ANNUAL REPORT
2011

INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES

ANNUAL REPORT
2011

J. D'Hondt – P. Marage
Directors

http://www.iihe.ac.be

CONTENT

I. INTRODUCTION

1. The Interuniversity Institute for High Energies (ULB-VUB)

The IIHE (ULB-VUB) was created in 1972 at the initiative of the academic authorities of the Université Libre de Bruxelles and the Vrije Universiteit Brussel. It is devoted to experimental research in elementary particle physics, using mainly high energy particle accelerators, and, more recently, in astroparticle physics with non-accelerator experiments.

The main goal of the experiments at accelerators, notably the CERN LHC, is the understanding of the strong, electromagnetic and weak interactions between the elementary building blocks of matter, which forms the standard model of particle physics, the search for missing pieces in the standard model (notably the Brout-Englert-Higgs boson and neutrino oscillations), and the search for physics beyond the standard model, possibly related to the dark matter in the Universe. Astroparticle physics is devoted to the study of the structure of the Universe, using the techniques developed in particle physics. All these experiments are performed in the framework of large to very large international collaborations (several hundred to several thousand physicists and engineers).

In addition to fundamental contributions to the understanding of the Universe, particle and astroparticle physics experiments imply major R&D developments concerning particle detectors, computing and networking systems, frontier technologies in various fields (electronics, superconductivity, cryogenics, etc.), with lead to break-thorough progress in industrial and medical applications.

2. Overview of research at the IIHE in 2011

The present report presents the research performed at the IIHE in 2011.

The major research effort using accelerators has been devoted in 2011 to activities within the CMS collaboration at the CERN proton-proton Large Hadron Collider, in Geneva. Since the early 1990's, IIHE teams have actively contributed designing, building, operating and maintaining the CMS detector, in particular through the construction – in collaboration with other Belgian and international teams – of the inner tracking detector. Since the first collisions in 2009, the LHC has performed extremely well, with steadily increasing luminosity, and the data accumulated in 2011 at 7 GeV centre of mass energy proton-proton interactions have led to numerous scientific publications, as listed below.

In addition to operational activities around the detector and its continuous survey and calibration, the Brussels team in CMS have contributed to physics analyses in mainly four directions: (i) top quark physics, including measurements of the standard model parameters and search for effects beyond the standard model, in particular from supersymmetry; (ii) the search for new heavy resonances, as expected from several approaches beyond the standard model, notably grand unified theories and models with extra space dimensions; (iii) the search for the Brout-Englert-Higgs boson and the study of multiboson production; (iv) the study of the underlying event in hard interactions, in particular neutral strange particle production.

In 2011, the OPERA collaboration has successfully continued detecting interactions in their detector, situated in the underground Gran Sasso laboratory, of muon-neutrinos emitted at CERN, 900 km away. The aim is to measure the oscillation rate of muon-neutrinos to tau-neutrinos, hence positively demonstrating these oscillations and constraining the oscillation parameter space. In 2011, the OPERA experiment has also attracted the attention because of the careful announcement of a possible indication of neutrino propagation through matter with speed faster than light in the vacuum. At the time of release of the present report, it has been clarified by the experiment that this possible effect was due to the malfunctioning of an optic-fibre cable. It should be stressed that the behaviour of the OPERA collaboration in this context has been in perfect agreement with scientific deontology.

The H1 experiment at the HERA electron-proton collider DESY at Hamburg has taken data from 1992 to 2007, with major contributions of the IIHE team to detector building, operating and upgrading, in particular through the conception and installation in 2002 of the very forward proton spectrometer (VFPS), devoted to the detailed measurement of diffractive interactions. Since the accelerator shut-down in 2007, the data analysis by the H1 collaboration is steadily continuing, with the Brussels group very actively involved in the analysis of the VFPS data, providing a new insight of Quantum Chromodynamics in the transition region from soft to hard interactions.

In the field of astroparticles, the IIHE has been involved in the search and measurement of interactions of ultra-high energy neutrinos from cosmic origin in the South Pole ice, since the start of this quest in the late 1990's with the AMANDA and IceCube experiments. Year 2011 has been the first year of full deployment of the IceCube detector, the largest ever built detector for particle astrophysics, including the Deep Core extension, with more densely placed detectors, aimed at extending the detection capacity to lower neutrino energies. The major research topics of the IIHE team are: (i) the search for cosmic point sources; (ii) the search for Dark Matter using neutrinos from WIMP particles; (iii) the detection of high-energy tau-neutrinos; (iv) the search for high-energy neutrinos from transient events; (v) the search for neutrinos from supernovae.

For the detection in the South Pole ice of "GZK" neutrinos, from the scattering of ultra-high energy cosmic rays off the cosmic microwave background, a sound-wave technique is being developed by the ARA experiment. A major activity of the IIHE group in conjunction with the R&D group of the IIHE has been the development of a digital communication circuit to permit the deployment of digitization electronics below the firn local to the antennas, under particularly stringent conditions.

Being devoted to experimental particle physics, the IIHE has always been very active in technical developments and instrumentation. This tradition points back to automatized bubble chamber and nuclear emulsion measurements, with important contributions to detectors at highest energy particle colliders (DELPHI at LEP, H1 at HERA and CMS at the LHC) as well as in the more recent astroparticle experiments (AMANDA, IceCube and ARA). Over the recent years, R&D activities are centred on the development of multi-purpose, very high-rate, robust and low-cost, industry-based data acquisition systems, aimed to particle and astroparticle experiments. The contributions have taken place in the framework of DAQ systems for a TPC prototype for a future linear collider detector, for the ARA experiment, and for the upgrade of the CMS muon spectrometer in the forward region.

In the field of biomedical imaging applications, which has been followed for several years, the medical instrumentation group of the IIHE has been exploring several research lines that could, in the future, improve the performance of PET scanners, and it is involved in the development of a second generation of the PET for mammography studies

To link the activities of their theoretical physics (THEP) and experimental particle physics (ELEM) groups, a phenomenology group has been settled by the VUB through a concerted action (GOA - Geconcerteerde OnderzoeksActies). The main topic of research is supersymmetric models and their signatures at the LHC, with in 2011 the main focus on the gravitino phenomenology at colliders.

Finally, large computing resources are requested by the experiments, in particular IceCube and CMS. The IceCube collaboration uses the IIHE cluster for large simulations of the complex ice optical structure. For CMS computing, a "Tier-2" cluster installed at the ULB-VUB Computing Centre is fully integrated in the worldwide LHC computing grid, with very high performance and stability.

On December 4, 2011, all the IIHE personnel joint the annual meeting, held at the Royal Library in Brussels, where a review of the activities in the different experiments, in computing and in R&D were presented and discussed, together with the development plans for the coming years.

The research activities at the IIHE and the responsibilities of IIHE physicists in the experiments are further detailed below. These activities have led to the publication of numerous scientific articles, conference reports and technical notes.

3. IIHE funding

Research at IIHE has been supported by the Université Libre de Bruxelles (ULB), the Vrije Universiteit Brussel (VUB), the Fonds de la Recherche Scientifique (F.R.S-FNRS), the Fonds voor Wetenschappelijk Onderzoek-Vlaanderen (FWO), the Fonds pour la Formation à la Recherche dans l'Industrie et dans l'Agriculture (FRIA), the Instituut voor de Aanmoediging van Innovatie door Wetenschap en Technologie in Vlaanderen (IWT), the Belgian Federal Science Policy Office, and the European Union.

The IIHE is part of the IAP P6/11 "Fundamental Interactions: at the boundary of theory, phenomenology and experiment" (www.f-i.be), which has grouped from 2007 until 2011 essentially all the particle physics community (theorists and experimentalists) in Belgium. The purpose of this IAP is to improve our understanding of Fundamental Interactions through a closer collaboration between Belgian research teams engaged in theoretical or experimental investigations in the field.

The activities of all teams were presented at the 2011 general meeting, held at ULB. IIHE physicists contributed actively to this general meeting and to common seminars and journal clubs. They also contributed to the working group dedicated to the preparation of future experiments. The contributions of the IIHE members to the IAP research program are described in the Midterm Report prepared for the ex-post evaluation which took place in 2010 (http://www.f-i.be/EvaluationDocumentIAP-VI-11.pdf). End of 2011, the ULB and VUB teams of IIHE submitted a new IAP project with the same partners. This new IAP has been approved in March 2012.

4. The IIHE team in 2011

a. ULB personnel

Academic and scientific personnel

Sabrina BECHET	FRIA PhD student until Sept.; Van Buren grant awarded in Oct.	IceCube
Daniel BERTRAND	Directeur de Recherche F.R.S.-FNRS; past IIHE co-director; honorary, and Professeur de l'Université since Oct.	IceCube
Barbara CLERBAUX	Maître de Recherche F.R.S.-FNRS; part-time Chargée de Cours	CMS
Gilles DE LENTDECKER	Chercheur Qualifié F.R.S.-FNRS; Maître d'Enseignement	CMS, DAQ R&D
Julie DELVAX	IAP post-doc fellow until Sept.	H1
Vincent DERO	IISN PhD student	CMS
Laurent FAVART	Maître de Recherche F.R.S.-FNRS; part-time Chargé de Cours	H1, CMS
Arnaud GAY	Chargé de Recherche F.R.S.-FNRS	CMS
Grégory HAMMAD	PhD student; Van Buren grant awarded in Jan.	CMS
Kael HANSON	Chargé de Cours	IceCube, ARA
David HEEREMAN VON ZUYDTWYCK	IISN PhD student	IceCube
Tomas HREUS	Chargé de Recherche F.R.S.-FNRS	H1, CMS
Alexandre LEONARD	Aspirant F.R.S.-FNRS since Oct.	CMS
Pierre MARAGE	Professeur ordinaire ; IIHE co-director	CMS, Hist. of Sc.
Alberto MAROTTA	IISN post-doc fellow until June	IceCube
Thomas MEURES	IISN PhD student	ARA
Luca PERNIÈ	IAP PhD student since Dec.	CMS
Yves PIERSAUX	collaborateur scientifique	Hist. of Science
Amita RAVAL	IISN post-doc (May-August)	CMS
Thomas REIS	IISN PhD student	CMS
Jean SACTON	Emeritus, Professeur ordinaire; past IIHE co-director	
Laurent THOMAS	teaching assistant until Sept.; FRIA PhD student since Oct.	CMS
Raffaella TONCELLI	collaborateur scientifique	Hist. of Science
CatherineVANDER VELDE	Professeur	CMS
Pascal VANLAER	Professeur Assistant	CMS
Erik VERHAGEN	ARC PhD student	IceCube
Pierre VILAIN	honorary Maître de Recherche F.R.S.-FNRS, Professeur de l'Université	OPERA
Gaston WILQUET	honorary Maître de Recherche F.R.S.-FNRS, Professeur de l'Université	OPERA
Florian ZENONI	AIP PhD student since Sept.	CMS

Master students

Cécile CAILLOL	civil engineer, since Sept.	CMS
Alexandre LEONARD	physics, until June	H1
Thierry MAERSCHALK	physics, until June	CMS R&D
Geoffrey MULLIER	physics, since Sept.	CMS R&D
Julien OLAST	civil engineer, since Sept.	CMS

Engineers, technical and logistic personnel

Patrick DE HARENNE	technician, general support
Léon ETIENNE	engineer, electronics, ½-time, until
Michael FRÈRE	computer technician

Fatimé PERO	secretariat	
Danielle PEYMANS	book-holding and secretariat, until Dec.	
Shkelzen RUGOVAC	computer scientist	
Edwin. TORISAEN	computer scientist	
René VANDERHAEGEN	technician, electronics	
Yifan YANG	post-doctoral logistic support, F.R.S-FNRS, electronics	

b. VUB personnel

Academic and scientific personnel

Freya BLEKMAN	Onderzoeksprofessor until March; VUB-docent since April	CMS
Stijn BLYWEERT	IAP scientific collaborator (PhD student)	CMS
Debanjan BOSE	FWO scientific collaborator (post-doc)	IceCube
Lionel BRAYEUR	FWO scientific collaborator (PhD student) since Oct.	IceCube
Peter BRUYNDONCKX	10% docent until Sept.	Crystal Clear
Stijn BUITINK	FWO scientific collaborator (post-doc) since May	IceCube
Martin CASIER	FWO scientific collaborator (PhD student) since Aug.	IceCube
Federico CECCOPIERI	Scientific collaborator (voluntarily) until Sept.	H1
Jun DANG	Bilateral Scientific Cooperation China Scientific collaborator	Crystal Clear
Karen DE CAUSMAECKER	GOA-ELEM scientific collaborator (PhD student) since Oct.	Pheno
Catherine DE CLERCQ	Hoofddocent	IceCube
Olivier DEVROEDE	FWO scientific collaborator (post-doc) since Febr., ½-time	CMS
Marc DIERCKXSENS	Scientific collaborator (voluntarily) until September 2011	IceCube
Jorgen D'HONDT	ZAP docent; IIHE co-director	CMS
Rebeca GONZALEZ SUAREZ	FWO & IAP scientific collaborator (post-doc)	CMS
Phil GRAJEK	GOA-ELEM scientific collaborator (post-doc)	Pheno
Abideh JAFARI	FWO scientific collaborator (PhD student) from March until Nov.	CMS
Alexis KALOGEROPOULOS	IAP scientific collaborator (PhD student)	CMS
Jan KUNNEN	FWO scientific collaborator (PhD student) since Oct.	IceCube 2011
Mathieu LABARE	FWO scientific collaborator (post-doc)	IceCube
Jacques LEMONNE	Emeritus professor; past IIHE co-director	
Joris. MAES	Scientific collaborator (voluntarily)	CMS
Michael MAES	IAP scientific collaborator (PhD student)	CMS
Kantarou MAWATARI	GOA-TENA scientific collaborator (post-doc)	Pheno
Bettina OEXL	GOA-TENA scientific collaborator (PhD student)	Pheno
Annik OLBRECHTS	FWO scientific collaborator (PhD student) since Oct.	CMS
Robert ROOSEN	Onderzoeksdirecteur FWO	H1
Erik STRAHLER	IAP scientific collaborator (post-doc)	IceCube
Stefaan TAVERNIER	Professor-emeritus	Crystal Clear, CMS
Walter VAN DONINCK	Onderzoeksdirecteur FWO, on leave of absence at CERN	CMS
Nick VAN EIJNDHOVEN	Hoogleraar	IceCube
Petra VAN MULDERS	IWT scientific collaborator (PhD student) until April; FWO scientific collaborator (post-doc) since April	CMS
Gerrit VAN ONSEM	FWO scientific collaborator (PhD student)	CMS
Maryam ZEINALI	FWO scientific collaborator from June until Nov. (PhD student)	CMS
Li ZHI	Bilateral Scientific Cooperation China Scientific collaborator (PhD Student) until Febuary	Crystal Clear

Master students

Ben DUMOULIN	physics, since Sept.	IceCube
Jan KUNNEN	physics, until June	IceCube
Annik OLBRECHTS	physics, until June	CMS

Engineers, technical and logistic personnel

Jan DE BRUYNE	technician, general support, ½-time
Stephane GERARD	computer scientist – Belspo
Marleen GOEMAN	book-holding and secretariat
Robert GOORENS	electronic engineer, ½-time, until July
Sven HANNAERT	technician, mechanics, until February
Abdelhak OUCHENE	computer technician
Daisy PIRNAY	secretariat, ½-time, until May
Rosette VANDENBROUCKE	computer scientist
Luc VAN LANCKER	mechanical engineer
Christian WASTIELS	electronic technician, ½-time, until May

c. Associated institutes

The following members of the Particle Physics Group of Antwerp University (UA) have been working in close collaboration with the IIHE Institute:
Prof. Em. Dr. Eddi De Wolf, Prof. Dr. Pierre Van Mechelen, Prof. Dr. Nick Van Remortel, Prof. Dr. Albert De Roeck, Prof. Dr. Hannes Jung, Dr. Leonardo Benucci, Dr. Igor Cherednikov, Dr. Xavier Janssen, Dr. Benoit Roland, Thomas Maes, Luca Mucibello, Silvia Ochesanu, Romain Rougny, Michele Selvaggi, Frederik Van Der Veken, Hans Van Haevermaet, Ir. Wim Beaumont, Ir. Eric De Langhe, and Ir. Dmirty Druzhkin.

The following members of the Particle Physics Group of Mons University (UMons) are closely associated to the IIHE activities through the Académie Wallonie-Bruxelles (ULB-UMons):
Prof. Evelyne Daubie, Dr. George Kohnen, Nikita Beliy, Florence Binet, Thierry Caeberts, Martine Fracas, Joseph Hanton, Michelle Lefebvre, Francis Lequeux.

5. With our greatest gratitude…

a. Catherine De Clercq, VUB IIHE codirector 2003-2011

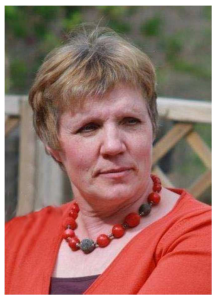
On October 2011 Catherine De Clercq handed over the VUB co-directorship of the IIHE after eight years of successfully running the Institute, after the retirement of Jacques Lemonne. During this period the IIHE geared up towards the construction and exploitation of the CMS experiment at the Large Hadron Collider at CERN. At the same time Catherine was a key player in the evolution of the Institute from particle physics research at accelerators to an institute including also astroparticle physics research. The symbiosis between collider physics and astroparticle physics provides a new platform for future ground-breaking research. Recently Catherine was also involved in the creation of a phenomenology group which links the research between the theoreticians at the VUB and the experimentalists. Together with Daniel Bertrand and after Jean Sacton and Jacques Lemonne, she has put the Institute in a strong international position to perform frontline research in high-energy physics. We would like to thank her for her investments in the Institute.

b. IIHE colleagues who retired in 2011

Léon Etienne, an electronic engineer, was hired in 1968. He contributed to numerous electronic developments in the IIHE, from automatizing the measurement of bubble chamber pictures, to developing electronic detectors for DELPHI at LEP, CMS at the LHC, and IceCube at the South Pole.

Robert (Bob) Goorens was hired in 1972. As an engineer in electronics he was responsible for the Polly machine to automatize the measurement of bubble chamber pictures. He then developed electronic readout systems for detectors based on NIM, CAMAC, VME and FastBus technologies, and contributed to the design and construction of detectors for DELPHI and CMS.

Danielle Peymans was hired in 1967 as a technician for scanning and measuring events in nuclear emulsion, before turning to the scanning and measurement of bubble chamber pictures for several experiments. She then contributed to hardware production for the Delphi, Chorus, H1 and CMS experiments. She took over the IIHE-ULB secretariat in 2003, including book-keeping, hiring of PhD and post-doc collaborators, contribution to the organization of conferences, and daily support to the ULB physicists and director.



Daisy Pirnay was hired in 1972 as a technician for the scanning and measuring of bubble chamber pictures. She coordinated our technical work in NA22 and provided technical help to the DELPHI and CMS experiments. She was in charge of the IIHE website and annual reports, provided administrative support for the IT group, and helped in the organization of several international conferences.

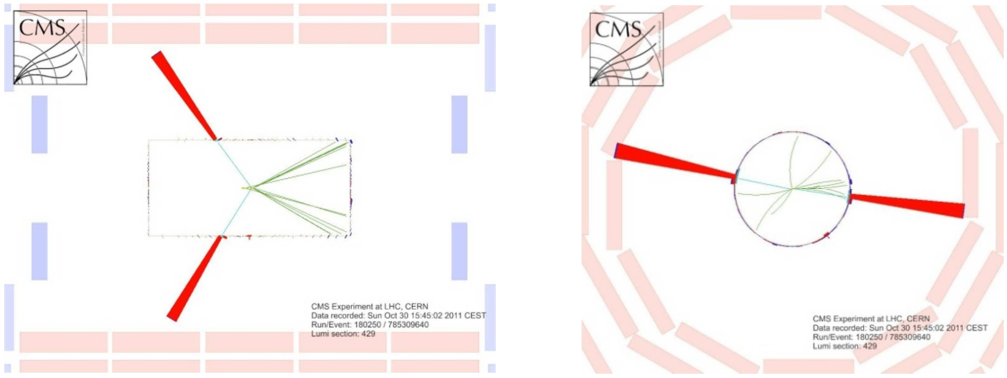
Christian Wastiels was hired in 1973 as an electronic technician. He designed and maintained the operation of the projection tables for bubble chamber pictures. He was part of the construction teams of the DELPHI and H1 detector, where he was a key player for the electronics readout. He participated in the R&D project on MSGC detectors, and constructed the electronics readout systems for the PET scanners developed in our institute.

