

ARA BOSCEN SOLID PET ICECUBE CMS H1 MUON NEUTRINO PHENO GRID
QCD DESY QUARKS 2013 OPERA CERN TOP DAQ SUSY HIGGS ELECTRONICS GEM GLUONS
ANNUAL REPORT

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BRUXELLES BRUSSEL



Vrije
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Brussel



UNIVERSITÉ
LIBRE
DE BRUXELLES

ANNUAL REPORT 2013



J. D'Hondt - L. Favart
Directors



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1 Introduction

1.1 The Interuniversity Institute for High Energies

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 form the standard model of particle physics, precision measurements of its parameters, the search for missing pieces in the standard model (notably until recently the Brout-Englert-Higgs boson), and the search for physics beyond the standard model, possibly related to the dark matter in the Universe and to cosmology.

Astroparticle physics is devoted to the study of the structure of the Universe, using particles as messenger of astrophysics activity in the universe and using several techniques developed in particle physics. All these experiments are performed in the framework of large to very large international collaborations (several hundreds to several thousands physicists and engineers).

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.), which lead to progress in industrial and medical applications.

1.2 Overview of 2013

The present report presents the research performed at the IIHE in 2013, that spans from the smallest accessible scales, below $10^{-19}m$ for e.g. the Brout-Englert-Higgs boson, quarks and neutrinos, to the largest scales above hundreds of thousands of light years for the source of ultra-high energy neutrinos detected by IceCube. During the year 2013 the IIHE published with its national and international research partners about 130 journal papers.

The year 2013 will stay in our memory as the year of the award of Nobel prize in physics to François Englert of the Université Libre de Bruxelles together with Peter W. Higgs of Edinburgh university “for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN’s Large Hadron Collider.” The announcement of the Brout-Englert-Higgs boson discovery by the CMS and ATLAS collaborations took place on 4 July 2012. The IIHE has contributed directly to this major finding.

The IIHE is deeply involved in the CMS experiment since its designing phase in the early 1990’s, and actively contributed to all aspects of such experimental project, i.e. building, operating and maintaining the CMS detector as well to the data analysis on searches for new physics and precision measurements of the fundamental interactions and particle properties. All aspects of this work is done in collaboration with other Belgian and international teams. Since the first collisions in 2009, the LHC has performed extremely well, with steadily increasing luminosity. The so-called RUN I, started in 2010, accumulated data with an energy up to 8 TeV, has been ended in February 2013. Data taken in proton-proton collision mode were complemented Pb-Pb and proton-Pb data.

During 2013, in addition to operational activities around the detector and its continuous survey and calibration, the Brussels team in CMS contributed to physics analyses in the study of the Brout-Englert-Higgs boson, on top quark physics, the search of new physics and precision measurements of the strong interaction (QCD) and the electro-weak interactions (EW).

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 in the very forward proton spectrometer (VFPS). The measurement of H1 and ZEUS at HERA deeply modified our understanding of the proton structure in terms of quarks and gluons. Since the accelerator shutdown in 2007, the data analysis of the Brussels group focuses on the finalisation of the VFPS related measurements, providing a new insight of Quantum Chromodynamics.

The IIHE has a long history of research in the field of neutrino (ν) physics. The OPERA experiment collected data between 2008 and 2012 accumulating in total about 16500 neutrino interactions in the target detector of which about 5800 have been located so far and 4700 fully analyzed. With these data the OPERA experiment studies the ν_μ to ν_τ oscillation through the identification of ν_τ . The detector is installed in the underground Gran Sasso Laboratory (LNGS) and exposed to the CNGS neutrino beam produced at CERN, 730 km away. Among the 4 events observed in this first experiment of ν_τ direct appearance, one new event has been published in 2013.

In the field of astroparticle physics, 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. Since 2011 the fully deployed IceCube detector operates as the largest ever built particle detector (1 km^3). The major research topics of the IIHE team are: the search for cosmic point sources, Dark Matter, high-energy neutrinos from transient events and the search for neutrinos from supernovae. The first hints of extra-terrestrial high-energy neutrinos came in April 2012 with the observation of two very high energy events (above 1000 TeV). Since then, with an intensified search more events have been found. This achievement that probably signs the birth of neutrino astronomy was awarded IceCube the title "*Breakthrough of the year 2013*" by the Physics World magazine.

For the detection in the South Pole ice of "GZK" neutrinos, from the scattering of ultra-high energy cosmic rays from 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), in neutrino oscillation experiments (CHARM II, CHORUS, OPERA) 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. Also in the area of medical imaging techniques the IIHE keeps on contributing to the development of PET and PEM scanners.

To link the activities of their theoretical physics (TENA) and experimental particle physics (ELEM) groups, a phenomenology group has been settled by the VUB through a concerted action (GOA - Gecon-



Figure 1: Signature of the MoU between ULB and Beihang University - Sept. 24th 2013.

certeerde OnderzoeksActies). The main topic of research is supersymmetric models and their signatures at the LHC. This was continued from 2013 with the framework of a Strategic Research Program “High-Energy Physics”.

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 November 8th 2013, all the IIHE members attended the annual meeting, 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.

In 2013, IIHE-ULB has started to develop privileged contacts with several Chinese groups. The collaboration with Beihang University (BUAA) for the exchange of students and professors has been officialised by a Memorandum Of Understanding in Particle Physics signed by the rectors of both universities. Other exchanges of PhD students have been initiated, with the support of the Chinese Scholarship Council (CSC), with the Institute of High Energy Physics (IHEP) and Peking University (PKU) in Beijing and with the Central China Normal University (CCNU).

1.3 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, the Odysseus programme and the European Union (FP7). Additional supports comes from our collaboration with the Institut de Recherche

de l'Institut Supérieur Industriel de Bruxelles (IRISIB) and Ion Beam Applications S.A. (IBA) for proton therapy.

1.4 The IIHE team in 2013

1.4.1 The ULB personnel

In September 2013, Laurent Favart replaced Pierre Marage as head of the ULB Particle Physics Department and became co-director of the IIHE.

Academic and scientific personnel

Patrizia BARRIA	IISN Post-doc since June	CMS, DAQ R&D
Daniel BERTRAND	Directeur de Recherche F.R.S.-FNRS; past IIHE co-director; honorary, and Professeur de l'Université	IceCube
Cécile CAILLOL	Aspirant F.R.S.-FNRS	CMS
Federico CECCOPIERI	collaborateur scientifique until July	H1
Barbara CLERBAUX	Maître de Recherche F.R.S.-FNRS; part-time Chargée de Cours	CMS
Gilles DE LENT-DECKER	Chercheur Qualifié F.R.S.-FNRS; Maître d'Enseignement	CMS, DAQ R&D
Valérie DE SMET	FREDONE PhD student	Instrumentation
Didar DOBUR	PAI Post-doc since November	CMS
Giuseppe FASANELLA	PAI PhD student since October	CMS
Laurent FAVART	Maître de Recherche F.R.S.-FNRS; part-time Chargé de Cours; IIHE director since September	H1, CMS
Arnaud GAY	Chargé de Recherche F.R.S.-FNRS until October	CMS
Anastasia GREBENYUK	PAI Post-doc since October	CMS
Kael HANSON	Chargé de Cours	IceCube, ARA
David HEEREMAN	IISN PhD student	IceCube
Tomas HREUS	Chargé de Recherche F.R.S.-FNRS until September	H1, CMS
Thomas LENZI	Aspirant F.R.S.-FNRS since October	CMS
Alexandre LEONARD	Aspirant F.R.S.-FNRS	CMS
Thierry MAERSCHALK	IISN PhD student	CMS, DAQ R&D
Pierre MARAGE	Professeur ordinaire ; IIHE co-director until September	CMS, Hist. of Sc.
Thomas MEURES	IISN PhD student	ARA
Abdollah MOHAMMADI	IISN Post-doc	CMS
Geoffrey MULLIER	Chercheur libre until November	DAQ R&D
David NDAYIZEYE	PhD student	Instrumentation
Aongus O'MURCHADHA	IISN Post-doc until October; Chargé de Recherche F.R.S.-FNRS since October	IceCube, ARA
Luca PERNIÈ	IISN PhD student	CMS
Yves PIERSAUX	co-tutelle with Rome University	Hist. of Science
Elisa PINAT	collaborateur scientifique	IceCube
Aidan RANDLE-CONDE	IISN PhD student	CMS
Thomas REIS	PAI Post-doc since August	CMS
Jean SACTON	IISN PhD student	CMS
Tomislav SEVA	Emeritus, Professeur ordinaire; past IIHE co-director	
Rachel SIMONI	IISN Post-doc	CMS
	Assistant PhD student since September	

Laurent THOMAS	FRIA PhD student	CMS
Catherine VANDERVELDE	Professeur	CMS
Pascal VANLAER	Premier Assistant; Chargé de Cours	CMS
Erik VERHAGEN	ARC PhD student	IceCube, CMS, DAQ R&D
Pierre VILAIN	honorary Maître de Recherche F.R.S.-FNRS, Professeur de l'Université	OPERA
Jian WANG	IISN Post-doc	CMS
Gaston WILQUET	honorary Maître de Recherche F.R.S.-FNRS, Professeur de l'Université	OPERA
Ryo YONAMINE	Chargé de Recherche F.R.S.-FNRS since October	CMS, DAQ R&D
Florian ZENONI	IISN PhD student	CMS, DAQ R&D

Master students

Patrick CONNOR	physics, since September	CMS
Hugo DELANNOY	physics, since September	CMS
Céline DE VOS	physics	IceCube
Gwenhaël DE WASSEIGE	physics, since September	IceCube
Thomas LENZI	physics, until September	CMS DAQ R&D
Federico LUCCHETTI	physics, since September	CMS DAQ R&D
Rachel SIMONI	physics, until September	CMS
David VANNEROM	physics engineer, since September	CMS
Marco ZECCHIN	physics, since September	CMS DAQ R&D

Engineers, Technical and Logistic Personnel

Samir AMARY	computer scientist since March
Abdelhakim BOUKIL	computer scientist
Patrick DE HARENNE	technician, general support
Michael KORNTHEUER	electronics
Fatimé PERO	secretariat, 1/2-time
Shkelzen RUGOVAC	computer scientist
Audrey TERRIER	secretariat
René VANDERHAEGEN	technician, electronics
Yifan YANG	ULB computing

1.4.2 The VUB personnel

Academic and scientific personnel

Shimaa ABU ZEID	ERASMUS MUNDOS (PhD student) since October	CMS
Freya BLEKMAN	ZAP docent	CMS
Stijn BLYWEERT	FWO scientific collaborator (PhD student) until September	CMS
Lionel BRAYEUR	FWO scientific collaborator (PhD student)	IceCube
Martin CASIER	FWO scientific collaborator (PhD student)	IceCube
Nadir DACI	FWO scientific collaborator (post-doc) since December	CMS
Priscilla DE AQUINO	VUB scientific collaborator (post-doc) till October	Pheno
Karen DE CAUSMAECKER	FWO aspirant (PhD student)	Pheno

Isabelle DE BRUYN	FWO scientific collaborator (PhD student) since October	CMS
Catherine DE CLERCQ	ZAP hoofddocent	IceCube
Krijn DE VRIES	FWO scientific collaborator (post-doc)	IceCube
Kevin DEROOVER	FWO scientific collaborator (PhD student) since October	CMS
Jorgen D'HONDT	ZAP hoofddocent; IIHE co-director	CMS
Geraldina GOLUP	FWO scientific collaborator (post-doc)	IceCube
Natalie HERACLEOUS	FWO scientific collaborator (post-doc) since June	CMS
Alexis KALOGEROPOULOS	FWO scientific collaborator (PhD student)	CMS
James KEAVENEY	FWO Pegasus Marie-Curie research fellow	CMS
Tae Jeong KIM	FWO scientific collaborator (post-doc) since September	CMS
Jan KUNNEN	FWO scientific collaborator (PhD student)	IceCube
Steven LOWETTE	ZAP docent since June	CMS
Michael MAES	FWO scientific collaborator (PhD student) until September	CMS
Giuliano MAGGI	FWO scientific collaborator (PhD student) since February	IceCube
Kentarou MAWATARI	VUB scientific collaborator (post-doc)	Pheno
Lieselotte MOREELS	FWO scientific collaborator (PhD student) since October	CMS
Bettina OEXL	VUB scientific collaborator (PhD student)	Pheno
Annik OLBRECHTS	FWO scientific collaborator (PhD student)	CMS
Quentin PYTHON	FWO scientific collaborator (PhD student)	CMS
Robert ROOSEN	Professor-emeritus	H1
Derek STROM	FWO scientific collaborator (post-doc) since August	CMS
Stefaan TAVERNIER	Professor-emeritus	PET & CMS
Pantelis TZIVELOGLOU	VUB scientific collaborator (post-doc) since November	Pheno
Walter VAN DONINCK	FWO onderzoeksdirecteur, on leave of absence at CERN, Emeritus since October	CMS
Nick VAN EIJNDHOVEN	ZAP hoogleraar	IceCube
Petra VAN MULDER	FWO research fellow (postdoctoraal onderzoeker)	CMS
Gerrit VAN ONSEM	FWO scientific collaborator (PhD student)	CMS
Isis VAN PARIJS	FWO scientific collaborator (PhD student) since October	CMS

Master students

Bert VERBRUGGEN	physics	CMS
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Engineers, Technical and Logistic Personnel

Jan DEBRUYNE	technician, general support, 1/2-time
Olivier DEVROEDE	computer scientist
Stéphane GERARD	computer scientist - VSC
Marleen GOEMAN	secretariat
Abdelhak OUCHENE	computer technician
Rosette VANDEN-BROUCKE	computer scientist - VSC
Luc VAN LANCKER	mechanical engineer till Augustus

With our greatest gratitude

Prof. Walter Van Doninck and Luc Van Lancker have retired in 2013.



Walter Van Doninck obtained his Ph.D. in 1977 at the VUB on the Gargamelle experiment at CERN that discovered in 1973 the existence of "Weak Neutral Currents" validating the Glashow-Weinberg-Salam model of electro-weak unification; the basis of the Standard Model of Particles and Fields. He was part of the DELPHI experiment (1983-1992) at the Large Electron Positron collider (LEP) at CERN where he was project leader for the Muon detection system. In 1992 he joined the Compact Muon Solenoid project (CMS) where in 2012 the scalar Boson predicted by the Brout-Englert-Higgs mechanism has been experimentally discovered. He was Research Director at the FWO Vlaanderen and Professor of experimental Physics at the Vrije Universiteit Brussel (VUB). He retired in 2013, but remains active as the vice-president of the CERN Council.



Luc Van Lancker was hired in 1973 as a mechanical engineer. He was responsible for the design and maintenance of instruments studying bubble chamber pictures, for example the BEBC scanning tables at the IIHE. Thereafter he was part of the construction teams of for example the UA5 camera system and the DELPHI forward muon chambers. In the nineties he joined the CMS experiment initially to work on the MSGC detectors and the Si-strip Tracker. At the end of his career he was a key member in the RPC project of the CMS Collaboration.

1.4.3 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. Albert Knutsson, Dr. Sunil Bansal, Dr. Igor Cherednikov, Dr. Xavier Janssen, Dr. Benoit Roland, Sara Alderweireldt, Tom Cornelis, Jasper Lauwers, Sten Luyckx, Tom Mertens, Pieter Taels, Merijn van de Klundert, Frederik Van der Veken, Hans Van Haevermaet, Sarah Van Mierlo, Alex Van Spilbeeck, Ir. Wim Beaumont, Ir. Eric De Langhe, Ir. Dmitry 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):

Dr. Evelyne Daubie, Dr. George Kohnen, Nikita Beliy, Florence Binet, Thierry Caebergs, Martine Fracas, Gregory Hammad, Joseph Hanton, Michelle Lefebvre, Francis Lequeux.

1.5 Hommage to Guy Van Beek

It is with great sorrow that we introduce this annual report with homage to our past colleague Guy Van Beek. Guy passed away on July 6th 2014 at the age of 69 after he lost a courageous fight against cancer. As a young industrial engineer trained in mechanics, he first worked at the Belgian Interuniversity Laboratory for High Energies (LIBHE/BILHE) of IISN until he joined the Service de Physique des Particules Élémentaires of ULB in 1972, at the time the IIHE was being constituted, until his retirement in January 2010.



Until the late 1970's, he mainly contributed to the design and construction of scanning and measuring devices for bubble chambers films, culminating with those used to analyse BEBC data. He then specialised in plastic and liquid scintillators and their read-out systems, Image Intensifiers (II) and multi-anode photomultiplier (MAPM) tubes. He made important contributions, from R&D to construction, installation and running, to the II optoelectronic chains of the large UA5 streamer chambers and their cameras in the 1980's, to the high resolution trackers of CHORUS made of the scintillating fibre ribbons read by II chains in the 1990's and finally to the scintillating strips tracker planes of OPERA read by MAPM tubes. In the late 1990's and early 2000's, he showed a strong involvement in an intensive R&D programme lead by CERN on liquid scintillator capillaries read by II chains. In the 1980's, he also participated to the design and construction of the central multi-wires proportional chambers of H1. These have been his main achievements besides many other activities having to do with smaller projects and with the everyday life of the institute, including running the mechanics workshop for a long while. Messages to his wife Michou, his family and us in Brussels have been received from all over the world from colleagues having collaborated with him over the years. The same words are constantly repeated. On one hand competence, courage, motivation, creativity, availability and on the other hand kindness, warmth, generosity, smiles. This is how we will remember Guy.

2 Research activities, development and support

2.1 The CMS experiment at the CERN LHC

(S. Abu Zeid, F. Blekman, S. Blyweert, C. Caillol, B. Clerboux, P. Connor, J. D'Hondt, I. De Bruyn, N. Daci, G. De Lentdecker, H. Delannoy, K. Deroover, O. Devroede, D. Dobur, G. Fasanella, L. Favart, A. Gay, R. Gonzalez Suarez, A. Grebenyuk, G. Hammad, N. Heracleous, T. J. Kim, A. Kalogeropoulos, J. Keaveney, S. Lowette, A. Léonard, J. Maes, M. Maes, P. Marage, A. Mohammadi, L. Moreels, A. Olbrechts, L. Pernie, Q. Python, A. Randle-Conde, T. Reis, T. Seva, R. Simoni, D. Strom, S. Tavernier, L. Thomas, W. Van Doninck, L. Van Lancker, P. Van Mulders, G. Van Onsem, I. Van Parijs, C. Vander Velde, P. Vanlaer, D. Vannerom, B. Verbruggen, E. Verhagen, J. Wang, Y. Yang, R. Yonamine, F. Zenoni.)

