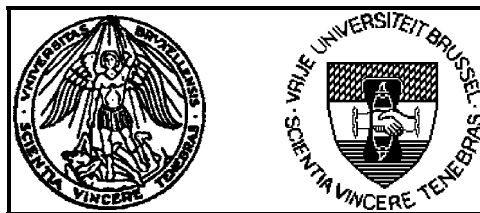


INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES

ULB-VUB, BRUSSELS

ANNUAL REPORT 2001



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

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**D. BERTRAND and J. LEMONNE,
February 2002**

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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 (FWO)**, the **Fonds pour la Formation à la Recherche dans l'Industrie et dans l'Agriculture (FRIA)** and the **Vlaams Instituut voor de bevordering van het wetenschappelijk-technologisch onderzoek in de industrie (IWT)**. Various R & D activities are supported by the European Community.

The scientists whose names are listed below have contributed to the various activities of the Institute in 2001.

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 O. Bouhali (chercheur IISN since April 2001)
 C. Collard (boursière FRIA)
 G. De Lentdecker (boursier FRIA)
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 S. Ghazryan (boursier post-doctoral ULB; until September 2001)
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 M. Krieguer (wetenschappelijk medewerker FWO since December 2001)
 J. Lemonne (gewoon hoogleraar)
 S. Leonard (wetenschappelijk medewerker FWO)
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 P. Niessen (wetenschappelijk medewerker FWO since June 2001)
 P. Olbrechts (IWT scholarship)
 R. Roosen (onderzoeksdirecteur FWO)
 S. Tavernier (gewoon hoogleraar)
 F. Udo (gastprofessor - deeltijds 20 %)
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 B. Van de Vyver (wetenschappelijk medewerker FWO)
 W. Van Doninck (onderzoeksdirecteur FWO, on leave of absence at CERN since January 2000)
 A. Van Lysebetten (assistent VUB until June 2001)
 D. Wisniewski (wetenschappelijk medewerker Bilateraal akkoord Vlaanderen-Polen)

T. Anthonis, W. Beaumont, T. Beckers, E. De Wolf (on leave of absence at CERN), P. Van Mechelen, F. Moortgat, N. Pukhaeva, N. Van Remortel, F. Verbeure and V. Zhukhov from the Universitaire Instelling Antwerp (UIA) have been working in close collaboration with the Institute.

Research in the field of telecommunications and data is conducted at IIHE/VUB by R. Vandenbroucke, A. Isaac and I.M. Martinez 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. The WA95 (CHORUS) experiment.

(R. El Aidi, B. Van de Vyver, P. Vilain, G. Wilquet)

The first phase of the search for an oscillation signal in the $\nu_\mu - \nu_\tau$ channel is completed and no signal was found. The 90% confidence level upper limit on the transition probability has been placed at $3.4 \cdot 10^{-4}$ for large Δm^2 . This result relies on an analysis method where the potential τ decay product is identified in the electronics detectors, located at its exit from the emulsion target, and scanned back to its vertex. The compatibility of the latter with a τ decay vertex is then checked. The full statistics on which this result is based consists of 440 000 events selected for emulsion scanning, 167 000 vertices located by fully automated microscopes, and 13 500 retained for precise manual scanning and measurement and further kinematics analysis.

In a second phase, currently in progress, the whole emulsion volume in the vicinity of the interaction vertex is scanned for interaction or decay topologies. This time consuming procedure has been made possible thanks to a new breakthrough in the automated microscope technology. Because of the gain in τ decay vertex finding efficiency, the sensitivity of the experiment will be improved by a factor of two.

A straightforward by-product of this procedure will be the collection of an unbiased sample of about 3000 decays of charged and neutral charmed particles. Several analyses are in progress and two results, based on about one third of the final statistics, have recently been accepted for publication. One concerns the evidence for associated charm in neutrino CC interactions. The second is a measurement of the D^0 production rate, relying on 283 decays and found to be $(1.99 \pm 0.13 \text{ (stat.)} \pm 0.17 \text{ (syst.)})$ % of the CC interactions rate.

The large statistics of neutrino interactions registered in the lead-scintillator calorimeter is used to study several aspects of the neutrino-nucleon interaction: structure functions, multi-muon events, etc... A paper has been published on the production cross-section of J/ψ mesons in NC interactions: $\sigma(J/\psi) = (5.8 \pm 2.4) \cdot 10^{-41} \text{ cm}^2/\text{nucleon}$.

B. The AMANDA experiment.

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

i) Physics results.

The AMANDA neutrino telescope aims for the observation of high energy neutrinos from astrophysical sources. It is located at the geographical South Pole. Photomultiplier-tubes (PMTs) deployed deep in the Antarctic glacier in depths between 1,500 and 2,000 meters detect the Cerenkov light from charged relativistic particles, which travel through the ice. An unambiguous signature for a neutrino event is an upward going muon, resulting from a charged current muon-neutrino nucleon interaction below the detector. A crucial test of the performance of the detector is the detection of high energy atmospheric neutrinos. An analyse was performed on data collected in 1997 using the so called AMANDA-B10 detector (302 PMTs in 10 strings within a cylindrical volume of a diameter of 120 m and a height of 500 m). A total of 325 events were found. The distribution of the cosine of the zenith angle is consistent with expectation from the simulations of atmospheric neutrinos. The detector achieves the largest efficiency for vertical events. This is favored by the geometry of the AMANDA-B10 detector, which extends about four times more in vertical than in horizontal directions. The distribution of celestial coordinates is consistent with the assumption of being random.