II. RESEARCH ACTIVITIES, DEVELOPMENT AND SUPPORT

1. The CMS experiment at the CERN LHC

(F. Blekman, S. Blyweert, B. Clerbaux, G. De Lentdecker, V. Dero, O. Devroede, J. D'Hondt, L. Favart, A. Gay, R. Gonzalez Suarez, R. Goorens, G. Hammad, T. Hreus, A. Léonard, J. Maes, M. Maes, P. Marage, L. Perniè, A. Raval, T. Reis, S. Tavernier, L. Thomas, C. Vander Velde, W. Van Doninck, P. Vanlaer, L. Van Lancker, P. Van Mechelen, P. Van Mulders, N. Van Remortel, I. Villella, Y. Yang, F. Zenoni.

The following members of Antwerp and Mons universities are also members of CMS:
W. Beaumont, N. Belyi, L. Benucci, K. Cerny, E. Daubie, Th. Caeberts, I. Cherednikov, E. De Langhe, A. Deroeck, E. De Wolf, D. Druzhkin, X. Janssen, H. Jung, Th. Maes, L. Mucibello, S. Ochesanu, B. Roland, R. Rougny, M.Selvaggi, F. Van Der Veken, H. Van Haevermaet, P. Van Mechelen, N. Van Remortel)



Display of the highest electron-positron mass event, M(ee)=1309 GeV/c^2, collected by CMS in year 2011

a. CMS operation and data taking

The Compact Muon Solenoid (CMS) experiment is one of the two general purpose experiments situated at the Large Hadron Collider (LHC) at CERN. The LHC has recorded the first proton-proton collisions in November 2009 at an energy of 900 GeV. In 2010, the LHC ran from March up to November at a centre of mass energy of 7 TeV, and the CMS experiment collected a total of 35 pb^{-1} of integrated luminosity.

Great activity and excitement followed in year 2011, since 10 times more data have been recorded by the experiments. This led to an impressive list of more than 70 published physics results, among which a tantalizing hint for the observation of the standard model Brout-Englert-Higgs (BEH) boson. The IIHE team in CMS have actively contributed to data taking and to detector response control, as well as to first physics result analyses, in particular precise tests of the standard model and the first search for new physics beyond the standard model, in different topologies..

Detector operation and tracker monitoring

In 2011, IIHE members have intensively contributed to general CMS operation and control during data taking. Several service work contributions were provided to the collaboration, including detector follow-up, Monte Carlo production, geometry description follow-up, etc.

The IIHE team contributed in particular to the development of data quality monitoring (DQM) programs for the CMS silicon strip tracker. An IIHE post-doc acted as an expert in tracker operations in 2011 and will be in charge of the coordination of the development of tracker data quality monitoring programs in 2012. He is assisted by a new post-doc from Brussels who will serve as a tracker DQM expert.

Building of forward muon chambers

Since 2011 the Forward Resistive Plate Chamber (RPC) upgrade plan has been embedded into the Upgrade Technical Design Report of the CMS experiment. A fourth RPC station is to be designed, built and installed in the CMS end caps to be operational after the long shutdown in 2013. The Forward RPC collaboration has been enlarged for this purpose and now consists of groups from Belgium, CERN, China, India, Italy, Korea and Pakistan. A total of 200 chambers will be built and tested in India (Mumbai), Belgium (UGhent) and CERN. Two IIHE members (W. Van Doninck and L. Van Lancker) are responsible for the mechanical design of the chambers and their integration into the CMS end caps.

CMS upgrades

The completion of the CMS muon spectrometer in the most forward region (pseudo-rapidity range $1.6 < |\eta| < 2.1$) is presently prepared in CMS, in view of the LHC high luminosity upgrade. A group of physicists at the IIHE is contributing to the study of installing micro-pattern gaseous detectors instead of Resistive Plate Chambers (RPC). For this project, the IIHE team are designing, in collaboration with CERN, Saclay and Bari, the data acquisition system of these new detectors. For more details on DAQ R&D developments, see the R&D section below.

b. Top quark physics

In 2011 the CMS experiment collected for the first time an enormous sample of top quarks, pair produced as well as singly produced. This allowed the IIHE team to measure and study diverse aspects of the top quark sector of not only the Standard Model, but also in models beyond the Standard Model.

Cross section of top quark pair processes at 7 TeV: In the lepton + jet decay channel a novel method was applied to simultaneously measure the b-tagging efficiency and the cross section after b-tagging. Both parameters were measured using the distribution of the invariant mass system formed by the lepton and the b-jet of the leptonically decaying top quark. The simultaneous measurement resulted in a reduced total uncertainty on the estimated cross section. Michael Maes won the best poster prize with this topic during the international CMS collaboration week in 2011.

Top quark mass and difference between top and anti-top quark masses: The ideogram technique was applied to measure the mass of the top quark. Using the electric charge of the lepton, the top quark or the anti-top quark can be separated. Using this separation the world most precise measurement of the difference between the top and anti-top quark masses was obtained by our team.

Measurement of the W helicity in top quark decays: Using the distribution of the angle of the lepton and the top quark in top quark pair events, the helicity fractions of the W boson can be fitted. A precise measurement was obtained by our team in collaboration with the CIEMAT (Madrid) group. These fractions have been interpreted to search for anomalous couplings of the top quark. The data does not show evidence for these anomalous couplings.

Search for single-top processes in the Wt channel: The Wt production process has not been observed yet. A new analysis was deployed to search for the first signatures of this process with the data accumulated in 2011. This resulted into the world best limits on the cross section of this process. It is expected that with the 2012 data a discovery can be made of the Wt process.

Search for fourth generation chiral quarks: A novel analysis has been designed and deployed to search inclusively for fourth generation chiral quarks (t' and b'), either in pair production or in single production. When coherently searching for an excess in all possible production processes, the world best limits were obtained on the existence of a fourth generation. With the 2012 data it can be expected that masses of fourth generation quarks can be excluded up to the point where the theory becomes non-perturbative.

Search for third generation supersymmetric particles: Supersymmetry is a popular extension of the standard model, but invokes a large set of new parameters. Simplified benchmark models are developed to allow a general interpretation. Studies have been made to search for the specific model where a pair of stop particles is produced directly, without an intermediate gluino or squark. The relevant observable topologies are studied and the possibility to differentiate these from the standard model processes is outlined.

The above results were presented at international conferences and will be the basis of journal publications soon. Using the dataset to be collected in 2012 we are prepared to study with high precision the production and decay properties of top quarks at the LHC as well as top-like quarks in models beyond the standard model.

c. Search for high mass resonances decaying into an electron pair

High mass resonances decaying into electron pairs provide some of the most important discovery potentials beyond the standard model at the LHC. They are predicted in various models as for example massive gravitons or new massive gauge bosons in the framework of extra spatial dimension models, as well as new heavy Z bosons in Grand Unified Theories.

Since a couple of years physicists of the IIHE play a leading role in the preparation of the physics analyses for the search of heavy resonances decaying into electron pairs. They initiated the creation of the HEEP (High Energy Electron Pairs) working group of CMS in 2006. The full analysis chain was designed and studied using MC simulation and has led to several publications. In 2010 and 2011, the Brussels group had a leading role in the analysis and control of the CMS data at 7 TeV. The group was strongly involved in every step of the analysis.

Triggers and selection: In order to select online high energy electrons, new trigger paths with different pt thresholds have been designed and tested. The selection was designed to have high efficiency (in view of the small expected number of signal events) while rejecting the multijet background from QCD processes, mainly thanks to electron identification and electron isolation criteria. Special attention has been given to the optimisation of the selection for running conditions at high instantaneous luminosity (end of 2011), with in average 10 interactions per beam bunch crossing.

Efficiency and backgrounds: An important work of the Brussels HEEP group was to find procedures to estimate, from the data themselves, the selection efficiency and the remaining background in the final sample, in order to be as independent as possible of Monte-Carlo simulations. For this purpose, several complementary methods have been designed, tested on simulated samples, and successfully applied to the data. The selection efficiency was measured using the "tag and probe method", at the Z pole and at high mass. The backgrounds coming from top-antitop production and from multijet production (QCD processes) were estimated with the "electron-muon" and the "fake-rate" methods, respectively.

Drell-Yan cross section measurement: Using the data driven methods described above to estimate the selection efficiency and the backgrounds, the Drell-Yan cross section was measured, both at the Z peak and at high mass (M > 120 GeV/c2).

Limits on new physics: Important work was also devoted to developing tools to estimate the CMS five-sigma discovery potential for heavy resonances, as well as the 95% confidence limit on the resonance production cross section in case of the absence of signal; statistical tools were also developed for the combination of the electron and the muon decay channels.

The full 2011 dataset was analysed, corresponding to almost 5 fb^{-1} of integrated luminosity, and the results were found to be in agreement with the standard model expectation. The dielectron and dimuon channel results were combined and limits were put on new physics models, exceeding the Tevatron ones. For example in the case of the Sequential Standard Model (SSM) benchmark model, where the massive neutral resonance has the same coupling to fermions as the standard Z boson, a 95% confidence level lower limit on its mass has been set to 2.32 TeV/c^2.

d. Search for the Brout-Englert-Higgs Boson and study of multi-boson production

With almost 5 fb^{-1} of accumulated data collected at 7 TeV in 2011, and 15fb^{-1} of data at 8 TeV expected in 2012, the sensitivity of the LHC experiments to a Brout-Englert-Higgs boson exceeds the sensitivity of Tevatron experiments by a large amount. The IIHE group contributes in two important searches: 1) the search for a heavy scalar boson in the H -> ZZ -> $l^+ l^- \nu \nu$ decay channel, and 2) the search for a light scalar boson in the H -> $\gamma\gamma$ decay channel.

The H -> ZZ -> $l^+ l^- \nu \nu$ decay channel is the most sensitive for a standard model (SM) heavy scalar with mass larger than 250 GeV/c^2, thanks to its large branching ratio compared to the decay into four charged leptons. While a standard model Brout-Englert-Higgs boson with mass between 127 and 600 GeV/c^2 is excluded by the 2011 data, heavier masses are still allowed. The H -> ZZ -> $l^+ l^- \nu \nu$ channel also has a discovery potential in non-standard scenarios, e.g. if a scalar boson only couples to vector bosons and not to fermions, where this channel provides the best experimental sensitivity in the high-mass range. The production would happen through the vector-boson fusion (VBF) mechanism, where the scalar boson is produced by the fusion of two W or Z bosons in association with two forward “tagging” jets. The experimental challenge is mostly the measurement of the missing energy carried by the neutrinos, that is distorted by the presence of a high number of superimposed p-p interactions (pile-up), and the rejection of the Drell-Yan background which has 10^5 times larger cross-section. The impact of pile-up on the selection of the leptons from the Z -> $l^+ l^-$ decay also needs to be minimized.

A team within IIHE is strongly involved in this search, with collaborators from CERN and from Purdue University, in the framework of the CMS H -> ZZ working group. The IIHE members bring their expertise in lepton selection and in the measurement of the ttbar background. This expertise has been gained from the Z’ resonance searches (see previous section)

and from responsibilities in the analysis groups of the CMS collaboration. A post-doctoral researcher also contributes to the determination of the sensitivity to a possible signal, and to the setting of exclusion limits. The IIHE team will contribute to journal papers on the data collected at 8 TeV.

The IIHE team also contributes to the measurement of the ZZ production cross-section in the same final state. This process is rare in the standard model. The SM cross-section is predicted with good theoretical precision, but it could be enhanced at high Z pt if anomalous γZZ and ZZZ triple gauge couplings exist. These couplings will be constrained at the LHC with unprecedented sensitivity, in particular in the ZZ -> $l^+ l^- \nu \nu$ channel thanks to its clean final state and high branching ratio. The ZZ process is also a calibration process for the search for H -> ZZ decay. The IIHE team plays a leading role in this analysis and will contribute to journal papers on 7 TeV and 8 TeV data.

In the search for a light scalar boson (mass < 145 GeV/c^2) via the H -> $\gamma\gamma$ decay channel, a PhD student from IIHE makes an important contribution in the calibration of the endcaps of the electromagnetic calorimeter (ECAL) using π^0 -> $\gamma\gamma$ decays. The expected performance of the ECAL endcaps has not been reached yet, since the constant term of the energy resolution, that determines the sensitivity to a possible peak in the di-photon mass spectrum with one photon detected in the endcaps, is of the order of 3%. If the design resolution of better than 1% is achieved, the sensitivity to a light scalar boson in the di-photon channel should be increased by 15%. This work is performed in close collaboration with the group of Rome University "La Sapienza", which is leading the ECAL calibration effort and with which the Brussels group shared in the past responsibilities in defining the standard electron selection for CMS.

e. Study of strange particle production and of the underlying event

The production of soft hadrons accompanying hard parton scattering in hadron collisions remains a topic that is poorly understood in QCD. This so-called "underlying event" is interesting to study in itself as it carries information about the particle production dynamics. It also constitutes a background to searches for new physics as it unavoidably accompanies each proton-proton collision.

IIHE members initiated a study of the production of neutral strange particles (K^0 mesons and Λ and anti-Λ baryons) in the underlying event. This study was shown to be competitive with other LHC experiments thanks to the remarkable tracking capability of the CMS tracker for low-pt charged particles (down to ~100 MeV/c).

The selection of primary K^0, Λ and anti-Λ hadrons relies on their long lifetime, known mass and two-prong decay topology. A kinematic fit is performed applying constraints on the mass, secondary vertex and flight direction using a program specifically developed at the IIHE. A sample with little background is achieved by selecting only those candidates that are consistent with these constraints.

The results show remarkable similarities with the study of the underlying event with primary charged particles published by LHC collaborations. The dependency of the activity in strange particles on the hard scale given by a track-jet exhibits the same fast rise followed by a plateau, the turn-on point being identical. This analysis was pre-approved by the CMS collaboration and is in the final approval phase before publication.

f. CMS yearly collaboration meeting in Brussels

From September 11 to 15, 2011, Brussels hosted the yearly CMS collaboration meeting that is held outside CERN.

The local organising committee was composed of F. Blekman (VUB), B. Clerbaux (ULB, co-chair), E. Daubie (UMons), J. D'Hondt (VUB, co-chair), X. Janssen (UA), V. Lemaître (UCL), M. Tytgat (UGent), P. Vanlaer (ULB).

Administrative support was provided by M. Goeman, F. Pero and D. Peymans, technical support was provided by J. De Bruyne, P. De Harenne, O. Devroede, M. Frère, A. Ouchene, S. Rugovac, E. Torisaen.

We also gratefully acknowledge the support of the ULB and VUB authorities and departments (external relations, press, promotion and ceremony, logistics, IT) and the financial support of the F.R.S.-FNRS, FWO, ULB, VUB, and of the Brussels Region and Walloon regions.

More than 350 CMS members attended the meeting. Both the new 2011 results and the strategy for the whole 2011 and 2012 data analysis were presented and discussed in detail by each CMS working group. Two special events were organized:

Prof. François Englert delivered a talk on the Brout-Englert-Higgs mechanism and the quest for the Scalar Boson, and Prof. Pierre Marage presented an historical talk on the famous Solvay Councils and the birth of modern physics.

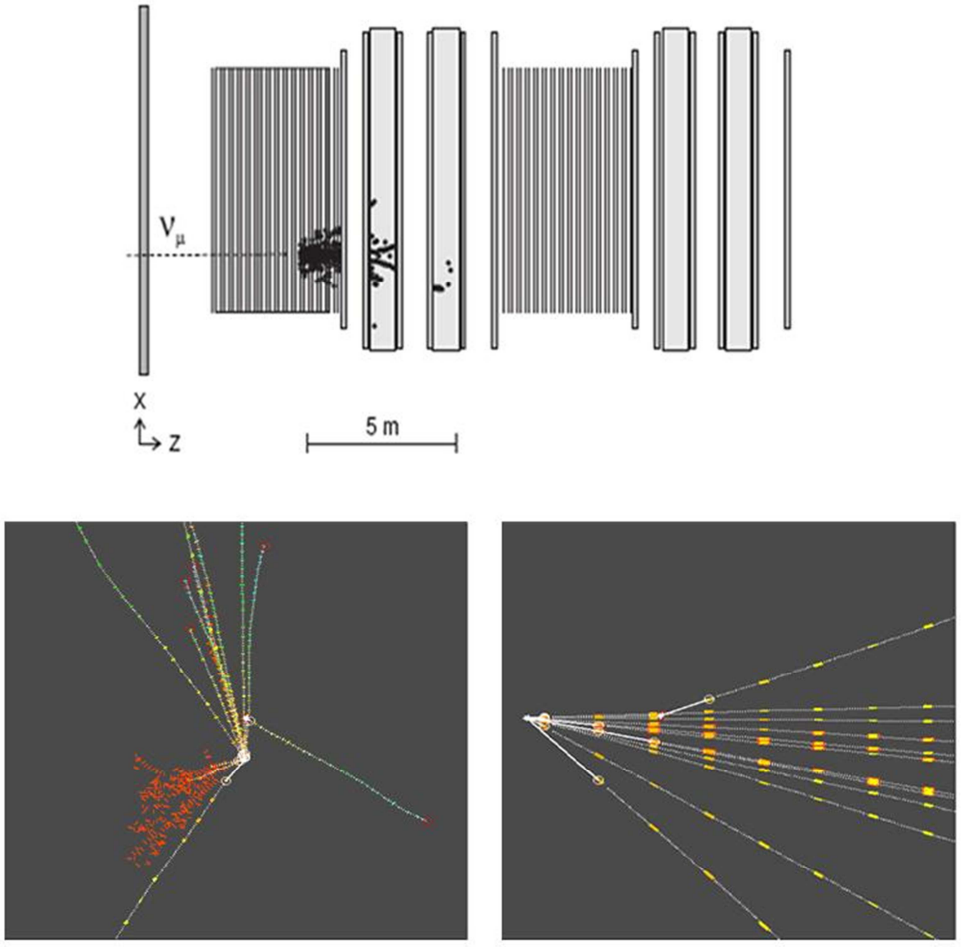
CMS week group photo, Brussels, September 2011

2. The OPERA experiment at CERN and LNGS

(G. Van Beek, P. Vilain, G. Wilquet)

The only experimental evidence today that there exists physics beyond the standard model (SM) is the fact that neutrinos have masses, even though very tiny compared to the other fermions. This is known through the observation of the neutrino oscillation phenomenon in which the neutrino flavour oscillates between ν_e, ν_μ and ν_τ as neutrinos propagate away from their source. This in turn implies that flavour and mass eigenstates mix. Adding masses to neutrinos may be a rather trivial extension of the SM if mass is generated through the same coupling as for the other fermions, only implying the existence of light sterile partners of opposite chirality and otherwise non-observable. Massive neutrinos have no conserved quantum number allowing distinguishing particles from antiparticles besides the lepton number. The apparent lepton number conservation in the neutrino sector may however be an experimental artefact resulting from both the smallness of their mass and the complete violation of parity in weak interactions. It is therefore most commonly admitted that the mechanism explaining the smallness of the masses of the three known neutrinos, the so-called see-saw mechanism, includes additional couplings and associates them to heavy partners with masses approaching the energy scale of the Grand Unification Theory. If the explanation is correct, neutrino masses are signs of physics well beyond the SM.

Not only is the mass matrix of the neutrinos aiming at new physics but also the large mixings between mass and flavour eigenstates is at contrast with the mixings existing in the quark sector. The measured CP violation phase in the quark mixing matrix is known to be too small to explain why the symmetry that must have existed in the early universe between matter and antimatter has led to a universe essentially consisting of matter. The very non-diagonal neutrino mixing matrix may therefore include a large CP violation phase so far not accessible to measurement.



Example of a charm event in OPERA. The top figure shows the event as recorded in the electronic detectors. The overall length of the picture is about 20 m. The two figures at bottom show the transverse and the longitudinal views of the event in the emulsion/lead ECC target. The kink topology compatible with a charm hadron decay is clearly seen. The decay length is 3247 μm and the P_T of the secondary particle measured by Coulomb multiple scattering is larger than 606 MeV/c at 90% CL. This makes the event incompatible with the decay of a charged π or a strange hadron. The probability that it is a hadron scattering in the lead is 4×10^{-4}. The transverse view also shows the electromagnetic showers left by two γ pointing to the primary vertex. Their energies have been estimated by counting the numbers of track segments and are compatible with the decay of a π^0.

The OPERA experiment aims at detecting for the first time the direct appearance of ν_τ in a ν_μ beam, through the identification of the τ^- lepton produced in their charged current interactions, as follows from the oscillation parameter space indicated by the atmospheric neutrinos experiments. The detector is installed in the underground Gran Sasso Laboratory (LNGS) and exposed to the CNGS neutrino beam produced at CERN, 730 km away. The design of the detector takes into account two conflicting requirements: a large target mass to cope with the minute neutrino interaction cross-section and a micrometric resolution to allow the detection of the short-lived tau lepton. The target is made of 150000 basic units called bricks each consisting of 56 lead plates of 1 mm thickness interleaved with emulsion films, for a total weight of 1250 tons. Bricks are assembled in walls and the target is instrumented with the Target Tracker (TT): 62 pairs of planes of horizontal and vertical plastic scintillator strips having their signal collected by WLS fibres and read by multi-anode PM tubes. They are aimed to trigger the DAQ, measure the trajectories of charged particles through the target and locate bricks where neutrino interactions occurred. The instrumented target is divided into two identical super-modules. Downstream of each of these, a magnetic spectrometer identifies and measures the momentum and the charge of the penetrating muons. The dipole

magnets are instrumented internally by planes of RPC and externally by stations of high precision streamer tubes to measure the bending of the tracks. A description of the OPERA detector is available in: The OPERA Collaboration, R. Acquafredda et al., JINST 4 (2009) P04018.

Our group was more specifically involved in the conception, construction and installation of the TT together with two groups of IN2P3 (IPHC, Strasbourg and LAPP, Orsay), the universities of Bern and Neuchâtel, and JINR, Dubna. The TT is described in: T. Adam et al., Nucl. Instrum. Methods A 577 (2007) 523-539. A study of the performances of the electronic detectors has been published: "Study of neutrino interactions with the electronic detectors of the OPERA experiment", The OPERA Collaboration, N. Agafonova et al., New J. Phys. 13 (2011) 053051.

The first physics run took place in 2008 with a fully operational detector. Between 2008 and 2011, more than 14 000 neutrinos interactions have been registered in the target. The integrated neutrino beam flux that has been accumulated corresponds to 79% of the nominal flux. It however reached 90% in 2010 and 107% in 2011. So far, about 26% of the registered interactions have been located into the target bricks and the search for signatures of short lived neutral and charged particles has been completed. A paper presenting the results based on the 2 first years of data-taking is about to be published: "Measurement of $\nu_\mu - \nu_\tau$ oscillation with the OPERA experiment in the CNGS beam", The OPERA Collaboration, N. Agafonova et al., accepted for publication in New J. Phys.

A first ν_τ candidate event has been observed with the τ^- decaying into one prong in a subsample of 1088 fully analysed interactions. The expected number of observed events at full $\nu_\mu - \nu_\tau$ mixing and for $\Delta m^2 = 2.5 \times 10^{-3} eV^2$ is 0.5. The most probable decay mode is $\tau^- \rightarrow \rho^- (\pi^- \pi^0) \nu_\tau$ where the two γ from the π^0 decay are observed and their energies measured in the bricks. The main sources of background are charged charmed particle decays where the primary muon is unidentified and hadron re-interactions at short distance from the primary vertex. From MC estimations, they amount to 0.018 ± 0.007 (syst.) events in the 1-prong hadron channel, the probability for the event to be due to a background fluctuation being of 1.8% and the statistical significance of the observation of a first ν_τ candidate event being of 2.36 σ. The event has been published in: The OPERA Collaboration, N. Agafonova et al., Phys. Lett. B 691 (2010) 138-145.

The analysis of the 2010 and 2011 data is steadily going on. Efforts are being deployed to improve the MC estimation of the charm background and to corroborate and ultimately replace the MC estimation of the hadron re-interactions background by experimental data. Another important ingredient to reduce the background is the possibility to apply selection criteria based on the kinematics of the decay candidates. The momentum of the charged particles can be estimated through the accurate measurement of their multiple Coulomb scattering in the brick. A paper describing the performance of OPERA on this subject has been recently published: "Momentum Measurement by the Multiple Coulomb Scattering Method in the OPERA Lead Emulsion Target", The OPERA Collaboration, N. Agafonova et al., New J. Phys. 14 (2012) 013026.

The study of high energy muons and neutrinos produced in cosmic ray interactions in the atmosphere is a very valuable by-product of this underground experiment. The flux ratio of positively to negatively charged muons has been measured with an unprecedented precision in the high energy region of 1.5 to 2 TeV. The results have been published in: The OPERA Collaboration, N. Agafonova et al.,Eur. Phys. J. C 67 (2010) 25–37. An improved analysis, combined with a substantial increase in statistics, will soon be submitted to publication.

In September 2011 the measurement of the neutrino velocity by the OPERA Collaboration has been released in the preprint arXiv:1109.4807[hep-ex]. The astonishing result is that the more than 15 thousand neutrinos detected by the apparatus exhibited a tiny though significant difference with respect to the expected velocity: CNGS neutrinos were measured to reach OPERA about 60 nanoseconds before the time light would take to travel the same distance, indicating a neutrino velocity higher than the speed of light *c* in vacuum by about 20 parts per million, with an overall significance of 6.2 σ.

In order to perform this study, the OPERA Collaboration, together with experts from CERN and metrology institutions, had performed a series of high precision measurements of distance and of neutrino time of flight. The distance between the origin of the neutrino beam and the OPERA detector was measured with an uncertainty of 20 cm over the 730 km travel path. The neutrino time of flight was determined with an accuracy of less than 10 nanoseconds by using sophisticated instruments including advanced GPS systems and atomic clocks. The time response of all elements of the CNGS beam line and of the OPERA detector had been measured with great precision, as well.

To exclude possible systematic effects related to the statistical treatment of the neutrino creation and arrival times, a two-week long beam test was performed in October with a dedicated SPS proton beam. The modified beam consisted of a single extraction including four bunches about 3 ns long (FWHM) separated by 524 ns and thus allowing to unambiguously associate each neutrino event to its corresponding proton bunch. A total of 20 events were retained, leading to a mean neutrino time of flight in agreement with the one obtained in the main analysis.

At this point, it is essential to note that if the OPERA Collaboration has reported a measurement on the neutrino velocity larger that the speed of light measured in vacuum, it has however never claimed experimental evidence of the violation of special relativity. Instead, the last paragraph of the conclusions of the preprint writes: “In conclusion, despite the large significance of the measurement reported here and the robustness of the analysis, the potentially great impact of the result motivates the continuation of our studies in order to investigate possible still unknown systematic effects that could explain the observed anomaly. We deliberately do not attempt any theoretical or phenomenological interpretation of the results.” This statement has been systematically repeated as an obligation made to speakers in conclusion to the seminars and conference contributions that have followed the release of this questioning result.

In the course of our investigations, two instrumental problems have then been identified. The first one has to do with the frequency of the oscillator of the main OPERA clock that slightly departs from its nominal value. Correcting for this effect leads to an increase of about 10 ns of the neutrino arrival time anticipation. The main problem, leading to an apparent neutrino arrival time anticipation of about 75 ns, is a difference of 75 ns between the measurements made at the time the instrumentation was calibrated in 2006 and 2007 and those made end of 2011, in the time transfer of the GPS signal along a 10 km long optical fibre from the LNGS external laboratory to the OPERA data acquisition system. An explanation, if not a good reason, why this measurement was not repeated before releasing our result relies on two arguments. First, no known effect like aging or temperature can possibly explain variations in the time transfer approaching values as large as several tens of nanoseconds. Secondly, a similar fibre at CERN, even though about 4 times shorter, has been monitored over the years and stability at the level of the nanosecond has been observed. The true cause of the mismatch between measurements has then been identified: a short fibre serving as interface between the long fibre and the LPI converting the analogue optical signal into a digital electronic signal was not properly connected. This in turn has generated a delay to the time at which the optical signal integrated by a photodiode crosses the threshold imposed to the digital signal generation. After the short interface fibre was properly reconnected, the measured time transfer delay was found identical to that obtained in 2006 and 2007 at the nanosecond level. From time coincidences between horizontal cosmic muon signals recorded in the OPERA and the nearby LVD detectors, it has been found that the misconnection dates from the second half of 2008, i.e. after the two calibration measurements in 2006 and 2007 and before the beginning of the data taking period in spring 2009. For which reason this fibre was disconnected and then incorrectly reconnected and by whom will remain unknown. This demonstrates that assuming the stability of the time transfer delay over a period of several years at a level adequate for the purpose of the neutrino velocity measurement was a sensible and by no mean presumptuous assumption. It however also shows that not having re-measured this time delay has been the mistake that has led to the release of a wrong measurement of the neutrino velocity measurement.

A new dedicated two-week run with a beam of narrow bunches this time separated by 100 ns instead of 524 ns and consequently a larger event sample is due to start in May 10 2012.

The experiment is scheduled to run until the end of 2012. If the already allocated data taking period is as successful as in 2011, OPERA will achieve 95% of the goal described in the Proposal in terms of integrated beam intensity. Additional, more accurate, equipment will also be installed to continue the study of the neutrino velocity.

The OPERA Collaboration includes about 160 physicists from 30 institutions in 11 countries. One of us (G. W.) is Chair of the OPERA Collaboration Board since 2008 and until June 2012.

3. The H1 experiment at HERA (DESY, Hamburg)

(F. Ceccopieri, J. Delvax, E. De Wolf (UA), L. Favart, T. Hreus, X. Janssen (UA), R. Roosen, and P. Van Mechelen (UA))

Following the discovery of point-like constituents in the proton at SLAC, during the late 1960’s, a series of neutrino and muon deep inelastic scattering (DIS) experiments was performed in order to further study the partonic structure of nucleons and to develop and test Quantum Chromodynamics (QCD), which had been put forward as the gauge field theory of the strong interaction of confined quarks and gluons.

From 1992 to 2007 the HERA accelerator collided electrons (and positrons) off protons with energies of resp. 27.5 GeV and 820/920 GeV in an underground tunnel at DESY (Hamburg). The main reasons why HERA was able to provide a much deeper understanding of the proton structure than the fixed target experiments in the eighties, was the much higher centre of mass energy and the well-equipped detectors of almost 4 π acceptance, which allowed measuring both the scattered electron and the hadronic final state in many details.

The IIHE and Antwerp groups have been active at HERA in the H1 collaboration since 1987. They contributed building and operating the detector, performed numerous physics analyses, and had numerous responsibilities within the collaboration. In particular, they designed, installed and operated the very forward proton spectrometer (VFPS) consisting of Roman pots devoted to the detailed measurement of diffractive interactions

After 15 years of successful operation, the HERA accelerator was shutdown permanently on July 2007 and the HERA experiments were dismantled in 2008. During this lifespan, a total luminosity of about 500 pb^{-1} has been delivered. The analysis of the collected data is still on-going and is very actively pursued (more than 60 FTE in 2011 in H1).

Since the end of data taking the main activities of the group are related to the VFPS data analysis. Primary issues to be addressed prior to any physics analysis are related to track reconstruction, determination of the scattered proton momentum and background estimates. They include the following:
- a detailed study of fibre efficiencies in the Roman pots has shown that the mean efficiency for the VFPS track reconstruction is 96%;
- using all detailed information on beam and Roman pot position, an approximate method was worked out, providing an estimate of the proton energy to a precision of a few per mil;
- the background due to tracks recorded by the VFPS in conjunction with a non-diffractive DIS event has been estimated by studying triggers in time slices around the physical time slice and found to be less than 2%;
- over the last year, reconstruction of the transverse momentum of the scattered proton has been achieved, providing a resolution of 100 MeV/c, the proton energy being close to 920 GeV. The method uses a neural net, trained using the beam optics, to reconstruct the proton momentum.

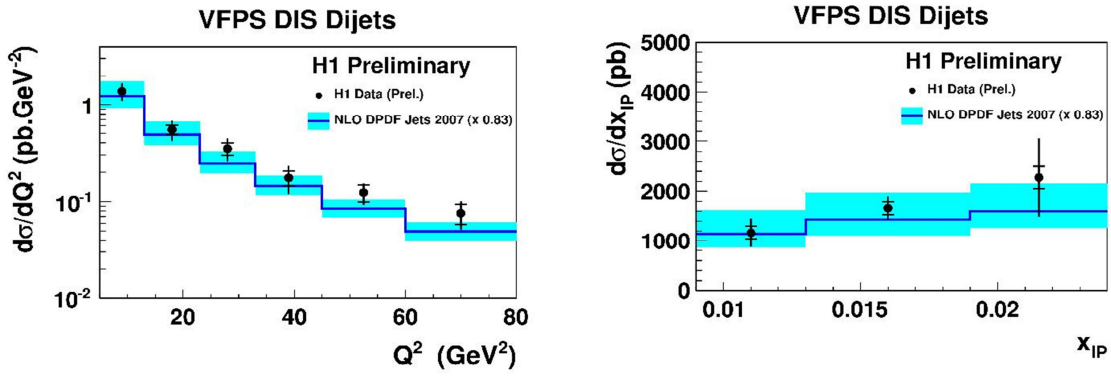
These studies have led to a first measurement of the diffractive proton structure function, $F_2^{D(3)}$, the results of which have been presented to the H1 collaboration and complement existing measurements. These data are presently used in a QCD analysis checking the compatibility between the existing and new data.

A second analysis, studying dijet events in diffractive deep inelastic scattering and in diffractive photoproduction, has been worked out. It will shed further light on the factorisation breaking observed in photoproduction by measuring the proton four-momentum transfer using the VFPS.

The diffractive dijet cross section, with the scattered proton being measured in the VFPS, has been measured in the electroproduction regime. The preliminary results, shown for the first time at the DIS2011 conference, indicate a good agreement with the QCD prediction as shown in the figure, where the cross section is presented differentially in the exchanged photon virtuality, Q^2, and in the proton momentum loss fraction x_{IP}.

Diffractive dijet production is also studied in the photoproduction regime to test QCD factorisation, in collaboration with the group of Charles University at Prague.

Phenomenological work is also being performed to extract the partonic structure in the case of diffractive scattering using the new and more precise H1 measurements. This work is done in collaboration with theorists of the ULg in the framework of the IAP Network.



Differential measurements of diffractive dijet production in deep inelastic scattering.

4. The IceCube experiment at the South Pole

(S. Bechet, D. Bertrand, Fl. Binet (UMons), D. Bose, S. Buitink, L. Brayeur, M. Casier, C. De Clerq, M. Dierckxsens, D. Dierderix, B. Dumoulin, N. van Eijndhoven, M. Frère, K. Hanson, D. Heereman von Zuydtwyck, G. Kohnen (UMons), J. Kunnen, M. Labare, K. Singh, E. Strahler, E. Verhagen)

Astroparticle physics revolves around phenomena that involve particle astrophysics under the most extreme conditions. Black holes with masses a billion times greater than the mass of the Sun, accelerate particles in jets to velocities close to the speed of light. The produced high-energy particles may be detected on Earth and as such provide an insight in the physical processes underlying these cataclysmic events.

Having no electrical charge and interacting only weakly with matter, neutrinos are special astronomical messengers. Only they can carry information from violent cosmological events at the edge of the observable universe directly towards the Earth. Furthermore, since they are hardly hindered by intervening matter, they are the only messengers that can provide information about the central cores of cosmic accelerators like Gamma Ray Bursts and Active Galactic Nuclei, which are believed to be the most violent cosmic events and the sources of the most energetic cosmic rays. Identification of related neutrino activity would unambiguously indicate hadronic activity and as such provide clues to unravel the nature of these mysterious phenomena.

Another mystery of the Universe is the illustrious Dark Matter, which has not yet been directly observed but is invoked to explain various observed phenomena. According to some models, this dark matter may consist of Weakly Interacting Massive Particles (WIMPs), which could annihilate among themselves. In these annihilation processes some of the produced particles would be high-energy neutrinos. Since these WIMPS are expected to get trapped in gravitational fields, there may be large concentrations of them at the centre of massive objects like our Sun, the Earth or the centre and halo of our galaxy. Consequently, observation of high-energy neutrinos from these objects could provide indirect evidence for the existence of these dark matter particles.

Members of the IIHE (as well as from UMons and, more recently, for Ghent University) have been involved since the 1990's in a world wide effort to search for high-energy neutrinos originating from cosmic phenomena or from dark matter particles. For this we use the IceCube neutrino observatory at the South Pole, the world's largest neutrino telescope, which is now complete and taking data.

The IceCube observatory

IceCube (http://www.icecube.wisc.edu) is a neutrino telescope consisting of an array of optical sensors, located in the icecap of the South Pole at depths between 1450 and 2450 m.

The sensors are arrayed on vertical cables, called strings, each of which comprises 60 sensors spaced by 17 m. In the horizontal plane, the strings are arranged in a triangular pattern such that the distance between adjacent strings is always 125 m. The overall configuration exhibits a hexagonal structure, which has been designed according to extensive optimisation procedures based on simulation studies.

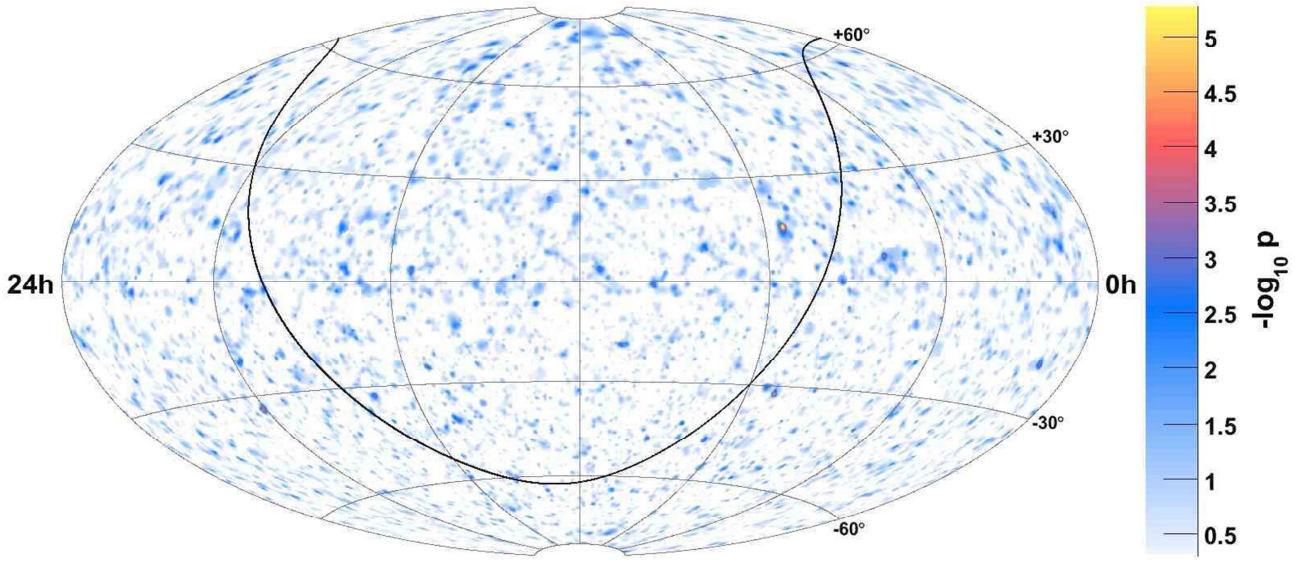
At the end of 2010 the foreseen 86-string detector, including its Deep Core extension (see hereafter), has been completed and started to take data, representing an operational observatory with an instrumented volume of 1 km^3.

Due to the geometrical configuration outlined above, the energy sensitivity for IceCube is ranging from a few hundred GeV up to several PeV. However, based on theoretical calculations the cosmic sources of interest are expected to yield an E^{-2} power law energy spectrum for the produced neutrino flux, whereas most of the neutrinos originating from dark matter particles are expected to have energies below the IceCube detection threshold. This implies that extending the sensitivity to lower energies will provide a significant increase in the neutrino detection potential.

Sensitivity to lower energies can be obtained by a smaller spacing between adjacent sensors. To achieve this, IceCube has been extended with a dense core located at the deepest parts of the detector. This so called Deep Core extension consists of 360 photomultipliers on 6 strings arranged around the central IceCube string, such that the distance between adjacent strings will be 72 m as opposed to the 125 m standard IceCube string spacing.

Each Deep Core string has 50 sensors at 7 m spacing covering depths between 2100 and 2450 meter and 10 sensors at 10 m spacing between 1750 and 1860 m. With this Deep Core extension the lower energy threshold will be pushed down by an order of magnitude, to about 20 GeV.

Furthermore, located at these large depths and completely surrounded by standard IceCube strings, an efficient trigger and veto system may be developed such that the Deep Core sensors provide sensitivity over the full 4π solid angle. This will allow investigation of sources in the Southern hemisphere, including the Galactic centre and the black hole within it.



All-sky neutrino map in equatorial coordinates, based on the IceCube data taken in 2009 (40 string detector, 376 days). Each dot represents the origin of one of the 5100 detected muon neutrinos. The hottest spot is visible at a right ascension of 113.75° and a declination of 15.15°. Its post-trial p-value is 18.17% (1817 of 10000 simulations of random background produce p-values at this level or lower). The thick black line represents the plane of the galaxy.

Research areas at the IIHE

The IIHE team is involved in the following IceCube related particle astrophysics topics :

Search for cosmic point sources: This research comprises a full sky search for "hot spots" of neutrino production, using a novel statistics method that has been developed at the IIHE. Identification of such "hot spots" on the neutrino sky would enable us to locate the sources of the most energetic cosmic ray particles.

Search for Dark Matter: In these studies the IIHE group is focusing on neutrino signatures from WIMPs located in the centre of the Sun or of the Earth. Using the data taken in the summer of 2010, a first attempt has been made at detecting down-going low energy neutrinos (< 500 GeV) with the Deep Core, using IceCube as a veto against atmospheric muons. The dark matter searches will be confronted with different models of physics beyond the standard model, like Supersymmetry, secluded dark matter, etc.

Detection of high-energy tau-neutrinos: The production of high-energy ν_τ particles in astrophysical processes is negligible. However, due to neutrino oscillations a tau-neutrino component may be present in the overall neutrino flux. Identification of these particles in the IceCube data would enable us to validate various neutrino oscillation scenarios.

Search for high-energy neutrinos from transient events: This study is aimed at the identification of high-energy neutrino production in relation with Gamma Ray Bursts or flares of Active Galactic Nuclei. At the IIHE a special analysis method for the study of these phenomena has been developed and with the full IceCube observatory now being operational, we have the possibility of observing neutrinos from these processes for the first time in history, with unprecedented sensitivity.

Search for neutrinos from supernovae: Neutrinos from supernovae are expected to have MeV energies, which is well below the detector threshold. These neutrinos are detected in IceCube as a global increase in the noise rate of the photomultipliers. A special trigger has been built to send alerts to the SNEWS (SuperNova Early Warning System) network. The IIHE group has taken the lead in developing a new readout system for the IceCube data acquisition system which will allow a complete snapshot of all activity in the detector for minutes surrounding a supernova trigger. While the current

supernova system relies on a simple scaler counting of photodetector activity and measures only the “light curve” of the neutrino shockwave emitted by the stellar collapse, this improved system will permit exploration of many other physical parameters taking place: neutrino temperature and matter oscillations of the neutrinos exiting the proto-neutron star are particular examples.

IceCube service tasks

The IIHE members are additionally involved in the aspects of operation of the IceCube facility that are vital to supporting the scientific mission: K. Hanson leads the engineering team responsible for the delivery of the IceCube data acquisition hardware and software. G. Kohnen is responsible for the maintenance of the IceCube database systems.

5. The ARA project at the South Pole

(K. Hanson, Th. Meures, Y. Yang)

Project overview

In 2009 researchers from the IceCube and ANITA collaborations began a concentrated effort to realize a 100 km^2 detector at the South Pole: the ARA (Askar’yan Radio Array) detector. The detector technology is premised on antennas sensitive to the electromagnetic Askar'yan pulse radiated when high energy electromagnetic cascades dissipate in dense RF transparent media.

The grand scale of the ARA project is necessitated by the main science goal of the experiment: the detection of the extremely weak flux of neutrinos resulting from the scattering of UHECRs (ultrahigh-energy cosmic rays) off the cosmic microwave background. This flux is conventionally called the GZK neutrino flux, after the researchers who first predicted the phenomenon 40 years ago.

A measurement of this signal or even a more stringent flux limitation than is currently available would provide valuable information to constrain further the properties of the UHECRs and advance the field of particle astrophysics closer to understanding the fundamental question of the origin of cosmic rays. The current theoretical predictions and the state-of-the-art ARA detector sensitivity, indicate that after three years of operation, a 100 km^2 ARA detector configuration would either be expected to measure O(10) events and positively establish the field of GZK neutrino astronomy, or would exclude even the most parsimonious models of GZK neutrino production.

Achievements in 2011

The technical challenges for ARA are manifold. The deployment below the firn at the South Pole of over 500 RF antennas and attendant electronics running at trigger thresholds of only a few times the thermal noise floor presents a challenge. Doing this with limited power resources is a further challenge. The antennas are moreover distributed over a 10 km by 10 km surface at the South Pole which drives the R&D efforts to generate the power locally and use wireless radio communications to bring the data collected by the antennas back to a central data acquisition facility.

The IIHE group has been active in the following areas of the development of the ARA detector:

- design and test of the ARA GPS clock system;

- development of firmware for the triggering and readout of ARA digitizer;

- procurement of the optical fibre cabling for ARA stations 1 and 2;

- ARA station 1 drilling and deployment: during the Austral summer season (2011-2012) T. Meures deployed to South Pole station to serve as drill team member. Additionally he tested the wireless communication system proposed to future deployment and made extensive RF background surveys of the South Pole site.

One of the major activities undertaken by the particle astrophysics group in conjunction with the R&D group of the IIHE has been the development of a digital communication circuit to permit the deployment of digitization electronics below the firn local to the antennas. The system requires that this communication infrastructure transmit at least 500 Mb/sec and additionally distribute a synchronous clock signal with a skew jitter of less than 50 ps. These technical goals were partially achieved with a system which used a modified Ethernet PHY and achieved the signalling over CAT5/6 twisted pairs. An improved system which uses optical fibre transceivers and gigabit transceiver blocks (GTPs) routinely built into FPGA devices is currently under development with first tests yielding performance results that are very close to the design goal. It should be mentioned that the technology developed here also has multiple applications in research and industrial domains: it

is a generic framework for synchronizing sensors or other systems to an accuracy of picoseconds over distances which are practically unlimited.

ARA Drilling 2011-2012: Dr. Gary Hill (left) and Thomas Meures (right) prepare the ARA drill. (Photo credit Mike Duvernois)

The ARA activity has resulted in presentations during 2011 by IIHE members. In addition, the ARA collaboration published the first performance results of data taken during 2010 with the ARA testbed.

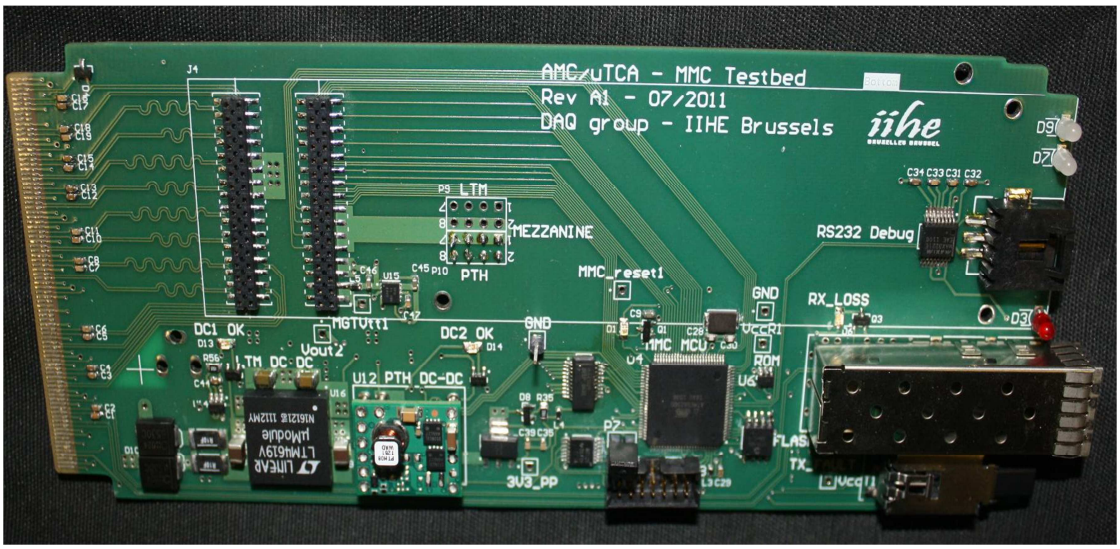
6. Data Acquisition R&D project

(G. De Lentdecker, K. Hanson, Th. Maerschalk, Th. Meures, E. Verhagen, Y. Yang)

Since 2007, the IIHE has started an R&D program in the field of data acquisition (DAQ) systems for future experiments in particle and astroparticle physics. Modern technologies allow designing a DAQ architecture independent of the detector technology to which the DAQ system will be connected, providing freedom to the choice of the future experiment. In addition, future particle and astroparticle experiments plan to use the most advanced technologies from the telecommunication and the digital programmable electronic industries: Advanced Telecom Computing Architecture (ATCA or micro-TCA) standard and Field Programmable Gate Arrays (FPGA). The choice to start such an R&D program at the IIHE has been driven by the fact that the laboratory has a large expertise in the development of DAQ systems for the major experiments in particle and astroparticle physics (DELPHI, H1, CMS, IceCube).

DAQ system for a prototype of TPC for a future linear collider detector: To conduct these developments in a concrete frame, the laboratory started a collaboration with the University of Lund (Sweden) and CERN to develop the DAQ system for a large prototype of Time Projection Chamber (TPC) that could be installed at a future linear electron-positron collider (ILC or CLIC), where the FPGAs and ATCA technologies will be largely used. The experience gained at the IIHE in developing DAQ systems in this framework will be a valuable asset for a probable participation of the laboratory in any future experiment in particle or astroparticle physics.

These developments, initially performed within the EUDET project supported by the European Commission (EC) in the 6th Framework Program (FP6), are now pursued in the framework of the EC FP7 AIDA (Advanced European Infrastructure for Detectors at Accelerators) project, which started on the 1st of February 2011. In AIDA, the DAQ system has been identified as a key component, and the design of a common DAQ system to all ILC or CLIC sub-detectors is now one of the main targets. In this project the IIHE is contributing to the development of the TPC DAQ prototype, by including components of the new micro-TCA standard to make it more flexible and easily adaptable to other detector technologies and other experiments. This should be achieved by designing Advanced Mezzanine Cards (AMC) equipped with FPGAs with Giga-bit Ethernet and PCIexpress connections to the micro-TCA backplane. The Figure shows the first board prototype built at the IIHE during summer 2011, which is now under test.



First micro-TCA Advanced Mezzanine Board (AMC) built at the IIHE

ARA: Since 2010, DAQ developments have started for the Askaryan Radiotelescope Array (ARA) project, where the detectors will be spread over an area of some 100 km^2 in the South Pole ice. One of the major activities undertaken by the IIHE team for this project has been the development of a digital communication circuit to permit the deployment of digitization electronics below the firn local to the antennas, with the transmission of at least 500 Mb/sec and the distribution of a synchronous clock signal with a skew jitter of less than 50 ps. See the "ARA project" chapter of this document for more details.

Front-end preamplifiers for the CMS forward muon spectrometer: Since July 2011, the IIHE is also contributing to the study of installing micro-pattern gaseous detectors instead of Resistive Plate Chambers (RPC) in the forward region ($1.6 < |\eta| < 2.1$) of the CMS muon spectrometer for the LHC high luminosity phase, after 2017. In this project the IIHE is responsible for the design of the digital part of the new front-end pre-amplifier as well as the design of the data acquisition and trigger systems that have to be integrated within the CMS DAQ system. The new readout system will be based on the micro-TCA standard.

Generic studies for CMS upgrades: Since the CMS collaboration is currently planning to use the new micro-TCA standard as the baseline for all the detector electronics upgrades of the experiment, our laboratory, together with the University of Antwerp, is also studying a general issue: the remote configuration and programming of the FPGAs that will equip AMCs mounted in the micro-TCA crates. This study is of interest for other experiments as well, where the detectors and the electronics are spread over a large area and cannot be easily accessed.

7. Development of new scintillation materials and of radiation detectors for biomedical imaging applications: the Crystal Clear project

(P. Bruyndonckx, Dang Jun, Li Zhi and S. Tavernier)

From its inception, PET technology has continually benefited from new developments in radiation detection for fundamental research in high energy physics, first using sodium iodide crystals, then using the improved performance from bismuth germinate (BGO), and more recently using superior materials such as lutetium orthosilicate or lutetium aluminates. These new scintillators are faster and produce more light than BGO. The arrival of more advanced position sensitive PMTs (PS-PMTs), Avalanche photo diodes (APDs) or Silicon PMTs make it possible to read out matrices of small crystals individually, without the introduction of excessive dead space.

In the framework of the Crystal Clear Collaboration (CCC), the medical instrumentation group of the IIHE has been exploring several research lines that could, in the future, improve the performance of PET scanners. In preparation for the design and construction of a new generation BrainPET scanner, studies using Avalanche Photo diodes (APD) are performed. APDs are more compact, more easily subdivided in small pixels, and potentially lower in cost. In these prototype detector modules, very small individual crystals are replaced by solid scintillator blocks to eliminate dead zones between the crystals. In addition, these scintillator blocks are less expensive to produce and easier to mount. The position and depth of interaction is determined from the light distribution measured over the pixels in the APD array. The information is extracted from the light profile using neural networks, support vector machines, or statistically based methods.

First prototype of multimodal dedicated PET/US scanner for mammography

The performance of these detector configurations for tomographic imaging can be evaluated on a hardware simulator. This device consists of two rotating platforms onto which two detector modules can be mounted. The two platforms can rotate over 360° and the modules can also rotate relative to one another. This allows us to simulate a complete (or partial) detector ring and reconstruct tomographic images of an object. The resulting image shows the very encouraging resolution of 1.6 mm FWHM.

The statistical learning algorithms used to find the photon incidence position need to be trained before they can be used. An in-situ position calibration procedure has been developed which allows a fully automatic collection of a training data sets for all detector modules in a fully assembled PET system.

The BrainPET project is a joined effort of de IIHE team, in collaboration with CIEMAT (Madrid, Spain) and FZJ (Julich, Germany). The basic detector modules will consist of a dual layer of trapezoidal LSO blocks. The complete system will consist of 4 detector rings, each with 52 detector modules. To determine the optimal design parameters of the detector modules, extensive simulations using GATE were performed. This allowed us estimating the impact of many parameters such as crystal thicknesses, training data pattern to be recorded, electronic noise level and digitization accuracy, APD gain, position of the APDs on the LSO blocks, scattering in photo detectors and electronics very close to the scintillators, etc. The final parameters of the BrainPET system that will be developed by the collaboration were determined on the basis of this study.

One of the conclusions of our study was that the spatial resolution is mainly limited by the signal to-noise ratio (SNR) of the APD signals. The SNR suffers from the low APD gain and high excess noise factor. The newly developed silicon PMTs allow a much larger gain and therefore could significantly improve the resolution that can be achieved with such a system.

Since a few years there has also been a steadily growing interest in using PET for mammography studies. Existing clinical PET systems are not optimized for this application, and the development of dedicated Positron Emission Mammography (PEM) scanners, which are specifically designed and optimized for the task at hand, is required.

Our research group is also actively involved in the development of a second generation of the ClearPEM prototypes. These are dedicated PET scanners for mammographic breast imaging. In this second generation, an ultra-sound (US) probe will be added to complement the mammographic PET studies with anatomical information. Our contribution will be the study of algorithms to fuse the PET and US images, overlaying the anatomical features with the corresponding molecular signatures of the cancer process. In order to develop and test appropriate algorithms, a suitable phantom has to be developed that can be used for both the PET and US imaging.

In collaboration with the Laboratoire de Mécanique et d'Acoustique of the CNRS in Marseille, several material mixtures have been tested for their ultra-sonic properties (speed of sound, attenuation of sound waves, absence of shear waves,..) and compared with those found in real human breast tissue. With the help of this phantom, strategies for image fusion of the PET an US image were studied, and a proposal on how this will be done as soon as the clinical images are available was worked out.

The ethical commission of the Hôpital de la Timone, in Marseille, has recently given the permission to start clinical trials with the Combined ClearPET - Ultrasound system that is now installed at their premises. These trials are due to start in 2012.

8. Phenomenology group

(F. Blekman, B. Craps, K. De Causmaecker (GOA), C. De Clercq, J. D'Hondt, P. Grajek (GOA), T. In't Veld (KUL), A. Kalogeropoulos, F. Maltoni (UCL), A. Mariotti, K. Mawatari (GOA), B. Oexl (GOA), A. Sevrin)

In the course of 2010 the theoretical physics (THEP) and experimental particle physics (ELEM) groups of VUB obtained a GOA (Geconcerteerde OnderzoeksActies) funding from the university, to start a phenomenology research group to link those groups. The promoters of the project are B. Craps (THEP), C. De Clercq (ELEM), J. D'Hondt (ELEM) and A. Sevrin (THEP). The leader of the group is K. Mawatari. This group has a close collaboration with F. Maltoni and his group from UCL.

The main topic of research is supersymmetric models and their signatures at the Large Hadron Collider (LHC) – see http://we.vub.ac.be/dntk/GOA.html . The project is to study the supersymmetry breaking mechanism on a formal theoretical level, explore the phenomenology of sometimes novel models, and provide methods to observe the signatures within particle collisions at the LHC.

In 2011, we mainly focused on the gravitino phenomenology at colliders. Gravitinos are spin-3/2 superpartners of gravitons in local supersymmetric extensions to the standard model, and can play an important role in collider signatures when those are the lightest supersymmetric particle, which is often the case in gauge mediated SUSY breaking scenarios.

The implementation of the gravitino/goldstino into the MadGraph/MadEvent generator was accomplished (EPJC71(2011)1529 and 1783) by K. Mawatari with K. Hagiwara and Y. Takaesu. This allowed us studying the gravitino phenomenology at future linear colliders (EPJC71(2011)1783, K. Mawatari, B. Oexl and Y. Takaesu) and the goldstino phenomenology at colliders (arXiv:1112.5058, R. Argurio, K. de Causmaecker, G. Ferretti, A. Mariotti, K. Mawatari and Y. Takaesu).

In addition, K. Mawatari presented the next-to-leading order cross section calculation for the squark-neutralino production as the first application of the fully automized MadGolem package (PRD84(2011)075005 with T.Binoth, D.Goncalves-Netto, D.Lopez-Val, T.Plehn, I.Wigmore).

9. Computing and networking

(D. Bertrand, F. Blekman, O. Devroede, M. Frère, J. D'Hondt, S. Gérard, K. Hanson, G. Kohnen (Umons), A. Ouchene, S. Rugovac, S. Tavernier, E. Torisaen, P. Vanlaer, R. Vandenbroucke)

a. Local computing resources

(coordinator: K. Hanson)

Computing

The local computing facility consists of a computing cluster containing 300 cores which uses the OpenPBS batch queuing system to handle job submission. In addition, a specialized graphics processing (GPU) platform which contains the recent Tesla processing engine from NVIDIA has been installed to support the specific scientific simulation tasks of the experimental teams at the IIHE.

