

INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES
ULB-VUB, BRUSSELS

ANNUAL REPORT 2003



PREFACE

The year 2003 was an unusual year for the IIHE and the Particle Physics group of the University of Antwerpen.

In June Frans Verbeure passed away after a long illness. He was the head of the Particle Physics group of the UIA since 1972, and maintained a close collaboration between his group and the IIHE.

In October the IIHE witnessed the retirement of Jacques Lemonne, co-founder of the IIHE in 1972 and for 31 years its co-director as head of the VUB Particle Physics group.

They were major actors on the scene of Belgian Particle Physics. Their departure represents an important loss for both groups.



On October 1st 2003, Jacques Lemonne retired after 42 years of research in Elementary Particle Physics, and 31 years of co-directorship of the IIHE.

J. Lemonne studied physics at the ULB where he obtained a Ph D in 1965. After this he went to CERN for four years, and came back to Brussels at the end of the sixties to contribute to the founding of the VUB. In 1972 he was co-founder of the Interuniversity Institute for High Energies, the IIHE. He was co-director of this Institute for 31 years (1972- to 2003).

The experiments in which Jacques participated start with emulsion techniques in the sixties, continue with the high statistics bubble chamber experiments with automatic measurement machines in the seventies and eighties, and ends with the giant electronic detector DELPHI at LEP. Each step was a jump beyond the known limits and a challenge. Thanks to the skills of the researchers of the IIHE, and the diligent leadership of J. Lemonne, each of these experiments was a success.

Besides all this scientific activity, Jacques participated to the management of the VUB at nearly all levels. He was dean of the Faculty of Sciences during two periods, president of the research council and member of many committees and study groups. He was a true defender of physics and research. He was an enthusiastic teacher and spent hundreds of hours training young future physicists, but also biologists, chemists and even veterinary surgeons.

During many years Jacques was the scientific representative of Belgium in the CERN council and co-organised many international schools and conferences.

On October 9th 2003, a “*Colloquium in honorem Prof. Jacques Lemonne*” was organised at the VUB. The program of the colloquium and the transparencies of the talks can be found at <http://web.iihe.ac.be/colloquium>



Frans Verbeure (1942 - 2003)

On 8 June 2003 Frans Verbeure, full professor at the University of Antwerpen and Head of the Particle Physics Group, passed away after a long illness.

Frans Verbeure started his research career in the early sixties, under the leadership of Prof. Fernand Grard, at the “Laboratoire des Hautes Energies” in Brussels, a laboratory funded by the Belgian National Science Foundation. His research initially centered around the bubble chamber physics programme. When the Universitaire Instelling Antwerpen (UIA) was created in 1972, he became the youngest professor in the Physics Department, and remained there until his untimely death.

From the beginning of the seventies, Frans associated his research activities with those of the IIHE(ULB-VUB). This collaboration has remained very intense till the end. Many of us remember how he participated to the scanning of bubble chamber films at the IIHE. When the time of the bubble chambers was over, both our groups took part in the Belgian effort in DELPHI at LEP, and we closely collaborated in the construction and maintenance of the Muon Chambers and in the analysis of the data. The last years our groups put hands together for the construction of the CMS tracker and the preparation of the physics analysis.

Frans Verbeure was a talented physicist, an efficient administrator and a good diplomat. He represented the Belgian particle physicists in many committees, had many important duties in the UIA, and was member of several Belgian committees for science policy.

Despite this heavy load of duties and responsibilities, Frans always kept a positive attitude towards life and people. He was helpful, full of joy, optimist and excited about what he was doing. He never lost sight of the important things in this world and was known for enjoying life.

This life was taken away from him much too early. We all miss him!

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C. DE CLERCQ and D. BERTRAND

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I. INTRODUCTION.

The work presented in this report is supported by the **Université Libre de Bruxelles (ULB)**, the **Vrije Universiteit Brussel (VUB)**, the **Fonds National de la Recherche Scientifique (FNRS)**, the **Fonds voor Wetenschappelijk Onderzoek-Vlaanderen (FWO)**, the **Fonds pour la Formation à la Recherche dans l'Industrie et dans l'Agriculture (FRIA)**, the **Instituut voor de aanmoediging van Innovatie door Wetenschap en Technologie in Vlaanderen (IWT)**, the **Belgian Federal Science Policy Office** and the **European Union**.

The scientists whose names are listed below have contributed to the various activities of the Institute in 2003.

U.L.B.

D. Bertrand (directeur de recherche FNRS; chargé de cours temps partiel)
O. Bouhali (collaborateur scientifique IISN)
B. Clerbaux (chercheur qualifié FNRS)
L. Favart (chercheur qualifié FNRS)
X. Janssen (chercheur FRIA until end of January 2003)
P. Marage (professeur ordinaire since October 2003)
L. Neukermans (chercheur PAI)
Y. Piersaux (collaborateur scientifique)
B. Roland (boursier FRIA)
J. Sacton (professeur émérite)
C. Vander Velde (professeur)
P. Vanlaer (chercheur PAI until September 2003, collaborateur scientifique FNRS since October 2003)
P. Vilain (chercheur qualifié FNRS; chargé de cours temps partiel)
J. Wickens (chercheur IISN)
G. Wilquet (chercheur qualifié FNRS; chargé de cours temps partiel)

V.U.B.

P. Bruyndonckx (wetenschappelijk medewerker GOA)
C. De Clercq (hoofddocent)
O. Devroede (wetenschappelijk medewerker from May 2003)
J. D'Hondt (IWT specialisatiebeurs until September 2003; FWO postdoctoraal onderzoeker since October 2003)
J. Heynink (doctoraatsbeurs from October 2003)
D. Hubert (IWT specialisatiebeurs)
D. Johnson (assistent VUB)
M. Krieguer (wetenschappelijk medewerker FWO)
C. Lemaître (wetenschappelijk medewerker, eigen middelen from October 2003)
J. Lemonne (gewoon hoogleraar, professor-emeritus from October 2003)
S. Leonard (wetenschappelijk medewerker FWO)
S. Lowette (wetenschappelijk medewerker FWO)
P. Niessen (IUAP P5/27 till September 2003)
P. Olbrechts (IWT specialisatiebeurs)
R. Roosen (onderzoeksdirecteur FWO)
P. Szupryczynski (wetenschappelijk medewerker Bilateraal akkoord Vlaanderen-Polen till March 2003)
S. Tavernier (gewoon hoogleraar)
F. Udo (wetenschappelijk medewerker)
R. Vandenbroucke (logistiek medewerker FWO)
W. Van Doninck (onderzoeksdirecteur FWO, on leave of absence at CERN since January 2000)
C. Yu (wetenschappelijk medewerker FWO)
Y. Wu (wetenschappelijk medewerker Bilateraal akkoord Vlaanderen-China from September 2003)

T. Anthonis, W. Beaumont, T. Beckers, E. De Wolf, F. Moortgat, M. Tasevsky, P. Van Mechelen, N. Van Remortel and F. Verbeure (†8 June 2003) from the Universiteit Antwerpen (UA) have been working in close collaboration with the Institute.

Research in the field of telecommunications and data communication is conducted at IIHE/VUB by R. Vandenbroucke in collaboration with the members of the "Service Télématique et Communication" led by P. Van Binst at the ULB.

II. RESEARCH ACTIVITIES IN PARTICLE PHYSICS.

II.1. NEUTRINO PHYSICS.

A. CHORUS experiment (CERN WA95).

(P. Vilain, G. Wilquet)

Built in 1993, the CHORUS detector has been exposed between 1994 and 1997 to the CERN-SPS neutrino beam. About one million interactions were recorded in the 770 kg nuclear emulsion target and more than 10 millions were produced in the calorimeter and spectrometer material. Events of this latter type were also recorded in 1998, when the beam was mainly operated for the NOMAD experiment.

The main purpose of the experiment was the search of ν_μ - ν_τ oscillation through the observation of the reaction $\nu_\tau + N \rightarrow \tau + \text{hadrons}$. The very high spatial resolution power of nuclear emulsion enables the direct detection of the τ trajectory.

In the phase I of the analysis, today completed, the microscope scanning speed was not sufficient to treat all events and selection criteria optimised for the ν_τ interactions were applied. About 180000 vertices were located in the emulsion volume and 13500 further selected for visual inspection. After kinematical analysis, none of these events is retained as a ν_τ signal, while the expected background from other processes is estimated at 1.1 events.

In an effective two-flavours scheme, the ν_μ - ν_τ transition probability is given by :

$$P_{\mu\tau} = \sin^2 2\theta_{\mu\tau} \times \sin^2 \left(\frac{1.27 \Delta m^2 L}{E} \right)$$

where $E(\text{GeV})$ and $L(\text{km})$ are the neutrino energy and flight length, $\Delta m^2(\text{eV}^2)$ is the squared mass difference of the mass eigenstates and $\theta_{\mu\tau}$ the mixing angle.

In the absence of a significant signal, an upper limit on $P_{\mu\tau}$ was established, after integration on E and L . At large Δm^2 , this limit corresponds, at 90 % C.L., to the limit:

$$\sin^2 2\theta_{\mu\tau} < 6.8 \cdot 10^{-4}$$

The phase II of the data analysis started in 1999 and should lead this year to an improvement by a factor 2 to 3 of this limit thanks to :

- A refined track reconstruction code and more accurate alignment of the fibre trackers;
 - The location of all events, without kinematical selection;
 - The search around each located vertex of all the produced tracks and secondary activities (so called "net scan").
- The two last items were made possible by the enormous progress achieved at the University of Nagoya in automated microscopes, allowing a gain in speed by two orders of magnitude.

The net scan method has opened, in addition, the possibility to accumulate a large and unbiased sample of charmed particles production and decay events. Several results were recently published:

- D^0 meson production rate,
- Observation of a charm-anticharm pair in a charged current interaction,
- Semi-leptonic charm branching fractions,
- Λ_c production
- Charmed baryons quasi-elastic production cross-section.

Several additional analyses are in progress and will be published during 2004 and early 2005.

B. OPERA experiment (CERN CNGS1).

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

In 2000, the CERN Council approved the construction of the SPS CNGS neutrino beam, pointing towards Gran Sasso LNGS underground laboratory. The long baseline neutrino oscillation OPERA project, based on this beam, was approved in February 2001.

The motivation for this experiment resides in the now clear evidence, mainly from the Super Kamiokande

experiment, of an energy and zenithal dependent deficit in the flux of atmospheric ν_μ 's. The data are well fitted in terms of ν_μ - ν_τ oscillation for Δm^2 about $2.5 \cdot 10^{-3} \text{ eV}^2$ and $\sin^2 2\theta > 0.9$ and compatible with full mixing. OPERA aims at covering this domain of the parameters space and demonstrating the ν_μ - ν_τ oscillation hypothesis through the direct observation of ν_τ interactions.