The same data were used to perform searches and analysis of neutrinos of cosmological sources :

- Search for a diffuse flux from sources of high energy neutrinos

The analysis is based on the shape of the neutrino energy spectrum which shows no excess of events in a sample corresponding to 130 days of data taking. The limit is based on a Monte-Carlo study assuming a E^{-2} flux behaviour. An upper limit was obtained :

$$E^2\Phi_{90\%}(E) \leq 0.9 \times 10^{-6} \text{ cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1} \text{ GeV} \quad (90\% \text{ CL})$$

allowing to test some models predicting neutrino emission by extra-terrestrial objects such as active galaxies.

- WIMP searches

There are strong indications for the existence of dark matter in the Universe. One possible candidate for the dark matter is a Weakly Interacting Massive Particle, a WIMP, for which the neutralino that arises in supersymmetric extensions of the Standard Model is a natural candidate. If these WIMPs exist, they accumulate in the center of the Earth and the Sun where they can annihilate and produce muon-neutrinos which were searched with the AMANDA detector. The analysis was looking for WIMPs annihilations in the center of the Earth. The expected signal is very peaked towards vertical muons. An upper limit was determined which is already comparable with limits obtained by Baikal, Baksan, Super-Kamiokande and MACRO with much longer accumulated lifetimes.

- Search for relativistic monopoles

Monopoles with $\beta=1$ would emit 8300 times more Cerenkov light than minimum ionizing muons. A search was performed for events with signals coming from a large number of optical modules. Multiple muons or very energetic single muons from atmospheric air showers constitute the main background. It was rejected by confining the analysis to the lower hemisphere, i.e. to upward moving particles. This limits the search to comparatively heavy monopoles : to be able to cross the Earth, monopoles must have masses above $\sim 10^{11}$ GeV. An upper limit of $0.62 \times 10^{-16} \text{ cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$ was obtained. It is the present best world limit established for monopoles with $\beta > 0.8$.

- Supernova neutrino-burst search

The AMANDA B10 detector is covering 70% of the galaxy with an efficiency of 90%. An upper limit at the 90% c.l. on the rate of star collapses in the Milky Way was derived, yielding 4.3 events per year. The detector is not designed to detect directly the low energy positrons (~ 20 MeV) resulting from the interaction in the ice of the ν_e 's emitted during the star collapse. The measurement consists in observing the increase in the dark-noise counting rate of the PMTs during the estimated ~ 10 sec duration of a neutrino burst. For a supernova in the center of the galaxy, the beginning of the neutrino emission can be determined with an accuracy of 14 ms. In the Antarctic summer seasons of 99/00 and 00/01 a new supernova detection system has been installed at the South Pole, including the AMANDA II set-up (677 PMTs), covering 90 % of the galaxy. It will be integrated in a world array of detectors.

Beside these published results, the AMANDA events reconstruction program was improved by the design of new filtering methods (Direct Walk) resulting in better startup values for the maximum likelihood adjustment. In parallel, all the analysis programs were adapted to the full detector (AMANDA II) in operation since the year 2000.

It was decided to proceed to a "blind analysis" for the data accumulated in '98, '99, '00 and '01. As described in point ii), the IIHE group took the responsibility to analyse the data of '98 and '99 which were recorded with a detector in an intermediate state between AMANDA B10 and AMANDA II. The data of '00 and '01 will be analysed by the Irvine, Madison and DESY groups.

From the hardware point of view, a special data acquisition system was developed for the full digital optical modules which were deployed on one string during the season '99/00.

The PMT signals of these modules are digitized in situ and the numeric signal is transmitted to the surface electronics through copper twisted pair cables. This technology allows a noise free transmission of an undistorted signal through relatively cheap cables.

It was tested in parallel with an analog transmission using optical fiber cables. This last technique avoids the problem to have a complex electronics system buried into the ice where any maintenance operation is impossible. All these tests were performed in the framework of the preparation of the future ICE³ deployment. A total of 37 optical modules can be read by the new system presently in use with a preliminary software. A wave form detection system was designed to digitize the signal coming from the optical modules equipped with an analog optical fiber transmission. On the reverse of the preceding technique, this operation is performed at the level of the electronics of the surface control room. The digitization is performed at 100MHz and allows to gather information on the number of photo-electrons detected by a particular module. This method will increase the precision of the reconstruction and the precision of the energy determination of the recorded showers. The first measurements look quite encouraging.

ii) Activities of the IIHE group.

As mentioned in point i), the IIHE group took the responsibility of the analysis of the data recorded by the AMANDA detector in '98 and '99. The task is difficult as the reconstruction and Monte-Carlo programs have to be adapted to a detector structure in evolution from AMANDA B10 (302 PMTs in 10 strings) to AMANDA II (677 PMTs in 19 strings). Two main analyses are ongoing and gave already preliminary results:

- The WIMP search from the center of the Earth and the center of the Sun
- The high-energy point like sources search inside and outside the galaxy

These analyses gave the opportunity to refine and to test the Monte-Carlo simulation programs. In particular, a careful study was performed in order to include in the programs the angular sensitivity of the PMTs. It was shown that the agreement between the simulated data and the observed experimental ones was improved by the introduction of this new parameter into the Monte Carlo simulation program.

From the hardware point of view two new test stations were completely designed:

- A wave length shifter test station

This station is intended to test the effect of polymers wave length shifting coating on the glass of the PMT vessels in order to improve the light transmission at wave lengths lower than 300 nm. As most of the Cerenkov light emitted by the relativistic muons have such wave lengths, a better transmission would result in an overall better efficiency for the detector. The design of the test station allows for an easy decoupling of the Cerenkov light emitted in water from the Cerenkov light emitted in the glass of the vessel. It is presently fully in operation and results will be used in order to design the optical modules of the future ICE³ experiment. A similar station, based on the same design, was built in the UMH laboratory.