Physicists are equipped with laptop computers.

Storage

The storage server which was purchased in 2009 by the IceCube group was installed into the IIHE cluster in 2010, providing 63 TB of disk space for users. At the end of 2010 IceCube purchased another 96 TB J4500 storage array. This storage will in large part be put to use to store IceCube experimental and simulated data: the level 2 reduced data set for the data runs of 2010 alone occupies over 50 TB.

Networking

In 2010, the IIHE computing support division began a program to install a wireless network infrastructure throughout the institute. This network now comprises 10 wireless access points distributed throughout the premises and each connected to a captive portal system for user authentication. This authentication is shared with the Unix account authentication both of which will be managed using LDAP. Additionally, the IT team is in the process of adding the IIHE into the eduroam network of distributed authentication. In this manner, visitors to the IIHE from participating institutions can securely and automatically connect to the wireless using their host institutions' credentials.

b. IceCube computing

The IceCube collaboration relies on its collaborating institutions to provide computing resources to generate simulated data sets. These data sets require vast amounts of CPU and because of the complexities of simulating the complex ice optical structure present, require compute hosts with at least 2 GB RAM per core to hold the "photon tables" which describe the complicated photon transport coefficients.

The IIHE cluster, described above, has been used by the IceCube Simulation Production group, under the local supervision of A. Marotta and G. Kohnen, to process more than 25000 simulation jobs for a total CPU time of over 5000 CPU-days. Additionally, the cluster is used to filter the data coming back from recent seasons for analysis by the IceCube researchers.

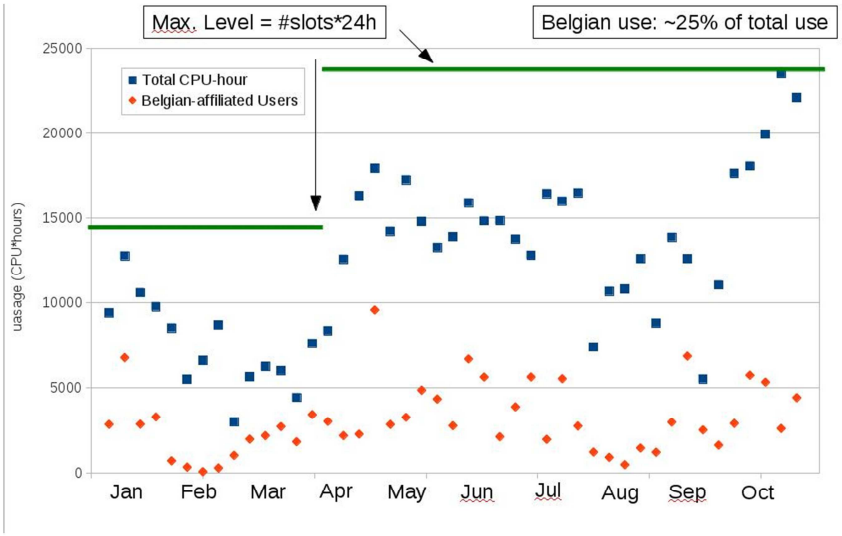
c. Large scale computing for CMS and TIER-2 cluster

Distributed computing based on Grid technology is the solution chosen by CERN for the storage and the analysis of the large amounts of data that are produced by the LHC experiments. The IIHE computing team is involved in several national and international Grid projects. A CMS "Tier-2" cluster has been installed since 2006 and is fully integrated in the worldwide LHC computing grid (W-LCG) of computing centres since 2007. In 2008, the Brussels Tier-2 cluster was moved to the ULB-VUB Computing Centre, to benefit from scale savings due to shared electric power, air conditioning and high-bandwidth networking infrastructures with the ULB-VUB high-performance computing equipment.

The Brussels Tier-2 contributes significantly to the computing resources of the CMS collaboration. It hosts the contributions of the UA, UGent, UMons, ULB and VUB universities, and is funded by the F.R.S.-FNRS and by the FWO. It is part of a "federated Tier-2"computing centre, together with another Tier-2 site at UCL. The two sites support the analyses of the ~65 Belgian CMS physicists, and have been a crucial tool in 2010 and 2011 to allow Belgian physicists contributing in an important way in the analyses of the LHC data.

In 2011 the Brussels Tier-2 was further developed, reaching the level of resources pledged for low-luminosity LHC running conditions as defined in the Memorandum of Understanding of the worldwide LHC computing grid. The equipment deployed in 2011 consisted in:
- an increase of 40% of computing power compared to 2010, i.e. 5.2 Tera-Flops and 400 batch slots. The total computing power is equivalent to 13.5 Tera-Flops or 9900 HepSpec06 units (1040 batch slots);
- 610 TB of mass storage disks, both to replace obsolete disks and to further extend the storage capacity, to reach a total of 850 TB in July 2012 as required by the CMS collaboration for a nominal Tier-2 site;
- an extra rack to host future additional equipment.

The computing team (J. Maes) also contributed to the testing of new releases of the CMS Remote Analysis Builder (CRAB) program, i.e. the interface to submit CMS analysis jobs on the grid.



Use of processing power in number of batch slots occupied times hours per day, compared to 100% use (green line). The use of the cluster in interactive mode is not included in the graph.

The level of use of the data processing power deployed at Brussels is shown in the Figure. The site is occupied at 70% (averaged over working and non-working days).

The Brussels Tier-2 team counted in 2011 four IT scientists (Sh. Rugovac, F.R.S.-FNRS; O. Devroede, UGent/VUB; J. Maes, UA; S. Gérard, VSC, part time). Pascal Vanlaer, seconded by G. Bruno (UCL), is in charge of the Belgian federated Tier-2 sites and the representative to the W-LCG and CMS computing boards. O. Devroede is the technical coordinator of the Belgian Tier-2 sites. In addition, IIHE members act as representatives of ULB and VUB in regional bodies promoting the deployment of large computing infrastructures in Belgium, the Consortium des Equipements de Calcul Intensif (CECI) in the Wallonia-Brussels Federation, and the Vlaams Supercomputer Centrum (VSC) in Flanders.

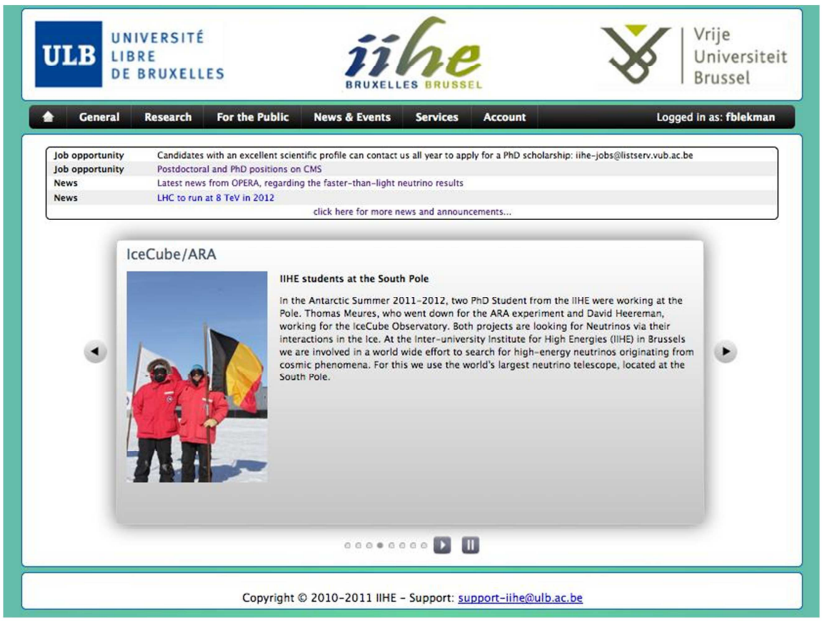
10. Communication and outreach

a. Web site

A new IIHE web site was created in 2011. The redesigned site, designed by M. Frère, E. Torisaen, and F. Blekman (coordinator), allows for a customizable user experience, with both secretariat and multiple administrators being able to perform standard tasks that were previously only possible to be done by the IT department.

Information such as articles aimed at the general public and the presentation of the experimental groups can now be edited without needing an access to the web server or the knowledge of HTML. News items and job advertisement are customizable via an easy user-interface and have an expiration date, to avoid outdated information remaining indefinitely on

the site. Additional content such as library access, travel declaration forms and other internal information are accessible to all IIHE users after login to the site.



The new IIHE home web page

b. Visit at CERN of ULB students

The tradition of proposing to the ULB physics students a visit at CERN has been started many years ago by P. Vilain. It has now been systematised (coordinator: B. Clerbaux), in the form of a three day visit, which is included in the official study program in BA3.

In 2011, 25 students visited CERN. They attended a lecture on accelerator technologies by Dr. Django Manglunki, which was illustrated by the visit of the proton and ion accelerator complex and of the CERN Control Centre; two experiments at the LHC (CMS and LHCb) were visited, as well as SPS fixed target experiments (NA61, NA62, COMPASS), antiproton experiments in the AD hall, and the CAST and CLOUD experiments.

c. Master classes and other activities for secondary school students

Like every year since 2005, master classes in particle physics have been organized.

The coordination was performed by G. De Lentdecker, with the scientific participation of B. Clerbaux, L. Favart, P. Vanlaer and C. Vander Velde, together with the help of the postdocs and PhD students. P. De Harenne, R. Goorens and D. Peymans contributed to the organisation.

Twice a year, the master classes gathers more than 30 secondary school students for an introductory day about particle physics. The students attend a series of lectures on the standard model, the evolution of the universe as well as on particle detectors and colliders. They visit the laboratories and perform on computers the analysis of Z boson decays recorded with the DELPHI experiment at CERN LEP collider.

The IIHE is also involved in the OCRE project, which aims at studying cosmic rays with a network of scintillators installed in Belgian secondary schools. At the IIHE, the detectors and their electronics have been designed by D. Bertrand and L. Etienne.

In 2011 the IIHE also welcome one secondary school student to perform a one week stage.

d. Wide public outreach

The yearly CMS meeting at Brussels attracted the interest of the press, with several echoes in Flemish and French-speaking newspapers and radio.

The announcement by the OPERA experiment of an unexpected measurement of neutrino velocity being larger than that of light in the vacuum also attracted a large interest. Although the effect was finally proven to be an experimental artifact, this event offered the opportunity to explain to a larger public the opened questions in science, and also how science works.

In addition, several members of the IIHE contributed in several ways to science outreach, as shown in the detailed lists of activities below.

11. Technical and administrative work

a. Workshop

(J. De Bruyne, P. de Harenne, L. Etienne, R. Goorens, S. Hannaert, G. Van Beek, R. Vanderhaeghen, L. Van Lancker, Ch. Wastiels and Y. Yang ; coordinator : G. De Lentdecker).

L. Van Lancker was responsible for the design of the additional RPC muon chambers which will be installed in the CMS detector during the next shutdown. He was also involved in the preparation of the installation procedure.

Y. Yang was responsible for the development of a test DAQ system based on the recent micro-TCA technology in the framework of the preparation of new detectors for future experiments. He was involved in the design of an FPGA based board. He also participated to the development of the readout of the ARA neutrino detector.

L. Etienne was responsible for the maintenance of the test station for the DOMs (Digital Optical Modules) of the IceCube experiment. He also maintained several didactic experiments which are used for teaching to BA and MA students in physics, and he was in charge of a cosmic ray experiment to be implemented in secondary schools (OCRE-KOSMIS).

J. De Bruyne, L. Etienne, S. Hannaert and G. Van Beek participated to the development of a new muon experiment, based on scintillating fibres and angular track information, to be used by students (ARCH).

In the framework of the spin-off activities related to detector developments for medical applications, J. De Bruyne and Ch. Wastiels were in charge of the technical support of the Crystal Clear project. More particularly Ch. Wastiels maintained electronics control cards for the small PET camera.

R. Vanderhaeghen was in charge of the maintenance of the electronic workshop.

b. Secretariat

The secretarial work and the general administrative and logistic support of the experiments were in charge of M. Goeman and D. Peymans, with the collaboration of J. De Bruyne, A. De Coster, P. De Harenne, F. Pero and D. Pirnay.

J. De Bruyne and P. De Harenne provided daily support for numerous tasks; A. De Coster was responsible for the library, and she maintained the publication database; F. Pero was in charge of ULB travels; D. Pirnay maintained the IAP and Phenomenology Group websites, and she contributed to the edition of the IIHE 2010 Annual Report.

The organisation of the annual meeting of the IIHE Brussels on December 4 was in the hands of J. D'Hondt and P. Vanlaer, with support from M. Goeman.

III. ACTIVITIES OF IIHE MEMBERS

1. Contributions to experiments

a. Responsibilities in experiments

Daniel Bertrand
- member of IceCube Executive Committee
- member of IceCube Collaboration Board

Barbara Clerbaux
- responsible CMS tracker geometry validation,
- contact person of CMS Exotica high pt electron
- co-coordinator of CMS HEEP (High energy electron pairs) group

Freya Blekman
- co-chair of CMS Analysis Review Committee for EXO-11-059 Search for monojets and unparticles
- editor for CMS Physics Analysis Summary BTV-11-002 Status of b-tagging tools for 2011 data analysis
- member CMS Analysis Review Committee for EXO-11-003 Search for monojets and unparticles

Catherine De Clercq
- Principal Investigator for VUB IceCube Collaboration Board
- member IceCube Executive Committee
- liaison officer IceCube International Oversight and Finance Group

Laurent Favart
- member H1 executive committee

Rebeca Gonzalez Suarez
- contact Person CMS Local Reconstruction of the Tracker Silicon Strips
- contact Person CMS High Level Trigger, Tracker Strips
- coordinator CMS Single top tW subgroup within Single Top physics

Kael Hanson
- member IceCube Collaboration Board
- member IceCube Executive Committee
- lead IceCube Data Acquisition Group
- member IceCube Detector Operations
- member IceCube Supernova Working Group
- responsible ARA Detector communications / Timing

Alexis Kalogeropoulos
- CMS Generators Group MadGraph Coordinator CMS PHYS GEN
- Central DCS swifter CMS DCS

Pierre Marage
- member CMS Publication Committee

Robert Roosen
- member H1 Collaboration Board

Erik Strahler
- offline Processing Representative IceCube Coordination Committee
- member IceCube WIMP working group
- coordinator IceCube Offline Data Processing
- early Career Scientist Representative IceCube Collaboration Board

Catherine Vander Velde
- member CMS Collaboration Board
- member CMS Finance Board

- member CMS Tracker Institution Board
- member CMS Tracker Finance Board
- member CMS Management Board

Walter Van Doninck
- coordinator CMS Muon FW RPC

Nick Van Eijndhoven
- coordinator of first guess reconstruction algorithms IceCube Muon and DeepCore working group
- member IceCube Muon working group
- member IceCube Gamma Ray Burst working group
- member IceCube Low Energy (DeepCore) working group
- member IceCube Low level data quality check team
- deputy member IceCube Collaboration board
- member IceCube Point source working group
- coordinator model-independent (time stacking) analyses IceCube Transient phenomena team
- coordinator of Bayesian analyses IceCube Point source and Gamma Ray Burst working group

Pascal Vanlaer
- Tier-2 representative CMS Computing
- responsible of ULB service contributions to CMS
- member of the Higgs->ZZ working group
- member of the electroweak di-boson working group

Luc Van Lancker
- responsible for mechanical design of CMS Muon FW RPC

Gaston Wilquet
- chairperson OPERA Collaboration Board
- member OPERA Editorial Board
- member OPERA Analysis Advisory Board

b. Presentations in collaboration meetings

Freya Blekman
-"b-tag DQM status"- CERN, CMS week, B-tag physics object group meeting 29/03/011

Debanjan Bose
-"GRB-IC86 sDST Analysis Progress at Brussels"- Uppsala, Sweden 21/09/2011

Olivier Devroede
-"The IIHE-CMS T2"- 08/12/2011

Laurent Favart
-"VFPS data analysis progress report"- DESY- Hamburg 01/02/2011
-"VFPS data analysis progress report"- DESY- Hamburg 15/11/2011

Kael Hanson
-"IceCube DOMHub Upgrade 2011"- IceCube Collaboration Meeting- Madison, WI USA 27/04/2011
-"IceCube DAQ Transition to Completed Detector"- IceCube Collaboration Meeting- Madison, WI USA 28/04/2011
-"IceCube DAQ 2011-2012"- IceCube Collaboration Meeting- Uppsala, Sweden 19/09/2011

Alexis Kalogeropoulos
-"SUSY search with top in final state"- CERN, Geneva 6/10/2011
-"MC Samples and needs for SUSY searches"- CERN, Geneva 6/12/2011
-"Feedback from SUSY"- CERN, Geneva 7/11/2011
-"Monte Carlo Reports / SUSY meeting"- CERN, Geneva 25/10/2011
-"SUSY searches with top in final state"- CERN, Geneva 6/10/2011
-"Status of MadGraph production and related issues"- CERN, Geneva 26/9/2011
-"Madgraph production status"- CERN, Geneva 4/7/2011
-"Monte Carlo status and issues"- CERN, Geneva 24/5/2011

-"Madgraph for SUSY production status"- CERN, Geneva 23/5/2011
-"Status of MadGraph production and related issues"- CERN, Geneva 14/3/2011
-"Status of MadGraph production and related issues"- CERN, Geneva 28/2/2011
-"Progress and status of MonteCarlo CMS production"- CERN, Geneva 14/2/2011
-"Status of MadGraph production and related issues"- CERN, Geneva 31/1/2011
-"Status of MadGraph 8TeV production"- CERN, Geneva 17/1/2011

Jan Kunnen
-"Status of IC59 Solar WIMP analysis"- Madison, Wisc., USA 27/04/2011
-"IC59 Solar WIMP analysis"- Uppsala, Sweden 20/09/2011

Mathieu Labare
-"GRB Stacking Analysis- Event Selection"- Uppsala, Sweden 20/09/2011

Thomas Meures
-"ARA down-hole digitization"- Kansas University (USA) 12/03/2011

Bettina Oexl
-"Gravitino production at Colliders"- IIHE, VUB 07/04/2011

Robert Roosen
-"VFPS t-Reconstruction"- DESY- Hamburg 11/09/2011

Erik Strahler
-"Status of IC79 austral summer solar WIMPs"- Madison, WI 27/04/2011
-"Status of IC79 austral summer solar WIMPs"- Uppsala, Sweden 20/09/2011

Walter Van Doninck
-"Many"- CERN

Nick Van Eijndhoven
-"GRB and AGN searches using the IceCube sDST data."- Uppsala, Sweden 21/09/2011

Pascal Vanlaer
-"Measurement of Strange Particle Production in the Underlying Event at 7 TeV in CMS"- CERN 14/10/2011
-"Dileptons in CMS Exotica physics analyses"- CERN 17/05/2011

Petra Van Mulders
-"Commissioning of the CSV tagger in CMS"- CERN, Geneva, Switzerland various occasions
-"Inclusive search for a fourth generation of quarks"- CERN, Geneva, Switzerland various occasions

2. Completed Master and PhD theses

Master theses

Jan Kunnen: "A search for Dark Matter from the Sun with the 59-string IceCube neutrino detector"
June 2011 Promotors: Catherine De Clercq, Erik Strahler

Alexandre Léonard: “Production diffractive de mesons ρ à HERA II” (AScBr award for the best Master thesis of the ULB Faculty of Science)
June 2011 Promotor: Laurent Favart

Thierry Maerschalk: “Étude d’un grand prototype de chambre à projection temporelle (TPC) et reconstruction de traces par filter de Kalman”
June 2011 Promotor: Gilles De Lentdecker

Annik Olbrechts: "Measurement of the W helicities in top quark events with CMS"
June 2011 Promotor: Jorgen D'Hondt

PhD thesis

Vincent Dero: "Recherche de nouvelle physique au LHC par l'étude du spectre de masse des paires de leptons a 7 TeV" 19/12/2011 Promotor: Pascal Vanlaer

3. Representation in scientific councils and committees

Daniel Bertrand
- Member of the Aspera Steering Committee (representative of the FNRS)
- Member of the FNRS ApPEC Steering Committee (representative of the FNRS)
- Member for Belgium of the Commission (Cosmic Rays) of the IUPAP (International Union for Pure and Applied Physics)
- Member for Belgium of SAC (Science Advisory Committee) of the Aspera Era-Net
- Member of PAI governing board for IIHE-ULB

Barbara Clerbaux
- Organizer of Invited seminars at the IIHE

Catherine De Clercq
- member of the ApPEC steering committee (representative of the FWO)
- member organisation comittee of the Belgian-Dutch-German summer school
- chair FWO Expert Panel W&T2 Fysica
- chair Belgian selection committee of CERN fellows
- member NIKHEF Scientific Advisory Committee
- member IISN Commission des Hautes et Basses Energies
- member of ASPERA Eranet Governing Board (representative of the FWO)
- vice-president board of the IAP 6/11 Fundamental Interactions
- member CERN European Strategy update Preparatory Group

Gilles De Lentdecker
- Vice-President ULB representative Belgian Physical Society

Laurent Favart
- Member SPS and PS experiments Committee

Pierre Marage
- member FWO - Commissie WT2 (physics except condensed matter)
- membre titulaire Comité national de Logique, de Philosophie et d'Histoire des Sciences

Robert Roosen
- Member Belgian representative RecFa

Catherine Vander Velde
- Member- Plenary European Committee of Future Accelerator (PECFA)
- Member- FNRS- IISN- Hautes et basses énergies
- Chairperson Belgium ACCU- CERN

Walter Van Doninck
- Belgian Scientific Delegate CERN Council
- Member EPS HEPP Board

Pascal Vanlaer
- Board member, ULB representative Consortium des Equipements de Calcul Intensif

Gaston Wilquet
- member FNRS IceCube International Oversight and Finance Group
- referee personal TUBITAK, the Scientific and Technological Research Council of Turkey

4. Diffusion of scientific results

a. Invited seminars

Debanjan Bose
- (Internal Seminar, IIHE):"Active Galactic Nuclei" 23/03/2011

Catherine De Clercq
- (Royal Military Academy, Brussels):"IceCube: neutrino astronomy at the South Pole" 28/03/2011

Phillip Grajek
- (University of Heidelberg, Heidelberg, Germany):"Dark Matter Indirect Detection and Uncertainty in CR Propagation" 22/02/2011

Kael Hanson
- (Granada University, Granada, Spain):"Neutrino Astrophysics at the South Pole" 08/06/2011
- (Radboud Universitiet Nijmegen, Netherlands):"Neutrino Astrophysics at the South Pole" 31/05/2011

Pierre Marage
- (Formation sur la 'neutralité', Agrégation de l'Enseignement secondaire supérieur, ULB): "Rapports entre sciences et religions" 23/03/2011.

Kentarou Mawatari
- (UCL):"Gravitino phenomenology at colliders" 20/01/2011
- (Chalmers U. of Technology):"Gravitino phenomenology at colliders" 08/03/2011
- (ULB):"The top window for dark matter" 01/04/2011

Walter Van Doninck
- (Flemish Academy (CEC)): “To be or not to be; we bring the answer” 20/0/2011

Nick Van Eijndhoven
- (General Physics Colloquium, Nijmegen University, The Netherlands):"IceCube : A First Glimpse of the Neutrino Sky" 11/01/2011
- (Science Colloquium, Astron, Dwingeloo, The Netherlands):"Neutrinos on the rocks" 03/03/2011
- (Vrije Universiteit Brussel (VUB), Brussel, Belgium):"The Micro and Macrocosmos" 13/12/2011

Gaston Wilquet
- (IIHE, Brussels):"Measurement of the neutrino velocity with the OPERA detector in the CNGS beam" 05/10/2011
- (ULB, Brussels):"Measurement of the neutrino velocity with the OPERA detector in the CNGS beam" 06/10/2011
- (Royal Observatory, Brussels):"Measurement of the neutrino velocity with the OPERA detector in the CNGS beam" 14/10/2011
- (VUB, Brussels):"Measurement of the neutrino velocity with the OPERA detector in the CNGS beam" 27/10/2011
- (VUB, Brussels):"Measurement of the neutrino velocity with the OPERA detector in the CNGS beam" 27/10/2011
- (Bern University):"Neutrino properties, oscillations, present status" 21/01/2011

b. Oral presentations at conferences and schools

Freya Blekman
-"Recent result on Same-Sign top production at the LHC"- Barcelona, Spain 30/09/2011

Stijn Blyweert
-"top mass, top mass difference and top mass pair reconstruction in CMS"- Brussels 14/09/2011

Debanjan Bose
-"Search for Cosmic Point Sources and Transient Events with IceCube"- Brussels 08/12/2011
-"Search for Cosmic Point Sources and Transient Events with IceCube"- IAP Meeting, ULB, Brussels 03/02/2012

Catherine De Clercq
-"Search for Dark Matter with the IceCube neutrino detector"- Dark Matter in the LHC Era workshop, Kolkata, India 04/01/2011

Gilles De Lentdecker
-"LCTPC DAQ upgrade plans"- Ecole Polytechnique de Paris, Palaiseau 10/11/2011

Laurent Favart
-"Exclusive electroproduction of vector mesons"- EDS Blois Workshop- 2011- Qui Nhon, Vietnam 17/12/2011

Alexis Kalogeropoulos
-"Searches for SUSY using Top topologies"- RAVELINGEN 12/09/10
-"Using Top-Quark as a probe for new physics with the use of Matrix Elements Generators "- SUSY11- Fermilab, IL 29/8/2011

Mathieu Labare
-"Catching neutrinos with an IceCube"- Marseille, France 04/04/2011

Kentarou Mawatari
-"Gravitino phenomenology with MadGraph/MadEvent"- Fermilab 06/05/2011
-"Gravitino productions at colliders"- Wisconsin-Madison 10/05/2011
-"MadGolem: automatized next-to-leading order calculations for BSM"- YITP, Kyoto 10/09/2011
-"Associated production of light gravitinos at future linear colliders"- Granada 28/09/2011
-"The top window for dark matter"- IIHE 09/12/2011

Pierre Marage
-"DVCS and vector meson production at HERA"- Valparaiso Int. Symp. on Particle Physics, 20/05/2011

Thomas Meures
-"The Askaryan Radio Array"- ISAPP Summer School, Varenna (Italy) 03/08/2011

Erik Strahler
-"Recent Results from the IceCube Neutrino Telescope"- Moscow, Russia 21/08/2011

Walter Van Doninck
-"To be or not to be; we bring the answer"- Flemish Academy Brussels 20/09/2011

Nick Van Eijndhoven
-"GRB and AGN searches using the complete IceCube detector"- Uppsala, Sweden 21/09/2011
-"IceCube : Catching Neutrinos at Antarctica"- Vrije Universiteit Brussel (VUB), Brussel, Belgium 04/11/2011

c. Poster presentations at conferences and schools

Stijn Blyweert
-"Measurement of the top mass difference with CMS"- TOP2011, Sant Feliu de Guixols, Spain 28/09/2011

Catherine De Clercq
-"IceCube neutrino observatory at the South Pole"- Colloquium of the Royal Academy, Brussels 19/03/2011
-"Search for Dark Matter with IceCube"- Colloquium of the Royal Academy, Brussels 19/03/2011

David Heereman Von Zuydtwyck
-"Supernova Neutrino Detection with IceCube"- Varenna, Italy 26/07/2011

Alexis Kalogeropoulos
-"Matrix-element based event generation in CMS using MadGraph"- CMS Physics Week, Brussels , 12-16/9/2011 12-16/9/2011

Yves Pierseaux
-"L'Univers de Minkowski est-il statique? Une explication inédite de l'origine de l'Énergie Noire et de l'Expansion Accélérée de l'Univers (revue IIHE décembre 2011)" - Bruxelles 12/10/2011,
-"Accelerating and Expanding Vacuum at Minkowskian Limit of Einstein's Equation of Gravitation with Cosmological Constant, (Why parameter of acceleration q = -1 in Cosmological Minkowskian Model?)" - Bruxelles 12/11/2011

Laurent Thomas
-"Search for Resonances in the Dielectron Mass Distribution in pp Collisions at sqrt(s) = 7 TeV"- Brussels 10/09/2011

Mateusz Wedrowski et al.
-“Artificial Neural Network Based Position Estimation in Positron Emission Tomography”, Int. conf. on medical physics and engineering, Poznan, Poland, September 2011.

Yifan Yang et al.
- “An Extended Range Ethernet and Clock Distribution Circuit for Distributed Sensor Networks”, TWEPP 2011, Vienna, Austria, September 2011.

5. Scientific training

a. Attendance to conferences and workshops

Daniel Bertrand
-"XIV International Workshop on Neutrino Telescopes", Venice Session chair-person from 15/03/2011 to 18/03/2011

Barbara Clerbaux
-"General meeting of the Belgian Physical Society BPS", Namur, Belgium 25/05/2011
-"General meeting of the PANDA doctoral school", Bruxelles, Belgium 09/06/2011,
-"CMS EXOTICA Workshop", Rome, Italy from 26/10/2011 to 27/10/2011
-"CMS physics week at Brussels", Brussels, Belgium Conference organisation from 11/09/2011 to 15/09/2011,
-"Topologies with dileptons session at the CMS week", CERN, Geneva from 16/05/2011 to 20/05/2011; session organizer: Topologies with dileptons; session chairperson

Freya Blekman
-"TOP2011", Barcelona, Spain Oral presentation from 24/09/2011 to 01/10/2011
-"CMS week", CERN from 27/11/2011 to 03/12/2011
-"CMS physics week", CERN Oral presentation from 16/05/2011 to 20/05/2011
-"CMS week", CERN from 28/03/2011 to 03/04/2011

Stijn Blyweert
-"CMS Week", CERN, Geneva, Switzerland from 27/06/2011 to 01/07/2011
-"TOP 2011- 4th International Workshop on Top Quark Physics", Sant Feliu de Guixols, Spain Poster from 25/09/2011 to 30/09/2011
-"CMS Physics Week", Brussels Oral presentation Poster from 11/09/2011 to 15/09/2011

Debanjan Bose
-"International Cosmic ray Conference", Beijing, China from 11/08/2011 to 18/08/2011
-"IAP Meeting", ULB, Brussels Oral presentation 03/02/2012
-"IIHE Annual Meeting", Brussels Oral presentation 08/12/2011
-"IceCube Collaboration Meeting", Uppsala, Sweden Oral presentation from 19/09/2011 to 23/09/2011
-"IceCube Collaboration Meeting", Wisconsin, Madison, United States of America from 26/04/2011 to 02/05/2011

Karen De Causmaecker
-"Top@Brussels", IIHE Oral presentation 09/12/2011
-"IIHE annual meeting", Brussels 08/12/2011

Catherine De Clercq
-"Dark Matter in the LHC era: direct and indirect searches", Kolkata, India Oral presentation from 04/01/2011 to 08/01/2012
-"100th Anniversary of the first Conseil de Physique Solvay- Academic Session", Hotel Plaza, Brussels from 18/10/2011 to 18/10/2011
-"Mini workshop on neutrino indirect detection of Dark Matter", Marseille, France from 13/12/2011 to 14/12/2011
-"ASPERA roadmap workshop", Paris, France from 21/11/2011 to 22/11/2011

Gilles De Lentdecker
-"AIDA KICK-OFF MEETING", CERN, Geneva from 16/02/2011 to 18/02/2011
-"CMS High Eta Electronics Meeting", CERN, Geneva Oral presentation 19/07/2011
-"CMS High Eta Electronics Meeting II", CERN, Geneva Oral presentation 27/10/2011
-"AIDA Electronics Workshop", Ecole Polytechnique de Paris, Palaiseau Oralvpresentation 10/11/2011

-"TWEPP-11 (Topical Workshop on Electronics for Particle Physics)", Vienna, Austria from 26/09/2011 to 30/09/2011.

Laurent Favart
-"Photon 2011", Spa (B) Session organizer Session title:QCDConference from 22/05/2011 to 27/05/2011; session organizer; session chair-person
-"14th Workshop on Elastic and Diffractive Scattering (EDS Blois Workshop)", Qui Nhon, Vietnam from 15/12/2011 to 21/12/201; oral presentation; session chair-person

Rebeca Gonzalez Suarez
-"Rencontres de Moriond, QCD and High Energy Interactions", Aosta, Italy from 20/03/2011 to 27/03/2011
-"TOP2011, 4th International Workshop on Top Quark Physics", Sant Feliu de Guixols (Spain) from 25/09/2011 to 30/09/2011
-"CMS Physics Week", Brussels (Belgium) Session chair-personfrom 11/09/2011 to 15/09/2011

Phillip Grajek
-"MadGraph 2011 FermiLab", FermiLab from 02/05/2011 to 08/05/2011
-"Pheno2011 Symposium", University of Wisconsin, Madison Oral presentation from 09/05/2011 to 11/05/2011
-"Recontres du Moriond", La Thuile, Italy from 13/03/2011 to 19/03/2011
-"MadGraph 2011- Rome", Rome, Italy from 19/09/2011 to 23/09/2011

Kael Hanson
-"TAUP 2011", Munich Germany Oral presentation from 05/09/2011 to 09/09/2011
-"Very Large Volume Neutrino Telescope Workshop 2011", Erlangen Germany from 12/10/2011 to 14/10/2011; Oral presentation; Session organizer: Computing and Data.

David Heereman Von Zuydtwyck
-"Annual Meeting of the German Physicists Society, Division Particle Physics", Karlsruhe, Germany from 28/03/2011 to 01/04/2011
-"IceCube Collaboration Meeting", Madison, Wisconsin from 25/04/2011 to 02/05/2011
-"BPS 11: Belgian Physicists Society Meeting 2011, Presentation of the IIHE's General IceCube Poster", Namur, Belgium Poster 25/05/2011
-"PandA: PhD Day : Talks of PhD Students about their research field.", ULB 09/06/2011
-"Hanse11: Hamburg Workshop on neutrinos from Supernova Explosion", Hamburg, Germany from 19/07/2011 to 23/07/2011,
-"IceCube Collaboration Meeting", Uppsala, Sweden from 19/09/2011 to 23/09/2011

Alexis Kalogeropoulos
-"Monte Carlo for Beyond Standard Model MC4BSM", Copenhagen, Denmark from 14/4/2010 to 16/4/2010
-"MadGraph annual meeting 2011", Rome, Italy Oral presentation from 19/9/2011 to 23/9/2011
-"SUSY11 Conference", FermiLab, IL Oral presentation from 28/8/2011 to 2/9/2011
-"SUSY 2011 WorkShop", CERN, Geneva Oral presentation from 6/12/2011 to 8/12/2011
-"CMS Week", CERN, Geneva from 28/3/2011 to 31/3/2011
-"CMS Physics Week", CERN, Geneva from 7/2/2011 to 11/2/2011
-"CMS Physics Week", CERN, Geneva from 16/5/2011 to 20/5/2011
-"CMS Physics Week", Brussels Poster from 12/9/2011 to 16/9/2011
-"CMS Week", CERN, Geneva from 27/6/2011 to 31/6/2011
-"Summer11 Monte Carlo Production Workshop", CERN, Geneva Oral presentation 24/10/2011
-"3rd International Workshop on Top Quark Physics", Brugge from 31/05/2010 to 04/06/2010

Jan Kunnen
-"IceCube Spring Collaboration Meeting", Madison, Wisc., USA Oral presentation from 26/04/2011 to 02/05/2011
-"IceCube Fall Collaboration Meeting", Uppsala, Sweden Oral presentation from 19/09/2011 to 23/09/2011
-"Joint meeting with ANTARES, Marseille, December 12-13, 2011", Marseille, France from 12/12/2011 to 13/12/2011

Mathieu Labare
-"IceCube Collaboration Meeting", Uppsala, Sweden Oral presentation from 19/09/2011 to 23/09/2011
-"IceCube Collaboration Meeting", Madison,WI,USA Oral presentation from 26/04/2011 to 02/05/2011
-"Worshop neutirno-gamma", Marseille, France Oral presentation from 04/04/2011 to 06/04/2011

Michael Maes
-"4th International Conference on Top Quark Physics", Sant Feliu De Guixols, Spain Poster from 25/09/2011 to 30/09/2011
-"CMS Physics Week", Brussels, Belgium Poster from 11/09/2011 to 15/09/2011

Kentarou Mawatari
-"MadGraph Spring 2011", Fermilab, from 03/05/2011 to 06/05/2011, Oral presentation Session chair-person
-"2011 Phenomenology Symposium", Wisconsin-Madison from 09/05/2011 to 11/05/2011, Oral presentation
-"IPMU-YITP Workshop on Monte Carlo Tools for LHC", YITP, Kyoto from 09/09/2011 to 10/09/2011, Oral presentation
-"International Workshop on Future Linear Colliders", Granada from 26/09/2011 to 30/09/2011, Oral presentation
-"Top @ Brussels meeting", IIHE Oral presentation 09/12/2011
-"Rencontres de Moriond EW 2011", La Thuile from 13/03/2011 to 20/03/2011
-"CMS meeting", VUB from 11/09/2011 to 15/09/2011
-"LHC forum", Heidelberg from 19/12/2011 to 21/12/2011

Thomas Meures
-"ARA collaboration meeting", Kansas University (USA) from 11/03/2011 to 14/03/2011, Oral presentation
-"IceCube Collaboration meeting", Madison, Wisconsin (USA) from 26/04/2011 to 02/05/2011
-"BPS meeting", Namur Poster 25/05/2011
-"PandA PhD Day", Bruxelles 09/06/2011

Bettina Oexl
-"MadGraph Meeting 2011", Rome, Italy from 20/09/2011 to 23/09/2011,
-"Theory at sea", Domein Westhoek, Belgium from 27/05/2011 to 28/05/2011.

Annik Olbrechts
-"4th International Workshop on Top Quark Physics", Sant Feliu de Guixols, Spain from 25/09/2011 to 30/09/2011,
-"CMS Physics Week", Vrije Universiteit Brussel, Belgium Poster from 11/09/2011 to 15/09/2011,
-"W helicity workshop", Cern, Geneve Oral presentation from 18/10/2011 to 22/10/2011.

Thomas Reis
-"CMS Physics Week", CERN, Merin, CH from 06/02/2011 to 11/02/2011
-"CMS Physics Week", CERN, Merin, CH from 16/05/2011 to 20/05/2011
-"CMS Physics Week", Brussels, BE from 10/09/2011 to 15/09/2011
-"CMS Exotica Workshop", Rome, IT from 27/10/2011 to 28/10/2011

Robert Roosen
-"EPS Conference on High Energy Physics", Grenoble, France from 20/07/011 to 28/07/011

Erik Strahler
-"15th Lomonosov Conference on Elementary Particle Physics", Moscow, Russia from 17/08/2011 to 24/08/2011, Oral presentation
-"IceCube Fall Collaboration Meeting", Uppsala, Sweden from 18/9/2011 to 23/9/2011, Oral presentation
-"IceCube Spring Collaboration Meeting", Madison, WI from 25/4/2011 to 2/5/2011, Oral presentation
-"BPS Annual Meeting", Namur, Belgium Oral presentation 25/05/2011

Laurent Thomas
-"Moriond 2011 (Ewk Session)", La Thuile from 13/03/2011 to 20/03/2011
-"CMS Physics week in Brussels", Brussels from 10/09/2011 to 15/09/2011, Poster
-"Annual meeting of the Belgian Physical Society", Namur 25/05/2011, Poster
-"CMS Exotica Workshop in Roma", Roma from 27/10/2011 to 28/10/2011, Oral presentation

Edwin Torisaen
-"VMware Forum 2011- Cloud Computing", Brussels 12/05/2011
-"Exclusive Networks Techdays 2011", Vilvoorde- Belgium 30/11/2011
-"ISCSI EqualLogic storage fromDell", Brussels- Belgium 13/09/2011
-"VMware End-user Computing Roadshow", Liège 23/11/2011
-"Belnet Networking Conference", Bruxelles 24/11/2011

Walter Van Doninck
-"International Europhysics Conference on High Energy Physics", Grenoble, France from 21/07/2011 to 27/07/2011, Conference organisation

Nick Van Eijndhoven
-"International Cosmic Ray Conference ICRC2011", Beijing, China from 10/08/2011 to 18/08/2011,Session chair-person
-"IIHE annual meeting", Brussels, Belgium 08/12/2011

Pascal Vanlaer
-"CMS Physics week", Brussels Conference organisation from 11/09/2011 to 15/09/2011.

Luc Van Lancker
-"ICCS16- International Conference on Composite Structures", Porto, Portugal from 27/06/2011 to 13/06/2011
-"ICCM16- International Conference on Composite Materials", Kyoto, Japan from 08/07/2007 to 13/06/2007
-"ECCM14- European Conference on Composite Materials", Budapest, Hungary from 07/06/2010 to 10/06/2010

Petra Van Mulders
-"Physics week, CMS", Brussels, Belgium from 11/09/2011 to 15/09/2011, organizer Poster session
-"Top2011 International Workshop on Top Quark Physics", Sant Feliu de Guixols, Spain from 25/09/2011 to 30/09/2011, Poster
-"Third Workshop on Beyond 3 Generation Standard Model", Bogazici University, Istanbul, Turkey from 23/10/2011 to 25/10/2011.

Gerrit Van Onsem
-"TOP 2011", Sant Feliu de Guixols, Spain from 25/09/2011 to 30/09/2011
-"CMS physics week Brussel", Brussels, Belgium Poster from 11/09/2011 to 15/09/2011
-"CMS physics week", Geneva, Switzerland from 07/02/2011 to 11/02/2011
-"CMS week", Geneva, Switzerland from 29/03/2011 to 01/04/2011
-"Third Workshop on Beyond 3 Generation Standard Model", Istanbul, Turkey from 22/10/2011 to 25/10/2011.

Pierre Vilain
-"EPS Conference on High Energy Physics", Grenoble, France from 20/07/011 to 28/07/011

Yifan Yang
-"AIDA kick off meeting", Cern,Geneva from 16/02/2011 to 18/02/2011
-"Askaryan Radio Array meeting", Kansas,American from 10/03/2011 to 14/03/2011
-"Topical Workshop on Electronics for Particle Physics", Vienna from 25/09/2011 to 30/09/2011, Poster
-"IEEE xTCA workshop", Valencia from 21/10/2011 to 23/10/2011

b. Attendance to schools

Gilles De Lentdecker.
-"ALTERA 28nm Technology Workshop" Antwerpen, Belgium 29/11/2011

David Heereman Von Zuydtwyck
-"ISAPP11: International School on Astro-particle Physics: Courses on Neutrino Physics and Astrophysics" Varenna, Italy from 26/07/2011 to 05/08/2011

Alexis Kalogeropoulos
-"PHYSTAT 2011 / TMVA Worksop" CERN, **Geneva** from 16/1/2011 to 22/1/2011
-"SUSY11 PreSUSY school" University of Chicago, IL from 24/8/2011 to 26/8/2011

Jan Kunnen
-"ISAPP 2011 : The dark side of the Universe" Heidelberg from 8/7/2011 to 15/7/2011

Kentarou Mawatari
-"IPMU-YITP School and Workshop on Monte Carlo Tools for LHC" YITP, Kyoto from 05/09/2011 to 08/09/2011

Thomas Meures
-"ISAPP11: International School on Astro-particle Physics: Courses on Neutrino Physics and Astrophysics" Varenna (Italy) from 26/07/2011 to 05/08/2011

Bettina Oexl
-"Summer School on Particle Physics" ICTP, Trieste, Italy from 06/06/2011 to 17/06/2011

Thomas Reis
-"PandA Doctoral School" Brussels, BE from 09/06/2011 to 09/06/2011
-"BND Summer School" Honderloo, NL from 19/09/2011 to 30/09/2011
-"PAT tutorial" CERN, Merin, CH from 04/04/2011 to 08/04/2011

Laurent Thomas
-" A review of B physics, Niels Turing" Brussels from 19/04/2011 to 20/04/2011
-"BND Summer School in Particle Physics" Hoenderloo, The Netherlands from 17/09/2011 to 30/09/2011

Luc Van Lancker,
-"FloEFD -V10" Brussel from 13/01/2011
-"Ansys pre-processing Geometry and meshing" Antwerpen 21/06/2011
-"Ansys Simulation turbulent flow" Antwerpen 08/11/2011
-"Ansys Belgium conference" La Hulpe 25/10/2011

Yifan Yang
-"ALTERA 28nm Technology Workshop" Antwerpen, Belgium 29/11/2011

c. Invited seminars at the IIHE

09 Dec Prof. Michael Doser,
"Perspectives for precision tests with antihydrogen"

21 Nov Erik van der Kraaij,
"Physics and detectors at CLIC"

16 Nov Lukas Vanelderen,
"Searches for new phenomena at the LHC: backgrounds and optimization"

15 Nov James Kaeveney,
"A measurement of the Z cross section at LHCb and prospective searches for new physics at CMS"

21 Oct Tomislav Ševa,
"High Resolution Λ Hypernuclear Spectroscopy by the (e,e'K+) Reaction at Jlab Hall C"

07 Oct Christos Lazaridis,
"Jets produced in association with Z-bosons in CMS at the LHC"

05 Oct Prof. Gaston Wilquet,
"Measurement of the neutrino velocity with the OPERA detector in the CNGS beam"

23 Sep Dr. Dayong WANG,
"New Physics searches in events with same-sign isolated dilepton, jets and missing transverse energy at CMS"

09 Sep Vassil Verguilov,
"Particle Identification in the International Muon Ionization Cooling Experiment (MICE)"

16 May Dr. Alessandro Caldarone,
"Test beam results of the EUDET telescope and the FORTIS detector"

08 Apr Karolos Potamianos,
"Search for rare SM processes in the MET+b-jets signature at CDF"

01 Apr Jef Ongena,
"JET, ITER and the future of fusion"

23 Mar Debanjan Bose,
"Active Galactic Nuclei"

21 Mar Amita Raval,
"Proton structure: results from HERA"

15 Mar Sophio Pataraia,
"Initial sensitivity of ATLAS inclusive SUSY search at 7 TeV by fitting and number counting"

25 Feb Laura Lopez Honorez,
"Interacting dark matter-dark energy"

18 Feb Phill Grajek,
"Indirect Detection of Dark Matter and Uncertainties in Cosmic Ray Propagation"

09 Feb Sera Markoff,
"David vs. Goliath: Using black hole mass scales to probe the largest accelerators in the universe"

02 Feb Garmt de Vries,
"Studying cosmic ray air showers with IceTop"

26 Jan Claudine Colnard,
"Status of IceCube-DeepCore: sensitivity study for the Southern Hemisphere"

20 Jan Tristan du Pree,
"Search for a Strange Phase in Beautiful Oscillations"

6. Teaching and academic activities

a. Teaching activities

Daniel Bertrand
- PHYS 105 "Stage de laboratoire" (0/0/75/0) MA1 en sciences physiques

Freya Blekman
- WE-DNTK-15069 "Simulation of Physics Phenomena and Detectors in Modern Physics" (15/0/10/20)

Karen De Causmaecker
- WE-DNTK-5648 "Kwantumfysica" (0/26/0/26) BA3

Olivier Devroede
- "Computervaardigheden" (60) MA1
- "Exercises Matlab" (6) BA1

Catherine De Clercq
- WE-DNTK-12521 "Astroparticle physics" (13/13/0/0) MA fysica VUB
- WE-DNTK-14101 "Experimentele Fysica" (0/0/78) BA1 Fysica en Sterrenkunde
- WE-DNTK-13971 "Externe mobiliteit A" (coordination) MA Physics

Barbara Clerbaux
- PHYS F416 "Interactions fondamentales et particules" (18/0/0/0) MA1
- PHYS F310 "Stage dans un service du departement" (0/0/10/0) BA3
- PHYS F312 "Laboratoire de physique des particules" (2 semaines) BA3

Gilles De Lentdecker
- PHYS-F-314 "Electronics" (12/6/36) BA3
- PHYS-F-312 "Laboratoire de physique des particules" (0/0/72) BA3

Laurent Favart
- PHYS-F102 "Laboratoire de physique generale I et II" (0/0/24/0) BA1

Kael Hanson
- PHYS-F-311 "Laboratoire de Physique Générale Approfondie" (0 / 0 / 96 / 0)
- PHYS-F-467 "Particle Astrophysics" (24 / 24 / 0 / 0)
- PHYS-F-210 "Laboratoire de physique générale III" (0 / 0 / 24 / 0)
- PHYS-F-314 "Electronique" (12 / 6 / 24 / 0)

Alexis Kalogeropoulos
- BA3 "Statistical Physics" (0/24/24) 2010-11

Mathieu Labare
- WE-DNTK-14103 "Subatomaire Fysica I: inleiding tot de kern- en deeltjesfysica" (0/26/0/0) Part time.

Pierre Marage
- HIST-F-500 "Histoire des Sciences et Epistémologie" (24/0/0/0) MA-didact., AESS
- HIST-F-101 "Histoire des Sciences" (24/0/0/0) BA
- COMM-B-515 "Questions d'actualité des sciences (MA2 Journalisme et communication)" (8/0/0/8) MA2

Thomas Meures
- PHYS-F-314 "Electronics for Physicists (teaching in the Lab-part)" (14)

Robert Roosen
- WE-DNTK-14538 “Elements of the History of Natural Sciences” MA fysica VUB-UA-UG
- WE-DNTK-14315 “Subatomic Physics II” fysica VUB

Erik Strahler
- WE-DNTK-12521 "Astroparticle Physics Exercise Sessions" (6)

Laurent Thomas
- PHYS-F-104 "Physique 1" (0/144/0/0) BA1
- PHYS-F-205 "Physique 2" (0/0/48/0) BA2
- PHYS-F-312 "Laboratoire de Physique des Particules" (0/0/36/0) BA3

Nick Van Eijndhoven
- WE-DNTK-1998 "Elementary Particles" (26/26/0/0)

Catherine Vander Velde
- PHYS-F-101 "Physique générale I - Mécanique" (48/0/12) BA1-chimie, physique, mathématique et polyvalente en sciences ,
- Coordinator "Objectif réussite- physique" (650) BA1-toutes sections
- PHYS-F-305 "Introduction à la physique des particules - aspects expérimentaux" (24/0/12) BA3-physique Part time
- PHYS-F-420 "Méthodes expérimentales de la physique des particules" (12/0/0) MA2-physique Part time

Pascal Vanlaer
- PHYS-F104 "Physique 1" (72/0/0/0) BA1
- PHYS-F205 "Physique générale 2- électromagnétisme" (24/0/0/12) BA 2
- PHYS-F420 "Détection de particules, acquisition et analyse de données" (6/0/24/0) MA 1/2
- PHYS-F101 "Laboratoires de physique générale" (0/0/36) BA1
- PHYS-H-303 "Projets de bibliographie de 3e annee Ingenieur civil physicien" (0/0/0/12) BA3

Walter Van Doninck
- ELEM II "The Standard Model" (15 hours) 2011 Part time.

Petra Van Mulders
- WE-DNTK-14102 "Statistische fysica" (0/26/0/100) BA3

Gerrit Van Onsem
- WE-DNTK-11545 "Inleiding tot de Kwantumfysica (WPO)" (0/26/0/30) 2011 Part time.

b. Membership to academic jurys

Freya Blekman
- Ph.D. – VUB "Aspects of Type II string theory" by Wieland Staessens, Member
- Ph.D. – UCL "First Observation of the top quark at the Large Hadron Collider" by Julien Caudron, Member
- Ph.D. – ULB "Data-driven multi-jet and V+jets background estimations for top quark pair production at CMS" by Gregory Hammad, Member
- Ph.D. – UGent "Searches for new phenomena at the LHC: backgrounds and optimization" by Lukas Vanelderen, Member
- Ph.D. – Sharif University, Iran "Measurement of the b-tagging efficiency in the CMS experiment with the first LHC collisions" by Abideh Jafari , Secretary
- Ph.D. – Isfahan University, Iran "Measurement of the Jet Energy Scale in the CMS experiment with the First LHC Proton Collisions" by Maryam Zeinali, Secretary
- M.Sc.- VUB: Annik Olbrechts : “First W helicity measurement in the muon+jet channel based on the 2010 CMS data”

Barbara Clerbaux

- Ph.D. – ULB "Recherche de nouvelle physique au LHC par l'étude du spectre de masse des paires de leptons a 7 TeV" by Vincent Dero, Chair
- Ph.D. – ULB "Effects of stellar surface inhomogeneities on astrometric accuracy" by Ester Pasquat, Chair

Catherine De Clercq
- Ph.D. – VUB "Optimization of accelerator based radionuclide production" by Razvan Adam Rebeles, Chair
- Ph.D. – ULB "Recherche de nouvelle physique au LHC par l'étude du spectre de masse des paires de leptons a 7 TeV" by Vincent Dero, Member

Laurent Favart
- Ph.D. – ULB "Data-driven multi-jet and V+jets background estimation methods for top quark pair production at CMS" by Gregory Hammad, President

Pierre Marage
- Ph.D. – ULB "Recherche de nouvelle physique au LHC par l'étude du spectre de masse des paires de leptons √s 7 TeV" by V. Dero, Secretary

Catherine Vander Velde
- Ph.D. – ULB "Data driven multi-jet and V+jets background estimation methods for top quark pair production at CMS" by Grégory Hammad, Promotor

Pascal Vanlaer
- Ph.D. – ULB "Recherche de nouvelle physique au LHC par l'etude du spectre de masse des paires de leptons a 7 TeV" by Vincent Dero, Promotor

Gaston Wilquet
- Ph.D. – University di Bologna and Université Claude Bernard Lyon 1 "Neutrino velocity measurement with the OPERA experiment in the CNGS beam" by Giulia Brunetti, Referee
- Habilitation thesis Bern University – "High granularity tracking detectors for neutrino physics experiments" by Igor Kreslo, Referee

c. Representation in academic councils and committees

Daniel Bertrand
- Responsible for the ULB Physics Department Erasmus Students Exchange Program

Barbara Clerbaux
- member of the « Bureau du Conseil du Département de physique », ULB
- chair of the « Département de physique », ULB
- member of the « commission de classement 1ere assistant » of the Faculty of Science, ULB

Freya Blekman
- Fysica PR responsible Facultaire PR Commissie

Olivier Devroede
- Member Vakgroepraad Fysica

Catherine De Clercq
- president examencommissie Master Fysica VUB
- secretary examencommissie Bachelor Fysica VUB
- member Facultaire Commissie Middelen en Personeel
- member Werkgroep Fysica Practica

Laurent Favart
- Chair « Jury de Master en Physique », ULB

Pierre Marage
- « Vice-recteur pour la politique académique et la recherche », ULB
- member of the Board of FNRS and FRSM
- member of the « Conseil de la Politique scientifique, Bruxelles-Capitale »
- member of the Board of the "Institut national des Radioelements", Fleurus
- « Directeur de section Institut des Hautes Etudes de Belgique »

- vice-chair of the « Centre de Culture scientifique de l'ULB à Charleroi – Parentville »
- member of the Board of “Altair, asbl d'Histoire des Sciences attachée à l'ULB”

Catherine Vander Velde
- Chairperson « Commission de sélection des assistants du département de physique », ULB
- member Commission d'attribution des Crédits pédagogiques du Département de Physique

Pascal Vanlaer
- Chair ULB-VUB computing centre user committee,
- Member Observatoire de la première année universitaire (BA1) en sciences, ULB.

7. Vulgarisation and outreach

Daniel Bertrand
-""- CERN laboratory visit to MA1 ULB students 29-31/03/2011

Barbara Clerbaux
-""- CERN laboratory visit to MA1 ULB students 29-31/03/2011
-"Introduction to cosmology"- Oral presentation for undergraduated students at the masterclasses 24/03/2011,
-"Semences de curieux"- interview for the RTBF (radio) 28/11/2011
-"CERN seminar on Higgs results"- Organisation of the video-transmission of the CERN seminar on Higgs results, followed by a Press meeting 13/12/2011,
-"CMS week at Brussels, interview RTBF radio and Television"- Press conference during the CMS week at Brussels 14/11/2011.

Freya Blekman
-"De deeltjesversneller op CERN"- Presentation at International day at XIOS (Hasselt) 10/05/2011
-"interview on the search for the Higgs boson and the forgotten contribution of Brout and Englert"- Interview 20/04/2011
-"Wiskundig Wiske finale VUB"- Bezetting infostand 14/03/2011
-"Infodag VUB"- Bezetting infostand 19/03/2011
-"Campus Talks International Womens day 2011"- Pecha Kucha presentation 08/03/2011
-"CERN tour for top Dutch high school students and Information Technology Students from Radboud Univer"- CERN tour 13/12/2011

Stijn Blyweert
-"VUB Herfstkampen 2011- Workshop: De eerste mini Big Bangs met de deeltjesversneller te CERN"- Oral presentation 03/11/2011

Catherine De Clercq
-"Member of the Flemish Physics Olympiads Committee"- Physics Olympiads since 2005
-"IceCube: neutrinos vangen op Antarctica"- Workshop- campus visit 24/02/2011
-"IceCube: neutrinos vangen op Antarctica"- Workshop- campus visit 15/11/2011

Gilles De Lentdecker
-"Organizer"- Master Classes 05/02/2011
-"Organizer"- Master Classes 26/03/2011

Rebeca Gonzalez Suarez
-"CERN visit"- CERN Guide 09/04/2011
-"CERN visit"- CERN Guide 12/05/2011
-"CERN visit"- CERN Guide 14/06/2011
-"Workshop leader of the Questions without answers at the LHC session"- Expanding your horizons (EYH) conference in Geneva 12/12/11
-"CERN visit"- CERN Guide 05/07/2011
-"CERN visit"- CERN Guide 18/07/2011
-"CERN visit"- CERN Guide 14/10/2011
-"CERN visit"- CERN Guide 26/10/2011

Pierre Marage
-"The Solvay Councils and the Birth of Modern Physics"- Conference, réunion internationale de CMS, Bruxelles 14/09:2011

Laurent Thomas
-"Participation au Salon Service d'Information sur les Études et les Professions (Bruxelles)"- Lien avec l'enseignement secondaire 26/11/2011
-"Research vulgarisation during an event organized by the Cercle des Sciences (ULB)"- Oral presentation 21/03/2011
-"Q&A after the projection of a CERN movie during the « Festival du Film Scientifique de Bruxelles »"- Oral presentation 22/03/2011
-"Master Class in Particle Physics"- Master class 26/03/2011
-"Visits of the Experimentarium de Physique to secondary school students (36h)"- Visits of the Experimentarium de Physique N/A

Catherine Vander Velde
-"Master classe de physique des particules"- Master classe 26/03/2011
-Encadrement de laboratoire pour les lauréats des olympiades de physique 11/04/2011
-"Que peut nous apporter le nouvel accélérateur du CERN, le LHC, pour comprendre la structure de la ma"- Conférence for CEPULB 14/03/2011
-"Le LHC, le nouvel accélérateur du CERN, à Genève."- Conférence at La maison de la laïcité, Condorcet 17/03/2011

Walter Van Doninck
-"Guide"- CMS visits many

Nick Van Eijndhoven
-"VUB Herfstkamp"- Oral presentation 04/11/2011
-"VUB studentenseminarie Actuele Wetenschappen"- Oral presentation 13/12/2011

Pascal Vanlaer
-"Instrumentation en physique des particules"- Master class 03/2011

Gerrit Van Onsem
-"Herfstkamp (presentation about the status of the experiments at the LHC)"- Oral presentation 03/11/2011
-"Campusbezoek (presentation about the status of the experiments at the LHC)"- Oral presentation 15/11/2011

Pierre Vilain
-"La vitesse des neutrinos"- Interview RTBF 25/09/011
-"Les physiciens : des masochistes heureux ?"- Editorial de la revue L'Artichaut (CEPULB) 01/12/011
-"Petites Histoires de Neutrinos"- Conférence ALTAÏR 03/12/011

Gaston Wilquet
-"Interview on neutrino velocity measurement for Le Soir"- Press interview 23/9/2011
-"Interview on neutrino velocity measurement for 'Le Forum de Midi', RTBF1 radio" - Radio broadcasting 27/9/2011
-"Interview on neutrino velocity measurement for La Libre Belgique"- Press interview 23/9/2011
-"Interview on neutrino velocity measurement for La Lettre du FNRS"- Press interview 6/10/2011
-"Interview for Paroles de Chercheur, ULB"- Interview 6/10/2011

IV. PUBLICATIONS

1. Refereed journals and conference proceedings

a. CMS

1. Measurement of the weak mixing angle with the Drell-Yan process in proton-proton collisions at the LHC.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev. D84 (2011) 112002, 23p.

2. Measurement of energy flow at large pseudorapidities in pp collisions at √s=0.9 and 7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1111 (2011) 148, Erratum-ibid. 1202 (2012) 055, 37p.

3. Forward Energy Flow, Central Charged-Particle Multiplicities, and Pseudorapidity Gaps in W and Z Boson Events from pp Collisions at 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Eur.Phys.J. C72 (2012) 1839, 28p.

4. Search for a Vector-like Quark with Charge 2/3 in t + Z Events from pp Collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 107 (2011) 271802, 25p.

5. Search for Supersymmetry at the LHC in Events with Jets and Missing Transverse Energy.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 107 (2011) 221804, 27p.

6. Measurement of the t $\bar{t} Production Cross Section in pp Collisions at 7 TeV in Lepton + Jets Events Using b-quark Jet Identification.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev. D84 (2011) 092004, 24p.

7. Measurement of the Differential Cross Section for Isolated Prompt Photon Production in pp Collisions at 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev. D84 (2011) 052011, 29p

8. Measurement of the Drell-Yan Cross Section in pp Collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1110 (2011) 007, 40p.

9. Search for B(s) and B to dimuon decays in pp collisions at 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 107 (2011) 191802, 27p.

10. Search for Resonances in the Dijet Mass Spectrum from 7 TeV pp Collisions at CMS.
CMS Collaboration (Chatrchyan et al.)
Phys.Lett. B704 (2011) 123-142

11. Measurement of the Inclusive W and Z Production Cross Sections in p p Collisions at sqrt(s) = 7 TeV with the CMS experiment.
CMS Collaboration (Chatrchyan et al.)
JHEP 1110 (2011) 132, 74p

12. Dependence on pseudorapidity and centrality of charged hadron production in PbPb collisions at a nucleon-nucleon centre-of-mass energy of 2.76 TeV.

CMS Collaboration (Chatrchyan et al.)
JHEP 08 (2011) 141, 33p.

13. Determination of Jet Energy Calibration and Transverse Momentum Resolution in CMS.
CMS Collaboration (Chatrchyan et al.)
JINST 6 (2011) P11002, 64p.

14. Search for Three-Jet Resonances in pp Collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 107 (2011) 101801, 15p.

15. Search for supersymmetry in pp collisions at sqrt(s)=7 TeV in events with a single lepton, jets, and missing transverse momentum.
CMS Collaboration (Chatrchyan et al.)
JHEP 1108 (2011) 156, 43p.

16. A search for excited leptons in pp Collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Lett. B704 (2011) 143-162

17. Measurement of the Underlying Event Activity at the LHC with $\sqrt{s}= 7$ TeV and Comparison with $\sqrt{s} = 0.9$ TeV.
CMS Collaboration (Chatrchyan et al.)
JINST 6 (2011) P09001, 56p.

18. Missing transverse energy performance of the CMS detector.
CMS Collaboration (Chatrchyan et al.)
JINST 6 (2011) P09001, 54p.

19. Search for New Physics with a Mono-Jet and Missing Transverse Energy in pp Collisions at √s=7TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 107 (2011) 201804, 15p.

20. Search for New Physics with Jets and Missing Transverse Momentum in pp collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1108 (2011) 155, 46p.

21. Measurement of the Strange B Meson Production Cross Section with J/Psi phi Decays in pp Collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev. D84 (2011) 052008, 16p.

22. Search for Supersymmetry in Events with b Jets and Missing Transverse Momentum at the LHC.
CMS Collaboration (Chatrchyan et al.)
JHEP 1107 (2011) 113, 25p.

23. Measurement of the t-channel single top quark production cross section in pp collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 107 (2011) 091802, 15p.

24. Search for Light Resonances Decaying into Pairs of Muons as a Signal of New Physics.
CMS Collaboration (Chatrchyan et al.)
JHEP 1107 (2011) 098, 33p.

25. Search for Same-Sign Top-Quark Pair Production at sqrt(s) = 7 TeV and Limits on Flavour Changing Neutral Currents in the Top Sector.

CMS Collaboration (Chatrchyan et al.)
JHEP 1108 (2011) 005, 27p.

26. Measurement of the Top-antitop Production Cross Section in pp Collisions at sqrt(s)=7 TeV using the Kinematic Properties of Events with Leptons and Jets.
CMS Collaboration (Chatrchyan et al.)
Eur.Phys.J. C71 (2011) 1721, 27p.

27. Search for Physics Beyond the Standard Model Using Multilepton Signatures in pp Collisions at sqrt(s)=7 TeV.
CMS Collaboration (Chatrchyan et al.)
Physics Letters B 704 (2011) 411-433

28. Measurement of the Ratio of the 3-jet to 2-jet Cross Sections in pp Collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Lett. B702 (2011) 336-354

29. Measurement of the Inclusive Jet Cross Section in pp Collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 107 (2011) 132001, 14p.

30. Measurement of the t t-bar production cross section and the top quark mass in the dilepton channel in pp collisions at sqrt(s) =7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1107 (2011) 049, 48p.

31. Search for First Generation Scalar Leptoquarks in the evjj channel in pp collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
32. Phys.Lett. B703 (2011) 246-266

33. Indications of suppression of excited ϒ states in PbPb collisions at √SNN= 2.76 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 107 (2011) 052302, 15p.

34. Search for supersymmetry in events with a lepton, a photon, and large missing transverse energy in pp collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1106 (2011) 093, 27p.

35. Measurement of W-gamma and Z-gamma production in pp collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys. Lett. B701 (2011), 535-555

36. Long-range and short-range dihadron angular correlations in central PbPb collisions at a nucleon-nucleon center of mass energy of 2.76 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1107 (2011) 076, 32p.

37. Charged particle transverse momentum spectra in pp collisions at sqrt(s) = 0.9 and 7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 08 (2011) 086, 38p.

38. Measurement of the Polarization of W Bosons with Large Transverse Momenta in W+Jets Events at the LHC.
CMS Collaboration (Chatrchyan et al.)
Phys. Rev. Lett. 107 (2011) 021802, 15 p.

39. Search for new physics with same-sign isolated dilepton events with jets and missing transverse energy at the LHC.

CMS Collaboration (Chatrchyan et al.)
JHEP 1106 (2011) 077, 46 p.

40. Measurement of the B0 production cross section in pp Collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys. Rev. Lett. 106, 252001 (2011), 15p.

41. Measurement of the differential dijet production cross section in proton-proton collisions at sqrt(s)=7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Lett. B700 (2011) 187-206

42. Measurement of the Inclusive Z Cross Section via Decays to Tau Pairs in pp Collisions at √s=7TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1108 (2011) 117, 31p.

43. Search for Neutral MSSM Higgs Bosons Decaying to Tau Pairs in pp Collisions at √s= 7 TeV
CMS Collaboration (Chatrchyan et al.)
Phys. Rev. Lett. 106 (2011) 231801, 15p.

44. Search for Large Extra Dimensions in the Diphoton Final State at the Large Hadron Collider.
CMS Collaboration (Chatrchyan et al.)
JHEP 1105 (2011) 085, 27p.

45. Measurement of the lepton charge asymmetry in inclusive W production in pp collisions at √s= 7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1104 (2011) 050, 30p.

46. Search for Physics Beyond the Standard Model in Opposite-Sign Dilepton Events at √s=7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1106 (2011) 026, 32p.

47. Search for Supersymmetry in pp Collisions at √s=7TeV in Events with Two Photons and Missing Transverse Energy.
CMS Collaboration (Chatrchyan et al.)
Phys. Rev. Lett. 106 (2011) 211802, 15 p.

48. Search for Resonances in the Dilepton Mass Distribution in
pp Collisions at √s=7TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1105 (2011) 093, 34p.

49. Search for a W′ boson decaying to a muon and a neutrino in pp collisions at √s=7TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Lett. B701 (2011) 160-179

50. Measurement of W+W- Production and Search for the Higgs Boson in pp Collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Lett. B699 (2011) 25-47

51. Study of Z boson production in PbPb collisions at nucleon-nucleon centre of mass energy = 2.76 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys. Rev. Lett. 106 (2011) 212301, 14p.

52. Search for a Heavy Bottom-like Quark in pp Collisions at √s=7TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Lett. B701 (2011) 204-223

53. Strange Particle Production in pp Collisions at sqrt(s) = 0.9 and 7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1105 (2011) 064, 39p.

54. Measurement of B anti-B Angular Correlations based on Secondary Vertex Reconstruction at sqrt(s)=7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1103 (2011) 136, 34p.

55. Measurement of Dijet Angular Distributions and Search for Quark Compositeness in pp Collisions at sqrts=7TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 106 (2011) 201804, 15p.

56. Observation and studies of jet quenching in PbPb collisions at nucleon-nucleon center-of-mass energy = 2.76 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev. C84 (2011) 024906, 26p.

57. First Measurement of Hadronic Event Shapes in pp Collisions at sqrt(s)=7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Lett. B699 (2011) 48-67

58. Dijet Azimuthal Decorrelations in pp Collisions at √s=7TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 106 (2011) 122003, 15p.

59. Inclusive b-hadron production cross section with muons in pp collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1103 (2011) 090, 28p.

60. Measurement of Bose-Einstein Correlations in pp Collisions at sqrt(s)=0.9 and 7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1105 (2011) 029, 28p.

61. Search for Supersymmetry in pp Collisions at 7 TeV in Events with Jets and Missing Transverse Energy.
CMS Collaboration (Chatrchyan et al.)
Phys.Lett. B698 (2011) 196-218

62. Search for Heavy Stable Charged Particles in pp collisions at sqrt(s)=7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1103 (2011) 024, 28p.

63. Measurement of the B+ Production Cross Section in pp Collisions at √s=7TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 106 (2011) 112001, 15p.

64. Search for a heavy gauge boson W' in the final state with an electron and large missing transverse energy in pp collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Lett. B698 (2011) 21-39

65. Upsilon production cross section in pp collisions at √s= 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev. D83 (2011) 112004, 27p.

66. Search for Pair Production of First-Generation Scalar Leptoquarks in pp Collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 106 (2011) 201802, 7p.

67. Search for Pair Production of Second-Generation Scalar Leptoquarks in pp Collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 106 (2011) 201803, 7p.

68. Search for Microscopic Black Hole Signatures at the Large Hadron Collider.
CMS Collaboration (Chatrchyan et al.)
Phys.Lett. B697 (2011) 434-453

69. Measurements of Inclusive W and Z Cross Sections in pp Collisions at sqrt(s)=7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1101 (2011) 080, 39p.

70. Measurement of the Isolated Prompt Photon Production Cross Section in pp Collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 106 (2011) 082001

71. Charged particle multiplicities in pp interactions at sqrt(s) = 0.9, 2.36, and 7 TeV.
CMS Collaboration (Chatrchyan et al.)
JHEP 1101 (2011) 079, 37p.

72. Search for Stopped Gluinos in pp collisions at sqrt s = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Rev.Lett. 106 (2011) 011801

73. Prompt and non-prompt J/psi production in pp collisions at sqrt(s) = 7 TeV.
CMS Collaboration (Chatrchyan et al.)
Eur.Phys.J. C71 (2011) 1575, 26p.

74. First Measurement of the Cross Section for Top-Quark Pair Production in Proton-Proton Collisions at sqrt(s)=7 TeV.
CMS Collaboration (Chatrchyan et al.)
Phys.Lett. B695 (2011) 424-443

b. OPERA

1. Study of neutrino interactions with the electronic detectors of the OPERA experiment.
OPERA Collaboration, N. Agafanova et al., New Phys. 13 (2011) 053051.

c. H1

1. Measurement of charm and beauty jets in deep inelastic scattering at HERA
H1 Collaboration (F. D. Aaron et al.)
Eur. Phys. J. C 71 (2011) 1509

2. Search for Squarks in R-parity Violating Supersymmetry in ep Collisions at HERA
H1 Collaboration (F. D. Aaron et al.)
Eur. Phys. J. C 71 (2011) 1572

3. Measurement of the cross section for diffractive deep-inelastic scattering with a leading proton at HERA
H1 Collaboration (F. D. Aaron et al.)
Eur. Phys. J. C 71 (2011) 1578

4. Measurement of the Inclusive e±p Scattering Cross Section at High Inelasticity y and of the Structure Function FL
H1 Collaboration (F. D. Aaron et al.)
Eur. Phys. J. C 71 (2011) 1579

5. Measurement of D_± Meson Production and Determination of Fc¯c2 at low Q2 in Deep-Inelastic Scattering at HERA
H1 Collaboration (F. D. Aaron et al.)
Eur. Phys. J. C 71 (2011) 1769

6. Measurement of Photon Production in the Very Forward Direction in Deep-Inelastic Scattering at HERA
H1 Collaboration (F. D. Aaron et al.)
Eur. Phys. J. C 71 (2011) 1771

7. Search for First Generation Leptoquarks in ep Collisions at HERA
H1 Collaboration (F. D. Aaron et al.)
Phys. Lett. B 704 (2011) 388

8. Search for Contact Interactions in e±p Collisions at HERA
H1 Collaboration (F. D. Aaron et al.)
Phys. Lett. B 705 (2011) 52

d. IceCube

1. Constraints on high-energy neutrino emission from SN 2008D.
IceCube Collaboration (R. Abbasi et al.). Jan 2011. 8pp.
Astron.Astrophys.527:A28,2011.

2. Search for neutrino-induced cascades with five years of AMANDA data.
IceCube Collaboration (R. Abbasi et al.). 2011. 11pp.
Astropart.Phys.34:420-430, 2011.

3. Measurement of the atmospheric neutrino energy spectrum from 100 GeV to 400 TeV with IceCube.
IceCube Collaboration (R. Abbasi et al.). Oct 2010. (Published Jan 1, 2011). 19pp.
Phys.Rev.D83:012001, 2011.

4. Observation of Anisotropy in the Arrival Directions of Galactic Cosmic Rays at Multiple Angular Scales with IceCube.
IceCube Collaboration (R. Abbasi et al.). May 2011.
Astrophys.J.740:16, 2011.

5. A Search for a Diffuse Flux of Astrophysical Muon Neutrinos with the IceCube 40-String Detector.
IceCube Collaboration (R. Abbasi (Wisconsin U., Madison) et al.). Apr 2011. 20 pp.
Phys.Rev. D84 (2011) 082001

6. Constraints on the Extremely-high Energy Cosmic Neutrino Flux with the IceCube 2008-2009 Data.
IceCube Collaboration (R. Abbasi et al.). Mar 2011. 9 pp.
Phys.Rev. D83 (2011) 092003, Erratum-ibid. D84 (2011) 079902

7. Search for Dark Matter from the Galactic Halo with the IceCube Neutrino Observatory.
IceCube Collaboration (R. Abbasi et al.). Jan 2011.
Phys.Rev. D84 (2011) 022004

8. First search for atmospheric and extraterrestrial neutrino-induced cascades with the IceCube detector.
IceCube Collaboration (R. Abbasi et al.). Jan 2011. 14 pp.
Phys.Rev. D84 (2011) 072001

9. Limits on Neutrino Emission from Gamma-Ray Bursts with the 40 String IceCube Detector.
IceCube Collaboration (R. Abbasi et al.). Jan 2011. 5 pp.
Phys.Rev.Lett. 106 (2011) 141101

10. Time-Integrated Searches for Point-like Sources of Neutrinos with the 40-String IceCube Detector.

The IceCube Collaboration (R. Abbasi et al.). Dec 2010. 44 pp.
Astrophys.J. 732 (2011) 18

11. Measurement of Acoustic Attenuation in South Pole Ice.
IceCube Collaboration (R. Abbasi et al.). Apr 2010. 15 pp.
Astropart.Phys. 34 (2011) 382-393

e. Crystal Clear

1. Development of an anthropomorphic breast phantom for combined PET, B-mode ultrasound and elastographic imaging
J. Dang et al.
IEEE Trans Nucl Science. 58(3), 660-667, 2011

2. Design and test of a robust multi-channel programmable sensor interface circuit for use in extreme environments
K. Van Cutsem et al.
Proceedings of the Animma 2011, Int. Conf. on Advancements in Nucl. Instrum., Measurement Methods and their Applications, June 2011 Ghent.

3. Development of ClearPEM-Sonic – a Multimodal Positron Emission Mammograph and Ultrasound Scanner
V. Juhan et al.
Proceedings of the IEEE conference in Valencia Spain, October 2011.

2. Refereed public and internal documents

CMS public PAS (Physics Analysis Summary)

1. W helicity in top pair events
CMS Collaboration, CMS PAS TOP-11-020

2. Measurement of btagging efficiency using ttbar events
CMS Collaboration, CMS PAS BTV-11-003

3. Status of b-tagging and vertexing tools for 2011 data analysis
CMS Collaboration, CMS PAS BTV-11-002 (FB editor)

4. Inclusive search for a fourth generation of quarks with the CMS experimentCMS Collaboration, CMS PAS EXO-11-054

5. Top pair cross section in lepton+jets+btag
CMS Collaboration, CMS PAS TOP-11-003

6. Top quark-antiquark mass difference
CMS Collaboration, CMS PAS TOP-11-019

7. Search for single top production in the tW-channel
CMS Collaboration, CMS PAS TOP-11-022

8. Search for Resonances in the Dilepton Mass Distribution in pp Collisions at $\sqrt{s}$ = 7 TeV,
CMS Collaboration, CMS PAS EXO-11-019

9. Measurement of Strange Particle Production in the Underlying Event in proton-proton collisions at 7 TeV with the CMS experiment
CMS Collaboration, CMS PAS QCD-11-010

CMS internal notes (CMS AN) and CMS Conference Reports (CR)

10. Measurement of the W polarisation in semi-leptonic top-pair decays
W helicity subgroup (incl. A. Olbrechts and J. D'Hondt), CMS AN-2011/325

11. Measurement of the b-tagging efficiency using muon+jets events
M. Maes, J. D'Hondt, CMS AN-2011/431

12. Search for inclusive b' or t' production
P. Van Mulders, CMS AN-2011/261

13. Combined measurement of the ttbar cross section and the b-tagging efficiency using muon+jet events
M. Maes, J. DHondt, CMS AN-2011/232

14. Measurement of the mass difference between top and antitop quarks
S. Blyweert, J. D'Hondt, M. Mulders, CMS AN-2011/307

15. Search for the Single top tW associated production in the dilepton decay channel
R. Gonzalez Suarez, F. Blekman, A. Giammanco, J. Wagner-Kuhr, J.Ott, CMS AN-2011/253

16. Search for High-Mass Resonances Decaying to Electron Pairs in the CMS Experiment with 4.7 fb^{-1} of data
B. Clerbaux et al., CMS AN-2011/444

17. Validation of ECAL calibration at high energy by the shower shape using Drell-Yan events in 2011 data,
Sh. Elgammal, B. Clerbaux, P. Marage, P. Miné, CMS AN 2011/355

18. High pt electrons efficiency measurement on the 2011 data using the Tag and Probe method
L. Thomas and B. Clerbaux, CMS AN-2011/270

19. Search for High-Mass Resonances Decaying to Electron Pairs in the CMS Experiment
B. Clerbaux et al., CMS AN-2011/159

20. High pt Electron selection efficiency measurement with Tag and Probe method,
L. Thomas, B. Clerbaux, G. De Lentdecker, CMS AN-2011/117

21. Validation of ECAL calibration at high energy using electrons in $\sqrt{s}$ = 7TeV data
Sh. Elgammal , B. Clerbaux, P. Marage, P. Miné, CMS AN-2011/085

22. Strangeness production in underlying event in proton-proton collisions at 7 TeV
T. Hreus, P. Vanlaer, P. Marage, CMS AN-2011/280