The detector design was based on two conflicting requirements: the τ detection calls for the spatial resolution of nuclear emulsion but the required target mass of at least 1000 tons prohibits the use of a pure emulsion target as was done in the CHORUS experiment. The solution consists in stacking 1 mm thick lead foils interleaved with 200 μm plastic sheets covered on both sides by 50 μm emulsion layers. Detailed simulations of this configuration have shown that high τ detection efficiency can be preserved while keeping the background at a tolerable level.

The modular detector structure is as follows:

- 56 foils of lead interleaved with emulsion sheets of about 120 cm^2 area stacked to form a 8.5 kg brick;
- 3264 bricks are assembled in a wall. Each wall, of about 40 m^2 area, is followed by a pair of orthogonal planes of plastic scintillator strip trackers;
- A super-module is made from 33 walls followed by a muon spectrometer;
- Two identical super-modules compose the detector that reaches an effective target mass of 2000 tons.

Our group is more specifically involved in the conception, construction and installation of the Target Trackers (TT) together with IReS, Strasbourg, the universities of Bern and Neuchâtel, IPNL, Lyon and JINR, Dubna. A tracker plane consists of 4 modules, each composed of 7-m long scintillator strips equipped with wavelength shifting fibres. The optical signals transmitted by the 64 fibres are readout at both ends by 64-channel photomultipliers.

Intensive R&D work has been performed to finalise the detailed design of each detector components. A prototype double plane has been built at IReS in order to carefully check the choice of components and the module construction and the plane assembly procedures. Our group has mainly contributed to the design study of the mechanical structure of the modules including the end-caps, the procedures to be used for their assembly into planes and on the detector, and the calibration and control system.

The contracts with the producers of the various detector elements have been signed during 2003 and the production of the 528 modules has started end of 2003. At least one of the two OPERA super-modules ought to be ready by mid-2006 when the CNGS beam is foreseen to enter into operation.

C. Neutrino astronomy with AMANDA.

(D. Bertrand, O. Bouhali, C. De Clercq, J.-P. Dewulf, D. Hubert, P. Niessen, Ph. Olbrechts and L. Etienne)

This research project is pursued with two co-promotors at the FNRS level: J.-M. Frère ("Professeur Ordinaire" in theoretical physics at the ULB) and F. Binon ("Directeur de recherches FNRS" at the ULB).

1) Physics results

The AMANDA neutrino telescope aims at the observation of high energy neutrinos from astrophysical sources in the northern hemisphere. The detector is located at the geographical South Pole and consists of 677 photo multiplier tubes (PMT) deployed on an array of diameter 200m and height 500m in the Antarctic ice at depths between 1500 and 2000 m. This neutrino detector is the first step towards the construction of the IceCube km^3 neutrino telescope. The PMTs measure the Cherenkov light emitted in the ice by charged relativistic particles, like the muons which are produced in charged current muon-neutrino nucleon interactions below the detector. A few analyses were still performed on data collected in 1997 with the AMANDA-B10 detector (302 PMT in 10 strings representing an array of diameter 120 m and height 500m)

• Search for neutrino-induced cascades

Events with high energy cascade-like signature were searched for. The observed events are consistent with expected backgrounds from atmospheric neutrinos and catastrophic energy losses from atmospheric muons. Effective volumes for all flavours of neutrinos, which allow the calculation of limits for any neutrino flux model, were determined. The limit on cascades from a diffuse flux of the three flavours of neutrinos and anti-neutrinos was evaluated to :

$$E^2 \frac{d\phi}{dE} < 9.8 \times 10^{-6} \text{ GeV cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$$

assuming a neutrino flux ratio 1:1:1 at the detector.

• *Measurement of the cosmic ray composition at the “knee“ of the spectrum.*

The SPASE-2 surface air shower array and the AMANDA-B10 detector were used in coincidence to measure air showers at energies above 10^{15} eV. Information from the electron component at SPASE and the high-energy muon component at AMANDA were used together to determine the change of the cosmic ray mass composition in the energy range from 400 TeV to 6 PeV. The data showed an increase of the mean log atomic mass $\langle \ln A \rangle$ within this energy range. Analyses performed on data gathered from the AMANDA II detector (677 PMT in 19 strings representing an array of diameter 200m and height 500m at depths between 1500 and 2000m) were published or presented with preliminary results at conferences.

• *Search for extraterrestrial point sources of neutrinos*

Flux limits on several active-galactic-nuclei blazars, micro quasars, magnetars and other candidate neutrino sources were established using data collected during the year 2000. A search for excesses above a random background of cosmic-ray-induced atmospheric neutrinos and misreconstructed down going cosmic-ray muons revealed no statistically significant neutrino point sources. It was shown that AMANDA-II had achieved the sensitivity required to probe known TeV γ -ray sources such as the blazar Markarian 501 in its 1997 flaring state at a level where neutrino and γ -ray fluxes are equal.

• *Search for high energy neutrinos of all flavours*

The rates of electro-magnetic and/or hadronic showers (cascades) induced by a diffuse flux of high energy neutrinos, were consistent with the expected rate of atmospheric neutrinos and muons. Preliminary upper limits were determined on a diffuse flux of extraterrestrial electron, tau and muon neutrinos. A flux of neutrinos following a E^{-2} spectrum and consisting of an equal mix of all flavours is limited to :

$$E^2 \phi(E) = 9 \times 10^{-7} \text{ GeV cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$$

for a neutrino energy range 80 TeV to 7 PeV.

• *Determination of the neutrino and muon spectra*

A new method to reconstruct the muon and neutrino energy spectra based on neural networks and regularized unfolding was developed. The atmospheric muon spectrum was used as a cross-check in the method and the atmospheric neutrino spectrum was measured up to 100 TeV.

• *Cosmic-ray flux measurement*

Predictions of six commonly-used high-energy interaction models (QGSJET, VENUS, NEXUS, DPMJET, HDPM and SYBILL) were compared to flux measurements of cosmic-ray muons with energies in the range 1.5 to 200 TeV. Best agreement was achieved with QGSJET, VENUS and NEXUS models (preliminary : $\phi_{0,H} = 0.106 \pm 0.007 \text{ m}^{-2} \text{ s}^{-1} \text{ sr}^{-1} \text{ TeV}^{-1}$, $\gamma_H = 2.70 \pm 0.02$).

• *Search for high energy muon neutrinos from gamma-ray bursts.*

The AMANDA detector has an effective area of the order of 50,000 m^2 for detecting a PeV muon. The data sets spanning 1997-2000 were searched for high energy neutrinos, that were spatially and temporally coincident with 317 triggered GRB's, detected by the Burst and Transient Source Experiment (BATSE) on NASA's Compton Gamma-Ray Observatory (CGRO) satellite, and 153 non-triggered GRB's, obtained by searching the BATSE archived data. The preliminary results were consistent with no GRB neutrino signal leading to an upper limit of 1.45 for the 317 BATSE triggered bursts.

• *Online search for neutrino bursts from supernovae.*

Although designed to detect neutrinos with energies of 100 GeV and above, the AMANDA telescope is also capable of detecting multi MeV anti-electron neutrinos for supernovae. The signature of such events is the simultaneous increase in rate in all optical sensors in the detector. The recent improvements in the reduction of correlated noise allowed the development of a fast and robust online filter which allowed participating to the SNEWS world wide alert system.

Together with these analyses, the AMANDA collaboration completed a major upgrade of the detector during the past Austral summer, especially aiming at the highest energy phenomena. Nearly dead-timeless operation has been achieved while the information content of the recorded event has improved dramatically by adding full waveform capture to the electronic readout. The Transient Wave form Recorders (TWR) are capable of recording the complete wave form of each PMT in a window of 10.24 μsec with a time resolution of 10ns and an accuracy of 12 bits. At present the TWR DAQ is running in parallel with the original system.

2) Activities of the IIHE group

The IIHE group took a large responsibility in the analyses of the data taken with AMANDA-B10 in 1998 and 1999. This is a difficult task as the reconstruction and simulation programs had to be adapted to the varying detector configuration (10 strings in 98, 13 strings in 99 and 19 strings from 2000 onwards). Two main analyses were pursued in 2003 :

- study of WIMP (neutralino) annihilations in the centre of the earth
- search for high energy point like neutrino sources inside and outside our galaxy.

After a careful work which lead to the definition of a "standard" selection of the events using a small part of the experimental statistics, the whole set of data was unblinded and the results are ready for publication. Work is presently in progress to combine these measurements with those obtained in 1997 and 2000.

Besides these analyses, work has also started to search for WIMP annihilations in the sun with data taken in 2001.

In the context of the preparation of the ICE³ detector, the tests which were started in 2001 were pursued. A new experimental set-up was built in order to get fast and reliable information on the efficiency enhancement brought by the application of a Wave Length Shifter (WLS) polymer in front of the OM. The set-up is based on the detection of the Cherenkov light emitted by electrons focused by a magnetic spectrometer on a fused silica thin glass.

Finally the IIHE has significantly contributed to the upgrading of the AMANDA reconstruction software (SIEGLINDE) and to analytical methods to describe the photon behaviour in ice which could be implemented in the simulation software. The IIHE was also responsible for the coordination of the online data monitoring in 2003 and has contributed to the calibration of AMANDA in situ during the maintenance campaigns.

II.2. STUDY OF e^+e^- ANNIHILATION AT LEP - THE DELPHI EXPERIMENT.

(D. Bertrand, C. De Clercq, J. D'Hondt, J. Lemonne, N. Van Remortel, F. Verbeure and J. Wickens)

During 12 years, between 1989 and 2000, the DELPHI experiment has taken about 4 million events at the Z^0 resonance (LEP I experiment), and about 10,000 W -pair events at energies between 161 and 209 GeV (LEP II experiment). The analyses of the data taken at the Z^0 peak are nearly finished and published, while the analysis of the high energy data is still in progress. In the following paragraphs the main results published in 2003 are discussed with special emphasis on the contributions from the physicists of the Brussels-Antwerp group.