- A PMT angular sensitivity test station

The design of this station is inspired by a set-up built in the Saclay laboratory to test the same parameter for the optical modules of the ANTARES experiment. Measurements were first performed by our team on the Saclay set-up. We started the tests in Brussels to confirm these first results and to refine the information which will be included in the Monte-Carlo simulation programs.

All the data acquisition for these test stations is performed by Camac systems. A full library of interfaces, including signal analysis and curve fitting, working with the LabVIEW system of National Instruments, was developed at the IIHE. It is presently included in the official Fermilab distribution list.

Finally a new set-up to prepare the data acquisition system for the ICE³ experiment is in development. It consists in an electronics card embedding a FPGA device coupled to a processor and an Ethernet interface. The device will receive the digital signal transmitted by the optical modules and transmit them to a concentrator (DOM Hub) through the Ethernet protocol. A dedicated FPGA design is under way together with a master/slave software interface.

C. The CNGS1 (OPERA) experiment.

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

The OPERA experimental project has been approved by the CERN-SPSC as experiment CNGS1 in January 2001 and then by the LNGS scientific committee. The cost estimate of the detector has been refined, it is of 90 MCHF, including the emulsion scanning and measuring stations. The funding of the experiment is insured at the level of 95 %, subject to final approval by the funding agencies. A major effort has also been put on the definition of detailed construction and assembly schedules in order to have a substantial fraction of the emulsion target mass installed in spring 2006 when the CNGS beam is due to become operational. Two scenarios are considered, depending in which underground hall, B or C, will be attributed to OPERA at Gran Sasso.

R&D on many components of the detector has naturally proceeded through year 2001: on emulsion, resistive plate chambers, high-resolution drift chambers, low radioactivity material, etc... The major technical decision that had to be taken concerned the choice between various technologies and read-outs considered for the trackers equipping the emulsion/lead target. The base line solution retained consists of large module ($7 \times 1.7 \text{ m}^2$) of 64 plastic scintillator strips, the signal of which is extracted by wavelength shifting fibres and read-out by a multi-anode photo-multiplier tube. A key point in this decision was the successful construction of a full size module prototype. The design of the modules is being finalised, as well as a list of all the detailed instructions concerning the tooling, the products and the procedures that will have to be followed in the course of the industrial fabrication of the modules. The participation to the construction of the target trackers is the main involvement of our group concerning the OPERA detector.

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

(D. Bertrand, C. De Clercq, J. D'Hondt, J. Lemonne, N. Pukhaeva, C. Vander Velde, W. Van Doninck, A. Van Lysebetten, N. Van Remortel, F. Verbeure and J. Wickens)

The LEP collider has been stopped in November 2000, after 12 years of successful running. The DELPHI endcaps were dismantled during the first half of 2001. The technicians of the IIHE were responsible for the dismantling of the MUF chambers which have been built and maintained by the Belgian Universities. The DELPHI barrel will stay in position underground as museum object and will be included in the CERN visitors tour from 2003 onwards.

During 12 years, between 1989 and 2000, the DELPHI experiment has taken about 4 million events at the Z^0 resonance, and about 10,000 W-pair events at energies between 161 and 209 GeV. 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 underway. In the following paragraphs the main results published in 2001 are discussed with special emphasis on the contributions from the physicists of the Brussels-Antwerp group.

1) Physics results at the Z^0 resonance

From the analysis of the total sample of events taken at LEP I the inclusive τ branching ratios for decay modes containing one, three or five charged particles have been determined, giving the following results:

$$\begin{aligned} B_1 &\equiv B(\tau^- \rightarrow (\text{particle})^- \geq 0\pi^0 \geq 0K^0\nu_\tau(\bar{\nu})) = (85.316 \pm 0.093(\text{stat}) \pm 0.049(\text{syst}))\% \\ B_3 &\equiv B(\tau^- \rightarrow 2h^-h^+ \geq 0\pi^0 \geq 0K^0\nu_\tau) = (14.569 \pm 0.093(\text{stat}) \pm 0.048(\text{syst}))\% \\ B_5 &\equiv B(\tau^- \rightarrow 3h^-2h^+ \geq 0\pi^0 \geq 0K^0\nu_\tau) = (0.115 \pm 0.013(\text{stat}) \pm 0.006(\text{syst}))\% \end{aligned}$$

A new precise measurement of $|V_{cb}|$ and of the branching ratio

$$BR(\bar{B}^0 \rightarrow D^{*+}l^- \bar{\nu}_l)$$

has been performed using a sample of about 5000 decays and by applying a new tagging of the soft pion from the D^{*+} decay. The results were:

$$\begin{aligned} |V_{cb}| &= (39.0 \pm 1.5(\text{stat})_{-2.6}^{+2.5}(\text{syst.exp.}) \pm 1.3(\text{syst.th.})) \times 10^{-3} \\ BR(\bar{B}^0 \rightarrow D^{*+}l^- \bar{\nu}_l) &= (4.7 \pm 0.13(\text{stat})_{-0.31}^{+0.36}(\text{syst.exp.}))\% \end{aligned}$$

From a sample enriched in b decays using the lifetime information and various techniques to separate leptons from direct and cascade b decays the following semileptonic b branching ratios were obtained :

$$\begin{aligned} BR(b \rightarrow l^-) &= (10.70 \pm 0.08(\text{stat}) \pm 0.21(\text{syst})_{-0.30}^{+0.44}(\text{model}))\% \\ BR(b \rightarrow c \rightarrow l^+) &= (7.98 \pm 0.22(\text{stat}) \pm 0.21(\text{syst})_{-0.20}^{+0.14}(\text{model}))\% \\ BR(b \rightarrow \bar{c} \rightarrow l^-) &= (1.61 \pm 0.20(\text{stat}) \pm 0.17(\text{syst})_{-0.44}^{+0.30}(\text{model}))\% \end{aligned}$$

The same analysis yielded the following value for the average b mixing parameter

$$\bar{\chi} = 0.127 \pm 0.013(\text{stat}) \pm 0.005(\text{syst}) \pm 0.004(\text{model})$$

2) Results from analyses of data taken above 161 GeV

The analyses performed at high energies can be divided in three categories: study of the properties of the W-boson, search for Higgs bosons and search for new (exotic) physics.