One of the two general-purpose detectors at CERN's Large Hadron Collider (LHC) is the Compact Muon Solenoid (CMS) experiment. The LHC produced proton-proton collisions in the LHC Run 1 in 2010, 2011 and 2012, in the latter year for the first time at the record energy of 8 TeV. The analysis of this data allowed precision tests of the Standard Model (SM) and the increased understanding of the data, in combination with the higher partonic cross subsections created by higher collision energy, allowed for over 300 publications in international scientific journals, of which 80 published in 2013.

The most important result in the LHC Run 1 is beyond doubt the observation of the last missing part of the SM, the BEH scalar boson predicted by R. Brout, F. Englert and P. Higgs at a mass of 125 GeV/c. This is also reflected by the award of the Particle Physics Division of the European Physical Society 2013 Prize to the ATLAS and CMS collaborations for this discovery, recognizing the collective efforts of the two collaborations, as well as visionary efforts of P. Jenni, M. Della Negra and T. Virdee, who led the teams that designed, constructed and commissioned the detec-

tors. While the discovery of the SM scalar boson is definitely the highlight of 2012, the year 2013 distinguished itself with a broader understanding of the SM, the scalar boson and more detailed analysis and examination for Beyond the SM physics (BSM) of particularly the 8 TeV LHC dataset.

Starting February 2013, the LHC was stopped for about two years dedicated to an upgrade of the machine and the detectors. The modifications will allow running at 13 TeV, almost doubling the energy, with an instantaneous luminosity that will be around three times more than in 2011 while keeping at the same time the pile-up contribution from multiple collisions at a reasonable level. During this first long shutdown, the IIHE physicists are developing an even more detailed understanding of the 7 and 8 TeV LHC datasets while preparing the triggers and their analysis strategy for the changes to come at higher energy and luminosity. This includes some previously impossible research directions, which are only possible with higher collision energies or larger datasets.

2.1.1 RPC construction

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 was designed, built, and installed in the CMS end caps to be operational after the long shutdown. The Forward RPC collaboration was 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 are responsible for the mechanical design of the chambers and their integration into the CMS end caps.

2.1.2 Activities related to the CMS upgrades

In the years 2020, CERN has the goal to further increase the LHC luminosity by a factor 10 above the present design parameters. In these extremely intense experimental conditions, new detector technologies are needed, to which IIHE physicists are contributing.

In the context of the LHC high luminosity upgrade, a group of physicists at the IIHE is contributing to the feasibility study of installing micro-pattern gaseous detectors (Triple-GEM) in the most forward region of the muon spectrometer (pseudo-rapidity range $1.6 < |\eta| < 2.1$). Using this novel technology instead of the more established RPC detectors would substantially improve the triggering properties at high pseudo-rapidities. To achieve this, the IIHE team is designing, in collaboration with CERN, Saclay and Bari, a trigger and data acquisition system for the Triple-GEM detectors. More details are discussed in the R&D subsection of this document.

One of the necessary improvements to be able to operate in the increased intensity of the LHC upgrade is the replacement of the CMS tracker. To fully benefit from the performance of the LHC, this new tracker detector should also need to contribute to the first level of the online trigger system, which is currently not the case. At the IIHE there is a team of physicists contributing to the development of the reconstruction of tracks that will be used by the track trigger algorithms, including preparation of studies of the performance of the track reconstruction for different tracking detector geometries and the implantation of this code in the upgrade software. In addition there is a development of the electronics necessary to the tracker upgrade. This technology is related to the work being undertaken on the readout electronics for the CMS Triple-Gem detector and also further discussed in the Data acquisition and R&D subsection of this document.

2.1.3 Study for the SM scalar boson and of multi-boson production

Since the existence of the SM scalar was confirmed in 2012, the study of the SM scalar now involves questions such as whether this particle is the only element to be added to the SM in order to give masses to the particles, and questions regarding the consistency of the discovered particle with respect to SM predictions. Measurements of its properties are thus essential to address. To obtain the maximal precision, the understanding of SM processes (EW and QCD) is crucial up to the highest possible precision.

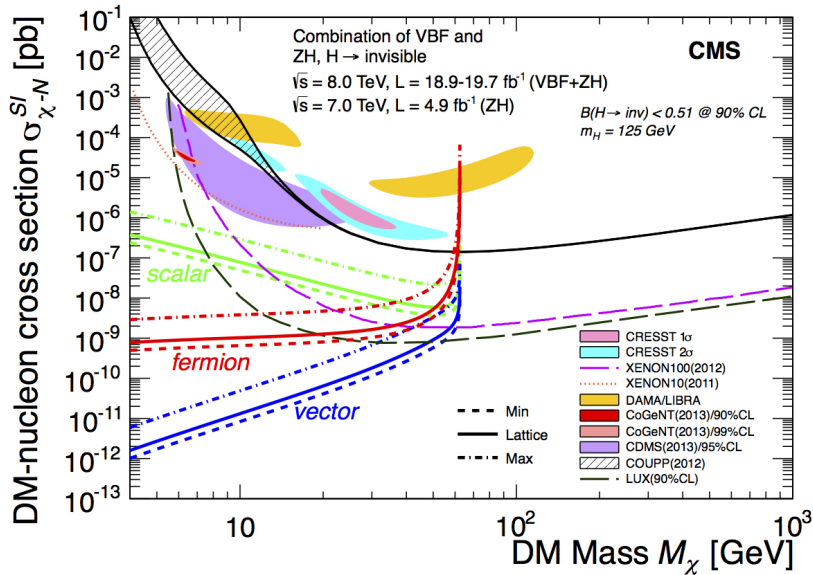
The IIHE group contributed in 2013 to the SM scalar boson studies on the following important aspects: 1) the study of the decay of the newly-discovered, “light”, boson into a pair of τ leptons in the $ZH \rightarrow l^+l^-\tau^+\tau^-$ channel; 2) the search for additional massive scalar(s) and the study of the properties of the light scalar boson in the l^+l^- plus missing energy channel, and 3) the calibration of the CMS electromagnetic calorimeter, which directly impacts measurements of the scalar boson in the $H \rightarrow \gamma\gamma$ channel. These studies were performed with the whole LHC Run 1

dataset, 5 fb^{-1} of data collected at 7 TeV center-of-mass energy and 20 fb^{-1} of data collected at 8 TeV.

The IIHE team leads the analysis of the $ZH \rightarrow l^+l^-\tau^+\tau^-$ channel, one of the important ways to confirm the coupling of the scalar boson to fermions. The $ZH \rightarrow l^+l^-\tau^+\tau^-$ channel is one of the significant inputs to the search for $H \rightarrow \tau^+\tau^-$ channel, for which 3 standard deviation evidence was observed with a branching fraction consistent with the SM, albeit within large uncertainties. The data to be collected from 2015 on should allow a more precise determination of this coupling.

The $H \rightarrow ZZ \rightarrow l^+l^-\nu\bar{\nu}$ decay channel is the most sensitive final states for the possible observation of an additional heavy scalar with SM-like couplings, thanks to its large branching ratio compared to the decay into four charged leptons. The IIHE team is strongly involved in this search. Limits on the production of a heavy scalar have been set with the $H \rightarrow ZZ \rightarrow l^+l^-\nu\bar{\nu}$ channel alone, excluding a SM-like scalar particle up to a mass of $930 \text{ GeV}/c^2$.

Being susceptible to couple to all massive particles, the scalar boson could decay into yet-undiscovered non-interacting particles such as those postulated to be responsible for the dark matter of the universe. The IIHE is contributes to the search for such decays in the $ZH \rightarrow l^+l^-$ plus missing energy channel and a post-doc is co-editor of the corresponding analysis notes. This final states is the same as is used for the measurement of the ZZ production cross-subsection in the $l^+l^-\nu\bar{\nu}$ final state. The SM cross-subsection is predicted with good theoretical precision, but it could be enhanced at high Z boson momenta if anomalous γZZ and ZZZ triple gauge couplings exist. These couplings are constrained at the LHC with unprecedented sensitivity, in particular in the $ZZ \rightarrow 4l^\pm$ and $ZZ \rightarrow l^+l^-\nu\bar{\nu}$ channels. The figure shows how these invisible scalar couplings can be used in a $H \rightarrow \text{DMDM}$ interpretation, which results in limits on the interaction cross subsection between dark matter candidates and nucleons.



The ZZ production cross subsection actually has a tiny but characteristic contribution from decays of off shell SM scalars. This contribution being closely related to the properties of the scalar boson, it can be exploited in a variety of ways. For instance, an upper limit on the off shell cross subsection can be reinterpreted as an upper limit on the decay width of the scalar boson that is at least two orders of magnitude better than a direct measurement of the line shape. The IIHE has contributed in a leading way to setting the world best constraints on the decay width of the scalar boson using off shell decays.

It is worth noting that for most of the SM scalar boson studies performed at the IIHE, a large increase in sensitivity is expected with the Run 2 data due to the increase in beam energy to 13 TeV.

2.1.4 Top quark physics

During the 2012 run of the Large Hadron Collider, at 8 TeV centre of mass energy, the CMS experiment collected an enormous sample containing top quarks in pair production as well as single production.

This allowed IIHE physicists to measure and study very diverse aspects of the top quark sector, focusing not only on the SM but also on searches for physics beyond the SM. The strong role of the institute in the top physics community was also visible in leading roles, as for example Prof Freya Blekman's role as convener of the beyond-two-generations group, a dedicated physics group in the CMS experiment that focuses exclusively on BSM searches in the top quark sector.

Using the 8 TeV dataset the IIHE group is preparing legacy papers on the high precision measurements of the production and decay properties of the top quark (some of these will not be possible to be performed as accurately in future LHC runs due to the high luminosity conditions) as well as searches for new physics in top-like final states. This results in a physics programme that reveals going from SM measurements via BSM-sensitive top quark physics to direct searches:

Cross subsection of top quark pair processes at 8 TeV: As a continuation of the 7 TeV production cross subsection measurement effort, the previously developed method to simultaneously measure the b-tagging efficiency and the cross subsection after b-tagging was used to provide a measurement on 8 TeV, in collaboration with the Universiteit Gent.

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. The 8 TeV analysis was a significant improvement of the 7 TeV result, resulting in the most precise measurement of this quantity.

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 extracted. A precise measurement was obtained 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.

Flavour-Changing Neutral Currents in the top quark sector: If new physics can not be directly observed at the LHC, it would in many cases still be possible to find evidence of such new physics processes through deviations to Standard Model rare processes. IIHE physicists are currently preparing an inclusive approach where all final states in top quark physics sensitive to Flavour-Changing Neutral currents (FCNC) such as the rare decays $t \rightarrow Hc$ and $t \rightarrow Zc$, are examined and these processes are accurately measured in all possible final states. This work relies heavily on identification of charm quarks so the same team is also developing the CMS experiment charm quark tagger.

Using precision techniques to identify BSM contributions in the top quark sector: A team of IIHE physicists is studying if it is possible to constrain BSM processes using theory-driven precision tools such as the matrix element method (relying on numerical integration of the SM Lagrangian convoluted with resolution functions). In the last years major progress was made in the computational performance of these tools, and the IIHE team is collaborating with the MadGraph experts at IIHE and UCL to use the MadWeight tools for the matrix element method. First feasibility studies started in the context of a masters thesis in 2013.

Search for single-top processes in the Wt channel: The production of a single top quark together with a W boson is a rare SM process that is sensitive to new physics and to the Vtb CKM matrix element. In addition this process is an important background to new physics searches. The 8 TeV analysis was performed in collaboration with University of Nebraska and Kansas State University, and resulted in the first discovery of this process, with a significance of over 5 standard deviations.

Search for production of four tops: The production of four top quarks, which in the SM is a very rare process with a cross subsection of the order of $1fb$, could be greatly enhanced by many new physics models, including Supersymmetry, but also more exotic models where gluon couplings are enhanced due to additional particles in the QCD sector. Depending on the physics model, these signatures will not display the typical Supersymmetry signature with large transverse missing energy. The first paper focusing solely on SM-like production of four-tops is currently in preparation, in collaboration with the IIHE phenomenology group for the BSM signatures.

Search for fourth generation chiral and vector-like quarks: Building on a 7 TeV search inclusively for

fourth generation quarks (t' and b'), either in pair production or in single production, resulting in the publication of the world best limits were on the existence of a fourth generation in 7 TeV LHC data, the IIHE team is examining the 8 TeV data looking for vector-like heavy quarks that can be produced consistently with observed observed cross subsection and branching fractions of the BEH scalar. This very difficult search is expected to yield results in 2014.

Search for third generation supersymmetric particles: Supersymmetry is a popular extension of the SM, 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 IIHE analysis focused on identification of relevant observable topologies and the possibility to differentiate these from the SM background processes.

Search for displaced production of top quarks: One of the possibilities why no new physics has been observed at the LHC is hypothesising that the Supersymmetry particles have a longer than expected lifetime before they decay. Such events would be rejected by nominal searches, which require that the SM decay products originate from the collision point. An analysis searching for these signatures in the 8 TeV data is currently in preparation.

2.1.5 Searches for high-mass resonances

Many scenarios beyond the Standard Model (SM) are expected to be manifest through the production of new heavy resonances and modifications of the spectrum of high mass charged lepton pairs, typically above 1 TeV. For example, massive gravitons or new massive gauge bosons, Kaluza-Klein recurrences, are expected in the framework of extra spatial dimension models, as well as new heavy Z bosons in Grand Unified Theories.

Since 2006, physicists from the IIHE play a leading role in the preparation and the coordination of the physics analyses in the di-electron final state. IIHE physicists initiated the creation of the **HEEP (High Energy Electron Pairs) working group**. In years 2010-2012, the Brussels group was strongly involved in every step of the CMS data analysis at 7 TeV and 8 TeV.

Electromagnetic calorimeter (ECAL) Calibration: The electromagnetic calorimeter of CMS, the ECAL, is the main detector used in the HEEP analysis. Expertise has been acquired in the ECAL calibration, resolution and linearity measurement. The Brussels group has designed and developed a method based on the ECAL shower shape to cross check the ECAL calibration and linearity at very high energy. This sophisticated method is the only one available at very high energy and is crucial for the control of the ECAL response in view of the search for new physics at high energy. Another contribution concerns the ECAL resolution estimation, in particular using the Z peak events from SM Drell-Yan process.

Limits on new physics: Studies were devoted to developing tools to estimate the CMS five-sigma discovery potential for heavy resonances, as well as the 95% Confidence Level (CL) on the resonance production cross subsection in case of the absence of signal. The dielectron and dimuon channel results were combined. The results on the CMS data at 7 TeV taken in year 2010 (luminosity of 35 pb⁻¹) and in year 2011 (luminosity of 5.0 fb⁻¹) have been published, as well as an update of the results using part of the 2012 data at 8 TeV. The legacy paper, presenting final results of the full Run1 dataset analysis, is about to be sent to JHEP journal publication. In parallel, the IIHE HEEP group is actively preparing the high energy run (at an energy of 13 TeV in the proton-proton centre of mass) data taking and analysis.

Searches for electron-muon resonances: In collaboration with ULB theorists, an additional analysis was performed to search for high mass resonances decaying into electron-muon pairs. The data were found to be in agreement with the SM expectation, and limits on new physics parameters for different models have been put. A CMS publication is in preparation.

2.1.6 SM precision measurements

To exploit the full discovery potential of CMS and to achieve the maximal precision on the BEH boson properties measurement, it is essential to reach the highest level of precision possible in SM physics area. For these reasons, the jet production associated to the Drell-Yan process is identified as a High Priority Analysis in CMS. In 2012, research activities at the IIHE have started to study it.

Drell-Yan production associated with jets: The Drell-Yan production cross subsection in hadron-hadron collision is known at the NNLO in QCD. The confrontation of the measurement to theoretical predictions provides a stringent test of perturbative QCD. Furthermore, the very high energy of the LHC allows producing many jets in the events. In particular Z events with more than 2 jets are frequently produced but beyond the scope of NNLO predictions. Alternative approaches are developed in Monte Carlos to predict many jets production. The IIHE group is leading the analysis at 8 TeV and has measured the Z +jet cross subsection for up to 7 jets with transverse momenta above 30 GeV and compared it to different Monte Carlo predictions (MadGraph, Sherpa and Powheg). The jet multiplicity as well as the different transverse momentum distributions are measured.

Double Parton Scattering: The amount and the phenomenological relevance of Double Parton Scattering (DPS) events, where two pairs of partons collide, become important for SM measurements as well as beyond the Standard Model physics, in particular with the coming data at 13 TeV. The study of $V+2$ jets, where V is a W or Z boson, is of particular interest for the understanding of DPS, with the V produced by a pair of partons and the 2 jets produced by another pair of partons. This process has been measured for the case of a Z boson by the group in the 7+8 TeV data, focusing on variables developed to enhance sensitivity to the DPS production.

2.1.7 Dark matter production at the Large Hadron Collider

Prof. Steven Lowette joined the IIHE in 2013, aiming to search in the upcoming high-energy run of the LHC for signatures of direct dark matter production in the CMS detector. These searches for dark matter production in the laboratory excellently complement the ongoing IIHE activities regarding dark matter, both in the IceCube experiment and in the phenomenology group. While the LHC is in maintenance mode a team of IIHE physicists started studies for dark-matter searches towards the next LHC run. In parallel, aiming for already collected data, an IIHE effort was initiated to search for strongly interacting dark matter, in collaboration with colleagues from the ULB phenomenology/theory department.

2.2 The H1 experiment - Study of ep collisions at HERA

(F. Ceccopieri, L. Favart, T. Hreus, X. Janssen, R. Roosen and P. Van Mechelen)

Deep-inelastic lepton-nucleon scattering has played a key role in understanding the structure of the nucleons since the late 1960. The results of these experiments led to the development and verification of Quantum Chromodynamics (QCD), the gauge field theory of the strong interaction.

HERA (Hadron-Electron-Ringanlage) was the first machine in which leptons collided with protons in a storage ring. Operating with electrons/positrons of 27.5 GeV and protons of 820/920 GeV, the center-of-mass energy in these collisions was increased by a factor ten over the previous fixed-target experiments. The two main detectors installed in the interaction regions, H1 and ZEUS, were magnetic spectrometers with a nearly hermtic coverage, allowing a complete measurement of the lepton and hadronic final states.

HERA started in 1992 and during phase I, which lasted until 2002, delivered about 200 pb^{-1} . During phase II which started in 2004, after a 4-fold luminosity upgrade, until the closedown in 2007 HERA produced another 560 pb^{-1} . The analysis of the data is still ongoing and represents more than 40 FTE in 2013 in H1.

For the first HERA operation phase, the Belgian groups built the central outer proportional chamber, COP, and designed and built the readout for all MWPC's in H1 and related software. During phase II, the Belgian groups took the responsibility for the construction, installation, and running of the very forward spectrometer (VFPS). The detector composed of two movable stations - Roman pots - consists of scintillating fibre detectors allowing the reconstruction of low track multiplicity events. The stations are only moved close to the beam when the beam conditions are stable.

The main activity of the group concerns the analysis of the VFPS data. In a first instance and prior to any physics analysis is the extraction of the diffractive track information from many datasets in which beam conditions and background change and different beam approaches have to be accounted for. This analysis has now been finalised and the results are published [1]. The knowledge obtained from this analysis has led to a software package which links of raw VFPS data to the diffractive track parameters, required by the any physics analysis. Two studies based on

VFPS data have been using this information: diffractive dijet production and the measurement of the proton structure function.

- A measurement and comparison of the ratio of the dijet cross subsection in deep-inelastic and photoproduction have confirmed with better precision that the QCD-factorisation in photoproduced jets is broken and that this breaking is unrelated to diffractive proton dissociation process. The results are written up and are in the process of submission for publication. Preliminary results have already been presented at conferences in 2013 as shown by Fig. 2.
- Measurement of a fourfold differentially inclusive cross subsection leading to a determination of $F_2 D^{(4)}$ is almost finished. The determination of the four momentum transfer to the diffractive proton, is still under investigation and is the last issue in the analysis chain.

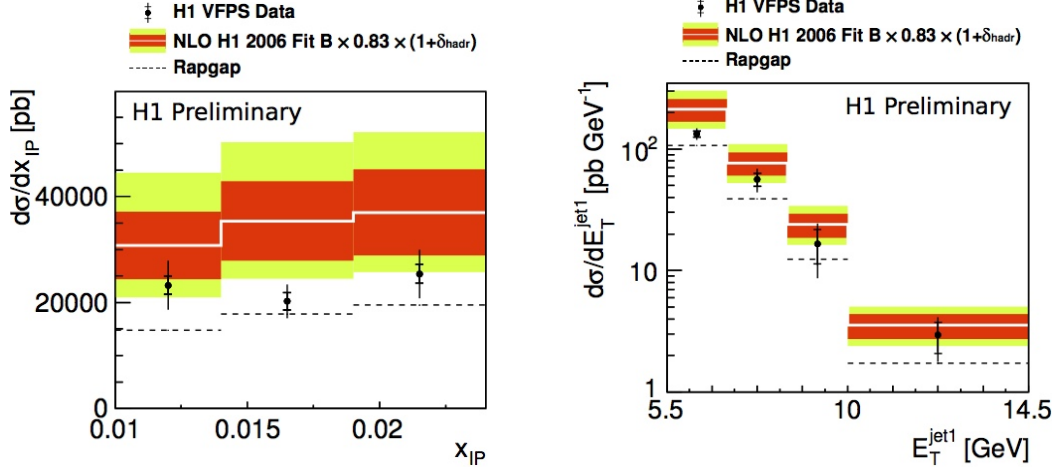


Figure 2: Differential dijet cross subsection in photoproduction as a function of x_P (left) and as a function E_T^{jet1} (right)

Further results obtained by the H1-collaboration are;

- From the measurement of inclusive jet, dijet and trijet differential cross subsections and comparison to QCD NLO calculations, the strong coupling constant is extracted,

$$\alpha_{M_Z}(s) = 0.1165 (8)_{exp} (38)_{pdf,theo}$$

To improve on the experimental precision a NNLO calculation is required.

- The effort to combine data from the two largest experiments, H1 and ZEUS, in order to reduce errors is still continued. The latest result is a combined QCD analysis of the charm production cross subsection in deep-inelastic scattering. Using different heavy flavour schemes, the optimum charm mass is determined and the implication on the production of $W^\pm$ and Z at the LHC investigated.
- The elastic and dissociative J/Ψ production cross has been measured at 2 different centre of mass energies. This has permitted to determine the difference in the t-behaviour between the elastic and dissociative production and to obtain a leading gluon parametrisation in agreement with the one obtained from DIS cross subsections. A fit to the elastic cross subsection measurement as a fuction of energy explains well the measurement obtained from LHCb, while the low energy data point covers the gap between the fixed target experiments and the HERA data as shown in Fig. 3.

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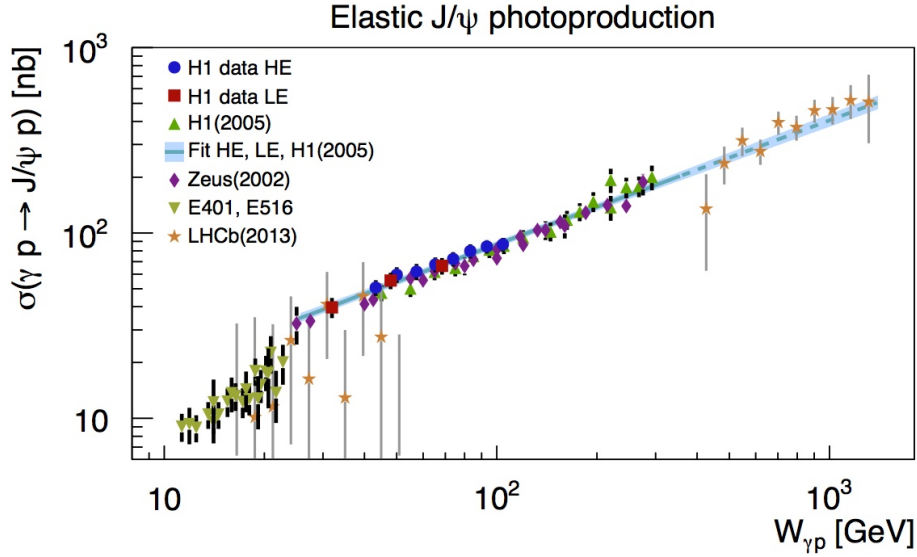


Figure 3: Compilation of elastic J/Ψ -production cross subsection as a function of the centre of mass energy, ranging from fixed target to LHCb.

2.3 The OPERA experiment (CERN CNGS1)

(P. Vilain, G. Wilquet)

The OPERA experiment aims at detecting for the first time the direct appearance of ν_τ in a ν_μ beam with a large signal/noise ratio through the identification of the τ^- lepton produced in their CC interactions in the oscillation parameters space indicated by the atmospheric neutrinos experiments: compatible with full $\nu_\mu - \nu_\tau$ mixing and $|\Delta m_{32}^2| \approx 2.32 \text{ eV}^2$. The detector is installed in the underground Gran Sasso Laboratory (LNGS) and exposed to the CNGS neutrino beam produced at CERN, at a distance of 730 km. The design of the detector takes into account two conflicting requirements: a large target mass to cope with the minute neutrino interaction cross-subsection and the baseline length and a micrometric resolution to allow the detection of the short-lived tau lepton. More information on the instrument may be found in previous reports and in [1]. Our group was more specifically involved in the conception, construction, installation and running of the scintillating strips trackers that instrument the targets. [2]. A study of the performances of the electronic detectors is available in [3]. The physics run with a fully operational detector started in spring 2008 and ended in December 2012. The achieved integrated neutrino beam flux corresponds to 18×10^{19} pot, i.e. 80% of its nominal value and about 16 500 neutrinos interactions have been registered in the target.

The analysis of the 2008-2009 data is completed as well as that the subsample of the 2010-2012 events that were found in the most probable brick. Four ν_τ candidate events have been observed so far [4], 3 where the τ^- decays in an hadronic mode and one in the muonic mode (Figure 4). A total number of (2.11 ± 0.42) signal and (0.23 ± 0.04) background events are expected and $\nu_\mu \rightarrow \nu_\tau$ oscillations in the appearance mode are therefore established with a statistical significance of 4.2σ . This result is based on a sample of about 5500 fully analysed events of which about 4700 have passed the kinematic selection cuts.

The procedure developed to detect particle decays occurring over distances of the order of 1mm from the neutrino interaction point has been applied to the search for charmed hadrons as these show similar mass, lifetime and decay topologies as the τ^- lepton. In the analysed subsample, 50 charm decay candidate events have been observed while 54 ± 4 are expected including background. This agreement in rate is further supported by the comparison between observed and simulated data for several relevant variables. This demonstrates that the detector performance and the full analysis chain applied to neutrino events are well reproduced by the OPERA simulation chain, thus validating the methods applied to the ν_τ appearance search [5].

The number of observed ν_τ candidate events is 4 and the number of expected events is 2.33 ± 0.42 including

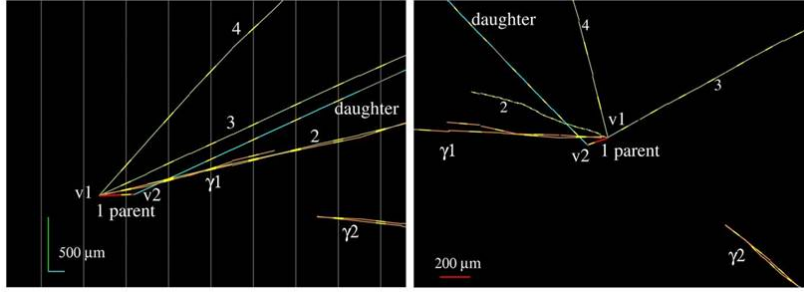


Figure 4: Zoom on the vertex region of event 4 in a projection longitudinal to the beam direction (left) and orthogonal to the beam (right). v_1 and v_2 are the primary and decay vertices.

background. There is no evidence for a statistically significant excess or lack of ν_τ interactions to be attributed e.g. to $\nu_\mu - \nu_\tau$ oscillation induced by the mixing with a sterile neutrino. Limits have been established on the existence of such a neutrino in a so-called 3+1 framework where it is separated by a squared mass difference $\Delta m_{41}^2 > |\Delta m_{31}^2|$. Such models are invoked to explain the excess of ν_e events in a ν_μ source at large Δm^2 observed by the LSND and Mini-BooNE experiments as well as the so-called nuclear reactor and Gallium neutrino anomalies. At high Δm_{41}^2 values, the measured 90% CL upper limit on the effective mixing angle $4|U_{\mu 4}|^2|U_{\tau 4}|^2$ ranges between 0.09 and 0.14, depending on the value of the CP-violating phase $Arg(U_{\mu 3}U_{\tau 3}^*U_{\mu 4}U_{\tau 4}^*)$. The long baseline of the OPERA experiment allows extending the exclusion limits on Δm_{41}^2 in the $\nu_\mu \rightarrow \nu_\tau$ appearance channel down to values $\approx 10^{-2} eV^2$ at large mixing [6].

A by-product of the experiment is the search for ν_e appearance in the ν_μ beam even though the large, 0.9%, beam contamination in ν_e does not allow measuring θ_{13} . A total of 19.8 background ν_e interactions are expected, of which 19.4 resulting from the beam contamination, where 19 are observed. This measurement further limits the parameter space available for a non-standard ν_e appearance in a ν_μ source that is suggested by the observations mentioned above. The OPERA result further constrains the still allowed region down to around $\Delta m_{new}^2 = 5 \times 10^{-2} eV^2$ and, for large Δm_{new}^2 values, the 90% C.L. upper limit on the new mixing $\sin^2(2\theta_{new})$ reaches 7.2×10^{-3} . [7].

The flux ratio of positively to negatively charged muons produced in cosmic rays interaction has been measured by the spectrometers with an unprecedented precision in the high muon energy region up to 20 TeV, supporting the validity of Feynman scaling in the fragmentation region up to 200 TeV/nucleon [8].

In 2013, the OPERA Collaboration included about 150 physicists from 30 institutions in 11 countries.

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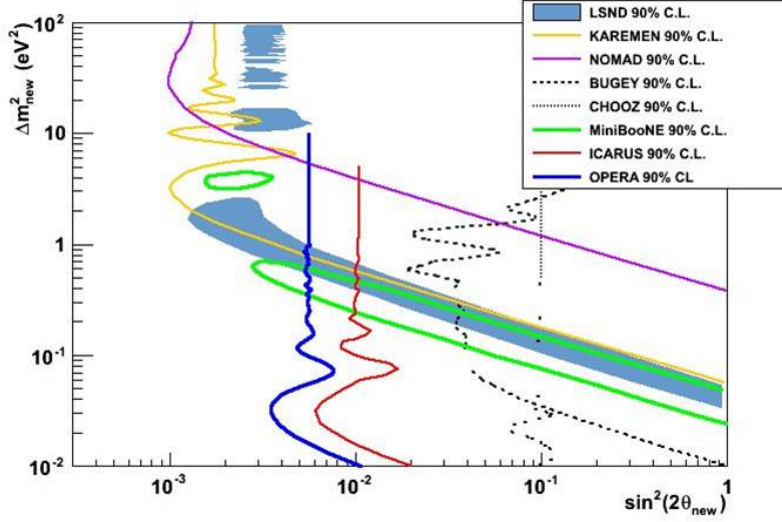


Figure 5: Exclusion region for the parameters of the non-standard $\nu_\mu \rightarrow \nu_e$ oscillation obtained by OPERA and other experiments. Regions corresponding to positive indications reported by LSND and MiniBooNE are also shown.

2.4 Astroparticle Physics with the IceCube Neutrino Observatory

(L. Brayeur, M. Casier, C. De Clerq, C. De Vos, G. De Wasseige, N. van Eijndhoven, G. Golup, K. Hanson, D. Heereman, J. Kunnen, G. Maggi, E. Pinat, K. de Vries.)

Astroparticle Physics revolves around phenomena that involve (astro)physics under the most extreme conditions. Black holes with masses a billion times greater than the mass of our Sun, accelerate particles to velocities close to the speed of light. The produced high-energy particles may be detected on Earth and as such provide us 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 Earth. Furthermore, since they are hardly hindered by intervening matter, neutrinos are the only messengers that can provide information about the central cores of cosmic accelerators like Gamma Ray Bursts (GRBs) and Active Galactic Nuclei (AGN), 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 observed but which has to be present to explain various observed phenomena. According to some models, this dark matter may consist of Weakly Interacting Massive Particles (WIMPs) which can annihilate among themselves. In these annihilation processes some of the produced particles are high-energy neutrinos. Since these WIMPs are expected to get trapped in gravitational fields, there may be large concentrations of them at the center of massive objects like our Earth, Sun or Galactic Center. Consequently, observation of high-energy neutrinos from these objects could provide indirect evidence for the existence of these dark matter particles.

At the IIHE we are involved 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 has now been taking data for several years.

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 (see fig. 6) exhibits a hexagonal structure, which is the result of extensive optimisation procedures based on simulation studies.

At the end of 2010 the full 86-string detector, including its DeepCore 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} powerlaw energy spectrum for the produced neutrino flux, whereas most of the neutrinos originating from dark matter particles are also 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 and to achieve this, IceCube has been extended with a dense core located at the deepest parts of the detector. This so called DeepCore extension consists of 8 additional strings arranged around the central IceCube string such that the distance between adjacent strings is 72 m as opposed to the 125 m standard IceCube string spacing. Each DeepCore string has 50 sensors at 7 m spacing covering depths between 2100 and 2450 m and 10 sensors at 10 m spacing between 1750 and 1860 m. With this DeepCore extension the lower energy threshold has been 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 DeepCore sensors provide sensitivity over the full 4π solid angle. This allows investigation of sources in the Southern hemisphere, including our Galactic Center and the black hole within it.

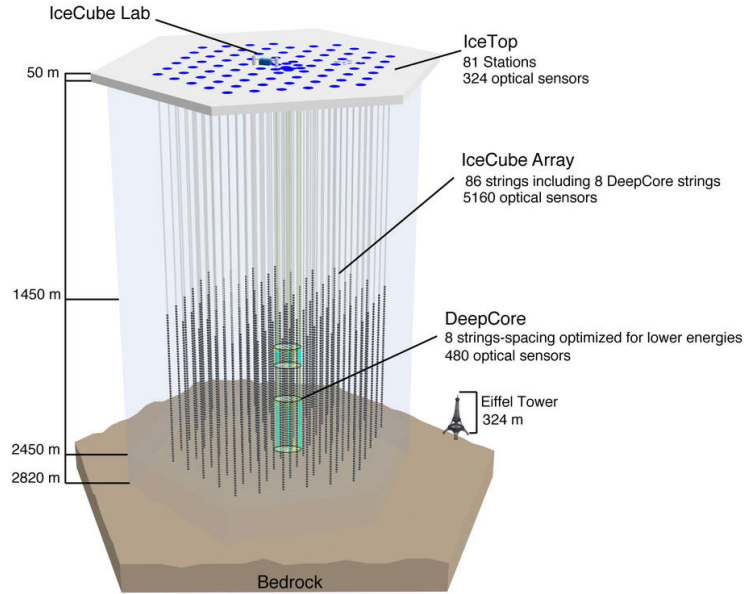


Figure 6: The IceCube observatory.

Research areas at the IIHE

In 2013 the IIHE was involved in the following IceCube related (astro)physics topics :

- **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. A first analysis (Nature **484** (2012) 351) has shown that Gamma Ray Bursts alone can not be the sources of the very energetic cosmic rays which we observe at Earth and this, rather shocking, result has also ruled out a large number of theoretical models. Consequently, the search is open for new, yet unknown candidates among which are the Active Galactic Nuclei. At the IIHE a special analysis method for the study of these cataclysmic phenomena has been developed and with the current and future data of the full IceCube observatory we have the possibility of observing neutrinos from these objects for the first time in history with unprecedented sensitivity.

- **Detection of a diffuse flux of very energetic cosmic neutrinos.**

Most of the detected high-energy neutrinos originate from particle interactions in our Earth's atmosphere. These so called atmospheric neutrinos represent an irreducible background in our search for neutrinos of cosmic origin. Due to the fact that the energy spectrum of these atmospheric neutrinos is relatively soft, compared to the E^{-2} cosmic spectrum, a cosmic neutrino signal might be detected by focusing on observation of events of Very High Energy (VHE), well above the flux of atmospheric neutrinos. Three years of data taken by the complete IceCube detector were analysed by making use of sophisticated veto techniques to select contained events. This resulted in a sample of events within an energy range not compatible with the atmospheric neutrino spectrum (Science **342** (2013) 1242856) and led to the discovery of cosmic high-energy neutrinos. This achievement was awarded the title "Breakthrough of the year 2013" by the Physics World magazine.

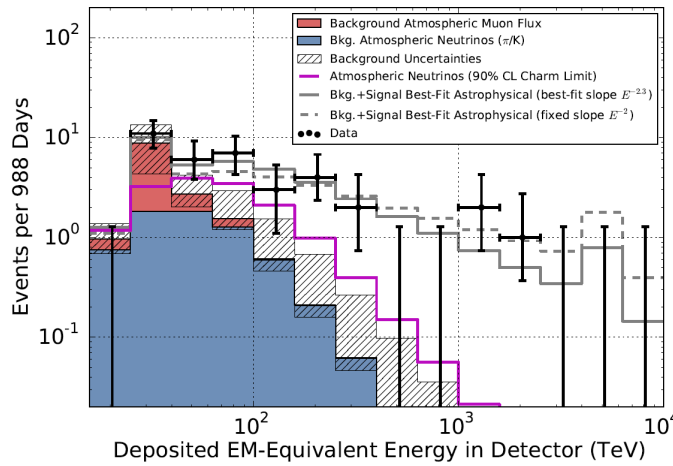


Figure 7: IceCube discovery of cosmic high-energy neutrinos.

Our group at the IIHE is involved in a combined study of these very energetic cosmic neutrinos and the ultra-high energy cosmic ray (UHECR) events observed with the Pierre Auger and Telescope Array observatories. The aim is to identify the sources of the highest energy particles via correlation studies.

- **Search for cosmic point sources.**

Apart from the correlation studies mentioned above, this research also comprises a full sky search for "hot spots" of neutrino production. Identification of such "hot spots" on the neutrino sky would enable us to locate the sources of the most energetic cosmic ray particles. At the IIHE we focus on a special class of Active Galactic Nuclei called Blazars. These AGN are steady sources of very energetic electromagnetic radiation for which the jet is aligned along our line of sight. However, instead of selecting the sources which are brightest in gamma rays as was done in previous analyses, we focus on the ones which are bright in radio flux but rather dim at more energetic radiation. The idea is that in this way we will be able to select dust obscured Blazars, where the dust provides an additional target for high-energy neutrino production. Together with a novel statistics method which has been developed at the IIHE we intend to achieve a better sensitivity for neutrino detection of these objects.

- **Dark matter searches.**

In these studies the focus is put on neutrino signatures from WIMPs located in the center of our Earth or Sun. In a previous analysis the IIHE team took the lead in the search for high-energy neutrinos from our

Sun when the source was above the horizon. This was possible thanks to the performant veto capabilities of the IceCube sensors surrounding DeepCore. That analysis yielded the most sensitive limits on spin dependent WIMP-nucleon cross subsections.

Currently at the IIHE a procedure is being developed to search for WIMP signals from the centre of the earth and preliminary results indicate that the sensitivity may be improved by about two orders of magnitude compared to previous IceCube searches.

- **Detection of neutrinos from supernova explosions.**

Since the observation of the supernova 1987A in the Magelanic Cloud, a nearby dwarf galaxy, it is known that in the collapse of a heavy star neutrinos are produced at a very early stage. Such an event may provide a large flux of neutrinos at Earth, which can be detected by IceCube with a specialised data acquisition system. Since IceCube is continuously observing the full sky, this would allow to provide a so called supernova alert to induce follow up programs with other instruments all over the world and in space. An early observation is essential to allow to study the full process of a supernova event, from the very first flash until the last afterglow, in order to gain insight in the underlying (astro)physical processes. At the IIHE a special data acquisition procedure, dubbed HitSpooling, has been developed which will significantly increase the sensitivity for an early detection of these phenomena.

- **Detection of Ultra-high energy (GZK) neutrinos.**

The most energetic cosmic ray particles will be destroyed by interactions with the Cosmic Microwave Background Radiation (CMBR) on their journey through the Universe. These interactions should be a source of very energetic neutrinos, but on basis of cosmic ray flux measurements the associated neutrino flux is expected to be extremely low. Consequently, a very large detector area is required to detect a substantial amount of these particles. To achieve this, a detector R&D program has been initiated to investigate the feasibility of using an area of about 80 km² equipped with radio detection systems to observe these GZK neutrinos. The project is called the Askaryan Radio Array (ARA) and at the IIHE we have participated in the development of the timing and data acquisition system and in the commissioning of the first detector elements. Currently an analysis of the data obtained with these first detector stations is being performed.

- **R&D for detector extensions**

The discovery of cosmic high-energy neutrinos has triggered feasibility studies of extending the existing IceCube observatory towards higher energies. However, in view of neutrino oscillation studies and in particular investigation of the neutrino mass hierarchy, also an extension towards lower energies (the so called PINGU project) is being examined. Both these extensions involve extensive detector R&D efforts in which the IIHE team participates via the development of new readout and data acquisition techniques. Furthermore, between the energy ranges of IceCube and the above mentioned ARA detector there exists an energy gap which is currently not covered by any detector. At the IIHE we are studying an innovative technique based on radar reflection in order to detect showers of very energetic neutrinos in the ice which would fill this gap in energy coverage.

2.5 The ARA project

(Kael Hanson, Yifan Yang, Krijn de Vries, Aongus Ó Murchadha, Thomas Meures, Michael Korntheuer)

The Askar'yan Radio Array (ARA) Collaboration is an international collaboration of over 30 scientists and engineers from institutions in 7 countries. The goal of the collaboration is the construction of a telescope capable of detecting neutrinos with energies in excess of 10¹⁸ eV. The project makes use of the 3 km-thick ice sheet at the geographic South Pole as a target for the cosmic neutrinos, which should interact in the ice and create a high-energy electromagnetic cascade. It is thought that such a cascade should produce sufficient radio emission to be detectable by radio antennas in the ice. Measurements of the attenuation length of radio-frequency waves indicate that antennas should be sensitive to interactions occurring up to a kilometer away. Consequently, the ultimate goal is a 37-station array covering over 100 km², which is expected to be able to detect (at the order of several events per year) the small flux of ultra-high energy neutrinos produced in interactions between ultra-high energy cosmic rays interacting with the cosmic microwave background radiation. A detection of this flux would have profound implications for our knowledge of the production, propagation, and composition of ultra-high energy cosmic rays.

In addition to a prototype "Testbed" station, there are currently 3 ARA stations installed at the South Pole. Each station consists of 4 radio antennas on each of 4 strings approximately 200-300 m deep in the ice.

Achievements in 2013

After having in-ice hardware for three years, the efforts of the IIHE team focused on maintaining and extending the capabilities of the maturing detector. As only a limited subset of data can be transmitted North via satellite, one of the collaboration's priorities for 2013 was the development of filtering algorithms to select events to be sent North. T. Meures developed one of the collaboration's two current filters, called TimeSequence, which investigates pairs of hit antennas per string to determine whether or not the sequence is consistent with a wavefront moving at the speed of light. TimeSequence was installed at the South Pole during the 2013-2014 season and is currently responsible for selecting 400 events per station per run out of a total quota of 1000 events per run (Figure 8).

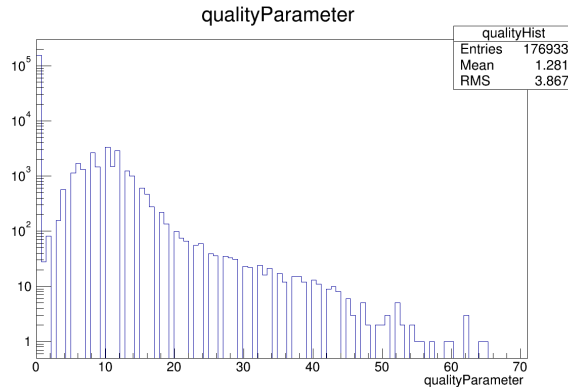


Figure 8: Distribution of events as ranked by the TimeSequence filter algorithm. The filter selects the top (in qualityParameter) 400 events per run to send North via satellite.

In preparation for future analyses of data, K. Hanson and T. Meures undertook a study of the calibration of the IRS2, the analog-to-digital converter chip at the heart of the ARA stations. They found that the calibrations used at the time had a number of flaws both in voltage and in timing calibration.

The IIHE team also took on significant operations and monitoring responsibilities. A Ó Murchadha managed the operation of the TestBed, calibrating and re-setting voltage thresholds on a per-channel basis in response to changing environmental conditions.

2.6 Instrumentation and electronics R&D

2.6.1 Data acquisition system R&D

(P. Barria, G. De Lentdecker, K. Hanson, M. Korntheuer, Th. Lenzi, A. Leonard, F. Lucchetti, Th. Maerschalk, Th. Meures, G. Mullier, E. Pinat, E. Verhagen, Y. Yang, R. Yonamine, M. Zecchin)

Since 2007, the IIHE has started an R&D program in the field of data acquisition (DAQ) systems for future experiments in particle and astro-particle physics. Modern technologies allow to design 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 the future particle and astro-particle experiments plan to use the most advanced technologies from the telecommunication and the digital programmable electronic industries: the Advanced Telecom Computing Architecture (ATCA or micro-TCA) standard and Field Programmable Gate Arrays (FPGA). The choice of the IIHE to start such a R&D program 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 astro-particle physics (DELPHI, H1, CMS, ICECube).

To conduct these developments in a concrete case, 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. Therefore the experience that the IIHE is gaining by 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 astro-particle physics.

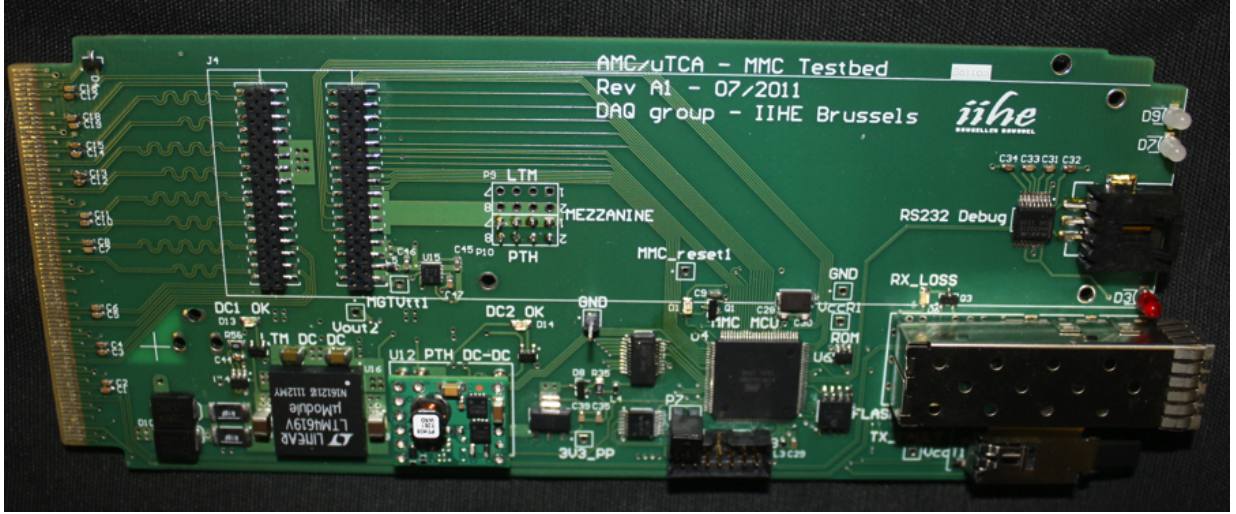


Figure 9: First micro-TCA Advanced Mezzanine Board (AMC) built at the IIHE.

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. Figure 9 shows the first board prototype built at the IIHE and which was used to launch the micro-TCA developments at the IIHE.

2.6.2 Measurement of the high-energy neutron dose in protontherapy

(G. De Lentdecker, V. De Smet, D. Ndayizeye)

Protontherapy uses proton beams with energies typically between 50 and 230 MeV to treat cancerous tumors very efficiently, while protecting as much as possible surrounding healthy tissues from radiation damage. Protons interacting with matter inevitably induce secondary radiation from which all people inside the protontherapy center have to be protected. The ambient dose equivalent $H^*(10)$ in such a facility is mainly due to neutrons, which can have energies up to 230 MeV. Although various dose monitoring systems sensitive to high energy neutrons have already been developed, the response function of these detectors is often insufficiently characterized, and so are the calibration factors appropriate for the specific neutron spectra encountered inside a proton therapy facility.

Since 2012 the IIHE is collaborating with the Institut de Recherche de l'Institut Supérieur Industriel de Bruxelles (IRISIB) and Ion Beam Applications S.A. (IBA) to study the response function of the extended-range rem meter WENDI-2 from thermal energies up to 5 GeV. Extensive Monte Carlo simulations using the MCNPX 2.5.0 software are now routinely been running on the IIHE cluster. A good match has been obtained with equivalent simulation results found in literature (see Figure 10). As a first step towards the characterization of the WENDI-2 response in continuous neutron fields, MCNPX simulations have also been carried out for the case-study of a bunker around an 18 MeV H^- cyclotron, which involves neutron fields from thermal energies up to 18 MeV. In the coming year, test beams with quasi mono-energetic neutron beams are planned. In addition the IIHE has started to simulate the WENDI-2 response using the GEANT4 simulation toolkit commonly used within the particle physics community.

Your text

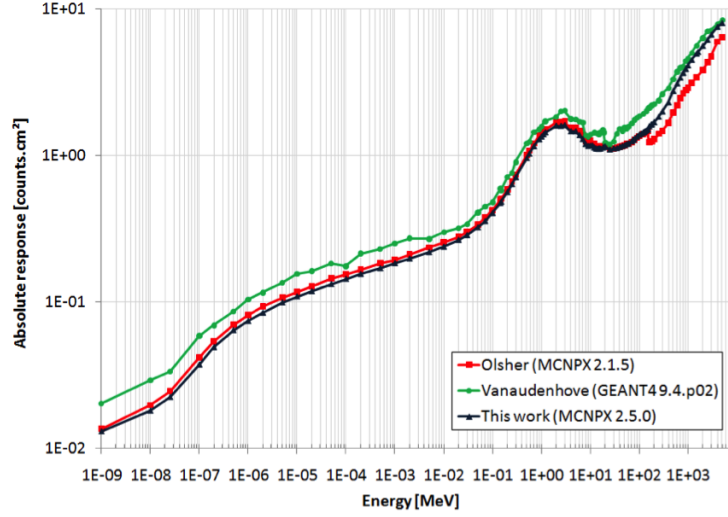


Figure 10: Simulation results of the WENDI-2 absolute response function. Ref: Olsher R.H. et al., WENDI: An improved neutron rem meter, Health Physics 79 (2), pp. 170-181 (2000).

2.7 Phenomenology

(P. de Aquino, K. De Causmaecker, K. Mawatari, B. Oexl, P. Tziveloglou)

In October 2010 a new phenomenological research activity started at the VUB in order to link between the existing theoretical (TENA) and experimental (ELEM) groups through phenomenological projects at first focused on supersymmetric theories. This was an initiative titled “Supersymmetric models and their signatures at the Large Hadron Collider” financed through a five-year “Geconcerteerde Onderzoeksactie” (GOA) research project at the VUB.

The initiative has been re-assured by a new approval of another five-year action which continues the development of the phenomenological research from 2013. This initiative is named “High Energy Physics Research Center” at the VUB (HEP@VUB) and comprises the main groups working on high energy physics; Collider physics (CMS), Astroparticle physics (IceCube), and Theoretical high-energy physics.

The main topic of research is supersymmetric models and their signatures at the Large Hadron Collider (LHC). 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 2013, we explored general gauge mediation with respect to the 125-GeV H-boson (JHEP1307(2013)109, Gratek, Mariotti, Redigolo), and provided a general simulation framework for spin-3/2 particles, i.e. gravitinos in SUSY models (EPJC73(2013)2580, Christensen, De Aquino, Deuschmann, Duhr, Fuks, Garcia-Cely, Mattelaer, Mawatari, Oexl, Takaesu). A tool for mass spectrum generation for new physics, Asperge, was also developed by J. D’Hondt and K. De Causmaecker with their collaborators (EPJC73(2013)2325).

After the discovery of a SM-like scalar boson at the LHC in 2012, P. de Aquino and K. Mawatari have done a lot of studies on the related issues, e.g. the spin/parity characterisation (JHEP01(2013)148, PRL111(2013)091802, JHEP11(2013)043). We were also invited by the LHC Higgs Cross Section Working Group to contribute the CERN Yellow Report 3, Higgs properties, as one of the authors (arXiv:1307.1347).

In addition, K. Mawatari with the MadGolem colleagues presented the next-to-leading order cross subsection calculation for squark and gluino production (PRD87(2013)014002) and leptogluon production (PRD87(2013)094023) in the fully automatized MadGolem framework.

2.8 Computing and networking

(S. Amary, F. Blekman, A. Boukil, O. Devroede, J. D’Hondt, S. Gerard, K. Hanson, G. Kohnen (Umons), A. Ouchene, S. Rugovac, P. Vanlaer, R. Vandenbroucke.)

2.8.1 Local computing resources

The IIHE hosts a ranger of general IT services like a web server, DNS and DHCP servers.

Most servers have been migrated to a virtual environment based on VMWARE. The implented solution consists of 2 hypervisors running the virtual machines. The images are kept on a central NAS server.

To Guarantee the machines against short power breaks, the infrastructure was connected to an 8kVA UPS (uninterruptible power supply).

In March 2013 the computing team was reinforced with a 3rd member: Samir Amary.

2.8.2 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 icecube cluster has 560 cores and 1392TB of RAM. It 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 was installed. The Cluster also has 100TB of mass storage attached to it.

The cluster is mainly used by the Icecube Simulation group and by local users for data analysis.

2.8.3 Large scale computing for CMS and TIER2 cluster

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.

Presently, the T2 has 1864 job slots for a total of 19TFLOPS (or 14.000HepSpec06 units). Attached to this, a mass storage system of 1.2 PB is found. Figure 11 shows the usage of the site over the last 3 years. In 2012, th site was optimised and so was filled for an average of 90the LHC was shut down for maintenance and upgrade works. The effect of the shutdown is clearly seen in the figure: the site was used for an average of 70in 2013.

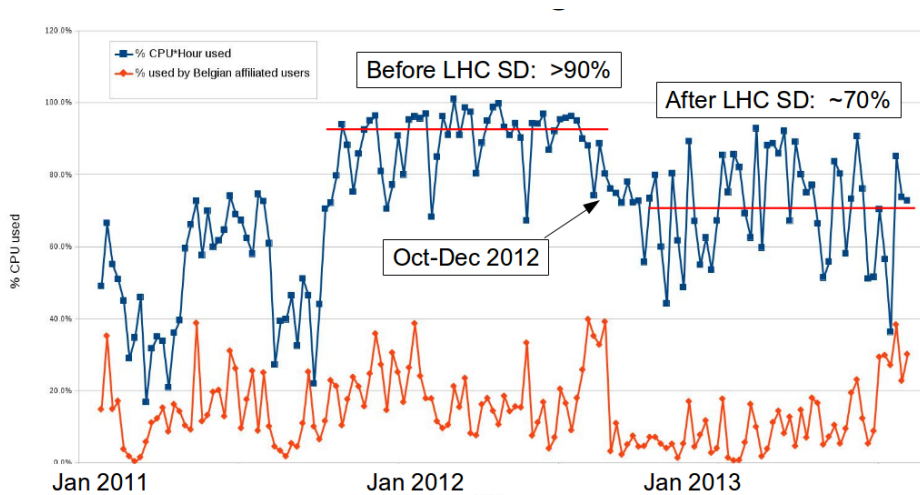


Figure 11: CPU usage of the T2 over the last 3 years. The effect of the LHC long shutdown in 2013 is clearly seen in a reduced need for CPU

In 2013, the Brussels Tier-2 team counted three IT scientists (S. Rugovac, F.R.S.-FNRS; O. Devroede, VUB; S.

G  rard, VSC, part time). Pascal Vanlaer, seconded by G. Bruno (UCL), is in charge of the Belgian federated Tier-2 sites and is 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.

2.9 Communication and outreach

The IIHE continuously stimulates and supports researcher to initiate and participate in activities to disseminate our research results. Numerous members of the IIHE therefore had the opportunity to give public lectures on both small and large scale, and at a variety of venues in Belgium. We have also welcomed many groups of young students from secondary schools to follow workshops and lectures in our institute. The participation to the international Master Classes in Particle Physics is a prime example. At the VUB, these are organized by IPPOG, the International Particle Physics Outreach Group in which Jorgen D'Hondt represents Belgium. At the ULB, they are organized twice a year by Gilles De Lendtecker for about 60 students. We also participate in national and international programs concerning science communication, and our researchers do follow regularly courses to disseminate their research to a wider audience.

Our researchers have also guided many groups for visits at CERN, ranging from children to politicians. Every year we also take the physics students from both the ULB and VUB for a detailed visit to CERN.

Around the 2013 Physics Nobel Prize many members of the IIHE were present in the media.

2.10 Technical and administrative work

2.10.1 Workshop

(J. De Bruyne, P. de Harenne, M. Korntheuer, R. Vanderhaeghen, L. Van Lancker and Y. Yang ; coordinator : G. De Lendtecker).

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.

R. Vanderhaeghen and M. Korntheuer were in charge of the maintenance of the electronic workshop.

2.10.2 Secretariat

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

J. De Bruyne and P. De Harenne provided daily support for numerous tasks; F. Pero was in charge of ULB travels.

3 Activities

3.1 Contributions to experiments

3.1.1 Responsibilities in experiments

Patrizia Barria

- Convener of Detector Response Modeling and Test Beam analysis subgroup for the CMS GEM Collaboration
- Participation in the October 2013 Fermilab test beam campaign

Freya Blekman

- Chair of Analysis Review committee (ARC) in CMS experiment
- Convener of CMS Beyond-Two-Generations physics group

Jorgen D'Hondt

- Chairperson of the CMS Career Committee
- Chairperson of the CMS International Committee
- Member of the CMS Collaboration Board
- Member of the CMS Executive Board
- Member of the CMS Management Board
- Member of the CMS Steering Committee of the Tracker Phase-2 Upgrade
- Member of the CMS Tracker Institution Board
- Member of the International Advisory Committee for CMS Schools
- Secretary of the CMS Collaboration Board

Nadir Daci

- CMS Tracker Phase 2 Upgrade : Local Reconstruction (validation and integration)
- Exotica trigger validator in CMS

Isabelle De bruyn

- Commissioning of the CMS Strip Tracker

Catherine De Clercq

- Belgian liaison in the IceCube International Oversight and Finance Group IOFG
- Member of the IceCube executive committee
- PI of VUB in the IceCube collaboration board

Gilles De Lentdecker

- Coordinator of the DAQ working group for the CMS GEM project

Valérie De Smet

- WENDI-2 measurements inside the proton therapy facility of Essen, Germany (25/05-26/05/2013). Coordination

Laurent Favart

- Internal CMS referee (ARC)
- Internal H1 referee

- Member of the H1 Physics Board
- Shift Leader - CMS data taking

Kael Hanson

- IceCube Data acquisition systems coordinator
- IceCube Executive Board member
- IceCube South Pole Summer Season Lead

Natalie Heracleous

- ARC member in CMS
- DCS shifter in CMS

James Keaveney

- CMS representative as an b-tagging expert in the TOPLHCWG
- Contact between CMS Top physics group and b-tagging and vertexing group.
- Monte Carlo generators expert/coordinator in CMS top physics group.

Jan Kunnen

- Responsible for the Vertical Event Filter, which is an online filter in IceCube

Steven Lowette

- Member of the CMS Thesis Award committee

Abdollah Mohammadi

- $H \rightarrow \tau\tau$ Monte Carlo contact person in CMS
- Member of the Analysis Review Committee (ARC), CMS editorial board
- Member of the FPS (Fundamental Physics scholarship) committee in CMS
- Tau Identification subgroup convener

Aongus O'Murchadha

- Managed Operations and Monitoring of ARA

Annik Olbrechts

- TOP dataset and T2 space manager

Thomas Reis

- Egamma HLT release validation developments in CMS

Derek Strom

- Convenor, CMS Silicon Strip Tracker DAQ Group

Stefaan Tavernier

- CMS finance board

Nick Van Eijndhoven

- Contact person for the IceCube Direct Walk (multi)track reconstruction
- Internal referee for IceCube publications

- Member of the IceCube Gamma Ray Burst working group
- Member of the IceCube muon working group
- Member of the IceCube point source working group

Petra Van Mulders

- CMS BTV POG L3 coordinator: software and algorithms

Gerrit Van Onsem

- CMS Detector Control and Safety shifts

Catherine Vander Velde

- CMS Collaboration Board member
- CMS Finance Board member
- CMS Tracker Institution Board member
- CMS-ULB Team Leader

Pascal Vanlaer

- CMS ULB Deputy team leader
- Co-convener of CMS Higgs trigger study group
- Member of CMS analysis review committees (ARCs)
- Physicist in charge of the ULB-VUB CMS Tier-2 computing cluster

Gaston Wilquet

- Member of the OPERA Collaboration Board
- OPERA Internal referee for publications

3.1.2 Presentations in collaboration meetings

Patrizia Barria

- Test Beam analysis - VFAT ntuples November 2012 - 12th RD51 Collaboration meeting and workshop on neutron detection with MPGDs - CERN from 14/10/2013 to 17/10/2013
- Test Beam analysis - VFAT ntuples November 2012 - CMS GEM Collaboration Workshop VII - CERN from 14/10/2013 to 18/10/2013

Freya Blekman

- B2G reconstruction strategy for LHC Run 2 - CMS - Taipei CMS week from 06/09/2013 to 13/09/2013
- B2G status and publication plans - CMS - Taipei CMS week from 06/09/2013 to 13/09/2013

Lionel Brayeur

- Alternative event selection - IceCube - Munich, Germany 07/12/2013

Geraldina Golup

- HESE-GRBs time pattern - IceCube - Munich, Germany 08/10/2013

David Heereman Von Zuydtwyck

- Hitspool analysis for supernova detection in IceCube - IceCube - Banff, Canada 10/03/2014

James Keaveney

- Approval of search for four top quarks at 8 TeV - CMS - CERN Geneva 16/12/2013

Jan Kunnen

- Status of the Earth WIMP search with IceCube - IceCube - Madison, WI, USA 08/05/2013
- Status of the Earth WIMP search with IceCube - IceCube - Munich, Germany 09/10/2013

Giuliano Maggi

- Direct Walk Track Reconstruction implementation in IceRec framework. - IceCube - Munich, Germany from 07/10/2013 to 12/10/2013

Thomas Meures

- Trigger and data filter development for ARA - ARA collaboration - Ohio state University from 10/06/2013 to 13/06/2013

Elisa Pinat

- “Furthermore DAQ Trigger Study” - IceCube Fall Collaboration Meeting - Munich, Germany 10/10/2013

Thomas Reis

- Approval talk for Z' search - CMS - CERN, Switzerland 12/02/2013

Derek Strom

- Strips Commissioning - Tracker - CERN 10/12/2013

Stefaan Tavernier

- High density LYSO matrix for ClearPEM - Crystal clear collaboration - London 22/03/2013

Pantelis Tziveloglou

- Flavour - Naturalness Interplay at LHC8 - Aristotle University, Thessaloniki, Greece 19/12/2013
- Flavour - Naturalness Interplay: Expectations from LHC14 - HEP@VUB - IIHE, Brussels 09/12/2013
- Flavour Models with Dirac Gauginos and how to fake a gluino - KUL, Leuven 27/11/2013

Nick Van Eijndhoven

- A New Track Reconstruction Approach using Direct Walk - IceCube - Madison (WI), USA 07/05/2013

Petra Van Mulders

- CSV Tagger for Run2 - CMS - CMS week, CERN, Geneva 10/12/2013
- Development of new b-tagging algorithms, over 15 presentations at various occasions - CMS - CERN, Geneva from 01/01/2013 to 31/12/2013
- status of supercombined tagger - CMS - CMS week, CERN, Geneva 10/04/2013

Pascal Vanlaer

- High-level trigger planning for 2015 - CMS - CERN, CMS Higgs boson workshop from 05/12/2013 to 06/12/2013

Erik Verhagen

- Triple-GEM workshop - GEM - CERN 15/07/2013

Jian Wang

- High mass Higgs to ZZ to 2l2nu, approval talk - CMS - CERN 07/05/2013

Yifan Yang

- GEM Opto-Hybrid design(PCB) for 30x30 prototypes - CMS GEM collaboration - CERN 12/03/2013
- Optohybrid status - CMS GEM collaboration - CERN 11/09/2013

3.2 Completed Master and PhD theses

Freya Blekman

- Isis Van Parijs
Measurement of the single top tW associated production in the dilepton decay channel in 8 TeV proton-proton collisions
Master thesis VUB, June 2013.

Gilles De Lentdecker

- Thomas Lenzi
Development and Study of Different Muon Track Reconstruction Algorithms for the Level-1 Trigger for the CMS Muon Upgrade with GEM Detectors
Master thesis ULB, May 2013.

Laurent Favart

- Rachel Simoni
Etude de la production de Z accompagnée de jets au LHC
Master thesis ULB, September 2013.

Petra Van Mulders

- Lieselotte Moreels
Search for stop quarks using the matrix element method at the LHC
Phd thesis VUB, July 2013.

3.3 Representation in scientific councils and committees

Jorgen D'Hondt

- Belgian representative in Restricted European Committee for Future Accelerators (RECFA)
- Belgian representative in the International Particle Physics Outreach Group (IPPOG)
- Member of the Advisory Board and Organisation Board of the workshop "Facing the Scalar Sector" (Brussels)
- Member of the FWO Committee for International Collaboration
- Member of the International Advisory Board at the Institute for Physics and Mathematics (IPM, Tehran, Iran)
- Member of the International Advisory Board and Organisation Board of the workshop "IPM international meeting on LHC Physics" (Tehran, Iran)
- Permanent member of the International Advisory Board of the workshop series "Top Quark Physics"
- President of the Jonge Academy of Belgium (Flanders)
- Promotor of the Strategic Research Program "High-Energy Physics" at the VUB

Catherine De Clercq

- chair of the FWO scientific committee WT2 'fysica'
- Member of the Belgian committee for the selection of CERN fellows
- Member of the board of the BND doctoral school
- Member of the FNRS scientific committee 'hautes et basses energies'
- Member of the NIKHEF Scientific Advisory Committee
- Member of the Preparatory Group for the upgrade of the European Strategy for particle physics
- Representative of FWO in the ApPEC General Assembly
- VUB representative in the organisation committee of the Flemish Physics Olympiads

Gilles De Lentdecker

- President of the Belgian Physical Society

Laurent Favart

- FNRS delegate to the IOFG (International Oversight and Finance Group) of the IceCube experiment
- Member of the Belgian committee for the selection of CERN fellows
- Member of the board of the BND doctoral school
- Official Representative of the FNRS at the “Astroparticle Physics European Consortium

Pierre Marage

- Membre titulaire Comité national de Logique, de Philosophie

Laurent Thomas

- Representative of the non permanent researchers at the Council of the Faculty of Sciences (ULB)

Walter Van Doninck

- Belgian Scientific Delegate to the CERN Council
- Member of the CERN DG Search Committee
- Member of the EPS HEPP Board
- Vice President of the CERN council

Nick Van Eijndhoven

- Adviser for the National Research Foundation (NRF), South Africa
- Member (Coordinator for exp. Neutrino Astronomy) Scientific Programme Committee for the International Cosmic Ray Conferences (ICRC)

Catherine Vander Velde

- Chairperson of the ACCU CERN and delegate for Belgium
- Member Commission FNRS-IISN ”Hautes et basses énergies”

Pascal Vanlaer

- President of the organising committee of the “Belgian-Dutch-German graduate school of particle physics” 2013, 25 August 2013 to 04 September 2013, Brussels
- Representative of the ULB in the CECI interuniversity high-performance computing infrastructure (FUNDP, UCL, ULB, ULg, UMons)

Gaston Wilquet

- FNRS delegate to the LHC Resources Review Board
- FNRS delegate to the OPERA Funding Agencies Board

3.4 Diffusion of scientific results

3.4.1 Oral presentations at conferences and schools

Freya Blekman

- Invited plenary talk: Searches for BSM in non-resonant signatures, European Physical Society HEP conference (EPS-HEP) - Stockholm, Sweden from 18/07/2013 to 24/07/2013
- Search for new physics beyond the standard model in events with third generation quarks, Invited Seminar University of Maryland - University of Maryland, College Park, Maryland, United States of America 14/06/2013
- Search for new physics beyond the standard model in events with third generation quarks, Invited seminar Universiteit Gent - Universiteit Gent, Belgium 05/11/2013
- Search for new physics beyond the standard model in events with third generation quarks, Invited Seminar Northwestern University - Northwestern University, Evanston, Illinois, United States of America 10/06/2013
- Search for new physics beyond the standard model in events with third generation quarks, Invited seminar Cavendish Laboratory - Cambridge University, United Kingdom 22/10/2013
- Searching for physics beyond the standard model in event signatures with third generation quarks, Fermilab Wine and Cheese Seminar - Fermilab, United States of America 19/04/2013
- Top physics, CERN/Fermilab Hadron Collider Physics School - CERN, Geneva, Switzerland from 28/08/2013 to 03/09/2013
- Top physics long exercise, CMS Data Analysis School at Fermilab - Fermilab, United States of America from 08/01/2013 to 12/01/2013
- Top physics long exercise, CMS Data Analysis School at DESY - DESY, Hamburg, Germany from 14/01/2013 to 19/01/2013

Barbara Clerbaux

- Searches for BSM physics at ATLAS and CMS, HS13: Hadron Structure 2013, June 30 to July 04 2013, Tatranske Matliare - Slovakia from 30/06/2013 to 04/07/2013
- Searches for new resonances at the LHC, IPMLHC2013: Second IPM Meeting on LHC Physics, School of Particles and Accelerators, IPM - Tehran, Iran from 07/10/2013 to 12/10/2013

Nadir Daci

- Dark Matter Searches in CMS, KUBEC 2014 - Brussels 27/08/2014

Karen De Causmaecker

- Automates mass matrix diagonalization in FeynRules, TASI school - Boulder, Colorado 24/06/2013
- Automates mass matrix diagonalization in FeynRules, MC4BSM - Desy, Hamburg 21/04/2013
- EFT and automated calculation of anomalous dimensions in FeynRules, ERC miniworkshop - Cern 05/12/2013
- Supersymmetric mass spectrum generators, Theory@sea 2013 - Oostduinkerke 08/04/2013

Catherine De Clercq

- IceCube: neutrino astronomy at the South Pole, FWO 85 year celebration - Gent 17/12/2013

Gilles De Lentdecker

- Lectures on Trigger and Data Acquisition in particle physics, BND school 2013 - Brussels from 27/08/2013 to 02/09/2013
- The CMS GEM project, Invited seminar - Pekin University, Beijing, China 24/09/2013

Krijn De Vries

- The EVA code: Macroscopic modeling of radio emission based on full MC simulations including a realistic index of refraction, International Cosmic Ray Conference - Rio de Janeiro 03/07/2013

Laurent Favart

- Experimental Particle Physics Departement of ULB, Several seminars at different Universities in Peking - China, at IHEP, PKU, BUAA and Tsinghua from 23/09/2013 to 25/09/2013
- Recent Results on Diffraction at HERA, Workshop on Multi-Parton Interactions at the LHC (MPI@LHC 2013) - Antwerp, Belgium from 02/12/2013 to 06/12/2013

Anastasia Grebenyuk

- Measurement of Charged Particle Spectra in Deep-Inelastic ep Scattering at HERA, MPI @ LHC 2013, Workshop on Multi-Parton Interactions at the LHC - Antwerp, Belgium from 02/12/2013 to 06/12/2013

Kael Hanson

- The Future of UHE Neutrino Astronomy in the Ice, XV International Workshop on Neutrino Telescopes - Venice, Italy 20/03/2013
- The IceCube Neutrino Observatory DAQ and Online System, Computing in HEP 2013 (CHEP2013) - Amsterdam 15/10/2013

Natalie Heracleous

- Top physics related analyses at CMS, IIHE Annual meeting (CMS analyses) - Brussels 07/11/2013

James Keaveney

- Measurements of $t\bar{t}+Z/W/\gamma$, TOP2013 - Durbach Germany 14/09/2013
- Top physics exercise , CMSDasia - Kolkata, India from 07/11/2013 to 11/11/2013

Jan Kunnen

- Earth WIMP searches with IceCube , ICRC 2013 - Rio de Janeiro, Brazil 07/07/2013

Steven Lowette

- *SUSY and dark matter searches at the LHC*, Belgian meeting of the Inter university Attraction Pole "Fundamental Interactions" - Louvain-la-Neuve, Belgium, 19/12/2013

Thierry Maerschalk

- Status of Standalone simulation (Full and Fast simulations), GEM Upgrade Workshop VII - CERN 15/10/2013
- Timing Resolution Techniques - TOT and CFD - and Fast Simulation, GEM Upgrade Workshop VI - CERN 22/05/2013
- TOT CFD methods, CMS GEM Electronics Physical Meeting - CERN 10/10/2013

Kentarou Mawatari

- Characterising a Higgs-like resonance at the LHC, Higgs as a Probe of New Physics 2013 - Toyama, Japan 13/02/2013
- Characterising a Higgs-like resonance at the LHC, KEK Phenomenology Meeting 2013 - KEK Tsukuba, Japan 07/03/2013
- Effective models for spin and CP studies, Higgs Couplings 2013 - Freiburg, Germany 14/10/2013
- Higgs characterisation – beyond leading order, SUSY2013 - Trieste, Italy 26/08/2013
- Higgs characterisation at colliders, ILC summer camp - Toyama, Japan 20/07/2013
- Higgs characterisation framework, YITP PPP2013 - YITP Kyoto, Japan 07/08/2013

- Higgs characterisation with FeynRules and MadGraph5, Monte Carlo for Physics Beyond the Standard Model 2013 - DESY Hamburg, Germany 20/04/2013
- Looking for leptogluons at the LHC, Tweedaagse van de Theoretische en Mathematische Fysica - Oostduinkerke, Belgium 08/04/2013
- Naturalness: motivation for the stop search, Top@Brussels meeting - IIHE, Belgium 17/05/2013

Thomas Meures

- Search for cosmic neutrinos at the South Pole with IceCube ARA, IAP meeting - Louvain la Neuve 19/12/2013
- The Askaryan Radio Array and Radio neutrino detection at the IIHE, IIHE annual meeting - Brussels 08/11/2013

Abdollah Mohammadi

- LHC results on the 125 GeV boson decaying to fermions, Belgian IAP meeting - Universite catholique de Louvain (Belgium) 19/12/2013
- Scalar Couplings, Solvay 2013 - Solvay Institutes (Belgium) from 29/05/2013 to 31/12/2013
- Search for the Standard Model Higgs boson decaying to a pair of taus, LOMONOSOV 2013 - Moscow State University (Russian Federation) from 22/08/2013 to 27/12/2013
- Search for the Standard Model Higgs boson in fermionic decay channels, IPMLHC2013 - School of Particles and Accelerators, IPM (Iran) from 07/10/2013 to 12/12/2013

Betina Oexl

- Jets plus missing energy from light gravitino production at the LHC, SUSY 2013 - Trieste, Italy 26/08/2013
- Spin 3/2 particles at the LHC, Belgian Physics Society Meeting - Louvain-La-Neuve, Belgium 22/05/2013

Luca Perniè

- Evolution of the response of the CMS ECAL, and upgrade design options for electromagnetic calorimetry at the HL-LHC, 14th ICATPP Conference on Astroparticle - Como 25/11/2013
- ZZ cross section measurement at CMS experiment and aTGC limits, Annual meeting of the PANDA - UCL, Louvain- La-Neuve, Belgium 17/05/2013
- ZZ cross section measurement at CMS experiment and aTGC limits, Belgian physics Society (BPS) - Brussels, Belgium 05/05/2013
- ZZ cross section measurements and limits on anomalous coupling constants for neutral triple gauge boson, 16th Lomonosov Conference on Elementary Particle Physics - Moscow State University 23/08/2013

Thomas Reis

- Searches for new massive resonances decaying to leptons at CMS, 16th Lomonosov Conference - Moscow, RU 27/08/2013

Stefaan Tavernier

- Dedicated PET Scanner for Breast Imaging, On behalf of the ClearPEM collaboration, IEEE NSS-MIC 2013 - Seoul, South Korea from 26/10/2013 to 02/11/2013
- Tavernier Experimental techniques in nuclear and particle physics, 2 lectures of 1.5 h., IEEE NSS-MIC 2013 - Seoul, South Korea from 26/10/2013 to 02/11/2013

Laurent Thomas

- Search for new heavy neutral bosons decaying into a dilepton pair with the CMS detector at $\sqrt{s} = 8$ TeV, Moriond EWK - La Thuile 08/03/2013
- Search for new heavy neutral bosons decaying into a dilepton pair with the CMS detector at $\sqrt{s} = 8$ TeV, Journée des doctorants - Liège 13/05/2013

Nick Van Eijndhoven

- The Muppets on Ice : Starring Bert & Ernie at the South Pole, IAP day - Ghent, Belgium 14/06/2013

Petra Van Mulders

- Combined search for the quarks of a sequential fourth generation of fermions, Young Scientist Oral Contest, Belgian Physical Society - UCL, Louvain-la-Neuve 22/05/2013
- Higgs at the LHC, WIN2013 - Natal, Brazil from 16/09/2013 to 21/09/2013

Jian Wang

- LHC High Mass Higgs to WW and ZZ, Higgs Hunting 2013 - Orsay, France 26/07/2013
- Standard Model Vector Boson pair productions, Physics in Collision 2013 - Beijing, China 03/09/2013

Yifan Yang

- DAQ electronics design activities in IIHE, - Institute of High energy physics Beijing 26/09/2013
- DAQ electronics design activities in IIHE, - Central China Normal University 03/11/2013

Florian Zenoni

- Simulation of the sensitivity of a Triple GEM to the CMS photon and neutron background using GEANT4, - CERN 15/10/2013

3.4.2 Poster presentations at conferences and schools

Patrizia Barria

- The status of the GEM project for CMS high- η muon system, VCI2013 13th Vienna Conference On Instrumentation - Wien from 11/02/2013 to 15/02/2013

Lionel Brayeur

- AGN analysis in IceCube, ICRC - Rio de Janeiro, Brazil from 04/12/2013 to 05/12/2013

Cécile Caillol

- Search for the standard model Higgs boson decaying to tau pairs produced in association with a W or Z boson, LHCC poster session - CERN 13/03/2013

Martin Casier

- Bayesian Approach for a Neutrino Point Source Analysis, IceCube Annual Meeting - Munich from 07/10/2013 to 12/10/2013
- Bayesian Approach for a Neutrino Point Source Analysis, International Cosmic ray Conference - Rio de Janeiro, Brasil from 30/06/2013 to 08/07/2013
- Studying High-Energy Gamma Ray Bursts and Active Galactic Nuclei Emissions, VUB PhD Day - VUB 29/05/2013

Gilles De Lentdecker

- Development of the data acquisition system for the Triple-GEM detectors for the upgrade of the CMS forward muon spectrometer, TWEPP2013 - Perugia, Italy from 23/09/2013 to 27/09/2013

Valérie De Smet

- Neutron $H^*(10)$ inside a proton therapy facility: comparison between Monte Carlo simulations and WENDI-2 measurements, NEUDOS12, Neutron and Ion Dosimetry Symposium 2013 - Aix-en-Provence, France from 03/06/2013 to 06/06/2013

Krijn De Vries

- Probing air-shower physics by Cherenkov effects in radio emission, International Cosmic Ray Conference 2014 - Rio de Janeiro 02/07/2013

Geraldina Golup

- Bayesian Approach for a Neutrino Point Source Analysis, General Scientific Meeting of the Belgian Physical Society - Louvain-la-Neuve, Belgium 22/05/2013
- Bayesian Approach for a Neutrino Point Source Analysis, 33rd International Cosmic Ray Conference - Rio de Janeiro, Brazil from 02/07/2013 to 09/07/2013

Thierry Maerschalk

- Simulations of Triple-GEM detectors for the CMS experiment at CERN LHC, EDIT 2013 - KEK Tsukuba (Japan) from 12/03/2013 to 22/12/2013
- Simulations of Triple-GEM detectors for the CMS forward muon upgrade, CMS Upgrade week at DESY - DESY from 03/06/2013 to 07/06/2013

Kentarou Mawatari

- A framework for Higgs characterisation, Kavli IPMU School on the Future of Collider Physics - Kavli IPMU Kashiwa, Japan 24/07/2013

Thomas Meures

- Trigger and data filtering approaches in the Askaryan Radio Array, International Cosmic Ray Conference (ICRC) - Rio de Janeiro, Brazil 07/07/2013

Annik Olbrechts

- Measurement of the W polarization in $t\bar{t}$ production in lepton+jets at 7 TeV, Top2013 - 6th International Workshop on Top Quark Physics - Durbach, Germany from 14/09/2013 to 19/09/2013

Luca Perniè

- ZZ cross-section measurement and limits on anomalous neutral triple gauge couplings, LHCC, CERN - CERN 11/09/2013

Quentin Python

- Search for Displaced top decays, Belgium Physics Society - Louvain 22/05/2013

Stefaan Tavernier

- ClearPEM-Sonic: a multimodal PET-ultrasound mammography system, Conference on Calorimetry for the high energy frontier - Paris from 22/04/2013 to 25/04/2014
- Design and Performance of an ASIC for TOF applications, IEEE NSS-MIC - KOREA from 26/10/2013 to 02/11/2013
- Detection Sensitivity and Light Collection Studies of an APD-based High Packing-Fraction LYSO: Ce Matrix for PET Applications, Vienna Conference on instrumentation - Vienna from 11/02/2013 to 15/02/2013

Yifan Yang

- A Bi-directional Fixed-latency Clock Distribution System, The Vienna Conference on Instrumentation - Vienna 11/02/2013
- Design of a Common Readout Prototype Board, IEEE Nuclear Science Symposium and Medical Imaging Conference - Seoul 27/10/2013

Florian Zenoni

- Simulation of Triple-GEM detectors for the CMS experiment at CERN LHC, - KEK (Tsukuba, Japan) from 12/03/2013 to 22/03/2013

3.5 Scientific training

3.5.1 Attendance to conferences and workshops

Samir Amary

- 16th Quattor Workshop - INFN CNAF - Bologna, Italy from 30/09/2013 to 02/10/2013
- Salon Solutions Linux / Open Source - Paris, France from 28/05/2013 to 29/05/2013

Patrizia Barria

- GEM Workshop - CMS GEM Collaboration Workshop VII - CERN from 14/10/2013 to 18/10/2013
- POSTER: The status of the GEM project for CMS high- η muon system - VCI2013 13th Vienna Conference of Instrumentation - Wien from 11/02/2013 to 15/02/2013
- RD51 Collaboration Workshop - 12th RD51 Collaboration meeting and workshop on neutron detection with MPGDs - CERN from 14/10/2013 to 17/10/2013

Freya Blekman

- Rencontres de Moriond 2013: QCD and High Energy Interactions - session chair and BSM discussion leader - Rencontres de Moriond 2013: QCD and High Energy Interactions - La Thuile, Italy from 09/03/2013 to 16/03/2013
- TOP2013 - 6th International Workshop on Top quark physics - Durbach, Germany from 14/09/2013 to 19/09/2013

Abdelhakim Boukil

- Salon Solutions Linux / Open Source - Paris, France from 28/05/2013 to 29/05/2013

Lionel Brayeur

- IceCube Fall meeting - Munich, Germany from 07/10/2013 to 12/10/2013
- IceCube Spring meeting - Madison, Wisconsin, USA from 07/14/2013 to 11/14/2013
- International Cosmic Ray Conference - Rio de Janeiro, Brazil from 02/07/2013 to 09/07/2013
- Les rencontres de Moriond - Moriond, Italy from 11/03/2013 to 15/03/2013

Cécile Caillol

- Facing the Scalar Sector - ULB, Brussels from 29/05/2013 to 31/05/2013

Martin Casier

- Belgian Physical Society - 22/05/2013
- IceCube annual Meeting - IceCube Spring meeting - Madison from 05/05/2013 to 11/05/2013

Barbara Clerbaux

- Electroweak interactions and unified theories - XLVIIIth Rencontres de Moriond - La Thuile from 02/03/2013 to 09/03/2013
- Facing the scalar sector - Solvay 2013 - Bruxelles from 29/05/2013 to 31/05/2013
- Journée PAI - Gent 14/06/2013
- Journée PAI - UCL 19/12/2013
- Réunion de l'école doctorale - PANDA2013 - Liège 17/05/2013
- Réunion de la Société Belge de Physique - SBP2013 - UCL 22/05/2013

Karen De Causmaecker

- ERC miniworkshop - ERC miniworkshop - Cern from 05/12/2013 to 06/12/2013
- Monte carlo - MC4BSM - Desy, Hamburg from 18/04/2013 to 20/04/2013
- Particle Physics: The Higgs Boson and Beyond - TASI - Boulder, Colorado from 03/06/2013 to 28/06/2013
- Theoretical physics in Flanders - Theory@sea 2013 - Oostduinkerke from 08/04/2013 to 09/04/2013

Catherine De Clercq

- CERN European Strategy council session - Brussels 30/05/2013
- Exotic physics with Neutrino Telescopes 2013 - Marseille from 03/04/2013 to 05/04/2013
- honorary colloquium for Christian Spiering - DESY Zeuthen 21/05/2013

Gilles De Lentdecker

- CMS GEM project - 7th CMS GEM Workshop - CERN, Geneva from 14/10/2013 to 18/10/2013
- CMS GEM project - 6th CMS GEM Workshop - CERN, Geneva from 21/05/2013 to 24/05/2013
- CMS GEM project - One day mini-Workshop - CERN, Geneva 31/01/2013

Valérie De Smet

- Workshop "Entervision round table - Monte Carlo: emission and detection of secondary particles in hadron-therapy" - Ion Beam Applications S.A., Louvain-la-Neuve 17/10/2013
- Workshop "Monte Carlo simulations and their applications in radiotherapy" (iMagX project) - UCL 14/05/2013
- Workshop "RD day at IBA" - Ion Beam Applications S.A., Louvain-la-Neuve 16/06/2013

Krijn De Vries

- International Cosmic Ray Conference - Rio de Janeiro from 02/07/2013 to 09/12/2013

Stéphane Gerard

- Grid and HPC Computing - EGI Technical Forum - Madrid from 16/09/2013 to 20/12/2013
- Grid and HPC Computing - EGI Community Forum - Manchester from 08/04/2013 to 12/12/2013

Geraldina Golup

- 33rd International Cosmic Ray Conference - Rio de Janeiro, Brazil from 02/07/2013 to 09/07/2013
- Rencontres de Moriond: Very High Energy Phenomena in the Universe - La Thuille, Italy from 09/03/2013 to 16/03/2013

Jan Kunnen

- Exotic Workshop with Neutrino Telescopes 2013 workshop - Exotic Workshop with Neutrino Telescopes 2013 workshop - Marseille, France from 01/04/2013 to 06/04/2013
- IceCube Fall Collaboration Meeting - IceCube Fall Collaboration Meeting - Munich, Germany from 06/10/2013 to 12/10/2013
- IceCube Spring Collaboration Meeting - IceCube Spring Collaboration Meeting - Madison, WI, USA from 05/05/2013 to 12/05/2013
- IceCube WIMP Group meeting - IceCube WIMP Group meeting - Uppsala, Sweden from 15/12/2013 to 21/12/2013
- ICRC 2013 - ICRC 2013 - Rio de Janeiro, Brazil from 30/06/2013 to 09/12/2013

Thomas Lenzi

- GEM Upgrades for CMS - GEM Workshop VII - CERN from 14/10/2013 to 17/10/2013

- Topical Workshop on Electronics for Particle Physics - TWEPP 2013 - Perugia, Italy from 23/09/2013 to 27/09/2013

Alexandre Leonard

- GEM Upgrade Workshop VII - CERN from 14/10/2013 to 18/12/2013
- General Scientific Meeting 2013 of the Belgian Physical Society - Louvain-La-Neuve 22/05/2013
- Physics and Astrophysics Graduate School (PandA) : Journée Des Doctorants 2013 - Liège 17/05/2013
- The Solvay Institutes in collaboration with the IAP "Fundamental Interactions" network organize a Solvay Workshop : "Facing the Scalar Sector" - Bruxelles from 29/05/2013 to 31/05/2013
- Workshop on Multi-Parton Interactions at the LHC - MPI @ LHC 2013 - Antwerpen from 02/12/2013 to 06/12/2013

Thierry Maerschalk

- CMS Upgrade week - DESY Hamburg from 03/06/2013 to 07/06/2013
- GEM Upgrade Workshop VI - CERN from 21/05/2013 to 24/05/2013
- GEM Upgrade Workshop VII - CERN from 14/10/2013 to 18/10/2013
- IAP national meeting - Louvain-La-Neuve 19/12/2013
- Inter-University Attraction Poles meeting - UGent 14/06/2013

Giuliano Maggi

- Cosmic Rays - ICRC - Rio De Janeiro, Brazil from 02/07/2013 to 09/07/2013

Kentarou Mawatari

- Higgs as a Probe of New Physics 2013 - Toyama, Japan from 13/02/2013 to 16/02/2013
- Higgs Couplings 2013 - Freiburg, Germany from 14/10/2013 to 16/10/2013
- Higgs effective field theories 2014 - CERN, Switzerland from 09/10/2013 to 11/10/2013
- ILC summer camp - Toyama, Japan from 20/07/2013 to 23/07/2013
- KEK Phenomenology Meeting 2013 - KEK Tuskuba, Japan from 04/03/2013 to 07/03/2013
- Monte Carlo for Physics Beyond the Standard Model 2013 - DESY Hamburg, Germany from 18/04/2013 to 20/04/2013
- Solvay workshop on Exploring higher energy physics - ULB, Belgium from 04/11/2013 to 06/11/2013
- Solvay workshop on Facing the scalar sector - ULB, Belgium from 29/05/2013 to 31/05/2013
- SUSY2013 - Trieste, Italy from 26/08/2013 to 31/08/2013
- Top@Brussels meeting - IIHE, Belgium 17/05/2013
- Tweedaagse van de Theoretische en Mathematische Fysica - Oostduinkerke, Belgium from 08/04/2013 to 09/04/2013
- YITP PPP2013 - YITP Kyoto, Japan from 05/08/2013 to 09/08/2013

Thomas Meures

- ARA Collaboration meeting - ARA collaboration meeting - Columbus, Ohio from 10/06/2013 to 13/06/2013
- BPS meeting - Louvain-la-Neuve 22/05/2013
- IAP meeting - Louvain-la-Neuve 19/12/2013
- IceCube collaboration meeting - IceCube collaboration meeting - Madison, WIconsin from 07/05/2013 to 11/05/2013

- IceCube collaboration meeting - Munich, Germany from 08/10/2013 to 12/10/2013
- International Cosmic Ray Conference - ICRC - Rio de Janeiro, Brazil from 02/07/2013 to 09/07/2013

Lieselotte Moreels

- Concepts I - Effective Scientific Communication - VUB 19/09/2013
- Concepts I and Tutorial - Effective Scientific Communication - VUB 04/10/2013
- Concepts II - Effective Scientific Communication - VUB 11/10/2013
- Practice I - Effective Scientific Communication - VUB 10/10/2013
- Practice II - Effective Scientific Communication - VUB 24/10/2013
- Top Trigger Tutorial - CERN 02/10/2013

David Ndayizeye

- Journées des doctorants de l'école doctorale Panda "Physics & Astrophysics" - ULG 17/05/2013

Aongus O'Murchadha

- ARA Collaboration Meeting - Columbus, Ohio, USA from 10/06/2013 to 14/06/2013
- IceCube Collaboration Meeting - Madison, Wisconsin, USA from 07/05/2013 to 15/05/2013
- IceCube Collaboration Meeting - Munich, Germany from 07/10/2013 to 12/10/2013
- ICRC - Rio de Janeiro, Brazil from 02/07/2013 to 09/07/2013

Betina Oexl

- Particle Physics: The Higgs Boson and Beyond - TASI 2013 - Boulder, Colorado, USA from 03/06/2013 to 28/06/2013

Annik Olbrechts

- Top2013 - 6th International Workshop on Top Quark Physics - Durbach, Germany from 14/09/2013 to 19/09/2013

Elisa Pinat

- BPS Meeting, Belgian Physical Society - Leuven, Belgium 22/05/2013
- ICRC2013, International Cosmic Ray Conference - Rio de Janeiro, Brazil from 02/07/2013 to 09/07/2013

Thomas Reis

- High energy elementary particle physics - 16th Lomonosov Conference - Moscow, RU from 22/08/2013 to 28/08/2013
- LHC physics - Meeting of the Belgian Physical Society - Louvain-La-Neuve, BE 22/05/2013

Stefaan Tavernier

- 12th International Conference on Inorganic Scintillators and their Applications - 12th International Conference on Inorganic Scintillators and their Applications - Shanghai, China from 15/04/2013 to 19/04/2013
- IEEE MSS-MIC - IEEE MSS-MIC - Seoul, Korea from 26/10/2013 to 02/11/2013
- PICOSEC workshop - Singel photon imaging - Delft, the Netherlands from 22/05/2013 to 24/05/2013

Pantelis Tziveloglou

- Exploring Higher Energy Physics - Solvay Workshop - ULB, Brussels from 04/11/2013 to 06/11/2013

Walter Van Doninck

- EPS HEP - Stockholm from 17/07/2013 to 24/07/2013

Nick Van Eijndhoven

- Coordinator of exp. Neutrino Astronomy for the ICRC Scientific Programme Committee - International Cosmic Ray Conference (ICRC) - Rio de Janeiro, Brazil from 01/07/2013 to 09/07/2013
- Multi-Track reconstruction in IceCube - Astroparticle Physics Workshop - Madison (WI), USA from 07/05/2013 to 12/05/2013

Isis Van Parijs

- Concepts I - Effective Scientific Communication - VUB, Brussels, Belgium 19/09/2013
- Concepts I and Tutorial - Effective Scientific Communication - VUB, Brussels, Belgium 04/10/2013
- Concepts II - Effective Scientific Communication - VUB, Brussels, Belgium 11/10/2013
- Practice I - Effective Scientific Communication - VUB, Brussels, Belgium 08/10/2013
- Practice II - Effective Scientific Communication - VUB, Brussels, Belgium 24/11/2013
- Top Trigger Tutorial - CERN, Geneva, Switzerland 02/10/2013

Yifan Yang

- 2nd MTCA Workshop - 2nd MTCA Workshop - Desy 10/12/2013

Florian Zenoni

- GEM Upgrade Workshop VI - CERN from 21/05/2013 to 24/05/2013
- GEM Upgrade Workshop VII - CERN from 14/10/2013 to 18/10/2013
- IAP National Meeting - Ghent 14/05/2013
- IAP national meeting - Louvain-La-Neuve 19/12/2013
- Physics and Astrophysics Graduate School (PandA): Journée Des Doctorants 2013 - Liège 17/05/2013

3.5.2 Attendance to schools

Samir Amary

- IceCube Bootcamp - Madison, WI, USA from 04/06/2013 to 15/06/2013

Lionel Brayeur

- BND - Brussels, Belgium from 25/08/2013 to 04/09/2013

Cécile Caillol

- BND school - Brussels from 23/08/2013 to 04/09/2013
- CMS Data Analysis School - Hamburg, Germany from 14/01/2013 to 18/01/2013
- INFN school of statistics - Vietri sul Mare, Italy from 03/06/2013 to 07/06/2013

Martin Casier

- BND School - Brussels from 26/08/2013 to 04/09/2013

Valérie De Smet

- "Safe Application of RAdiation and radionuclides" (SARA 2013) - Czech Technical University of Prague from 17/02/2013 to 02/03/2013

Kevin Deroover

- BND school 2013 - Brussels (ULB) from 25/08/2013 to 04/09/2013

Stéphane Gerard

- Grid and HPC Computing - EasyBuild Tutorial - Ghent 21/02/2013

Jan Kunnen

- BND school - Brussels, Belgium from 25/08/2013 to 04/09/2013

Thomas Lenzi

- Belgian Dutch German Graduate School in Particle Physics - BND - Brussels from 26/08/2013 to 04/09/2013

Alexandre Leonard

- 2013 CERN-Fermilab Hadron Collider Physics Summer School - CERN from 28/08/2013 to 06/09/2013

Thierry Maerschalk

- Excellence in Detectors and Instrumentation Technology school 2013 - KEK Tsukuba (Japan) from 12/03/2013 to 22/03/2013
- Physics and Astrophysics Graduate School - Liège 22/05/2013

Giuliano Maggi

- General particle physics - BND school - Brussels from 25/08/2013 to 04/09/2013
- Neutrinos - Neutrino Physics: present and future - Erice-Sicily, Italy from 16/09/2013 to 24/09/2013

Kentarou Mawatari

- Kavli IPMU School on the Future of Collider Physics - Kavli IPMU Kashiwa, Japan from 16/07/2013 to 19/07/2013

Thomas Meures

- International School of Nuclear Physics, 35th Course, Neutrino Physics: Present and Future - Erice, Italy from 16/09/2013 to 24/09/2013

Lieselotte Moreels

- Electroweak physics, tracking, trigger and data acquisition - BND School - Brussels from 25/08/2013 to 04/09/2013

David Ndayizeye

- BND School 2013 - ULB from 25/08/2013 to 04/09/2013

Luca Perniè

- Physics - CMSSDAS school - Hamburg, Germany from 14/01/2013 to 19/01/2013
- Physics - INFN School Of Statistics - Vietri, Italy from 03/06/2013 to 07/07/2013
- Physics - Belgium Netherlands Dutchland (BND) doctoral school - Bruxelles 29/08/2013

Elisa Pinat

- BND2013, Belgian Dutch German Graduate School in Particle Physics - Brussels, Belgium from 25/08/2013 to 04/09/2013
- IceCube Boot Camp 2013 - Madison, Wisconsin, USA from 05/06/2013 to 14/06/2013
- IceCube Bootcamp - Madison, Wisconsin, USA from 05/06/2013 to 14/06/2013

- ISAPP2013, International School on AstroParticle Physics - Canfranc, Spain from 15/07/2013 to 22/07/2013
- Panda School, Particle and Astroparticle Physics School - Liège, Belgium 17/05/2013

Quentin Python

- BND school Brussels - Brussels from 25/08/2013 to 04/09/2013

Thomas Reis

- Statistics - INFN School of Statistics - Vietri sul Mare, IT from 03/06/2013 to 07/06/2013

Gerrit Van Onsem

- Hadron collider physics - 2013 CERN-Fermilab Hadron Collider Physics Summer School - CERN, Geneva, Switzerland from 27/08/2013 to 06/09/2013

Isis Van Parijs

- Electroweak physics, tracking, and trigger and data acquisition - BND School - ULB, Brussels, Belgium from 25/08/2013 to 04/09/2013

Florian Zenoni

- EuroSciPy 2013 - Brussels from 21/08/2013 to 22/08/2013
- International School EDIT (Excellence in Detectors and Instrumentation Technologies) 2013 - KEK (Tsukuba, Japan) from 12/03/2013 to 22/03/2013
- X Seminar on Software for Nuclear, Subnuclear and Applied Physics - Alghero (Italy) from 02/06/2013 to 08/06/2013

3.6 Teaching and academics activities

3.6.1 Teaching activities

Freya Blekman

- VUB - INGRWET-4016098 : Measurement Techniques in Nuclear Science, (15/0/15/0) MA2 Optional course for bioengineering Ma students at VUB/UGent. Focus on detection techniques in HEP an
- VUB - Mobility VUB : Organiser CERN visit for VUB Physics and Engineering students, (1/0/0/15) BA1 BA2 BA3 MA1 MA2
- VUB - WE-DNTK-7136 : Simulation of Physics Phenomena and Detectors in Modern Physics, (15/10/15/20) MA2 Simulation course suited for second year Physics Masters students. The course focuses on actually us

Lionel Brayeur

- VUB - 4016549FNR : Muon Lab, (0/0/16/2) MA1

Cécile Caillol

- ULB - PHYS-F101 : Physique générale I et II, (0/36/0/0) BA1 Bachelier en sciences mathématiques

Martin Casier

- VUB - 1015238ANR : Fysica: trillingen, golven en thermodynamica, (0/30/0/15) BA1

Barbara Clerbaux

- ULB - PHYSF416 : Interaction fondamentales et particules, (36/12/12/0) MA1
- ULB - PHYS-F312 : Laboratoire de physique des particules + Visite annuelle du CERN, (0/0/36/24) BA3
- ULB - PHYS-F310 : Stage dans un service du département, (0/0/0/36) BA3

- ULB - PHYS-F305 : Visite annuelle du CERN, (0/0/0/24) BA3

Catherine De Clercq

- VUB - WE-DNTK-12521 : Astro-particle physics, (13/13/0/0) MA1 MA2
- VUB - WE-DNTK-14101 : Experimentele fysica, (0/0/78/0) BA1
- VUB - WE-DNTK-14089a : Fysica:trillingen, golven, thermodynamica, (0/0/78/0) BA1
- VUB - WE-DNTK-13971a : Mobiliteit A, (0/0/0/26) MA2

Gilles De Lentdecker

- ULB - PHYS-F314 : Electronics, (12/6/18/0) BA3 Introduction to electronics
- ULB - PHYS-F205 : General Physics II, (0/12/0/0) BA2 Electromagnetism for Biologists
- ULB - PHYS-F312 : Particle Physics Lab, (0/0/36/0) BA3 Laboratory of Particle Physics

Krijn De Vries

- VUB - WE-DNTK-... : Fysica: inleiding mechanica, (0/28/0/0) BA1

Olivier Devroede

- VUB - WE-DNTK-14101 : Experimentele Fysica, (0/12/0/0) BA1 First Matlab Course
- VUB - 4015950FNR : Object Oriented Programming (C++) for Physicists, (12/12/12/60) MA1 MA2

Laurent Favart

- ULB - PHYS-F312 : Laboratoires de Physique des particules, (0/0/0/12) BA3 Physique - Visite du CERN
- ULB - PHYS-F102 : Laboratoires de Physique générale I et II, (0/0/36/0) BA1 Physique
- ULB - PHYS-F477 : Physique auprès des collisionneurs, (24/0/0/0) MA1 Physique

Geraldina Golup

- VUB - WE-DNTK : Subatomic Physics, (0/12/0/0) BA3

Kael Hanson

- ULB - PHYS-F-311 : Advanced Physics Laboratory, (0/0/36/0) MA1 Nuclear physics laboratory
- ULB - PHYS-F-467 : Astroparticle Physics, (24/24/0/12) MA1 MA2
- ULB - PHYS-F-314 : Electronics, (24/24/12/0) BA3 Digital electronics portion (50

James Keaveney

- VUB - Statistical physics : Statistical physics, (1/1/0/4) MA1 3rd bachelor statistical physics

Jan Kunnen

- VUB - WE-DNTK- : Experimentele Fysica, (0/0/80/80) BA1

Thomas Lenzi

- ULB - PHYS-F420 : Détection de particules, acquisition et analyse de données, (0/0/12/0) MA2
- ULB - PHYS-F314 : Electronique, (0/0/20/0) BA3
- ULB - PHYS-F102 : Laboratoire de physique générale I et II, (0/0/36/0) BA1

Alexandre Leonard

- ULB - PHYS-F-477 : Physique auprès des collisionneurs, (0/12/0/0) MA1

Steven Lowette

- VUB - 4015948FNR : Experimental Techniques in Particle Physics, (32/20/0/99) MA1 MA2
- VUB - 4012730CNR : Extensions of the Standard Model, (36/0/0/99) MA1 MA2

Thierry Maerschalk

- ULB - PHYS-F-312 : laboratoires de physique des particules, (4/0/80/10) BA3

Pierre Marage

- ULB - HIST-F-101 : Histoire des Sciences, (24/0/0/0) BA1
- ULB - HIST-F-500 : Histoire des Sciences et Epistémologie, (24/0/0/0) MA2

Annik Olbrechts

- VUB - 1015265ANR : Experimentele Fysica, (0/0/39/15) BA1
- VUB - 1015236ANR : Fysica: trillingen golven en thermodynamica, (0/0/39/15) BA1

Elisa Pinat

- ULB - PHYS-F-102 : Laboratoire de physique générale, (0/0/24/24) BA1

Thomas Reis

- ULB - PHYS - F312 : Laboratoire de physique des particules, (0/0/30/3) BA3 Cherenkov radiation

Robert Roosen

- VUB - 4015954ENR : Elementen van de geschiedenis van de natuurwetenschappen, (18/18/0/0) MA1 MA2

Laurent Thomas

- ULB - PHYS-F-416 : Interactions fondamentales et particules, (0/12/0/0) MA1 MA2
- ULB - PHYS-F-102 : Laboratoire de physique générale, (0/0/24/0) BA1

Nick Van Eijndhoven

- VUB - WE-DNTK-6406 : Experimental Study of the Micro and Macrocosmos, (13/13/0/0) BA3
- VUB - WE-DNTK-6331 : Subatomic Physics I : Introduction to Nuclear and Particle Physics, (26/26/0/0) BA3

Petra Van Mulders

- VUB - 1010183ANR : WPO Mechanics, (0/22/0/22) BA1

Gerrit Van Onsem

- VUB - 004136 : Inleiding tot de Kwantumfysica, (0/26/0/26) BA2

Isis Van Parijs

- VUB - WE-DNTK-14094 : Fysica: elektromagnetisme, (0/36/0/0) BA2

Catherine Vander Velde

- ULB - XXX : Coordinatrice Objectif réussite - physique, (0/0/0/12) BA1 toutes sections
- ULB - PHYS-F-416 : Interactions fondamentales et particules, (18/0/0/0) MA1 physique
- ULB - PHYS-F-305 : Introduction à la physique des particules élémentaires, (24/0/0/12) BA3 Physique
- ULB - PHYS-F-420 : Méthodes expérimentales de la physique des particules, (12/0/0/0) MA2 physique

- ULB - PHYS-F-101 : Physique générale I - Mécanique, (48/0/0/12) BA1 chimie, physique, mathématique et polyvalente en sciences

Pascal Vanlaer

- ULB - PHYS-F420 : Détection de particules, acquisition et analyse de données, (12/0/24/0) MA1 MA2 Physique
- ULB - PHYS-F102 : Laboratoires de Physique Générale, (0/0/42/0) BA1 Physique, Chimie, Année polyvalente
- ULB - PHYS-F104 : Physique 1, (72/0/0/0) BA1 Biologie, Géographie, Géologie
- ULB - PHYS-F205 : Physique 2: Electricité et magnétisme, (24/0/0/0) BA2 Biologie, Géographie, Géologie

Florian Zenoni

- ULB - PHYS-F-312 : Laboratoire de physique des particules, (2/0/70/10) BA3

3.6.2 Membership to academic juries of Master and Phd theses

Freya Blekman

- Phd thesis - VUB, April 2013 - Federico Galli : Applications of the AdS/CFT correspondence to non-equilibrium physics at strong coupling
Referee
- Phd thesis - VUB, October 2013 - Michael Maes : Measurement of the top quark pair production cross section at the LHC with the CMS experiment
Referee
- Phd thesis - VUB, January 2013 - Stijn Blyweert : Measurement of the top-quark mass and the mass difference between top and antitop quarks at the LHC
Referee

Barbara Clerbaux

- Master thesis - ULB, September 2013 - Rachel Simoni : Etudes des jets associés à la production d'un boson Z pour les collisions pp à CMS
Referee

Catherine De Clercq

- Phd thesis - Vrije Universiteit Brussel, October 2013 - Stijn Blyweert : Measurement of the top-quark mass and the mass difference between top and antitop quarks at the LHC
President

Laurent Favart

- Master thesis - ULB, January 2013 - Samy Azaz : Etude des caractéristiques d'étoiles géantes K enrichies en Lithium et présentant un excès
Referee

Kael Hanson

- Master thesis - ULB, September 2013 - Thibault Le Polain De Waroux : Turbulence dans le vent solaire en expansion
Referee

Steven Lowette

- Phd thesis - VUB, September 2013 - Michael Maes : Measurement of the top quark pair production cross section at the LHC with the CMS experiment
Referee

- Phd thesis - VUB, August 2013 - Stijn Blyweert : Measurement of the top-quark mass and the mass difference between top and antitop quarks at the LHC
Referee
- Phd thesis - VUB, November 2013 - Alexis Kalogeropoulos : Search for direct stop quark pair production at the LHC with the CMS experiment
Referee
- Master thesis - VUB, June 2013 - Lieselotte Moreels : Search for stop quarks using the matrix element method at the LHC
Referee

Pierre Marage

- Master thesis - ULB, September 2013 - Laure-Anne Douchamps : Récursion BCFW et amplitude de diffusion
Referee

Kentarou Mawatari

- Master thesis - VUB, July 2013 - Lieselotte Moreels : Search for stop quarks using the matrix element method at the LHC
Referee

Nick Van Eijndhoven

- Phd thesis - VUB, September 2013 - : Measurement of the top quark pair production cross section at the LHC with the CMS experiment
President
- Phd thesis - VUB, December 2013 - : Search for direct stop quark pair production at the LHC with the CMS experiment
President

Catherine Vander Velde

- Master thesis - ULB, June 2013 - Thomas Lenzi : Caractérisation d'un algorithme pour le Trigger de niveau 1 de nouveaux détecteurs GEM (expérience CMS du LHC)
Referee
- Master thesis - ULB, June 2013 - Chaïmae El Aisati : Etude de la désintégration d'une particule de matière noire avec un neutrino dans l'état final
Referee

Pascal Vanlaer

- Phd thesis - Universiteit Antwerpen, May 2013 - Hans Van Haevevermaet : Study of the underlying event at forward rapidity in pp collisions at $s = 0.9, 2.76$ and 7 TeV
Referee

3.6.3 Representation in academic councils and committees (in universities)

Freya Blekman

- Coordinator of Physics representation VUB open days, VUB
- Responsible for the IIHE web page - mostly content management and coordination, VUB
- Responsible of public relations and outreach of VUB physics department - including member of faculty PR council, VUB

Barbara Clerbaux

- Membre de la commission pédagogique facultaire, ULB

- Présidente du département de physique, ULB

Jorgen D'Hondt

- Chairperson of the Education Committee of the Faculty of Science, VUB
- Chairperson of the Legal Appeal Committee of the Faculty of Science, VUB
- Chairperson of the Selection Committee for new assistant hirings in the Department of Physics, VUB
- Chairperson of the Selection Committee for new professor hirings in the Department of Physics, VUB
- Chairperson of the VUB PhD-day poster competition, VUB
- Delegate of the Faculty of Science in the Education Council of the VUB, VUB
- Member of the Doctoral Student Committee of the Faculty of Science, VUB
- Member of the Gender Committee of the Faculty of Science, VUB
- President of the Physics Department, VUB

Catherine De Clercq

- Chair of the examination committee of the Master in Physics and Astronomy, VUB
- Chair of the Womens council of VUB, VUB
- DNTK member of the Commissie Middelen en Personeel of the Science faculty, VUB
- Member of the examination committee of the Bachelor in Physics and Astronomy, VUB
- Member of the Gender committee of the Science Faculty, VUB
- Member of the working group for the Visitation Fysica, VUB
- Member of the working group on the new physics practicals, VUB
- Proxima and co-organisation of the Doctores Honoris Causa 2013, VUB

Gilles De Lentdecker

- Membre de la commission enseignement du département de physique de l'ULB, ULB

Laurent Favart

- Secretary of the Doctorate Committee, ULB
- ULB - President of the Jury for the Admission in MA in Physics, ULB
- ULB - President of the Jury for the Master in Physics, ULB

Kael Hanson

- Member - Bureau Facultaire, Dean of Faculty of Science, ULB

Thomas Lenzi

- Représentant du corps scientifique dans la commission d'enseignement du département de Physique, ULB
- Représentant du corps scientifique dans le conseil de Physique, ULB

Steven Lowette

- Afgevaardigde DNTK in facultaire doctoraatscommissie, VUB
- Lid van de examencommissie Master, VUB
- Verantwoordelijke internationalisering DNTK, VUB

Pierre Marage

- Directeur de section Institut des Hautes Etudes de Belgique, Other
- Membre Conseil de la Politique scientifique, Bruxelles-Capitale, Other
- Membre Conseil de la Politique scientifique, Région wallonne, Other
- Membre du CA Altair, asbl d'Histoire des Sciences attachée à l'ULB, Other
- Membre du CA FNRS et FRSM, Other
- Membre du Conseil d'Administration Institut national des Radioéléments, Fleurus, Other
- Vice-président Centre de Culture scientifique de l'ULB à Charleroi - Parentville, Other
- Vice-recteur pour la recherche et le développement régional, ULB

Annik Olbrechts

- Visitation Physics Education: Representative of alumni and teaching assistants, VUB

Nick Van Eijndhoven

- Astroparticle Physics coordinator within the High-Energy Physics strategic research programme, VUB
- Chair of the Physics and Astronomy curriculum board, VUB
- Chair of the Physics and Astronomy educational audit preparation committee, VUB
- Committee member c.q. Physics and Astronomy contact person for plagiarism control, VUB
- Faculty coordinator of the Physics and Astronomy educational audit, VUB
- Member of the Advisory Board of the VUB Physics department, VUB
- Member of the Education Board of the VUB Faculty of Science, VUB
- Member of the evaluation board for the VUB institutional review, VUB
- Member of the internal advisory board for the Bio-Engineering educational audit, VUB
- Member of the internal advisory board for the Biology educational audit, VUB

Gerrit Van Onsem

- Opleidingsraad fysica (education council physics); representing VUB alumni, VUB

Catherine Vander Velde

- Member - Commission d'attribution des crédits pédagogiques du Département de physique, ULB
- Membre - Commission de sélection des assistants du Département de physique, ULB
- Membre - jury de l'examen d'admission à l'université, ULB
- Membre - Observatoire de BA1, ULB
- Présidente du jury du BAC en physique et de sa commission d'admission, ULB

Pascal Vanlaer

- Coordinator of the Physics department in the AEQES higher-education quality assessment process in the French community, ULB
- Member of the BA1 observatory, ULB
- President of the users committee of the ULB-VUB computing center, ULB

3.7 Vulgarisation and outreach

Freya Blekman

- CAMPUS talks for International Womens Day - VUB - 08/03/2013
- Coordination and tour CERN visit - CERN, Switzerland - 29/05/2013
- Hangout with CERN - Weekly Google/Youtube hangouts aimed at the general public - Online - 06/06/2013
- Hangout with CERN - Weekly Google/Youtube hangouts aimed at the general public - Online - 07/02/2013
- Member of Organising Committee Flemish Physics Olympiad - Belgium - 27/04/2013
- Research At CERN - London International Youth Science Forum, Imperial College, London, Great Britain - 02/08/2013

Barbara Clerbaux

- La découverte du boson de Brout-Englert-Higgs - Bouillon - ULB extension - 22/04/2013
- La découverte du boson de Brout-Englert-Higgs - Diverses activités média/conférence de presse/interviews - Bruxelles - 10/2013

Jorgen D'Hondt

- Main responsible for the magazine "Maja" - Brussels - 01/12/2013
- Organiser of the colloquium "The origin of mass" - Brussels - 12/11/2013
- Organiser of the first Bright Sparks workshop on Quantum Physics - Brussels - 13/01/2013
- Prize of the Royal Academy for Science Communication - Brussels - 01/06/2013
- Prize of the University for Valorisation - Brussels - 01/12/2013
- Young Scientist 2013 Prize of the World Economic Forum - Dalian, China - 01/09/2013

Catherine De Clercq

- Co-organiser of the finals of the Flemish Physics Olympiads - VUB - 27/04/2013

Gilles De Lentdecker

- Master Class of Particle Physics - IIHE - 04/05/2013

Krijn De Vries

- IceCube: Neutrino's vangen op Antarctica - VUB - 29/10/2013

Laurent Favart

- Introduction à la physique des particules - Master Class IIHE - 04/05/2013

Thomas Lenzi

- Vulgarisation sur le boson de Higgs : <http://boson.ulb.ac.be> - Brussels - 30/09/2013

Lieselotte Moreels

- Short explanation of the H-boson - Terzake (Nobelprize of physics awarded to F. Englert and P. Higgs – together with A. Olbrechts and P. Van Mulders) - Brussels - 08/10/2013

Annik Olbrechts

- Sid-in VUB - Haasrode - 18/01/2013
- Television report (Terzake) about the BEH boson - VUB, Brussels - 08/10/2013

Yves Pierseaux

- Limite Minkowskienne de la Relativité Générale avec Constante Cosmologique et Univers en expansion accélérée, Annales de la fondation de Broglie, 2013 - <http://aflb.ensmp.fr/AFLB-381/aflb381m761.htmg/>. - 10/10/2013

Aidan Randle-conde

- Nobel Prize website for the IIHE - IIHE - 06/10/2013

Shkelzen Rugovac

- Computing Activities at IIHE - Beersel - 08/11/2013

Laurent Thomas

- Masterclasses de physique des particules - IIHE - 04/05/2013

Nick Van Eijndhoven

- Bert Ernie provide a new view on the Universe - Interview on the Belgian Radio1 - 22/11/2013
- IceCube : Catching Neutrinos at Antarctica - VUB campus visit - 27/03/2013
- The Gamma Ray Burst Mystery - VUB physics seminar - 28/02/2013
- The hunt for the Higgs and cosmic ghost particles - Den Dungen, The Netherlands - 24/06/2013
- Unraveling the Universe with Neutrinos - VUB campus visit - 25/04/2013

Petra Van Mulders

- Explaining the Brout-Englert-Higgs mechanism, Terzake (VRT) - IIHE, Brussels - 08/10/2013

Catherine Vander Velde

- La découverte du Boson de Brout-Englert-Higgs. - Congrès pluraliste des Sciences - ULB - 22/08/2013

Pascal Vanlaer

- Contributions au Forum Le Soir "Grandes idées de la Science" - web site of the Le Soir newspaper - 01/10/2013
- Découverte de la particule de Brout-Englert-Higgs au CERN - Centre de Culture Scientifique de Parentville - 01/12/2013
- Radio programme RTBF1 "Forum de midi: Le Nobel de Physique. Et maintenant ?" - RTBF1 - 09/10/2013
- Scalar boson: main results - ULB, Laboratoire d'Information Quantique - 17/10/2013

4 Publications

4.1 Refereed journals and conference proceedings

4.1.1 CMS

1. *Angular analysis and branching fraction measurement of the decay $B^0 \rightarrow K^{*0} \mu^+ \mu^-$*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Lett. B **727** (2013) 77
2. *Energy Calibration and Resolution of the CMS Electromagnetic Calorimeter in pp Collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
JINST **8** (2013) P09009
3. *Event shapes and azimuthal correlations in $Z + \text{jets}$ events in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Lett. B **722** (2013) 238
4. *Evidence for associated production of a single top quark and W boson in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Rev. Lett. **110** (2013) 022003
5. *Forward-backward asymmetry of Drell-Yan lepton pairs in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Lett. B **718** (2013) 752
6. *Identification of b -quark jets with the CMS experiment*
S. Chatrchyan *et al.* [CMS Collaboration]
JINST **8** (2013) P04013
7. *Inclusive search for supersymmetry using the razor variables in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Rev. Lett. **111** (2013) 8, 081802
8. *Interpretation of Searches for Supersymmetry with simplified Models*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Rev. D **88** (2013) 5, 052017
9. *Jet and underlying event properties as a function of charged-particle multiplicity in proton-proton collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Eur. Phys. J. C **73** (2013) 12, 2674
10. *Measurement of associated production of vector bosons and top quark-antiquark pairs at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Rev. Lett. **110** (2013) 172002
11. *Measurement of differential top-quark pair production cross sections in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Eur. Phys. J. C **73** (2013) 3, 2339

12. *Measurement of masses in the $t\bar{t}$ system by kinematic endpoints in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Eur. Phys. J. C **73** (2013) 2494
13. *Measurement of neutral strange particle production in the underlying event in proton-proton collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Rev. D **88** (2013) 052001
14. *Measurement of the Λ_b^0 lifetime in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
JHEP **1307** (2013) 163
15. *Measurement of the $\Upsilon(1S)$, $\Upsilon(2S)$, and $\Upsilon(3S)$ cross sections in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Lett. B **727** (2013) 101
16. *Measurement of the $t\bar{t}$ production cross section in pp collisions at $\sqrt{s} = 7$ TeV with lepton + jets final states*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Lett. B **720** (2013) 83
17. *Measurement of the $t\bar{t}$ production cross section in the all-jet final state in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
JHEP **1305** (2013) 065
18. *Measurement of the W^+W^- Cross section in pp Collisions at $\sqrt{s} = 7$ TeV and Limits on Anomalous $WW\gamma$ and WWZ couplings*
S. Chatrchyan *et al.* [CMS Collaboration]
Eur. Phys. J. C **73** (2013) 10, 2610
19. *Measurement of the ZZ production cross section and search for anomalous couplings in 2 l2l final states in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
JHEP **1301** (2013) 063
20. *Measurement of the azimuthal anisotropy of neutral pions in PbPb collisions at $\sqrt{s_{NN}} = 2.76$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Rev. Lett. **110** (2013) 042301
21. *Measurement of the $B(s)$ to $\mu^+\mu^-$ branching fraction and search for B^0 to $\mu^+\mu^-$ with the CMS Experiment*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Rev. Lett. **111** (2013) 101804
22. *Measurement of the cross section and angular correlations for associated production of a Z boson with b hadrons in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
JHEP **1312** (2013) 039
23. *Measurement of the differential and double-differential Drell-Yan cross sections in proton-proton collisions at $\sqrt{s} = 7$ TeV*

S. Chatrchyan *et al.* [CMS Collaboration]
JHEP **1312** (2013) 030

24. *Measurement of the elliptic anisotropy of charged particles produced in PbPb collisions at nucleon-nucleon center-of-mass energy = 2.76 TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Rev. C **87** (2013) 014902
25. *Measurement of the hadronic activity in events with a Z and two jets and extraction of the cross section for the electroweak production of a Z with two jets in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
JHEP **1310** (2013) 062
26. *Measurement of the inelastic proton-proton cross section at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Lett. B **722** (2013) 5
27. *Measurement of the production cross section for $Z\gamma \rightarrow \nu\bar{\nu}\gamma$ in pp collisions at $\sqrt{s} = 7$ TeV and limits on $ZZ\gamma$ and $Z\gamma\gamma$ triple gauge boson couplings*
S. Chatrchyan *et al.* [CMS Collaboration]
JHEP **1310** (2013) 164
28. *Measurement of the prompt J/ψ and $\psi(2S)$ polarizations in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Lett. B **727** (2013) 381
29. *Measurement of the ratio of the inclusive 3-jet cross section to the inclusive 2-jet cross section in pp collisions at $\sqrt{s} = 7$ TeV and first determination of the strong coupling constant in the TeV range*
S. Chatrchyan *et al.* [CMS Collaboration]
Eur. Phys. J. C **73** (2013) 10, 2604
30. *Measurement of the sum of WW and WZ production with W+di-jet events in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Eur. Phys. J. C **73** (2013) 2, 2283
31. *Measurement of the top-antitop production cross section in the tau+jets channel in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Eur. Phys. J. C **73** (2013) 4, 2386
32. *Measurement of the W-boson helicity in top-quark decays from $t\bar{t}$ production in lepton+jets events in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
JHEP **1310** (2013) 167
33. *Measurement of the $X(3872)$ production cross section via decays to $J/\psi \pi \pi$ in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
JHEP **1304** (2013) 154

34. *Measurement of the $Y1S$, $Y2S$ and $Y3S$ polarizations in pp collisions at $\sqrt{s} = 7$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
Phys. Rev. Lett. **110** (2013) 081802
35. *Measurement of $W+W^-$ and ZZ production cross sections in pp collisions at $\sqrt{s} = 8$ TeV*
S. Chatrchyan *et al.* [CMS Collaboration]
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