1) DELPHI results

At LEP I the inclusive production of two isoscalar mesons decaying into $(K \bar{K} \pi^0)$ states was observed whose properties are consistent with those of the $f_1(1285)$ and $f_1(1420)$ resonances. The production rates $\langle n \rangle$ per hadronic Z -decay were measured to be

$$\langle n \rangle = .165 \pm .051 \quad \text{for the } f_1(1285)$$

$$\text{and } \langle n \rangle = .056 \pm 012 \quad \text{for the } f_1(1420)$$

The inclusive branching fractions for the decay of b -hadrons into "wrong sign" charm mesons, which is mainly due to double charm transitions of the type $b \rightarrow D \bar{D} X$, were also measured in Z^0 decays with the result

$$\begin{aligned} \beta(b \rightarrow \bar{D}^0 X) + \beta(b \rightarrow D^- X) \\ = (9.3 \pm 1.7 \text{ (stat)} \pm 1.3 \text{ (syst)} \pm .4 \text{ (syst)})\% \end{aligned}$$

$$\text{and } \beta(b \rightarrow D_s^- X) = (10.1 \pm 1.0 \text{ (stat)} \pm .6 \text{ (syst)} \pm 2.8 \text{ (syst)})\%$$

Neutral B meson oscillations in the $B_s^0 - \bar{B}_s^0$ and $B_d^0 - \bar{B}_d^0$ systems were studied using a sample of approximately 4 million hadronic Z -decays recorded at LEP1 and LEP2. The mass difference between the two physical states in the $B_d^0 - \bar{B}_d^0$ systems was measured to be

$$\Delta m_d = (0.531 \pm 0.025 \text{ (stat)} \pm .007 \text{ (syst)}) \text{ ps}^{-1}$$

As no evidence for $B_s^0 - \bar{B}_s^0$ oscillations was found, only a lower limit on the mass difference of the two physical states of

$$\Delta m_s > 5.0 \text{ ps}^{-1}$$

could be established at 95% C.L.

Combining the results of a study of the energy evolution of events shape distributions in e^+e^- collisions at centre of mass energies between 45 and 202 GeV with data from low energy experiments the one loop coefficient of the QCD- β function was measured to be

$$\beta_0 = 7.86 \pm 0.32$$

corresponding to the number of active flavours of

$$n_f = 4.75 \pm 0.44$$

These values agree well with QCD-expectations of $\beta_0 = 7.67$ and $n_f = 5$

Inclusive J/ψ production in photon-photon collisions has been observed at LEP II ($161 \leq \sqrt{s} \leq 207$ GeV) and has led to the inclusive cross-section estimate

$$\sigma(J/\psi + X) = 45 \pm 9 \text{ (stat)} \pm 17 \text{ (syst) pb}$$

From a study of the event shapes it is concluded that $(74 \pm 22)\%$ of the observed J/ψ events are due to “resolved” photons, the dominant contribution of which being most probably due to the gluon content of the photon. ZZ -production in e^+e^- interactions at $\sqrt{s} = 183 - 209$ GeV was found to be in good agreement with the expectations from the Standard Model (SM). The cross sections measured from the dominant NC02 (t-channel electron exchange) processes, normalised to the predicted SM-values, were combined into a single value

$$R_{\text{NC02}} = 0.91 \pm .08 \text{ (stat)} \pm .02 \text{ (syst)}$$

No significant excess was observed in a search for pair-produced doubly charged Higgs bosons decaying into τ -leptons leading to an improved lower limit on the mass of these particles of $97.3 \text{ GeV}/c^2$ at 95% C.L.

Several searches for exotic particles such as sleptons, neutralinos, charginos, sgoldstinos made in scenarios in which the lightest super symmetric particle is the gravitino, remained unsuccessful. In some super symmetric models, it is the gluino (\tilde{g}) which is predicted to be light and stable. From a search for events of the type $q\bar{q}\tilde{g}\tilde{g}$ at the Z^0 resonance, the existence of light gluinos with a mass between 2 and 18 GeV/c^2 could be excluded at the 95% C.L. Moreover, the results of searches at LEP2 for a gluino with mass greater than 30 GeV/c^2 were negative. This was also the case for a search for resonant $\tilde{\nu}$ -production in e^+e^- collisions in the center of mass energy range extending from 183 to 208 GeV.

2) Activities of the Brussels-Antwerp group

At the IIHE we concentrated our efforts on:

- *Determination of the W-boson mass and width*

The IIHE contributed to the measurement of the W mass and width using the fully hadronic WW final state events up to the highest energies (209 GeV). An ideogram technique was used. The effort was concentrated on very careful studies of the systematic errors resulting from Bose-Einstein correlations and of colour-reconnection effects (PhD thesis work of J. D'Hondt - VUB).

- *Bose-Einstein correlations (BEC)*

Several analyses were made to examine whether there are BEC between pions from different W's in hadronically decaying WW's. Different mixing methods were used to make a reference sample and selection cuts were applied to improve the sensitivity of the measurement (PhD thesis work of N. Van Remortel - UIA). An indication for the existence of inter-W-BEC was found which is however not yet confirmed by other LEP experiments.

- *Measurement of the W-boson polarisation and determination of anomalous Triple Gauge Boson couplings (TGC)*

The Spin Density Matrix elements were measured for semi-inclusive W production in the energy domain ranging from 189 GeV up to 208 GeV. The semi-leptonic muon and electron events were used. Preliminary results on the W polarisation as a function of the W production angle and on anomalous CP-conserving and CP-violating TGC'S have been derived from these data. The study of anomalous CP-conserving couplings is still in progress and the results for CP-violating TGC's are consistent with the zero values expected in the Standard model.

II.3. STUDY OF ep COLLISIONS AT HERA - THE H1 EXPERIMENT.

(T.Anthonis, E.De Wolf, L.Favart, X.Janssen, D. Johnson, P.Marage, R.Roosen, P.Van Mechelen and K. Vervink)

1) HERA, H1 and COP

The period 2002-2003 corresponds to the transition of the HERA-I to the HERA-II running phase, the main goal of the latter being 5 fold increase in luminosity. However various machine problems and high background rates prevented to run the accelerator during 2003 at the maximum currents possible. Only by the end of the year were these problems mastered.

During 2003 the COP detector and readout electronics were still performing well, although after 11 years of running the overall efficiency tends to decrease. Also the coming higher beam intensities will put further constraints on the running conditions of the chamber.

The increased trigger rates that accompany the larger beam intensities necessitated a more selective trigger scheme: the implementation of an L3-reject mechanism at the central H1 trigger by which an event during the readout can be aborted. This mechanism requires a special event handling at the front-end MWPC-DAQ which was implemented but not operational. During the summer period, this mechanism was made fully operational and is working well at present.

2) VFPS

The main activity centred on the installation of the VFPS, the Very Forward Proton Spectrometer installed at 220m from the H1 detector. At the beginning of 2003 the "Cold Bypass" structure which bypasses the cryogenic lines of the supra conducting magnets around the warm beam pipe section which contain the Roman pots, was first cryogenically tested at DESY and then successfully installed in the HERA proton ring. Subsequently, the warm beam pipe with the Roman pots were installed in April. The good performance of the optical fibre detectors that form the inserts in the Roman pots was checked by means of cosmic muons. During summer and autumn, the stability of various components such as the Heidenhain readout, temperature control, motor and movement control and corresponding monitoring were thoroughly tested. In the mean time the full front-end electronics were installed and the new data acquisition system which now groups the existing FPS Roman pots and the VFPS became operational. The first movements into the beam under real beam conditions were executed by the end of 2003 but were interrupted because of beam safety reasons. First particle signals were observed beginning of 2004.

3) Physics analysis

During the period 2002-2003 a total of 44 articles were published in international journals. The various topics studied can be grouped under the following headings:

- Measurements of the proton structure functions at very high- Q^2 ;
- Study of the electroweak processes;
- Heavy flavour physics;
- Searches for Standard Model deviations: leptoquarks and exotics;
- Searches for QCD related instanton processes;
- Study of diffractive processes (including DVCS) at large momentum transfer.

The activity regarding the physics analysis of the Brussels-Antwerp group is concentrated around the topics of :

- Deep virtual Compton scattering;
- ρ - and ϕ -meson production at large Q^2 - and t -transfer;
- Inclusive properties of diffractive and non-diffractive hadronic final states.

II.4. STUDY OF pp COLLISIONS AT LHC - THE CMS EXPERIMENT.

(W. Beaumont, T. Beckers, D. Bertrand, O. Bouhali, B. Clerbaux, O. Devroede, E. De Wolf, J.P. Dewulf, R. Goorens, J. Heyninck, S. Lowette, F. Moortgat, L. Neukermans, M. Tasevsky, S. Tavernier, F. Udo, C. Vander Velde, W. Van Doninck, P. Vanlaer, L. Van Lancker, F. Verbeure, J. Wickens, Yu Chunxu).

In December 1994, the CERN council decided the construction in the LEP tunnel of a "Large Hadron Collider" (LHC) which is expected to be operational in 2007. This machine will allow the study of proton-proton interactions at a center-of-mass energy of 14 TeV with luminosities around $10^{34} \text{ cm}^{-2} \text{ s}^{-1}$. Two multipurpose detectors, ATLAS and CMS, will be installed at LHC.

A large research program will be performed at this collider. Even if the existence of a Higgs boson at $115 \text{ GeV}/c^2$, suggested by the last LEP results, would be confirmed at the Tevatron, there remains a vast domain of physics to be explored at the LHC. The energy and luminosity at the LHC will allow a detailed study of the symmetry breaking mechanism in the electroweak interactions, and extensive studies of the top quark properties will become possible. The LHC will also allow discriminating between different theories to extend the Standard Model, as could be done, for example, with the observation of supersymmetric particles. Study of CP violation in weak interactions, in the $B^0 - \bar{B}^0$ system, will be possible with an unprecedented precision due to the large $b - \bar{b}$ pairs production rate.

The Compact Muon Solenoid (CMS) collaboration consists of more than 1700 physicists and engineers from 150 institutes all over the world among which five Belgian research groups from the IIHE (ULB-VUB), UIA, UCL and UMH. The Belgian teams have chosen to participate to the design and construction of the tracker detector of CMS.

At the end of 1999 the CMS collaboration took the decision to build an all silicon tracker. The IIHE took on the following responsibilities : coordination of the design and production of 17000 frames to support the Si detector modules and 17000 pitch adapters, assembly of 3500 of these modules for the forward wheels of the tracker, mounting of modules on 42 support structures in the shape of a sector of a wheel (so called petals), long term tests of the modules and the petals.

The procurement of the pitch adapters is now successfully terminated and our technicians participated to their tests in CERN, under the coordination of R. Goorens. Half of the frame components are delivered to the assembly centres in Italy, in Pakistan and at the IIHE. A thermal conductivity measurement set-up, installed at the IIHE, allowed to check that the carbon fiber plates received up to now are within specifications for that property.

More than 1000 frames were already assembled at the IIHE and the laboratory is now ready to start testing the hybrids upon reception and assembling modules on the gantry. The storage of detector components, their shipping among the various laboratories of the collaboration and their registration in the data base is being organised.