Concerning the study of W-boson production, the results published in 2001 originate from the analysis of the data taken up to 189 GeV. Preliminary results at higher energies have been presented at the Moriond and the EPS-HEP conferences.

The published W mass result is

$$M_W = (80.387 \pm 0.087(\text{stat}) \pm 0.034(\text{syst}) \pm 0.017(\text{LEP}) \pm 0.035(\text{FSI})) \text{GeV} / c^2$$

Presently much effort is invested to reduce the systematic error from Final State Interactions which is common to the measurements from the four experiments.

The anomalous CP-conserving WWZ and WW γ Trilinear Gauge Boson couplings have been measured to be

$$\Delta g_1^Z = -0.02_{-0.07}^{+0.07}(\text{stat}) \pm 0.01(\text{syst})$$

$$\Delta \kappa_\gamma = 0.25_{-0.20}^{+0.21}(\text{stat}) \pm 0.06(\text{syst})$$

$$\lambda_\gamma = 0.05_{-0.09}^{+0.09}(\text{stat}) \pm 0.01(\text{syst})$$

These measurements are in agreement with the Standard Model (SM) expectations of 0, 0, 0 respectively. A preliminary measurement of the Spin Density Matrix for semi-inclusive W production has been obtained based on the analysis of the data taken at 189 GeV. The resulting polarised differential cross sections were in agreement with the SM expectations.

A search for the SM Higgs boson with the data taken at the highest cm energy (209 GeV) was performed, but no conclusive evidence for a signal was observed. A 95% CL lower mass limit could be set at 114.3 GeV/c², to be compared with an expected median limit of 113.5 GeV/c² for these data.

More exotic searches were performed for supersymmetric particles and for technicolor. No signals were found at LEP II.

3) Activities of the Brussels-Antwerp group

At the IIHE we concentrated our efforts on:

- *The study of τ lepton properties.*
The IIHE contributed to the final state identification of the τ decays by developing a method based on the neural network technique. It was used both in the topological branching ratios and in the τ polarisation determination.
- *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 the study of the systematic errors resulting from Final State Interactions, a task for which the IIHE group still has a major responsibility.
- *Determination of the WW cross section*
This analysis was finalised in 2001 and published as a DELPHI internal report. The method used to measure the cross section was based on a neural network technique.
- *Determination of the CP-conserving Triple Gauge Boson couplings*
A measurement of the anomalous charged TGCs was performed with fully hadronic WW events at 183 and 189 GeV. This was the subject of the thesis of A. Van Lysebetten, which was defended successfully in public in January 2001.
- *Measurement of the W-boson polarisation*
The Spin Density Matrix elements were measured for semi-inclusive W production at 189 GeV. The semi-leptonic muon and electron events were used. Preliminary results on the W polarisation as a function of the W production angle were obtained.
- *Bose-Einstein correlations*
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.

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

(T.Anthonis, C.Collard, E.De Wolf, L.Favart, R.Heremans, X.Janssens, D. Johnson, P.Marage, R.Roosen, R.Stamen and P.Van Mechelen)

1. HERA, H1 and COP

At the end of the year 2000, a 9 year period of HERA running (1992-2000), HERA phase I, terminated in which a total integrated luminosity of 130 pb^{-1} was collected. Machine modifications immediately started to upgrade HERA for high luminosity running in 2002. It is expected that after the upgrade a final luminosity of $240 \text{ pb}^{-1}/\text{year}$ will be achieved.

These upgrade modifications fundamentally affect the H1 detector. The beta inserts which are necessary for the high luminosity running are located in forward and backward regions of the H1 detector such that the inside of the backward spaghetti calorimeter, SPACAL, had to be removed as well as the small angle electron tagger, VLQ. Also the forward part of the H1 detector has been modified. The forward drift chambers and MWPC have been replaced by planar chambers and scintillator planes. In addition a new CIP detector has been built replacing the old 2 plane CIP proportional chamber by a 4 layer CIP. Most of these modifications are presently done and a first cosmic run took place in July to test the detectors. The first ep interactions were observed on the 7th of October 2001.

The COP detector and readout electronics performed well up to the end of the HERA-I period although at the end recurrent HV trips were becoming more frequent. During the July cosmic run these problems were not observed and are therefore ascribed to the beam conditions. We have to wait for the new beam conditions to investigate the problem further. Unfortunately one of the anode wires broke during this cosmic test run.

2. Physics analysis

During the year 2001, 10 papers were published. A total of 47 papers were submitted to the International Conference of the European Physical Society (EPS 2001 at Budapest, Hungary)

The main results obtained are given below.

- QCD studies and Structure functions

The structure function measurements have been extended to the low Q^2 region $1.5 < Q^2 < 12 \text{ GeV}^2$ which complement the previous F_2 and F_L measurements. With the analysis of radiative events, a value as low as $Q^2 = 0.35 \text{ GeV}^2$ was reached, where the influence of the non-perturbative effects dominate and the data are well described by Regge based phenomenological models.

A study of the derivative of $\left. \frac{dF_2}{d \ln x} \right|_{Q^2} = \lambda(x, Q^2)$ is shown to be independent of x and to increase linearly with Q^2 in the range $5 \cdot 10^{-5} < x < 0.01$. This behaviour is well described by NLO DGLAP indicating that at low x the rise of F_2 is solely driven by the gluon field.

An analysis of 3 jet production in deep inelastic e^+p scattering in a Q^2 and M_x range of resp. $5 < Q^2 < 5000 \text{ GeV}^2$ and $25 < M_{3j} < 140 \text{ GeV}/c^2$ shows that the three jet cross section, the ratio of 3-jet to 2 jet cross section and the jet angular distributions are well described by QCD in NLO.

- Heavy flavors

Photoproduced J/ψ 's at large t , the four momentum transfer squared to the proton, $1 < t < 21 \text{ GeV}^2$, have been analysed showing the same hard scale behaviour in $d\sigma/dt$ as the low t data and are well described by pQCD.

From the inclusive differential $D^{*\pm}$ cross section measurement the F_C^z has been extracted and found to represent a large fraction of the F_2 proton structure function varying from 10% at low Q^2 (1 GeV^2) to 25 % at large Q^2 ($>25 \text{ GeV}^2$). The analysis also indicate that the CCFM based model shows better agreement than that obtained from an NLO DGLAP formalism.

For the first time beauty production in deep inelastic scattering was observed via the semileptonic decay. The measured cross section $39 \pm 8(\text{stat}) \pm 10(\text{syst}) \text{ pb}$ is significantly above the QCD NLO production which is $11 \pm 2 \text{ pb}$.

- *Diffractive phenomena*

The $F_2^{D(3)}(\beta, Q^2, x_p)$ structure function measurement has also been extended. It is shown that the Pomeron intercept varies with Q^2 and that the ratio of t-integrated diffractive cross section to the total gamma-p cross section is rather flat. The scaling violations of F_D^2 are similar to those of F_2 except at large β .

The diffractive $D^{*\pm}$ production cross section has been measured to be $246 \pm 54(\text{stat}) \pm 56(\text{syst})$ pb in the kinematic region $x_p < 0.04$, $t < 1 \text{ GeV}^2$, $p_t > 2 \text{ GeV}^2 < Q^2 < 100 \text{ GeV}^2$. This represents approximately 6 % of the total $D^{*\pm}$ production cross section. Differential cross sections are well described by QCD-based models and show that the boson-gluon fusion process plays an important role.

The deep virtual Compton scattering (DVCS) process has been measured for the first time, in the kinematic region $2 < Q^2 < 20 \text{ GeV}^2$; $30 < W < 120 \text{ GeV}$ on 8 pb^{-1} and found to dominate the Bethe Heitler process for $W < 100 \text{ GeV}$. The differential cross sections are in good agreement with QCD-based model predictions although the overall normalisation in the theoretical models is uncertain as it depends on the t-slope which cannot be predicted.

The production of ρ mesons at large momentum transfer, t has been investigated by measuring the density matrix elements as a function of t. From this analysis it follows that the s-channel helicity is violated and the effect increases with increasing t.

Using the leading proton spectrometer, the diffractive structure function has been determined in the low x_p range ($x_p < 0.1$). The slope parameter B, $d\sigma/dt = \exp(Bt)$ has been measured to be $B = 5.0 \pm 0.3(\text{stat}) \pm 0.8(\text{syst})$. Comparison with earlier data at larger x_p show the transitions from pomeron exchange to reggeon \square , and π exchange.

Dijet production with a leading neutron has been studied in the photoproduction and in deep inelastic scattering. The data are only well described by models that include pion exchange. Comparison with the inclusive dijet sample shows that the data are compatible with factorisation between the photon-pion and pion-proton vertices.

With respect to new phenomena,

- a search was made for excited neutrino's using an integrated luminosity of 15 pb^{-1} . No candidate was found. New exclusion limits are set as a function of the coupling to compositeness scale up to excited neutrino masses of $240 \text{ GeV}/c^2$.

- using the complete data sample of HERA-I, a search for scalar and vector leptoquarks coupling to the first generation of fermions has been conducted. No evidence has been found implying that for couplings of the electromagnetic strength, leptoquark masses up to 290 GeV are ruled out.

- a search for squarks in R parity violating supersymmetry has been performed in e^+p collisions using a data sample corresponding to 35 pb^{-1} . No deviation from the Standard Model expectation has been observed.

- in a search for events with an isolated lepton and a large missing p_t , a sample of 18 events has been found using an integrated luminosity of 13.6 pb^{-1} (e^-p) and 101.6 pb^{-1} (e^+p), half of which can be attributed to W-production. This leaves an excess of 10 events, where about 3 events are expected.

3. Activities of the members of the Brussels-Antwerp group

i) *VFPS, the Very Forward Proton Spectrometer project in H1*

During the Physical Review Committee (PRC) sessions April/October 2000, the VFPS project was approved, but some technical questions remained to be answered. In particular it was requested to include the full beam pipe geometry in the beam transport calculation. This modification has had very profound consequences. The beam transport calculation originally based on the optical functions, has been completely rewritten and is now based on a detailed list of the beam magnet positions and strengths. Also non linear beam components were included in the calculation. This new treatment affects the VFPS resolutions which are degraded with respect to the original estimates. With the new resolutions the complete VFPS physics program was reviewed in a 39 page document which was presented to the PRC in October 2001. In the October session the PRC considered that all open questions with respect to the VFPS project had been answered.

In the mean time the design of the cold bypass has been finished resulting in some 320 technical drawings. The construction will start in the beginning of 2002. The construction of the Roman pot plunger vessel has been delayed by the Beam Vacuum Group because they wanted proof that the proton beam hitting the Roman pot in case of a beam magnet failure would not melt the Roman pot base plate. Subsequently such a detailed simulation has been performed showing that the temperature increase is important but way off the melting point. Hence in October we were allowed to use the present Forward Proton Spectrometer design for the VFPS. The redesign of the FPS electronics where necessary has been terminated and the series production of the electronic cards can start.

In the past year several meetings have been organised in which the online, offline and Monte Carlo software as well as the VFPS program has been discussed. At presently the VFPS time schedule is such that it could be successfully installed in H1 at the end of 2002.

As the FPS detector has been upgraded with a detector type similar to the one used in the VFPS, the group has also participated in the analysis of the FPS cosmic ray data, which gave a first indication on the new detector performance.

ii) *Physics analysis*

The main analysis topics of the Belgian group relate to the subject of diffraction :

- Deep Virtual Compton Scattering (DVCS): first measurement of the $\gamma+p$ elastic cross section, published in Phys.Lett. B517 (2001),47
- electroproduction of ρ mesons at high t , presented at DIS2001, publication ready for submission to Phys Lett. B
- High Q^2 - ρ production: the analysis has been performed on the 1997 and 1999-2000 data. A study of the systematic errors is in progress which will finalise the analysis.
- Inclusive diffractive photo-production: analysis of the data is finished. Various type of Regge fits to the differential cross section are performed. This analysis is almost finished.
- Measurement of the F2 structure function at low Q^2 and moderate x using radioactive events. A publication is in preparation.
- A study of the properties of the hadronic final state in diffraction is in progress on the 1999-2000 data.

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

(W. Beaumont, T. Beckers, D. Bertrand, G. De Lentdecker, O. Devroede, J. Lemonne, S. Lowette, F. Moortgat, J. Stefanescu, S. Tavernier, F. Udo, C. Vander Velde, W. Van Doninck, P. Vanlaer, F. Verbeure, and V. Zhukov).

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 2006. 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 GeV/ c^2 suggested by the last LEP results, would be confirmed at the Tevatron, the energy and luminosity expected at the LHC will allow a detailed study of the symmetry breaking mechanism in the electroweak interactions. At the LHC, extensive studies of the top quark properties will become possible. The LHC will also allow to disentangle different theories existing to extend the Standard Model, as, for example, the observation of supersymmetric particles. At startup, the LHC will not yet reach its maximal luminosity; study of CP violation in weak interactions, in the $B^0 - \bar{B}^0$ system, shall 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 Brussels and Antwerp laboratories received the following responsibilities : coordination of the design and production of 17000 frames to support the Si detector modules and 17000 pitch adaptors, assembly of 3500 of these modules for the forward wheels of the tracker, mounting of modules on 48 support structures in the shape of a sector of a wheel called petals, long term tests of the modules and the petals.

The Gantry robot in Brussels is now operational and the first modules assembled on it fulfil the precision requirements. A probe station with a X-Y-Z stage has been installed to test Si sensors. The automatization of the control is underway. A set-up to test electronics hybrids before and after module assembly has been delivered by the RWTH-Aachen and will be installed soon. Set-ups to test frame deformation after temperature cycles and to measure their thermal conductivity, are being installed. The clean room and the module test station in Antwerp are now ready to start to test the Si modules of a preseries production expected in the Autumn 2002. The test procedure was defined and the software for the module test setup was developed. An electronic circuit was designed to measure the supply currents of the Si-modules and zero suppressing algorithms were studied for the readout system. The group participated in the measurements for the qualification of the first pre-production Si-modules at CERN.

This year several meetings and contacts with companies took place in order to define the production of the 17000 detector supports that will be made of carbon fiber and graphite. The 200 supports needed for the modules of the autumn preseries are produced and being assembled. The drawings of the frames for the various modules are almost finalized, the technical specifications written and the call for tender for the final production was sent in September. The contract will be discussed in the following weeks.

The 200 pitch-adaptors needed for the preseries modules have been delivered and tested; they are ready to be mounted on the electronics hybrids and allow the connection between the Si detector strips and the electronics channels via bondings. A market survey for the final production was organized in August and the results are under study.

In parallel, the CMS physicists of the IIHE continue to prepare the physics analysis. They contribute to the track and vertex reconstruction software and are now also involved in trigger algorithms developments, namely the selection of b quarks, via the detection of a secondary vertex, and the selection of muon candidates. A muon selection algorithm has been developed combining the data of the muon chambers and of the tracker. These signatures will play a crucial role in the detection of the standard model Higgs boson when decaying into muons and in the detection of additional Higgs bosons predicted by the minimal supersymmetric model, decaying to b quarks. Simulation studies of supersymmetric particle searches are performed in Antwerp. In particular the decays $H^0, A^0 \rightarrow \tilde{\chi}_2^0 \tilde{\chi}_2^0 \rightarrow 4\ell^\pm$ with four isolated leptons in the final state may be observed in the low and intermediate tangent θ region of the MSSM parameter space, if neutralinos and sleptons are light enough, but the discovery potential will depend on other MSSM parameters.

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, S. Tavernier, A. Fremout, F. Tallouf, M. Krieguer, S. Leonard, L. Jjiangui, D. Wisniewski)

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, PET, works by administering harmless but selective radioisotopes which emit positrons. These isotopes are introduced in molecules involved in metabolic functions of cells or organs. These molecules work their way into the part of the organism being studied, where the emitted positrons annihilate with atomic electrons, each annihilation producing a characteristic back-to-back pair of 511 keV photons (gamma rays). Measuring the distribution of these gammas reveals the detailed structure of where the isotope is localized. In addition, the PET camera can give a time-dependent moving image of metabolic function. The latter is particularly useful for genetic and drug research, showing how the organism is affected. For instance cancers cells are known to have a more rapid metabolism than normal cells, consuming therefore more energy in the form of glucose. Introducing one ^{18}F positron emitter in fluorodesoxyglucose molecules (FDG) injected to the patient, one can easily reveal FDG uptakes by cancer cells and detect primary cancers and metastatic activity with very high efficiency.

Since its inception, PET technology has continually benefited from new developments in radiation detection, first using sodium iodide crystals, then the improved performance from bismuth germanate (BGO), and more recently superior materials such as lutetium orthosilicate or aluminate, faster and more effective than BGO.

Scintillator development

As part of the preparations for the experimental programme for CERN's LHC collider, the IIHE group participated in the development of new scintillating materials in the framework of the CRYSTAL CLEAR collaboration. Using input from different disciplines (crystallography and solid-state physics as well as particle physics) one early accomplishment led to the decision by the collaboration for the CMS experiment at the LHC to use lead tungstate (PbWO_4) for its electromagnetic calorimeter.

In parallel, the collaboration, now led by Stefaan Tavernier from the VUB, established the use of cerium fluoride (CeF_3) as another high energy physics standard, and worked with specialist companies in the US, China and the Czech Republic to ensure its production on the industrial scale. The Crystal Clear collaboration also pioneered the use of new compounds based on lutetium. In 2001 we showed that $\text{YPO}_4:\text{Nd}$ and $\text{LuPO}_4:\text{Nd}$ are very fast and luminous scintillators emitting below 200 nm, thus finding the first efficient VUV scintillators.

Working with the Czech Crytur company, the collaboration has developed scintillating crystals of yttrium aluminate perovskite (YAP) doped with increasing amounts of Lutetium, which gives twice as much light as BGO and over a broader range of wavelengths. YAP is extensively used in medical instrumentation and in screens for electron microscopes but its density is marginal for high sensitivity PET applications, which requires very high stopping power for 511 KeV photons. Replacing up to 100% of Yttrium by Lutetium ions allows to produce a very bright and fast scintillator (LuAP) with the unprecedented density of 8.34g/cm^3 .

A new generation of PET scanners

The spatial resolution of commercially available cameras meant that PET analysis was limited until recently to relatively large subjects, like humans or large animals. Now new PET techniques extend this approach to smaller specimens, and this is where the technique becomes interesting for genetic laboratory studies.

In the Crystal Clear collaboration, YAP, lead tungstate and lutetium aluminate are all being investigated for their possible use in small PET scanners. On the readout side, the traditional photomultiplier readout of scintillation light can be replaced by avalanche photodetectors which are more compact, are more easily subdivided in small pixels, and are potentially lower cost.

In the framework of the Crystal Clear collaboration, 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. A project for a mammography PET camera (ClearPEM) is under discussion with Portugal. The collaboration is also negotiating licence contracts of our technology with major commercial companies selling such instruments.

Our design is based on the use of avalanche photodiodes and a phoswich of LSO/LuAP scintillators to provide the depth of interaction information. The IIHE group has been concentrating on the design of the front-end detector modules and on parts of the electronics.

III.2. R&D ON LIQUID SCINTILLATORS.

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

The R&D programme on detectors based on liquid scintillator technology is mainly sponsored by a TMR contract of the EC that will end in 2002. Two papers on their use with layers of thin glass capillaries forming hig-

resolution active targets or micro-vertex detectors have been published. Large tracker modules consisting of TiO₂-doped polycarbonate panels divided into tubular cells equipped with wavelength shifting fibre read-out by an electron-bombarded CCD, a multi-anode PM tube or an hybrid photo-diode, have been successfully constructed and the results accepted for publication. This technology was one of the three considered for the OPERA target trackers.

IV. COMPUTING AND NETWORKING

Management: R. Vandenbroucke

Research staff: Alain Isaac

Logistic and technical staff: G. Depiesse (till 30 July 2001), 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 as 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 (a ECFA subcommittee) that looks at ICT related problems for HEP in Europe.

Operations

The computer support group saw a change in its composition with the arrival of E. Torisaen and the retirement of G. Depiesse. E. Torisaen followed some training courses to improve Unix support. A major effort has been put on the mastering of Linux on the PCs by the whole ICT team.

G. Depiesse, 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. More specifically G. Depiesse took care of the VMS cluster, a task which is now taken over by G. Rousseau. 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, PCs, VMS and Unix machines. E. Torisaen takes care of software installation for all UNIX flavoured machines (workstations and PCs) and gives high-level support for PCs and UNIX. G. Rousseau, E. Torisaen and R. Vandenbroucke install Windows NT PC's and PC applications. Next to administrative tasks D. Pirnay creates web pages, as well those for the IIHE as those for DECUS BELUX.

Systems

The number of PCs in the laboratory has continued to grow during 2001. The PCs often run a double operating system: Windows NT 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).

New disks have been added to the central diskstorage system. The total amount of central storage is now about 400 Gbyte spread over the experiments and general user space. A new storage system has been acquired to cope with the growing storage needs for the coming years and to be able to access this storage from different types of "computing" servers.

Networking

Local area networking

All new LAN connections are now done via the 10/100 Mbps Xylan switch. Most of the physicists have now 100 Mbps to their desktop.

Wide area networking

At the end of November the European Research network TEN-155 has been replaced by GEANT, a network at Gbit/s rates. Belnet is connected to GEANT at 2.5 Gbit/s. This upgrade ensures a good communication channel for the physicists to CERN and DESY.

Project Activities

Alain Isaac worked on the NGN-lab project. NGN-lab is a CEC project that is essentially focused on the

installation and testing of IPv6 protocol stacks and applications in an international environment.

V. TECHNICAL AND ADMINISTRATIVE WORK.

Technical and Administrative work.

The members of the workshop staff in 2001 were : J. De Bruyne, H. De Nil, 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 R. Pins. D. Bertrand was in charge of the general coordination.

The IIHE took the responsibility to design 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 electronics boxes for the whole collaboration. R. Vanderhaeghen and H. De Nil participated to the assembly of the boxes. 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. Part of the silicon detector will be tested at the IIHE on a set-up partly assembled by R. Gindroz and S. Hannaert. R. Pins was involved in preliminary tests of assembly of the frames. R. Goorens has in charge of the design of the pitch adapters which will interface the modules to the amplification electronics. G. Van Beek is involved in the preparation of the OPERA experiment on ν oscillation at Gran Sasso. He took part in the design of the scintillators of the trackers.

L. Etienne participated to the calibration of the test station for the wave length shifter for the optical modules of the AMANDA detector. He also prepared a test station for the angular dependency measurement of the efficiency of the optical modules.

J.-P. Dewulf worked on the design of a new DAQ interface for the future ICE³ experiment.

In the framework of the spin-off activities related to detector developments for medical applications, J. De Bruyne with the help of L. Etienne and R. Pins were in charge of the technical support of the CRYSTAL CLEAR project.

The secretarial work and the general administrative support of the experiments was accomplished by R. Alluyn-Lecluse and M. Garnier assisted by M. De Schutter, M. Goeman, J. Liesen and D. Luybaert-Peymans. M. Pins has contributed with the help of M. De Schutter to the maintenance of our documentation centre and have provided illustrations for several publications and lectures of members of the laboratory. A. De Coster-Vancouwenberge 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 doctoral school in microscopic physics and astrophysics (ULB), President of the commission of pedagogic coordination (ULB; until June 2000), President-elect of the physics council (ULB; since October 2000), member of the nomination commission of the physics department (ULB).

C. De Clercq was a member of the CERN Microcosm Advisory Board and she represented the Physics Department in the PR-commissie of the Faculteit Wetenschappen of the VUB

G. De Lentdecker was representative of the "Corps scientifique non définitif" in the council of the "Département de Physique" de l'ULB.

L. Favart was "secrétaire du département de physique de l'ULB".

X. Janssen acted at the ULB as member of : "Conseil de la Faculté des Sciences (effectif)", "Commission de discipline pour étudiants (effectif)", "Commission des affaires sociales étudiantes (effectif)", "Commission culturelle (suppléant)", "Conseil des bibliothèques (suppléant)".

J. Lemonne was dean of the Faculty of Sciences and member of the Council of the VUB until September 2001. He was also member of the "Nationaal Comité voor Natuurkunde" of the Belgian Academy of Sciences and of the Council of the "Vlaams Interuniversitair Instituut voor Biotechnologie" (VIB).

J. Lemonne and G. Wilquet were members of the Scientific Commission "Hautes et Basses Energies" of the IISN.

D. Bertrand, J. Lemonne (President) and F. Verbeure were members of the Belgian Selection Committee of CERN fellows.

P. Marage is dean of the Faculty of Sciences of the ULB. He is member of the International Advisory Committee of "9th International Workshop on Deep-Inelastic Scattering and QCD - DIS2001", Bologna, Italy, April 2001. He is member of the Conseil d'Administration de l'Institut national des Radioéléments à Fleurus.

R. Roosen acted as delegate of the physics department for the European Mobility Scheme, EMSPS, delegate of the physics department in the doctoral commission and secretary of the doctoral examination commission of the VUB.

S. Tavernier acted as chairman of the physics department of the VUB until September 2001; he was member of the "Onderzoeksraad" and chairman of the "Facultaire onderzoekscommissie Wetenschappen" van de Onderzoeksraad. He is spokesman of the "Crystal Clear Collaboration" (CERN, R & D18). He acted as project co-ordinator of the EC/INNOVATION project MICADO

C. Vander Velde acted as member of the FWO-committee "Subatomaire fysica".

W. Van Doninck acted as a Belgian representative in RECFA, as member of the FWO-committee "Subatomaire fysica" and as a member of the Board of directors of the Belgian Physical Society.

F. Verbeure was member of the Committee of Council and Council of CERN, he was dean of the class of natural sciences of the European Academy of Sciences and Arts, since July 2001. He was chairman of the Research Board of the UIA, member of the Research Board of the UA and co-chair of the XXXth International Symposium on Multiparticle Dynamics, Datong, Chine, Sept. 1-7, 2001

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 Budapest Conference

G. Wilquet is a Belgian delegate at the European Committee for Future Accelerators (ECFA) and at the ACCU of CERN and member of the Board of the Belgian Physical Society.

The following responsibilities were taken in the organisation

1) of the *DELPHI* experiment :

- **D. Bertrand** : representative of "Belgium" in the collaboration board.
- **J. Wickens** : project leader of Offline Software, member of the Physics Steering Panel and of the Software Steering Panel
- **F. Verbeure** : convenor of the research line "QCD and gamma-gamma"

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.
- **X. Janssen** : Diffractive data quality responsible.
- **R. