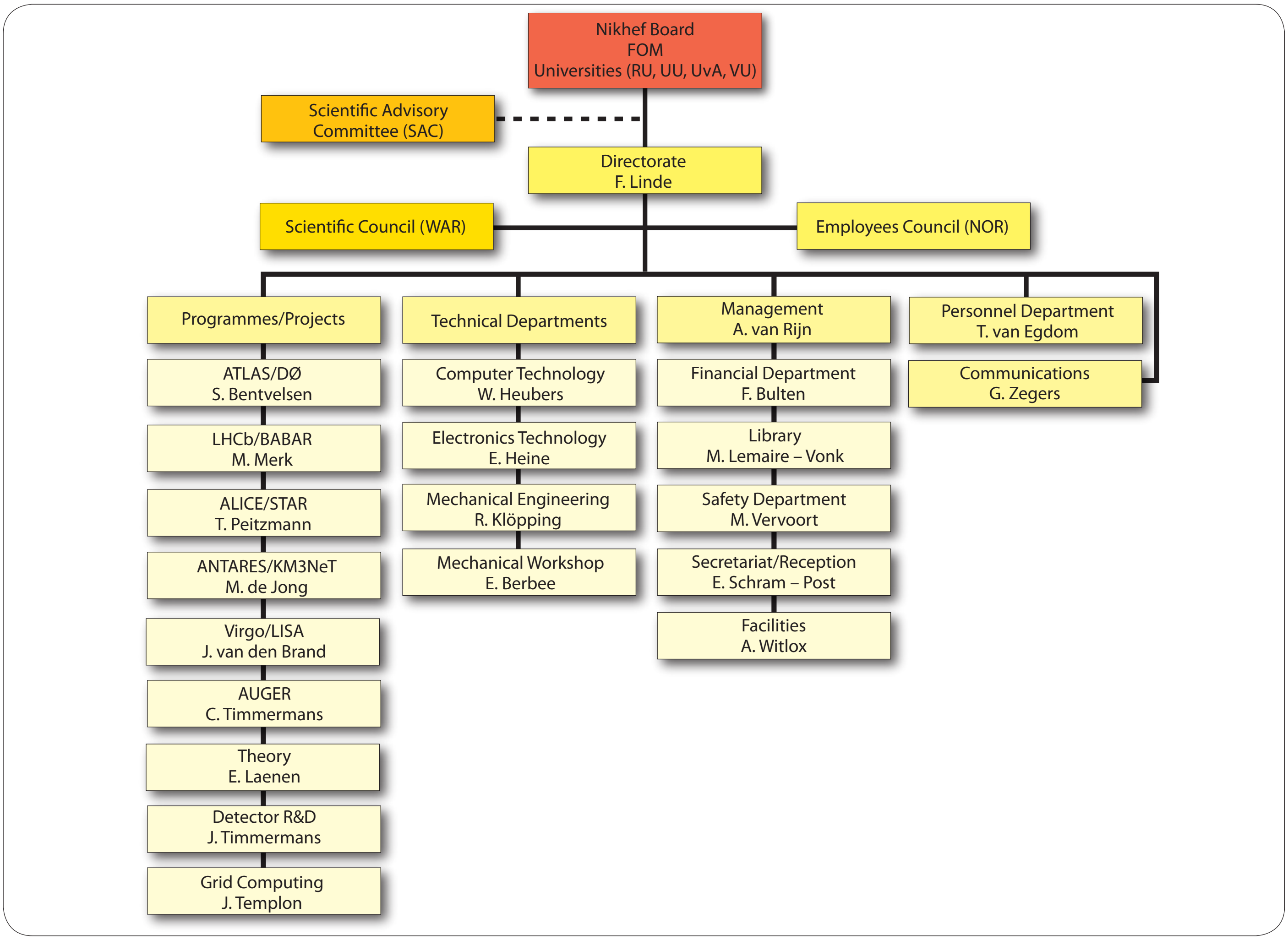


Deeltjesfysica Grootste deeltjesversneller ter wereld gestart, op zoek naar het 'Higgsdeeltje'
Na twintig minuten zijn ze halverwege
Deeltjesversneller start en
Deeltjeswereld vergaat niet
Peter Higgs
Het deeltje van
Knallend naar de Big
Ondergrondse deeltjesversneller
Een miljard botsingen
per seconde
Gelukzalig gevoel bij
Deeltjesfysica Europees Centrum voor deeltjesonderzoek heeft na acht jaar weer een versneller
Ring waar het kouder is dan in het heelal

5

Resources

5.1 Organigram*



* *as of 31 December 2008.*

5.2 Organisation*

Nikhef Board
A. Bliek (Utrecht University)
K. Chang (FOM)
R. Griessen (FOM, VU University Amsterdam)
J. de Kleuver (secretary, FOM)
J. Kuijpers (Radboud University Nijmegen)
J. van Mill (chair, VU University Amsterdam)
K. van der Toorn (chair, University of Amsterdam)

Management Team
T. van Egdom
F. Linde
A. van Rijn

Scientific Advisory Committee (SAC)
S. Bethke (Max-Planck-Institut für Physik, Munich)
R. Cashmore (Brasenose College, Oxford)
C. De Clercq (Vrije Universiteit Brussel, Brussel)
T. Hebbeker (chair, RWTH Aachen, Aachen)
Y. Karyotakis (LAPP, Annecy le Vieux)
B. Webber (University of Cambridge, Cambridge)

Employees Council (NOR)
J. Amoraal (secretary)
Th. Bauer (vice chair)
H. Boer Rookhuizen (chair)
J. Dokter
M. Gosselink (vice secretary)
J. Kok
A. Korporaal
N. Rem
L. Wiggers

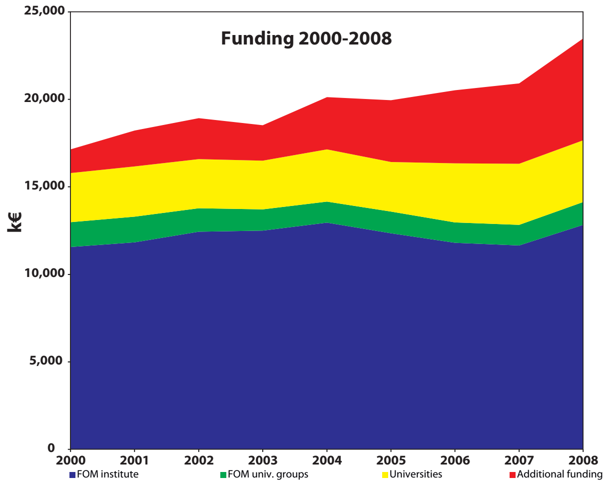
Scientific Council (WAR)
S. Bentvelsen
A. van den Berg (KVI, Groningen)
J. van den Brand
H. van der Graaf
N. de Groot
M. de Jong
P. de Jong
S. de Jong
E. Koffeman
E. Laenen
F. Linde
M. Merk (chair)
Th. Peitzmann
A. van Rijn (secretary)
J. Templon
R. Timmermans (KVI, Groningen)

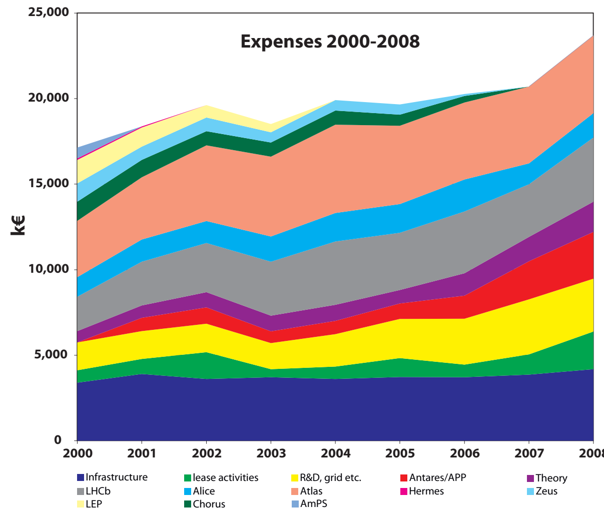
* *as of 31 December 2008.*

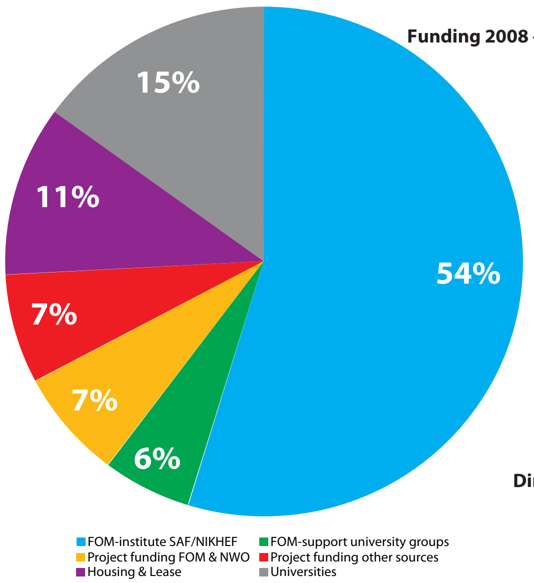
5.3 Funding & Expenses

From a funding perspective the year 2008 has been exceptionally fruitful. Due to the excellent result of the mission review, which took place in 2007, the mission budget of Nikhef as provided by FOM has increased with 900 k€ per 2008, of which 450 k€ is temporary (2008-2010). Furthermore, two new programs have been acquired, Cosmic Rays and Theory, which together will add on average 500 k€ to Nikhef's funding envelope during the next six years (2008-2013). Nikhef has also succeeded in acquiring other funds through NWO ('Vernieuwingsimpulsen', BiG Grid) and European Commission sponsored projects (such as EGEE, EUDET, ASPERA, KM3NeT and MC-PAD). Finally, the turnover in contracts with customers of the Internet Exchange housing facility has also increased further (about 2.0 M€), so that the funding of the Nikhef collaboration is now at the level of 23,5 M€ (as compared to 20,9 M€ in 2007).

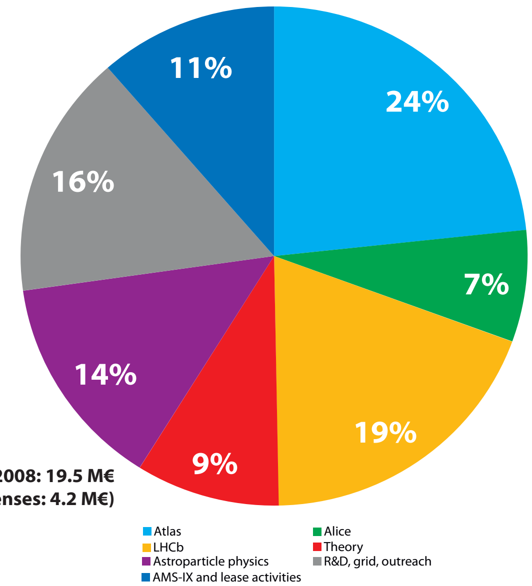
The expenses show a slight shift from accelerator based particle physics to astroparticle physics. The expenses for the LHC experiments, of which the costly detector construction phase has now come to an end, form about 50% of (direct) expenses, while astroparticle physics now comprises about 14%; this share has more than doubled in the last 2 years. An increase in expenses is also visible for the lease activities: this reflects the preparatory costs for the extension and upgrade of the housing facility for the Grid and Internet Exchange activities. These expenses will have their peak in 2009.







Funding 2008 – 23.5 M€



Direct expenses 2008: 19.5 M€
(indirect expenses: 4.2 M€)

5.4 Personnel*

Overview of Nikhef personnel in fte (2008)

I – Scientific groups
(fte – 2008, institute & university groups)

Permanent scientific staff	54.8
PhD students	59.4
Post–docs	27.9
Total I	**142.1**

II – Management, technical/engineering and general support (fte – 2008, institute)

Management team	
Director	1.0
Institute manager	1.0
Personnel/HRM officer	0.8
Subtotal	**2.8**
Technical/engineering support	
Electronics technology	26.7
Computer technology	19.4
Mechanical engineering	11.0
Mechanical workshop	15.7
Project management support	1.6
Subtotal	**74.4**
General support	
Financial administration	3.8
Personnel/HRM administration	1.0
Library	0.4
Technical and domestic services	8.1
Secretariat and reception desk	4.6
PR & communication	1.2
Occupational health & safety	1.0
Subtotal	**20.1**
Total II	**97.3**
Total I & II	**239.4**

III – Other groups
(persons 2008)

Guests (researchers, retired staff)	**28.0**
Master students	**31.0**

ATLAS/DØ

Ancu, drs. L.S.	RU
Bentvelsen, prof.dr. S.C.M.	UvA
Berg, drs. P.J. van den	GST
Bobbink, dr. G.J.	FOM
Bos, dr. K.	FOM
Colijn, dr. A.P.	UvA
Consonni, dr. M.	FOM/RU
Demarteau, prof.dr. M.W.J.M.	Fermilab/UvA
Doxiadis, Msc. A.D.	FOM
Ferrari, mevr. dr. P.	FOM
Filthaut, dr. F.	RU
Froidevaux, prof.dr. D.	CERN/RU
Gosselink, ir. M.	FOM
Groot, prof.dr. N. de	RU
Hegeman, ir. J.G.	FOM
Hessey, dr. N.P.	FOM
Houben, drs. P.W.H.	GST
Igonkina, mevr. dr. O.B.	FOM
Jansen, drs. E.	FOM
Jong, dr.ir. P.J. de	FOM
Kayl, MSc. M.S.	FOM
Kesteren, drs. Z. van	UvA
Klous, dr.ing. S.	FOM
Kluit, dr.drs. P.M.	FOM
Klok, drs. P.F.	FOM/RU
Koetsveld, drs. F.	FOM
Koffeman, mevr. prof.dr.ir. E.N.	FOM
König, dr. A.C.	RU
Koutsman, drs. A.J.	FOM
Kraaij, drs. E.E. van der	FOM
Lee, MSc. H.C.	FOM
Liebig, dr. W.	FOM
Limper, mevr. drs. M.	UvA
Magrath, mevr. Msc. C.A.	FOM
Mechnich, Dipl.Phys. J.	FOM
Meijer, Msc. M.M.	FOM/RU
Mussche, Msc. I.	FOM
Ottersbach, Dipl.Phys. J.P.	FOM
Poel, Msc. E.F. van der	FOM
Raas, MSc. M.J.P.	FOM/RU
Resende Vaz de Melo Xavier, dr. B.	FOM
Rijpstra, mevr. drs. M.	FOM
Ruckstuhl, mevr. Msc. N.M.	FOM
Salamanna, dr. G.	FOM
Sandström, dr. A.R.	FOM

* *as of 31 December 2008.*

Snuverink, ir. J.	GST
Svoisky, dr. P.	FOM
Tsiakiris, Msc. M.	FOM
Verkerke, dr. W.	FOM
Vermeulen, dr.ir. J.C.	UvA
Vreeswijk, dr. M.	UvA
Vulpen, dr. I.B. van	UvA

LHCb/BABAR

Amoraal, drs. J.M.	FOM
Bauer, dr. T.S.	FOM
Belyaev, dr. I.	FOM
Beuzekom, dr.ing. M.G. van	FOM
Bos, drs. E.	FOM
Carvalho Akiba, dr. K.	FOM/VU
Eijk, Msc. D. van	FOM
Farinelli, mevr. Msc. C.	FOM/VU
Hulsbergen, dr. W.	FOM
Jans, dr. E.	FOM
Jansen, ir. F.M.	FOM
Ketel, dr. T.J.	FOM/VU
Kozlinskiy, Msc. A.	FOM
Lysebetten, mevr. dr. A. van	FOM
M'charek, mevr. drs. B.	VU
Merk, prof.dr. M.H.M.	FOM
Mous, Msc. I.V.N.	FOM
Palacios, dr. J.P.	FOM
Papadelis, drs. E.A.	FOM
Pellegrino, dr. A.	FOM
Pree, drs. T.A.du	FOM
Raven, dr. H.G.	VU
Serra, dr. N.	FOM
Simioni, drs. E.	FOM/VU
Snoek, mevr. drs. H.L.	GST
Storaci, mevr. Msc. B.	FOM
Terrier, dr. H.J.C.	FOM
Tuning, dr. N.	FOM
Vries, dr. H. de	GST
Wiggers, dr. L.W.	FOM
Ybeles Smit, drs. G.V.	GST
Zupan, drs. M.	GST

ALICE/STAR

Bilandžic, drs. A.	FOM
Botje, dr. M.A.J.	FOM
Braidot, drs. E.	FOM
Chojnacki, drs. M.	FOM/UU
Christakoglou, dr. P.	FOM/UU
Eijndhoven, dr. N. van	UU
Ivan, ir. C.G.	FOM/UU
Kamermans, prof.dr. R.	FOM/UU
Kolk, mevr. drs.ing. N. van der	FOM
Krzewicki, Msc. M.	FOM
Kuijer, dr. P.G.	FOM
Leeuwen, dr. M. van	UU
Mischke, dr. A.	UU
Nooren, dr.ir. G.J.L.	FOM/UU
Peitzmann, prof.dr. T.	UU
Snellings, dr. R.J.M.	FOM

ANTARES/KM3NeT

Astraatmadja, Msc. T.L.	UL
Bouwhuis, mevr. dr. M.C.	FOM
Colnard, mevr. drs. C.M.M.	GST
Decowski, dr. M.P.	GST
Jong, prof.dr. M. de	FOM
Kavatsyuk, mevr. dr. O.	FOM
Kooijman, prof.dr. P.M.	UvA
Lim, ir. G.M.A.	UvA
Palioselitis, Msc. D.	FOM
Petrovic, mevr. dr. J.	FOM
Presani, mevr. drs. E.	FOM
Santos Assis Jesus, mevr. dr. A.C. dos	FOM
Steijger, dr. J.J.M.	FOM
Wijnker, drs. G.P.J.C.	FOM
Wolf, mevr. dr. E. de	UvA

Virgo/LISA

Brand, prof.dr.ing. J.F.J. van den	VU
Bulten, dr. H.J.	VU
Holtrop, prof.dr. M.	FOM
Koekoek, drs. G.	VU
Putten, drs. S. van der	FOM
Rabeling, dr. D.S.	VU

AUGER

Coppens, mevr. drs. J.M.S.	FOM
Grebe, Msc. S.	FOM
Harmsma, ir. S.	FOM
Jiraskova, Mevr. Msc. S.	FOM
Jong, prof.dr. S.J. de	RU
Schoorlemmer, Msc. H.	FOM/RU
Timmermans, dr. C.W.J.P.	FOM

Theory

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Åkerblom, dr. N.	FOM
Beenakker, dr. W.J.P.	RU
Boer, dr. D.	VU
Boomsma, Msc. J.K.	VU
Gato-Rivera, mevr. dr. B.	GST
Gmeiner, dr. F.K.	FOM
Herquet, dr. M.	FOM
Holten, prof.dr. J.W. van	FOM
Kleiss, prof.dr. R.H.P.	RU
Koch, prof.dr. J.H.	FOM
Laenen, prof.dr. E.L.M.P.	UvA
Maio, Msc. M.	FOM
Mantz, Msc. C.L.M.	FOM
Mulders, prof.dr. P.J.G.	VU
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Postma, mevr. dr. M.E.J.	FOM
Reiter, dr. T.	FOM
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Stavenga, Msc. G.C.	RU
Veltman, prof.dr. M.J.G.	GST
Vermaseren, dr. J.A.M.	FOM
Vollinga, dr. J.	FOM
White, dr. C.D.	FOM

Detector R&D

Bosma, Msc. M.J.	FOM
Bilevych, dr. Y.	FOM
Chefdeville, drs. M.A.	FOM
Fransen, Msc. M.	FOM
Graaf, dr.ir. H. van der	FOM
Hartjes, dr. F.G.	FOM
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Timmermans, dr. J.J.M.	FOM
Reinhold, dr. E.	FOM
Rogers, Msc. M.	FOM/RU
Snippe, ir. Q.H.C.	FOM
Veenhof, dr. R.J.	GST
Visschers, dr. J.L.	FOM
Visser, dr. J.	FOM

Grid Computing

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Garitaonandia, drs. H.	FOM
Groep, dr. D.L.	FOM
Keijser, drs. J.J. (CT)	FOM
Koeroo, ing. O.A. (CT)	FOM
Sallé, dr. M. (CT)	FOM
Starink, dr. R. (CT)	FOM
Suerink, ing. T.C.H. (CT)	FOM
Templon, dr. J.A.	FOM

HiSPARC

Colle, dr. J.J.H.C.	GST
Eijk, prof.dr.ing. B. van	FOM
Fokkema, drs. D.B.R.A.	FOM
Heesch, drs. A.J.A.M. van	GST
Pennink-Bakker, mevr. D.H.M.	GST
Poortenga, ing. F.	GST
Vegting, drs. M.	GST
Vriens, ir. A.J.P.M.M.	GST
Wolst, ing. J.F.	GST

Miscellaneous

Blok, dr. H.P.	HERMES/GST
Keramidas, drs. A.A.	ZEUS/GST
Engelen, prof.dr. J.J.	CLIC/UvA

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Hart, ing. R.G.K.	FOM
Heubers, ing. W.P.J.	FOM
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Venekamp, drs. G.M.	FOM
Wijk, R.F. van	FOM

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Hogenbirk, ing. J.J.	FOM
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Jansen, L.W.A.	FOM
Jansweijer, ing. P.P.M.	FOM
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Kluit, ing. R.	FOM
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Mos, ing. S.	FOM
Oskamp, C.J.	FOM/UU
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Verkooijen, ing. J.C.	FOM
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Wijnen, ing. T.	RU
Zwart, ing. A.N.M.	FOM
Zwart, F. de	FOM

Mechanical Engineering Group

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Mul, ing. G.	FOM
Munneke, ing. B.	FOM
Schuijlenburg, ing. H.W.A.	FOM
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Mechanical Workshop

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Brouwer, G.R.	FOM
Buis, R.	FOM
Ceelie, L.	UvA
Homma, J.	FOM
Jaspers, M.J.F.	UvA
John, D.	FOM
Kok, J.W.	FOM
Kuilman, W.C.	FOM
Leguyt, R.	FOM
Mul, F.A.	FOM/VU
Overbeek, M.G. van	FOM
Petten, O.R. van	FOM
Rietmeijer, A.A.	FOM
Roeland, E.	FOM
Rövekamp, J.C.D.F.	UvA

Management and Administration

Azarfane, M.	PANTAR
Barneveld, mevr. K.M. van	FOM
Berg, A. van den	FOM
Bulten, F.	FOM
Dekker, mevr. C.E.	FOM
Dokter, J.H.G.	FOM
Echtelt, ing. H.J.B. van	FOM
Egdom, T. van	FOM
Faassen, mevr. N.F.	FOM
Greven-Van Beusekom, mevr. E.C.L.	FOM
Heuvel, mevr. G.A. van den	FOM
Kesgin-Boonstra, mevr. drs. M.J.	FOM
Klei, mevr. M.M.	STAR JOB
Kleinsmiede-van Dongen, mevr. T.W.J. zur	FOM
Langenhorst, A.	FOM
Lapikás, dr. L.	GST
Lemaire-Vonk, mevr. M.C.	FOM
Linde, prof.dr. F.L.	FOM
Meer, dr. R.L.J. van der	FOM
Mors, A.G.S.	FOM
Pancar, M.	FOM
Rem, drs.ing. N.	FOM
Rijksen, C.	FOM
Rijn, drs. A.J. van	FOM
Schram-Post, mevr. E.C.	FOM
Spelt, ing. J.B.	FOM
Vervoort, ing. M.B.H.J.	FOM
Vreeken, D.	PANTAR
Werneke, ing. P.J.M.	FOM
Willigen, E. van	FOM
Witlox, ing. A.M	FOM
Woortmann, E.P.	FOM
Zegers, mevr. drs. G.E.	FOM

Glossary

Glossary

Accelerator
A machine in which beams of charged particles are accelerated to high energies. Electric fields are used to accelerate the particles whilst magnets steer and focus them. A collider is a special type of accelerator where counter–rotating beams are accelerated and interact at designated collision points. A synchrotron is an accelerator in which the magnetic field bending the orbits of the particles increases with the energy of the particles. This keeps the particles moving in a closed orbit.

ALICE (A Large Ion Collider Experiment)
One of the four major experiments that will use the *LHC*.

AMS–IX (Amsterdam Internet Exchange)
The main place in the Netherlands for Internet Service Providers to interconnect and exchange IP traffic with each other at a national or international level.

Annihilation
A process in which a particle meets its corresponding antiparticle and both disappear. The resulting energy appears in some other form: as a different particle and its antiparticle (and their energy), as many mesons, or as a single neutral boson such as a Z boson. The produced particles may be any combination allowed by conservation of energy and momentum.

ANTARES (Astronomy with a Neutrino Telescope and Abyss Environmental Research)
Large area water *Cherenkov* detector in the deep Mediterranean Sea near Toulon, optimised for the detection of muons resulting from interactions of high–energy cosmic neutrinos.

Antimatter
Every kind of matter particle has a corresponding antiparticle. Charged antiparticles have the opposite electric charge as their matter counterparts. Although antiparticles are extremely rare in the Universe today, matter and antimatter are believed to have been created in equal amounts in the *Big Bang*.

Antiproton
The antiparticle of the proton.

ApPEC (Astroparticle Physics European Coordination)
Consortium of national funding agencies aiming to develop long–term strategies in the field of astroparticle physics research.

ASPERA
Sixth Framework Programme for co–ordination across European funding agencies for financing astroparticle physics.

ATLAS (A Toroidal LHC Apparatus)
One of the four major experiments that will use the *LHC*.

BaBar
$B\bar{B}$ detector at SLAC's B Factory. Named for the elephant in Laurent DeBrunhoff's children's books.

Beam
The particles in an accelerator are grouped together in a beam. Beams can contain billions of particles and are divided into discrete portions called bunches. Each bunch is typically several centimeters long and can be just a few μm in diameter.

Big Bang
The name given to the explosive origin of the Universe.

BNL (Brookhaven National Laboratories)
Laboratory where the *RHIC* accelerator is located.

Boson
The general name for any particle with a spin of an integer number (0, 1 or 2...) of quantum units of angular momentum (named for Indian physicist S.N. Bose). The carrier particles of all interactions are bosons. Mesons are also bosons.

Calorimeter
An instrument for measuring the amount of energy carried by a particle.

Cherenkov radiation
Light emitted by fast–moving charged particles traversing a dense transparent medium faster than the speed of light in that medium.

CLIC (Compact LInear Collider)
A site–independent feasibility study aiming at the development of a realistic technology at an affordable cost for an electron–positron linear collider for physics at multi–TeV energies.

Collider
See *Accelerator*.

Cosmic ray
A high–energy particle that strikes the Earth's atmosphere from space, producing many secondary particles, also called cosmic rays.

CP violation
A subtle effect observed in the decays of certain particles that betrays nature's preference for matter over antimatter.

DØ (named for location on the Tevatron Ring)
Collider detector, studies proton–antiproton collisions at Fermilab's Tevatron.

Dark matter
Only 4% of the matter in the Universe is visible. The rest is known as dark matter and dark energy. Finding out what it consists of is a major question for modern science.

Detector
A device used to measure properties of particles. Some detectors measure the tracks left behind by particles, others measure energy. The term '*detector*' is also used to describe the huge composite devices made up of many smaller detector elements.

Dipole
A magnet with two poles, like the north and south poles of a horseshoe magnet. Dipoles are used in particle accelerators to keep the particles on a closed orbit.

EGEE (Enabling Grids for E–SciencE)
An EU–funded project led by CERN, now involving more than 90 institutions over 30 countries worldwide, to provide a seamless Grid infrastructure that is available to scientists 24 hours a day.

Elliptic flow
When two heavy nuclei collide in the centre of the *STAR* detector, the initial shape of the collision zone is usually an ellipse. Pressure in the liquid seeks to make the matter round, and so makes the liquid flow faster in the shorter direction. This elliptic flow can be measured in the speed and direction of the particles when they reach the detector, and the flow is largest when many particles are emitted from a given collision. The number of particles emitted depends on the intensity of that collision: how '*head–on*' the collision between the two nuclei was.

End cap
Detector placed at each end of a barrel–shaped detector to provide the most complete coverage in detecting particles.

EUDET (European Detector R&D towards the International Linear Collider)
EU–funded R&D project for research on future *ILC* detectors.

EUnet
European UNIX network, Europe's largest Internet Service Provider.

eV (Electronvolt)
A unit of energy or mass used in particle physics. One eV is extremely small, and units of million electronvolts, MeV, or thousand million electronvolts, GeV, are more common in particle physics. The latest generation of particle accelerators reaches up to several million million electronvolts, TeV. One TeV is about the energy of motion of a flying mosquito.

Fermion
General name for a particle that is a matter constituent, characterized by spin in odd half integer quantum units ($\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$...). Named for Italian physicist Enrico Fermi. Quarks, leptons and baryons are all fermions.

Forces
There are four fundamental forces in nature. Gravity is the most familiar to us, but it is the weakest. Electromagnetism is the force responsible for thunderstorms and carrying electricity into our homes. The two other forces, weak and strong, are connected to the atomic nucleus. The strong force binds the nucleus together, whereas the weak force causes some nuclei to break up. The weak force is important in the energy–generating processes of stars, including the Sun. Physicists would like to find a theory that can explain all these forces in one common framework. A big step forward was made in the late 1970s when the electroweak theory uniting the electromagnetic and weak forces was proposed. This was later confirmed in a Nobel prize–winning experiment at CERN.

FTE (Full Time Equivalent)
Unit of manpower

Globus
Grid middleware toolkit development in the USA.

Gluon
See *Particles*.

Masterclass students listening to an explanation of how a cloud chamber works.

Gravitational wave
The gravitational analog of an electromagnetic wave whereby gravitational radiation is emitted at the speed of light from any mass that undergoes rapid acceleration.

Grid
A service for sharing computer power and data storage capacity over the Internet.

Hadron
A subatomic particle that contains quarks, antiquarks, and gluons, and so experiences the strong force (see also *Particles*).

High–Energy Physics
A branch of science studying the interactions of fundamental particles; called 'high–energy' because very powerful accelerators produce very fast, energetic particles probing deeply into other particles.

Higgs boson
A particle predicted by theory, linked to the mechanism by which physicists think particles acquire mass.

HiSPARC (High School Project on Astroparticle Cosmic Rays)
Cosmic–ray experiment with schools in the Netherlands.

ILC
International Linear Collider, now under study. A possible future electron–positron accelerator, proposed to be built as an international project.

Kaon
A meson containing a strange quark (or antiquark). Neutral kaons come in two kinds, long–lived and short–lived. The long–lived ones occasionally decay into two pions, a CP–violating process (see also *Particles*).

KM3NeT (Cubic Kilometre Neutrino Telescope)
Planned European deep–sea neutrino telescope with a volume of at least one cubic kilometre at the bottom of the Mediterranean Sea.

LCAS (Local Centre Authorization System)
System to verify the *GRID* authorization.

LCG (LHC Computing Grid)
The mission of the LCG is to build and maintain a data–storage and analysis infrastructure for the entire high–energy physics community that will use the LHC.

LCMAPS (Local Credential MAPping Service)
Provides all credentials necessary to access *GRID* services within a centre.

LEP
The Large Electron–Positron collider, which ran until 2000.

Lepton
A class of elementary particles that includes the electron. Leptons are particles of matter that do not feel the strong force (see also *Particles*).

LHC (Large Hadron Collider)
CERN's accelerator which started in 2008.

LHCb (Large Hadron Collider beauty)
One of the four major experiments that will use the *LHC*.

Linac
An abbreviation for linear accelerator.

LISA (Laser Interferometric Space Array)
ESA/NASA mission, the first space–based gravitational wave observatory; three spacecraft, orbiting around the Sun as a giant equilateral triangle 5 million km on a side.

LOFAR (Low Frequency Array)
First radio telescope of a new generation of astronomical facilities, mainly in the Netherlands.

Muon
A particle similar to the electron, but some 200 times more massive (see also *Particles*).

Muon chamber
A device that identifies muons, and together with a magnetic system creates a muon spectrometer to measure momenta.

Neutrino
Uncharged, weakly interacting lepton, most commonly produced in nuclear reactions such as those in the Sun. There are three known flavours of neutrino, corresponding to the three flavours of leptons. Recent experimental results indicate that all neutrinos have tiny masses (see also *Particles*).

NLO (Next–to–Leading Order)
Second order calculations in perturbative *QED* and *QCD*.

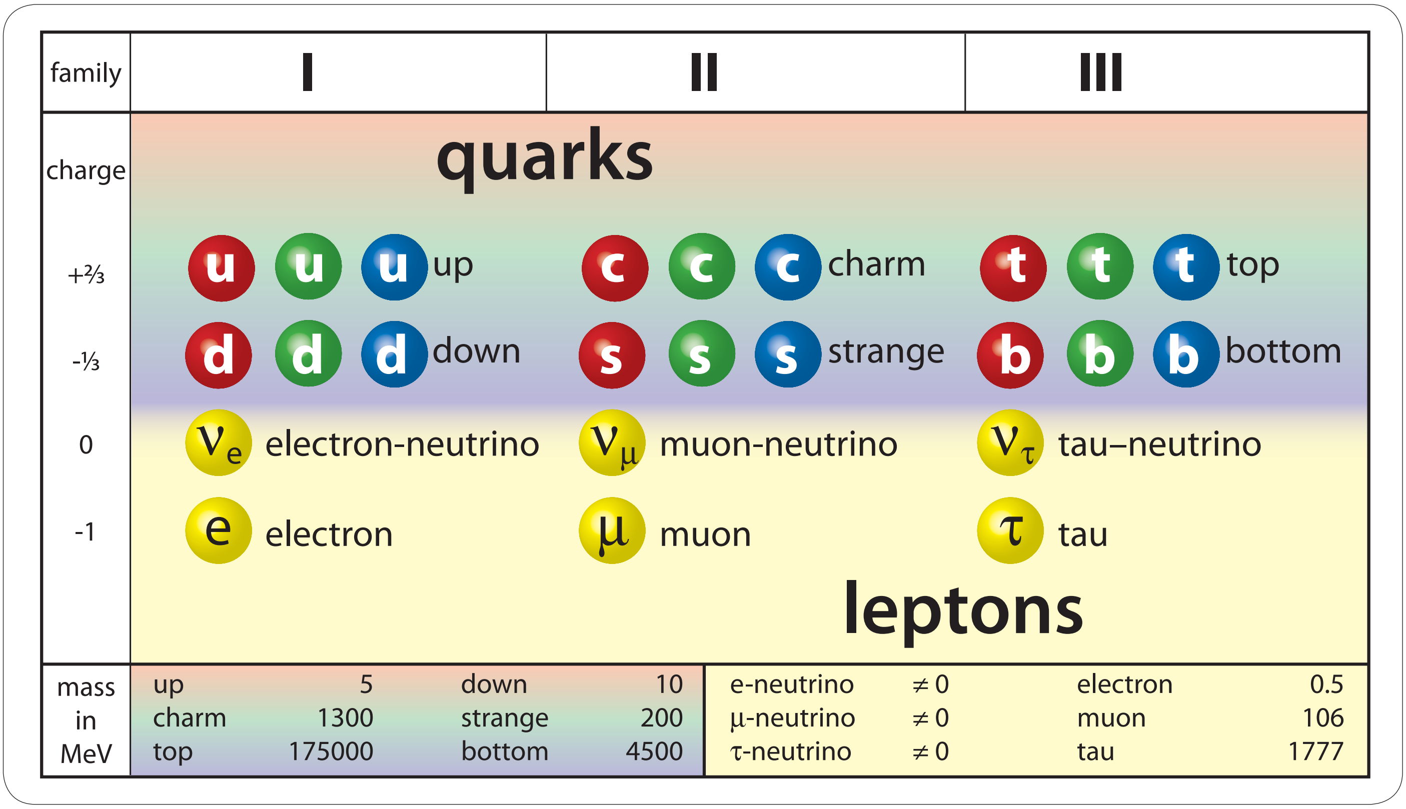
NWO
The Netherlands Organisation for Scientific Research funds thousands of top researchers at universities and institutes and steers the course of Dutch science by means of subsidies and research programmes

Nucleon
The collective name for protons and neutrons.

Particles
There are two groups of elementary particles, quarks and leptons, with three families each. The quarks are named up and down, charm and strange, top and bottom (or beauty). The leptons are electron and electron neutrino, muon and muon neutrino, tau and tau neutrino. There are four fundamental forces, or interactions, between particles, which are carried by special particles called bosons. Electromagnetism is carried by the photon, the weak force by the charged W and neutral Z bosons, the strong force by the gluons; gravity is probably carried by the graviton, which has not yet been discovered. Hadrons are particles that feel the strong force. They include mesons, which are composite particles made up of a quark–antiquark pair, and baryons, which are particles containing three quarks. Pions and kaons are types of meson. Neutrons and protons (the constituents of ordinary matter) are baryons; neutrons contain one up and two down quarks; protons two up and one down quark.

Photon
See *Particles*.

Pierre Auger Observatory
International experiment in Argentina to track down the origin of ultra–high–energy cosmic rays.



The three families of particles according to the Standard Model.

Pion
See *Particles*.

Positron
The antiparticle of the electron.

Quantum electrodynamics (QED)
The theory of the electromagnetic interaction.

Quantum chromodynamics (QCD)
The theory for the strong interaction analogous to QED.

Quark
The basic building blocks of matter (see also *Particles*).

Quark–gluon plasma (QGP)
A new kind of plasma, in which protons and neutrons are believed to break up into their constituent parts. QGP is believed to have existed just after the Big Bang.

RASNIK (Red Alignment System Nikhef)
Optical alignment system where a pattern is projected by a lens on a CCD and deviations measured.

Relaxd
EU–funded development of the large area fast detector system using Medipix technology.

RHIC
Brookhaven's Relativistic Heavy Ion Collider; began operation in 2000. RHIC collides beams of gold ions to study what the Universe looked like in the first few moments after the Big Bang.

RICH (Ring Imaging CHerenkov)
A kind of particle detector that uses the light emitted by fast–moving charged particles as a means of identifying them.

RIPE (Réseaux IP Européens)
A collaboration between European networks which use the *TCP/IP* protocol suite. RIPE NCC is an IP registry, allocating Internet Protocol numbers to the European region.

Scintillation
The flash of light emitted by an electron in an excited atom falling back to its ground state.

Solenoid
An electromagnet produced by current flowing through a single coil of wire. Many particle detectors are surrounded by a solenoidal magnet, since this produces a fairly uniform magnetic field within.

Spectrometer
In particle physics, a detector system containing a magnetic field to measure momenta of particles.

Spin
Intrinsic angular momentum of a particle.

Standard Model
A collection of theories that embodies all of our current understanding about the behaviour of fundamental particles.

STAR
Experiment at *RHIC*.

String Theory
A theory of elementary particles incorporating relativity and quantum mechanics in which the particles are viewed not as points but as extended objects. String theory is a possible framework for constructing unified theories that include both the microscopic forces and gravity (see also *Forces*).

Supersymmetry
A theory linking matter and forces.

SURFnet
Networking organisation in the Netherlands.

TCP/IP (Transmission Control Protocol / Internet Protocol)
Suite of communications protocols to connect hosts on the Internet, invented in 1981.

TDR (Technical Design Report)
The blueprint for a (LHC) detector system.

Tevatron
Fermilab's 2–TeV proton–antiproton accelerator.

Tier–1
First tier (category) in the *LHC* regional computing centers. Tier–0 is the facility at CERN collecting, reconstructing and storing the data.

Trigger
An electronic system for spotting potentially interesting collisions in a particle detector and triggering the detector's read–out system to record the data resulting from the collision.

Vertex detector
A detector placed close to the collision point in a colliding beam experiment so that tracks coming from the decay of a short–lived particle produced in the collision can be accurately reconstructed and seen to emerge from a 'vertex' point that is different from the collision point.

Virgo
Detector near Pisa for gravitational waves: a Michelson laser interferometer made of two orthogonal arms, each 3 km long.

W boson
A carrier particle of weak interactions; involved in all electric–charge–changing weak processes.

Z boson
A carrier particle of weak interactions; involved in all weak processes that do not change flavour and charge.