A module test station is operational at the UIA. The petal assembly set-up and the petal test set-up are being installed at the IIHE with the help of the UIA. The optical electronic system to be used in these tests has been developed for the collaboration by J.P. Dewulf, he is presently developing the test system for the hybrid light generations.

In parallel, the CMS physicists of the IIHE, both in Brussels and in Antwerp, continue to prepare the physics analyses. They contribute to the simulation studies of several physics channels of high relevance at the LHC. They participate to the development of the simulation and reconstruction programs which are required in order to perform the analyses.

The physics channels studied are the following :

- the search for heavy neutral Higgs bosons through their decay into a pair of next-to-lightest neutralinos leading to a final state with four leptons, in the framework of the Minimal Supersymmetric Standard Model (MSSM)
- the search for a MSSM heavy charged Higgs boson through the decay into a top-antitop quark pair
- the search for Kaluza-Klein recurrences of the Z and photon through the decay into an electron-positron pair, in models with large extra dimensions
- the semi-leptonic decay of a top-antitop quark pair within the Standard Model, in order to measure the top mass with precision

The related software developments are :

- precise reconstruction of the particle interaction and decay points (vertices) in the ambiguous and noisy events expected at the LHC; Brussels is coordinating these developments for the collaboration
- fast Monte-Carlo simulation (FAMOS) of the response of the CMS muon detector
- reconstruction and calibration of jets from light and heavy partons
- reconstruction of very energetic electrons, in particular the treatment of saturated cells of the CMS electromagnetic calorimeter

A fraction of these studies have been already approved by the CMS collaboration and have been presented at international conferences, or accepted for publication in international scientific journals. The IIHE physicists are also

actively interacting with theorists and phenomenologists, in the framework of the Belgian Inter-University Attraction Pole on Fundamental Interactions.

III. APPLIED R&D AND SPIN-OFF.

III.1. DEVELOPMENT OF NEW SCINTILLATION MATERIALS AND OF RADIATION DETECTORS FOR BIOMEDICAL IMAGING APPLICATIONS -THE CRYSTAL CLEAR PROJECT.

(P. Bruyndonckx, O. Devroede, M. Krieguer, C. Lemaître, S. Léonard, P. Szupryczynski, S. Tavernier, Y. Wu)

At the front line of organic research, molecular and cellular biologists engineer new molecular arrangements, including genes and proteins. Having produced these new strains, the next task is to investigate what happens when they are implanted in living tissue. The researchers want to know how the new genes "express" themselves. In a different area - pharmaceutical research - the effects of potential new drugs have to be established as quickly as possible. In the past, results have been established "in vitro", by either killing the samples or by taking biopsies. Until recently, there has been no other way of studying the effects of genetic manipulation or drug administration. Now researchers have found how imaging techniques used in medical diagnosis can be adapted for genetic or drug research, providing an immediate picture of how the modified tissue behaves "in vivo". One of these techniques is Positron Emission Tomography (PET).

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

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

In the framework of the Crystal Clear Collaboration (CCC), the IIHE, together with the RUG, CERN, the Université Claude Bernard, Lyon, the Ecole Polytechnique Fédérale de Lausanne, and the Forschungszentrum Juelich is developing a new generation of high-resolution small animal PET scanners. We have also negotiated license contracts of our technology with major commercial companies. The first design of these small animal PET scanners is based on the use of position sensitive PMTs (PSPMT) and a phoswich of LSO/LuAP scintillators to provide the depth of interaction information. In addition, a project for a mammography PET camera (ClearPEM) has been set-up. This CCC project is in collaboration with the VUB university hospital and a Portuguese consortium of scientific institutes led by LIP (Lisbon), which is also a member of the Crystal Clear Collaboration.

The IIHE is responsible for the design and construction of the front-end detector modules for a number of small animal PET systems being developed within the collaboration. These detector modules consist of a double layered 8x8 crystal matrix mounted on a position sensitive PMT. The upper layer contains 64 LSO crystals measuring 2x2x8 mm while the bottom layer consists of 64 LuYAP crystals measuring 2x2x8 mm. To check several thousand LSO and LuYAP crystals, an automated crystal evaluation set-up was developed. This set-up measures the light yield and decay time of crystal batches. The results are stored in a database and used for crystal selection. To optimize the magnitude and uniformity of the light collection of the individual pixels of crystal matrix on the PS-PMT, extensive tests were performed to select the best procedure to optically couple the crystal matrices to the PMTs. To check the quality of a fully assembled detector module, a set-up was created allowing us to measure energy spectra and sensitivity measurements of each pixel in the detector.

In preparation for the design of the PEM prototype, studies using Avalanche Photo diodes (APD) are performed. APDs are more compact, are more easily subdivided in small pixels, and are potentially lower in cost. In these prototype detector modules, very small individual crystals are replaced by a solid scintillator block to eliminate dead zones in-between the crystals. In addition, these scintillator blocks are much cheaper to produce and easier to mount. The position and depth of interaction is determined from the light distribution measured over the pixels in the APD array. The information is extracted from the light profile using neural networks, support vector machines or statistically based methods.

To evaluate the performance of these detector configurations for tomographic imaging, a simulator was developed. This device consists of two rotating platforms onto which two detector modules can be mounted. The two

platforms can rotate over 360° and can also rotate relative to one another. This allows us to simulate a complete (or partial) detector ring of a PEM (or a next generation small animal PET) scanner and reconstruct tomographic images of an object.

In addition to the hardware development, the IIHE is also involved in the development of the software to acquire the list mode data and store all necessary scan and instrumentation information in an appropriate format for image reconstruction. Furthermore, the description of the scanner geometry for generic cylindrical systems and the implementation of a process to compute the 3D coordinates of an event in the laboratory (x, y, z) system has been implemented. This library is now full operational and has been tested by using LMF data produced by GATE (Geant4 Application for Tomographic Emission). GATE is a PET simulation platform based on the Geant4 Monte-Carlo toolkit, developed by Crystal Clear members together with others groups interested in the field of nuclear medicine, and in collaboration with the Geant4 low energy development team.

IV. COMPUTING AND NETWORKING

Management: R. Vandenbroucke

Logistic and technical staff: D. Pirnay, G. Rousseau, E. Torisaen

Management

The management of the IIHE computer and network infrastructure and services is realised by R. Vandenbroucke. She coordinates the tasks of the technical staff and regularly meets with them to ensure the follow-up of all tasks. She is responsible for all maintenance contracts as well for the insurance of all computer related equipment. She plans for system and network upgrades and holds contact with suppliers of IT equipment. Communication between the computer group and the physicists is realised by the IIHE Computer Coordinating Committee. Moreover R. Vandenbroucke is active in the HTASC Committee that looks at ICT related problems for HEP in Europe.

Operations

G. Rousseau and E. Torisaen are sharing the day-to-day logistic tasks necessary to be done in the IIHE computing environment; these tasks include backups, printers maintenance and management of the redistribution of user equipment, follow-up of repairs... and the very important user support. G. Rousseau takes care of the network infrastructure and realises all cabling and network connections needed for the maintenance and extension of the IIHE local area network. He gives a first level support for Macs, Windows, VMS and Unix machines. He does the day-to-day verification work for the Anti-virus and anti-spam mail software. E. Torisaen takes care of software installation for all Unix flavoured machines (workstations and PCs) and Windows PCs. He gives high-level support for Windows and Unix.

D.Pirnay assures logistic support and creates web pages, for the IIHE as well as for CUO BELUX and BTA.

Systems

The number of PCs in the laboratory has continued to grow during 2003. The PCs often run a double operating system: Windows and Linux. PCs are also more and more used for real-time data acquisition (e.g. for the AMANDA experiment, CMS and for several student set-ups).

Central disk storage has been added to the Storage Area Networking (SAN) system providing extra disk space to the Alpha disk server and to the Linux cluster of PCs, and bring the total disk capacity to 2 Terabyte.

A tape robot with a double read/write interface and a total capacity of 26 drives that can each take 220 Gbyte has been taken into production to cope with backup for the 2 Terabyte of disk storage.

A Windows 2000 server has been set up and all new Windows PCs run now Windows 2000 or Windows XP while all older PCs are gradually moved to Windows 2000.

An internal cluster of 20 PC's has been set up to perform simulation and event reconstruction tasks for the AMANDA and CMS experiments.

A first cluster of PCs has been set up to start work on GRID computing.

V. TECHNICAL AND ADMINISTRATIVE WORK.

Technical and Administrative work.

The members of the workshop staff in 2003 were : J. De Bruyne, J.-P. Dewulf, L. Etienne, R. Gindroz, R. Goorens, S. Hannaert, G. Van Beek, R. Vanderhaeghen, L. Van Lancker, Ch. Wastiels, with the help of A. De Coster, M. Goeman, D. Peymans, D. Pirnay, J. Liesen, M. Pins and R. Pins. D. Bertrand was in charge of the general coordination.

The IIHE took the responsibility of designing part of the control electronic of the robot (GANTRY machine) which will be used to assemble modules of the tracker of the CMS experiment. Ch. Wastiels realised the design of printed circuit boards and coordinated the production of the control electronics for the whole collaboration. R. Vanderhaeghen participated to the assembly of this electronics. The mechanical part of the GANTRY machine was assembled by R. Gindroz and S. Hannaert under the responsibility of L. Van Lancker. L. Van Lancker has the general responsibility of the design and of the assembly process of carbon fiber frames which will support the silicon detector of the forward CMS tracker. He is also responsible for the mechanics of the Gantry Robot. Part of the silicon detector will be tested at the IIHE on a set-up partly assembled by R. Gindroz and S. Hannaert. A. De Coster, D. Peymans, J. Liesen and R. Pins were involved in preliminary tests of assembly of the frames, and in the first productions made in 2003. C. Carlier, M. Goeman, M. Pins and D. Pirnay participated in the preliminary tests of the mountings on the Gantry Robot. R. Goorens was in charge of the design and tests of the pitch adapters which will interface the modules to the amplification electronics. The quality of the pitch adapters was and will be checked during all the production on special machine at CERN. M. Pins and R. Gindroz participated to these tests in 2003. J.-P. Dewulf contributed to the design and development of the CMS readout electronics. The shipping of the CMS tracker modules between the participating laboratories is taken care of by M. Goeman.

G. Van Beek is responsible for the mechanics of the scintillator strips target trackers for OPERA. His contributions include R/D on tracker design and construction and follow-up of the tracker end-caps production by industry. He is also co-responsible for the trackers installation on the OPERA detector and for the procedure to be used for their survey. R. Gindroz, S. Hannaert, M. Pins and G. Van Beek have participated to the construction of tracker modules and planes prototypes. L. Etienne and R. Vanderhaeghen have contributed to OPERA through help for the set-up of test benches and R. Gindroz and S. Hannaert through the fabrication of prototypes parts.

L. Etienne participated to the design, implementation and calibration of the test station for the wave length shifter tests for the optical modules of the AMANDA detector. Several different test stations have been built in 2003.

The UIA worked on the production design of a simple PCB for the CMS tracker.

In the framework of the spin-off activities related to detector developments for medical applications, J. De Bruyne and Ch. Wastiels were in charge of the technical support of the CRYSTAL CLEAR project. They were helped by R. Pins.

The secretarial work and the general administrative support of the experiments was accomplished by R. Alluyn-Lecluse, M. Garnier and D. Peymans. They were assisted by M. De Schutter, M. Goeman, J. Liesen and D. Pirnay. M. Pins has contributed with the help of M. De Schutter to the maintenance of our documentation centre and have provided illustrations, (photos, video) for several publications and lectures of members of the laboratory. A. De Coster-Van Cauwenberge took care of the library. Ch. Carlier took care of the DELPHI and CMS documentation.

VI. REPRESENTATION IN COUNCILS AND COMMITTEES.

D. Bertrand acted as President of the ULB Physics Department, President of the doctoral school in microscopic physics and astrophysics (ULB), member of the Doctoral commission of the ULB Physics Department, member of the ApPEC, ULB representative in the Belgian selection committee of CERN fellows.

O. Bouhali was member representing the postdoc researchers at the physics council of the ULB, faculty of sciences 2002-2003.

C. De Clercq was member of AppEC, Vice-chairperson of the IUAP/PAI P5/27 "Fundamental interactions", representative of the physics department in the "PR commissie faculteit wetenschappen VUB", VUB representative in the Belgian selection committee of CERN fellows, member of the VUB "BaMa commissie" (Bologna hervorming), member of the "Commissie Federale en Internationale Samenwerking" of the VRWB.

E. De Wolf acted as member of the FWO-committee "Subatomaire Fysica" and of the IWT-committee "Kern- en Elementaire Deeltjes Fysica". He organized the IUAP General meeting, Antwerpen, 14 April 2003

L. Favart was secretary of the Physics Department of the ULB until March 2003.

J. Lemonne was Vice-President of the "Nationaal Comité voor Natuurkunde" of the Belgian Academy of Sciences and representative of the FWO in the Resources Review Board for the CMS experiment.

P. Marage was dean of the Faculty of Sciences of the ULB until September 2003 and became vice-dean from October 2003

R. Roosen acted as representative of the physics department in the "Commissie Doctorale Opleidingen (CDO)", secretary of the "Doctorale Examen Commissie" of the VUB, representative of the physics department in the "Commissie internationalisering, European Mobility Shem, EMSPS".

S. Tavernier was member of the "Onderzoeksraad" and chairman of the "Facultaire onderzoekscommissie Wetenschappen", member of the organizing committee of the 2003 IEEE Nuclear Science Symposium and Medical imaging Conference.

R. Vandembroucke acted as chairperson of the Belgian Broadband Platform, delegate of the VUB, and of the CUO Belux and as the Belgian representative of the HTASC.

C. Vander Velde acted as member of the FWO-committee "Subatomaire fysica" and was the Belgian representative at the Outreach Subcommittee of the European Linear Collider Steering Group.

W. Van Doninck acted as a Belgian representative in ECFA and RECFA, as member of the FWO-committee "Subatomaire fysica" and as a referee of IEEE conference proceedings and MIUR (INFN-Italy).

P. Vanlaer acted as representative of the "Corps Scientifique non-définitif" in the ULB Physics department and in the "commission de restructuration des cours de Maîtrise de Physique (réforme Bologna)".

P. Vilain was member of the High Energy Particle Physics Board of the European Physical Society and member of the International Organizing Committee of the EPS Aachen Conference, vice-president of the ULB Physics Department and organizer of the IIHE seminars (up to September 2003)

G. Wilquet is delegate of Belgium in the European Committee for Future Accelerators (ECFA), delegate of Belgium at the Advisory Committee of CERN Users (ACCU), member of the Board of the Belgian Physical Society (BPS), member of the Organization Committee of the General Scientific Meeting of the BPS and organiser of the HEP session and of the Journées Jeunes Chercheurs of the SBP and SFP, member of the Scientific Commission "Hautes et Basses Energies" of the IISN.

The following responsibilities were taken in the organisation

1) of the *DELPHI* experiment :

- **D. Bertrand** : representative of "Belgium" in the collaboration board.
- **C. De Clercq** : member of the editor board
- **J. Wickens** : project leader of Offline Software, member of the Physics Steering Panel and of the Software Steering Panel

2) of the *H1* experiment :

- **D. Bertrand** : FNRS representative at the Funding Agencies Board.
- **E. De Wolf** : co-convenor of the physics working group on hadronic final states and QCD.
- **L. Favart** : convenor of the Physics working group on diffraction
- **X. Janssen** : Diffractive data quality responsible.
- **R. Roosen** : representative of "Belgium" in the Collaboration Board and in the H1 Executive board at DESY.

- **P. Van Mechelen** : librarian of the H1 PHAN software package for physics analyses.
- 3) of the CMS experiment :
- **W. Beaumont** : member of the tracker institution board
 - **O. Bouhali** : coordinator of the Gantry Software group.
 - **J. Lemonne and J. Sacton** : acting as representatives of the FWO and FNRS, respectively, in the Resources Review Board.
 - **C. Vander Velde** : member of the Collaboration Board (CB), the Finance Board (FB), the Tracker Institution Board (TIB), the Tracker Finance Board (TFB) the CMS Thesis Award committee and responsible for the pitch adapter procurement for the Si Tracker and for the frames procurement for the Si Modules.
 - **W. Van Doninck** : coordinator for the muon system integration and for the inner end caps, resources manager for the Forward RPC system and member of the CTF (Commissioning Task Force).
 - **S. Tavernier** : was member of the Finance Board, collaboration board, tracker institution board and tracker finance board.
 - **P. Vanlaer** : coordinator of the CMS vertex reconstruction group
- 4) of the CHORUS experiment :
- **P. Vilain** : member of the Editorial Board.
 - **G. Wilquet** : member of the Collaboration Board.
- 5) of the OPERA experiment :
- **G. Wilquet** : member of the collaboration board, convenor of the working group on electronic detectors.
 - **P. Vilain** : Member of the Academic and Editorial Board.
- 6) of the AMANDA/ICE³ experiments :
- **D. Bertrand** : member of the collaboration board of the AMANDA experiment and of the interim collaboration board of the ICE³ experiment.
 - **C. De Clercq** : member of the interim collaboration board of the ICE³ experiment.
 - **Ph. Olbrechts** : monitoring coordinator for AMANDA South Pole data quality check.
- 7) of the Crystal Clear Collaboration :
- **S. Tavernier** : spokesman of the collaboration, chairman of the collaboration board and convenor of the photo-detector working group.
 - **P. Bruyndonckx** : member of the Steering committee and of the "Open Gate" Steering Committee.

VII. TEACHING ACTIVITIES.

ACADEMIC YEAR 2002-2003

- **D. Bertrand**

- PHYS 109 "Physique des Particules" (0-0-75)
Practicals 1^{ère} licence sciences physique
- President of the Jury of a PhD Thesis
- STAT606 "Computer Principles" (39-0-13) – 1st year in English
Lectures and practicals
- "Description des ordinateurs (aspects matériels et logiciels)" (45-0-15)
Preparatory year to the "Licence en informatique(orientation gestion)" UMH-Charleroi, lectures and practicals

- **O. Bouhali**

- "Experimental Physics Techniques", practical work for the 3rd year in physics, ULB
- Practical work (35h) 3rd year in physics, ULB

- **P. Bruyndonckx**

- "Beeldvormingstechnieken (Verplicht aanvullend practicum 1^{ste} licentie Natuurkunde VUB)
- Labo "Meting levensduur van het muon" (1^{ste} licentie Natuurkunde VUB)
- "Inleiding tot Mathematica" (Natuurkunde VUB, 1ste Kandidatuur)
- "Fysische modellen in geneeskunde" (2de licentie Natuurkunde VUB)

- **B. Clerbaux**

- PHYS 109 "Physique des Particules" (0-0-75)
Practicals 1^{ère} licence sciences physique
- Member of the PhD thesis jury of V. Van Elewyck (ULB)

- **C. De Clercq**

- Contribution to the 26 h of the "Practicum" for the course "Fysica van de Elementaire Deeltjes I", in the 1^{ste} jaar licentiaat Natuurkunde, VUB
- Responsible of the 30 h of "Practicum Algemene Natuurkunde " in the 1^{ste} Kandidatuur Natuurkunde, VUB.
- Organisation of the visit to CERN of the VUB students (Natuurkunde and Burg. Ing.)

- **E. De Wolf**

- Kanstheorie en Statistiek, theorie (30 h - 1^{ste} kandidatuur Natuurkunde RUCA)
- Fundamentele Interacties (30 h; 2^{de} licentie Natuurkunde UIA)
- Member of the Ph.D jury of X. Janssen

- **J. Heyninck**

- Contribution to "Practicum algemene Natuurkunde" – Prof. C. De Clercq (26h, 1ste Kandidatuur Natuurkunde VUB)

- **D. Hubert**

- Exercices of the course "Fysica van de Elementaire Deeltjes" (1^{ste} licentie natuurkunde - 6h - VUB)

- **L. Favart**

- PHYS 109 "Physique des Particules" (0-0-75)
Practicals 1^{ère} licence sciences physique
- Member of the PhD juries of X. Janssen (ULB) and G. Soyez (Ulg)

- **D. Johnson**

- Practica "Algemene en Proefondervindelijke Natuurkunde" (60 h - 1^{ste} kandidatuur met polyvalentie VUB)

- **J. Lemonne**

- "Algemene Natuurkunde" (90 h + 30 h practical work - 1^{ste} kandidatuur wis- en natuurkunde - VUB)
- "Algemene Natuurkunde II" (60 h + 60 h of practical work - 2^{de} kandidatuur natuurkunde, VUB and 30 h + 30 h of practical work - 2^{de} kandidatuur scheikunde en geologie VUB)
- "Elementaire Deeltjes" (26 h + 26 h of practical work - 1^{ste} licentie natuurkunde VUB)

- **S. Lowette**

- Exercices of the course "Algemene Natuurkunde" taught by Prof. J. Lemonne (1^{ste} kandidatuur wis- en natuurkunde - 30 h - VUB)

- **P. Marage**

- "PHYS096 : Histoire des sciences" (15 h) - 2^{ème} licence en sciences physiques et sciences mathématiques, DEA en Sciences, ingénieurs chimistes - ULB)
- "METH083 : Histoire des sciences et épistémologie" (15 h) - agrégation de l'enseignement secondaire supérieur - toutes sections Faculté des Sciences (ULB)
- Member of the jury of the "Mémoire de licence" of C. Ruth (ULB)
- practicals for the course "Physique générale" of Prof. M. Malek – Mansour, 1^{ère} candidature biologie (36h), 1^{ère} candidature bioingénieurs (26h)

- **Ph. Olbrechts**

- "Practicum Algemene Natuurkunde" - Prof. C. De Clercq , 26h (1^{ste} kandidatuur natuurkunde - VUB)

- **B. Roland**

- PHYS 109 "Physique des Particules" (0-0-75)
Practicals 1^{ère} licence sciences physique

- **R. Roosen**

- Course "Elementaire deeltjes fysica", deel Iib - Elektromagnetische en Zwakke wisselwerkingen - (15 h - 2^{de} licentie natuurkunde VUB)
- Course "Geschiedenis van de natuurkunde" deel III - Geschiedenis van de natuurkunde - Filosofie - (10 h - 2^{de} licentie natuurkunde VUB)
- Practical for the course "Fysica van de elementaire deeltjes I", 1^{ste} licentie natuurkunde VUB

- **S. Tavernier**

- "Detectie van Ioniserende Stralingen" (15 h + 15 h of practical work - 2^{de} licentie natuurkunde and bijzondere

- licentie medische fysica - VUB)
- "Transmission lines" (practical work - 2^{de} kandidatuur natuurkunde - VUB).
- "Introduction to Nuclear Physics" (part 10/05 – GGS Nucleaire Techniek)
- "Radiation protection and nuclear measurement" (part 07/03 – GGS Nucleaire Techniek)

- **C. Vander Velde**
- Physique du secondaire et du supérieur (30 h + 110 h practical work) – agrégation de physique
- Eléments d'électromagnétisme (30 h lecture) – 1^{ère} candidature informatique
- Electronique (coordination of the practicals) – 2^{ème} candidature informatique

- **W. Van Doninck**
- "Elementaire deeltjes II – Testing the Standard Model" (15 h - 2^{de} lic. natuurkunde VUB)
- Organisation of the visit to CERN for the VUB students (Natuurkunde en Burg. Ing.)

- **P. Vanlaer**
- "PHYS026 : Physique générale et éléments de cristallographie" (32 h - 2^{ème} candi en physique - ULB) - practicals – responsible Prof. Ph. Emplit
- Co-direction of the "Travail de fin d'études" of S. Skhiri Dit Gabouje, Ingénieur Civil Informaticien
- Co-direction of the "Travail de fin d'études" of X. Loozen, Ingénieur Civil Physicien

- **P. Van Mechelen**
- Practicum "Kanstheorie en Statistiek" (15 h - 1^{ste} kandidatuur Natuurkunde – RUCA)
- "Subatomaire Fysica", 1^{ste} licentie Natuurkunde (30h) - UIA

- **P. Vilain**
- "Physique des Particules" (26 h) - 1^{ère} licence en physique (ULB)
Practical work associated to this course (3*35 h)
- Optional practical works (75 h) – 1 group of 2 students (with G. Wilquet - ULB)
- "Questions approfondies de Physique des Particules" (15 h) – 2^{ème} licence en Physique (ULB)
Practical work associated to this course (35 h)
- Direction of the "Travail de fin d'études" of E. Sanna, 4th year Applied Science Faculty, ULB
- Member of the PhD thesis jury of V. Van Elewyck (ULB)

- **G. Wilquet**
- "Technique de la physique expérimentale" (PHYS106) - 1^{ère} licence en sciences physiques ULB (14 h partime de 26 h)
- Practical - 1^{ère} licence en sciences physiques ULB (4*30h and 1*75h)
- Organization of the practicals in high-energy physics, 1^{ère} licence en Sciences Physiques, ULB
- Organisation of the visit to CERN for the 1^{ère} licence en sciences physique, ULB

VIII. PHD THESES, "MEMOIRES DE LICENCE" AND "LICENTIAATSVERHANDelingen" COMPLETED IN 2003.

* PhD thesis

- *X. Janssen* : "Electroproduction diffractive de mesons ρ à HERA"
Promotor : P. Marage
- *O. Devroede* : " Contribution to the study of the CMS central tracking system "
Promotor : W. Van Doninck – Co-promotor : F. Udo
- *J. D'Hondt* : " Measurements of the W boson resonance at LEP2"
Promotor : C. De Clercq

* Mémoires de licence" and "licentiaatverhandelingen"

- *J. Heyninck* : "Studie van het geladen Brout-Englert-Higgs boson aan de nieuwe LHC versneller"
Promotor : S. Tavernier, begeleider : S. Lowette

- *C. Lemaître* : "Evaluatie van een hoge resolutie positron emissie tomografie-scanner voor proefdieren gebaseerd op avalanche fotodiodes door middel van een simulatieopstelling"
Promotor : P. Bruyndonckx
- *P. Nica* : "Beeldreconstructie in PET door modellering van de detectorpuntresponsfunctie "
Promotor : M. Defrise, co-promotor : P. Bruyndonckx

IX. SEMINARS AND ORAL PRESENTATIONS AT CONFERENCES, SCHOOLS AND COLLABORATION MEETINGS.

IX.1. SEMINARS AT THE IIHE (organised by P. Vilain and L. Favart) :

The IIHE had the pleasure to welcome the following invited speakers :

- *G. Gerbier* (CEA-Saclay) : "Looking for WIMPS's with EDELWEISS".
- *R. Arnold* (CNRS-Strasbourg) : "Neutrinoless double beta decay search with the NEMO3 detector".
- *E. Perez* (CEA-Saclay) : "Searches for new phenomena at colliders".
- *P. Berghaus* (Collège de France) : "Calibration and first results from HESS".

IX.2. SEMINARS GIVEN BY MEMBERS OF THE IIHE AND ANTWERP GROUPS:

- *J. D'Hondt* :
 - "W mass measurement at LEP", invited seminar at the University of Wuppertal, Wuppertal (Germany), 16th of January 2003
- *N. Van Remortel* :
 - "Bose-Einstein correlations in W pair production and multi-jet Z decay at LEP", invited talk at the Institute for High Energy Physics Vienna, Vienna (Austria), 12 August 2003

IX.3. ORAL PRESENTATIONS AT CONFERENCES, SCHOOLS AND COLLABORATION MEETINGS.

- *T. Anthonis* :
 - "Final states in diffraction (H1-ZEUS)", talk at "Low x workshop", Nafplion (Greece) 3-7th June 2003
 - "The forward proton taggers at H1", talk at "Physics with forward proton taggers at the Tevatron and LHC", Manchester (England) 14-16th December 2003
- *D. Bertrand* :
 - "Outreach activities in High Energy Physics in Belgium", presented at the RECFA General Meeting, Louvain-la-Neuve, 9 May 2003
- *O. Bouhali* :
 - "Neutrino point sources search with the AMANDA telescope", talk presented at the International Workshop on Astroparticle and High Energy Physics, 12-16 October 2003
- *P. Bruyndonckx* :
 - "Crystal matrix production shedule", talk presented at the Crystal Clear Collaboration meeting, Brussels 9-10 April 2003

- "Performance of a detector module using APD's and LSO", talk presented at the Crystal Clear Collaboration meeting, Julich (Germany), 1-2 October 2003
- **J. D'Hondt :**
 - "Colour reconnection feasibility study for LEP and how to optimise the W mass measurement", LEP WW Workshop, CERN-Geneva (Switzerland), 13-14 February 2003
 - "Mixed Lorentz Boosted Z's : the final result", LEP WW Workshop, CERN-Geneva (Switzerland), 13-14th February 2003
 - "DELPHI results on m_w and colour reconnection", DELPHI general meeting, CERN-Geneva (Switzerland), 4-7 March 2003
 - "Overview of the LEP WW Workshop", DELPHI general meeting, CERN-Geneva (Switzerland), 4-7 March 2003
 - "Measurement of the W boson mass at LEP", talk at the International Scientific Meeting of the Belgian Physical Society, Ghent (Belgium), 27-28 May 2003
 - "W mass and width measurements at LEP", Lake Louise Winter Institute, Calgary (Canada), 16-22 February 2003
- **O. Devroede :**
 - "Status of front end module production" talk presented at the Crystal Clear Collaboration meeting, Juelich (Germany), 1-2 October 2003
- **L. Favart :**
 - "DVCS at HERA : present and future" – invited talk at the "Workshop on Compton scattering from low to high momentum transfer", ECT, Trento (Italy), 31 March-4 April 2003
 - "Study of DVCS and high $|t|$ photon production with the H1 detector", talk at the "International Europhysics Conference on High Energy Physics EPS03", Aachen, 17-23 July 2003
- **D. Hubert :**
 - "Dark matter searches with the AMANDA neutrino telescope" - talk presented at the 15th Annual Graduate School of Particle Physics (Joint Belgian-Dutch-German Summer School), Bonn (Germany), 15-26 September 2003
 - "Dark matter searches with the AMANDA neutrino telescope" - talk presented at the "Journée Jeunes Chercheurs" 2003, La Roche-en-Ardenne (Belgium), 30th November-5th December 2003
- **M. Krieguer :**
 - "Implementation of FPGA DAQ on LabVIEW" – talk presented at the Crystal Clear Collaboration meeting, Brussels, 9-10 April 2003
 - "Data acquisition system implemented in LabVIEW" – talk presented at the Crystal Clear Collaboration meeting, Julich (Germany), 1-2 October 2003
 - "Construction d'une caméra TEP dédiée aux petits animaux" – talk presented at the "9^{ème} Journées Jeunes Chercheurs", Aussois (France), 30 November-5 December 2003
- **S. Leonard :**
 - "Spatial resolution study of a detector module using APD's and LSO" – talk presented at the Crystal Clear Collaboration meeting in Brussels, 9-11 April 2003
- **S. Lowette :**
 - "Charged Higgs search in CMS in $H^+ \rightarrow tb$ " - talk presented at "Les Houches Workshop on Physics at TeV Colliders", Les Houches (France) – 26 May-6 June 2003
 - "Charged Higgs in CMS in the $H^+ \rightarrow tb$ channel" - talk presented at the 15th Annual Graduate School of Particle Physics (Joint Belgian-Dutch-German Summer School), Bonn (Germany), 15-26 September 2003
 - "Heavy charged Higgs in $H^+ \rightarrow tb$ " - talk presented at the plenary CMS PRS Physics meeting, CERN-Geneva, (Switzerland), 11 December 2003
- **F. Moortgat :**
 - "Higgs to particles and Higgs in cascade decays" - talk presented at the "CMS Physics Workshop", CERN-Geneva (Zwitzerland), 8 May 2003
 - "Detection of MSSM Higgses through cascade decays of sparticles" - talk presented at the "3rd Les Houches Workshop on Physics with TeV Colliders", Les Houches (France), 12 July 2003
 - "Higgs to sparticle and sparticle to Higgs decays" - talk presented at the "Advanced Study Institute : Physics at LHC", Prague (Czech Republic) 6-12 July 2003
 - "Experimental experience and needs for new physics processes in Monte Carlo generators" - talk presented at the "Monte Carlo tools for LHC workshop", CERN-Geneva (Switzerland), 7 July-1 August 2003
 - "Observability of MSSM Higgs bosons via sparticle decay modes in CMS" – talk presented at the "LHC Phenomenology Journal Club", University of Antwerpen, Antwerpen, 1 July 2003

- **L. Neukermans :**

- "Search for $Z\gamma$ Kaluza-Klein excitations in CMS", GDR Susy, Marseille (France) – 23-25 April 2003
- "Search for extra-dimensions at hadron colliders", talk presented at the "International Scientific meeting BNV-SBP", Gent – 27-28 May 2003

- **P. Niessen :**

- "Implementation of optical ice properties into the simulation of the AMANDA neutrino telescope", talk presented at the "International Scientific meeting BNV-SBP", Gent – 27-28 May 2003
- "Recent results from the AMANDA experiment", 38th Rencontres de Moriond, Electroweak Interactions and Unified Theories, Les Arcs, March 15-22, 2003

- **Ph. Olbrechts :**

- "Search for muons from WIMP annihilation in the Center of the Earth with the AMANDA-B10 detector", talk presented at "The 28th International Cosmic Ray Conference (ICRC), Tsukuba (Japan) – August 2003
- "The search for neutralino dark matter with the AMANDA detector", talk presented at the "International Scientific meeting BNV-SBP", Gent, 27-28 May 2003
- "The search for WIMPS coming from the center of the Earth with the AMANDA detector", talk presented at the plenary Amanda/Icecube Collaboration meeting, University of Irvine, California (USA), 28 March – 1 April 2003
- "Results from the search for neutralino dark matter inside the earth with the AMANDA detector", talk presented at the plenary Amanda/Icecube collaboration meeting, University of Wisconsin (USA) – 23-30 June 2003
- "Determination of systematic uncertainties on upper limits in the 99 WIMP analysis", talk presented at the plenary Amanda/Icecube collaboration meeting, University of Mons-Hainaut (B), 17-21 October 2003

- **B. Roland**

- "Deep virtual Compton scattering at H1", talk given at the 15th Annual Graduate School of Particle Physics, Walberberg (Germany) – September 2003 and at the H1 student workshop "cross Talk 2003", DESY-Hamburg (Germany) – October 2003

- **S. Tavernier :**

- "The ClearPET project" - talk presented at the IInd International Conference on Imaging Technologies in Biomedical Sciences : ITBS2003
- "Recent advances in detectors and techniques for clinical and experimental nuclear imaging", Milos (Greece) 26-30 May 2003
- "A high resolution PET detector based on continuous scintillators.SCINT2003" – talk presented at the 7th International Conference on Inorganic scintillators and Industrial applications, Valencia (Spain), 8-12 September 2003

- **R. Vandenbroucke**

- "IP Protocols", FOREM, Charleroi, January
- "Network Infrastructures", FOREM, Charleroi, January
- "Renewal in the LAN infrastructure, Dimension Data", Brussels, September
- "IP protocols and Ipv6, Dimension Data", Brussels, September
- "De gevolgen van Internetdiensten", Conferentie 2002 van het CIBG, Brussels, 4 October

- **P. Vanlaer :**

- "Vertex reconstruction framework and its implementation for CMS", International Conference on Computing in High Energy Physics (CHEP 2003), La Jolla, California (USA), 24-28 March 2003
- "Physics at the LHC", invited talk given at the "Colloquium in honorem Prof. J. Lemonne", Brussels 9 October 2003
- "CMS Tracker Software Tutorial", CERN, 3-7 March 2003

- **W. Van Doninck :**

- "Discovery physics at the LHC", invited series of lectures at the FANTOM International Research School, Amsterdam (the Netherlands), 3-8 November 2003

- **P. Van Mechelen :**

- "Belgian activities in the H1 and ZEUS collaborations", invited talk at the general meeting of the Restricted European Committee on Future Accelerators (RECFA), Louvain-la-Neuve (Belgium) 9 May 2003
- "Diffraction in ep collisions", invited talk at the "28th Rencontres de Moriond : QCD and high energy hadronic interactions", Les Arcs (France) 22-29 March 2003

- “Jet production in ep collisions”, invited talk at the “28th Rencontres de Moriond : QCD and high energy hadronic interactions”, Les Arcs (France) 22-29 March 2003
- “Deep inelastic diffractive scattering at HERA”, invited talk at the “10th International QCD Conference”, Montpellier (France) 3-9 July 2003

- **N. Van Remortel :**
 - “Bose-Einstein correlations in WW events at LEP”, talk at the “XXXVIIIth Rencontres de Moriond”, Les Arcs (France), 24 March 2003

 - “BEC in hadronic WW decays at LEP”, talk at the “XXXIIIrd International Symposium on Multiparticle Dynamics”, Krakow (Poland), 6 September 2003

- **P. Vilain :**
 - “Neutrino Physics in Belgium”, presented at the General Meeting of RECFA, Louvain-la-Neuve, 9 May 2003
 - 3h course “Neutrino Physics” at the 15th Annual Graduate School of Particle Physics (BND School), Bonn
 - “Neutrino Oscillations”, 2 seminars at the MICAS doctoral school, ULB

- **G. Wilquet :**
 - “8th lectures on Neutrino Physics”, given at the University of Salerno doctoral school (Italy)
 - Overview of the Research and Teaching in High Energy Physics in Belgium, presented at the RECFA General Meeting, Louvain-la-Neuve, 9 May 2003

- **C. Yu :**
 - “Measurement of Si-tracker deformation”, general meeting of the IUAP/PAI P5/27 Antwerpen, April 14th, 2003

IX.4. POSTER PRESENTATIONS AT CONFERENCES, WORKSHOPS AND SCHOOLS.

- **P. Bruyndonckx**
 - “Parallax recovery using neural networks in PET detectors based on continuous scintillators”, poster presented at the “IEEE Conference 2003” in Portland, Oregon (USA), 19-25 October 2003

- **M. Krieguer**
 - “Construction d’une caméra TEP dédiée aux petits animaux”, poster presented at the “9^{ème} Journées Jeunes Chercheurs” in Aussois, France, 30 November – 5 December 2003

- **S. Léonard**
 - “Spatial resolution performance study of a PET detector module based on continuous scintillator”, poster presented at the “IEEE Conference 2003” in Portland, Oregon (USA), 19-25 October 2003

X. SCIENTIFIC VULGARISATION, OUTREACH ACTIVITIES, SCIENCE AND SOCIETY.

T. Anthonis, E. De Wolf, F. Moortgat, N. Van Remortel, P. Van Mechelen :

- Organisation of the 2nd Edition of “Meesterklassen Elementaire Deeltjes”, Antwerpen (Belgium), 17-18 October 2003

D. Bertrand :

- Organisation of a visit of CERN for High School students, April 2003
- Set-up of a cosmic ray experiment in High School, October-December 2003
- Supervision of High School students in the framework of “Le Printemps des Sciences” – Histoire d’eau

C. De Clercq, J. D’Hondt, D. Hubert, S. Lowette, Ph. Olbrechts :

- Guided tours in the ULB Experimentarium for High School students

C. De Clercq :

- Organisation of a visit of CERN for High School students, July 2003

P. Marage :

- "Une plongée dans l'infiniment petit : la physique des particules élémentaires", opération "Bibliothèques scientifiques", Université du Travail, Charleroi, March 12th 2003
- "Une plongée dans l'infiniment petit : la physique des particules élémentaires", at the "Opération Bibliothèques scientifiques", Bibliothèque d'Ath, May 16th 2003
- "L'histoire du vide", at the "Université du Temps Libre", Ecaussines, March 20th 2003
- "L'histoire du vide", at the "Institut des Hautes Etudes de Belgique", November 4th 2003
- "La raison, un concept dépassé ?" ULB, débat with J. Bricmont, organized by the "Cercle du Libre-Examen et l'Union rationaliste", December 3rd 2003
- Interview for Radio Nostalgie, Le Soir, La Capitale, La Nouvelle Gazette, concerning the publication of "Les filles face aux études scientifiques", March 6th 2003
- "Les filles face aux études scientifiques – réussite scolaire et inégalités d'orientation", M. Alaluf, N. Imatouchan, P. Marage, S. Pahaut, R. Sanvura, A. Valkeneers, A. Vanheerswinghels, 122p., Editions de l'Université de Bruxelles, 2003
- Co-organiser with profs. M. Alaluf and D. Meulders of the study day "Femmes et Universités – Choix d'études, carrières professionnelles", ULB, March 5th.
- "L'accès des jeunes femmes aux études universitaires scientifiques et techniques", for research group "Newtonia" ULB, Journée des Prefets, May 14, 2003 and Cahier du CeDoP, 2003

F. Moortgat :

- CERN guide : guided tours for High School Students, for the VUB students and the students 1^{ste} Licentie Natuurkunde, University Antwerpen

C. Vander Velde :

- Laboratory sessions for secondary schools in the framework of "Le Printemps des Sciences"
 - "Le pendule simple" – classes de 3^{ème} et 4^{ème}
 - "La loi d'Ohm" – classes de 5^{ème} et 6^{ème}

W. Van Doninck :

- Guided tours at CERN

XI. ATTENDANCE TO CONFERENCES, WORKSHOPS AND SCHOOLS.

XI.1. CONFERENCES AND WORKSHOPS.

- Eight International Workshop on Topics in Astroparticle and Underground Physics (TAUP 2003), University of Washington, Seattle (USA), 5-9 September 2003
D. Bertrand, C. De Clercq
- CMS Workshop on RPC link system, Warsawa (Poland), 23-26 January 2003
W. Van Doninck
- LEP WW workshop, CERN (Switzerland), 13-14 February 2003
C. De Clercq, J. D'Hondt, J. Lemonne
- Lake Louise Winter Institute, Calgary (Canada), 16-22 February 2003
J. D'Hondt
- Xth International Workshop on Neutrino Telescopes, Venice (Italy), 10-14 March 2003
P. Vilain
- HERA-II detector meeting, Zeuthen (Germany), 10-14 March 2003
P. Van Mechelen

- LabVIEW RealTime seminar 2003, Lausanne (Switzerland), 19 March 2003
M. Krieguer
- 28th Rencontres de Moriond, QCD and high energy hadronic interactions, Les Arcs (France) 22-29 March 2003
T. Anthonis, P. Van Mechelen, N. Van Remortel
- 28th Rencontres de Moriond, Electroweak Interactions and unified theories, Les Arcs (France, 15-22 March 2003
P. Niessen
- International Conference on Computing in High Energy Physics (CHEP2003), La Jolla, California (USA)
24-28 March 2003
P. Vanlaer
- Exotic signals at hadron colliders, Durham (UK) 26-28 March 2003
L. Neukermans
- Workshop “Compton scattering from low to high momentum transfer”, ECT, Trento (Italy), 31 March-4 April 2003
L. Favart
- OpenGATE meeting, Ghent (Belgium), 7-8 April 2003
P. Bruyndonckx, M. Krieguer, S. Tavernier
- 6th International Workshop on Deep Inelastic Scattering and QCD, St. Petersburg (Russia), 23-27 April 2003
T. Anthonis, E. De Wolf, R. Roosen, P. Van Mechelen
- EUROMEDIM workshop, Lausanne, CERN (Switzerland), 14-15 May 2003
S. Tavernier
- IInd International Conference on imaging technologies in Biomedical sciences : ITBS2003 – Recent advances in detectors and techniques for clinical and experimental nuclear imaging, Milos (Greece), 26-30 May 2003
S. Tavernier
- Les Houches Workshop on Physics at TeV Colliders, Les Houches (France), 26 May-6 June 2003
S. Lowette, F. Moortgat
- International Scientific Meeting of the BNV-SBP, Gent, 27-28 May 2003
C. De Clercq, J. D’Hondt, L. Neukermans, P. Niessen, Ph. Olbrechts
- Low-x meeting, Nafplion (Greece), 4-7 June 2003
T. Anthonis, E. De Wolf
- Data acquisition in LabVIEW, Lausanne (Switzerland), 19 June 2003
M. Krieguer
- EUROMEDIM workshop, Lyon-Paris (France), 29 June-1 July 2003
S. Tavernier
- 10th International QCD Conference, Montpellier (France), 3-9 July 2003
P. Van Mechelen
- LHC Physics Workshop, Prague (Czech Republic), 5-12 July 2003
E. De Wolf, F. Moortgat
- Monte Carlo tools for LHC workshop, CERN-Geneva (Switzerland), 7 July-1 August 2003
F. Moortgat
- CMS Electronics Systems Review (ESR) RPC link system, Warsaw (Poland), 8-9 July 2003
W. Van Doninck

- OpenGATE workshop, Grenoble (France), 9-11 July 2003
P. Bruyndonckx
- International Conference on High Energy Physics (EPS-HEP), Aachen (Germany), 17-23 July 2003
L. Favart, J. Lemonne, P. Vilain
- The 28th International Cosmic Ray Conference (ICRC), Tsukuba (Japan), 31 July-7 August 2003
P. Olbrechts
- XXI International Symposium on Lepton Photon Interactions at High Energies, FERMILAB, Chicago (USA), 11-16 August 2003
D. Johnson
- 23rd International Symposium on Multiparticle Dynamics, Krakow (Poland) 5-11 September 2003
E. De Wolf, N. Van Remortel
- SCINT2003, 7th International Conference on Inorganic scintillators and industrial applications, Valencia (Spain), 8-12 September 2003
S. Tavernier
- International Workshop on Astroparticle and high energy physics, Valencia (Spain), 12-16 October 2003
O. Bouhali
- 2003 IEEE Nuclear science symposium and medical imaging conference, Portland, Oregon (USA), 19-25 October 2003
P. Bruyndonckx, S. Léonard, S. Tavernier
- EUROMEDIM workshop, CERN-Geneva (Switzerland), 4-6 November 2003
S. Tavernier
- OpenGATE workshop, CERN-Geneva (Switzerland), 5-7 November 2003
P. Bruyndonckx
- CMS Workshop on Inner End Cap Integration, Dubna (Russia), 1-5 December 2003
W. Van Doninck
- Physics with forward proton taggers at the Tevatron and LHC, Manchester (England), 14-16 December 2003
T. Anthonis

XI.2. SCHOOLS.

- Journée des doctorants de l'école doctorale MICAS de l'ULB, 4 February 2003, Parentville
L. Favart, B. Roland, P. Vilain
- 15th Annual Graduate School of Particle Physics, Joint Belgian-Dutch-German Summer School, Walberberg (Germany) – 15-26 September 2003
J. Heyninck, D. Hubert, S. Lowette, Ph. Olbrechts, B. Roland
- H1 student workshop “Cross Talk 2003”, DESY-Hamburg (Germany), 9-10 October 2003
B. Roland
- DESY Academic Training Lectures on Generalized Parton Distributions – DESY-Hamburg (Germany) – 3-7 November 2003
L. Favart, B. Roland
- Journées Jeunes Chercheurs 2003, La Roche-en-Ardenne (Belgium), 30th November-5th December 2003

B. Clerbaux (co-organiser), D. Hubetr, P. Vanlaer (co-organiser), M. Krieguer, P. VanlaerG. Wilquet (co-organiser)

XI.3. TECHNICAL FORMATIONS.

- 14th International Conference on Composite Materials (ICCM14), San Diego (USA) 14-18 July 2003
L. Van Lancker
- ICCE-10, 10th annual international conference on composites engineering, New Orleans (USA), 19-27 July 2003
G. Van Beek
- IEEE 2003 Nuclear and space radiation effects conference, Monterey (USA), 21-25 July 2003
R. Goorens

XI.4. OTHERS.

- General meeting of the IAP P5/27 “Fundamental Interactions”, Universiteit Antwerpen, April 14th 2003
Talks were given by the following members of the IIHE and the University of Antwerpen:
O. Bouhali : Search for point sources of high energy neutrinos with AMANDA
F. Moortgat : MSSM physics in CMS
- Meeting of the Restricted European Committee for Future Accelerators (RECFA) on “Status of High Energy Physics in Belgium”, Louvain-la-Neuve, 9-10 May 2003
The following members of the IIHE and of the University of Antwerpen gave a talk at this review:
G. Wilquet : HEP community and activities in Belgium
P. Vilain : Neutrino Physics in Belgium
C. De Clercq : LEP Physics in Belgium
P. Van Mechelen : Activities in H1 and ZEUS
S. Tavernier : Medical applications
D. Bertrand : Outreach activities
- In the framework of the IAP P5/27 “Fundamental Interactions” several members of the IIHE and of the Antwerp group participated to the organisation of the “LHC Phenomenology Journal Club” and the “Neutrino Journal Club”.

XI. LIST OF PUBLICATIONS, REPORTS AND CONTRIBUTIONS TO CONFERENCES.

XII.1. PUBLICATIONS.

NEUTRINO PHYSICS : CHORUS

Measurement of lambda-C production in neutrino charged current interactions

A. Kayis-Topaksu et al., ... R. El Aidi, P. Vilain, G. Wilquet, ...

Phys. Lett. B555 (2003) 156-166)

Measurement of the Z/A dependence of neutrino charged-current total cross sections

A. Kayis-Topaksu et al., ... R. El Aidi, P. Vilain, G. Wilquet, ...

Eur. Phys. J. C30 (2003) 159-167

Cross-section measurement for quasi-elastic production of charmed baryons in neutrino nucleus interactions

A. Kayis-Topaksu et al., ..., P. Vilain, G. Wilquet, ...

Phys. Lett. B575 (2003) 198-207

NEUTRINO PHYSICS : AMANDA

Results from the AMANDA telescope

J. Ahrens et al., ..., D. Bertrand, O. Bouhali, C. De Clercq, J.P. De Wulf, P. Niessen, P. Olbrechts, ...
Nucl. Phys. A721 (2003) 545c-548c

Limits on diffuse fluxes of high energy extraterrestrial neutrinos with the AMANDA-B10 detector

J. Ahrens et al., ... D. Bertrand, O. Bouhali, C. De Clercq, P. Niessen, P. Olbrechts, ...
Physical Review Letters 90 (2003), n° 25, 251101

Search for point sources of high energy neutrinos with AMANDA

J. Ahrens et al., ..., D. Bertrand, O. Bouhali, C. De Clercq, J.P. De Wulf, P. Niessen, P. Olbrechts, ...
The Astrophysical Journal 583 (2003) 1040-1057

Search for neutrino-induced cascades with the AMANDA detector

J. Ahrens et al., ... D. Bertrand, O. Bouhali, C. De Clercq, J.P. De Wulf, P. Niessen, P. Olbrechts, ...
Phys. Rev. D67 (2003) 012003

Evidence for quark-hadron duality in the proton spin asymmetry A_1

A. Airapetian et al., ... O. Bouhali, ...
Eur. Phys. J. C26 (2003) 527-538

The Q^2 -dependance of the generalised Gerasimov-Drell-Hearn integral for the deuteron, proton and neutron

A. Airapetian et al., ..., O. Bouhali, ...
Eur. Phys. J. C26 (2003) 527-538

ep PHYSICS : H1

Inclusive Dijet production at low Bjorken-x in deep inelastic scattering

A. Aktas et al., ... L. Favart, X. Janssen, D. Johnson, P. Marage, R. Roosen, ...
Submitted to Eur. Phys. Journal 10/03

Muon pair production in ep collisions at HERA

A. Aktas et al., ... L. Favart, X. Janssen, D. Johnson, P. Marage, R. Roosen, ...
Submitted to Phys. Letters B 11/03

Search for single top quark production in ep collisions at HERA

A. Aktas et al., ... L. Favart, X. Janssen, D. Johnson, P. Marage, R. Roosen, ...
Submitted to Eur. Phys. Journal 10/03

Multi-electron production at high transverse momenta in ep collisions at HERA

A. Aktas et al., ... L. Favart, X. Janssen, D. Johnson, P. Marage, R. Roosen, ...
Accepted by Eur. Phys. Journal 07/03

Diffraction photoproduction of J/Ψ mesons with large momentum transfer at HERA

A. Aktas et al., ... L. Favart, X. Janssen, D. Johnson, P. Marage, R. Roosen, ...
Phys. Lett. B568 (2003) 205-218

Search for new physics in e^+q contact interaction at HERA

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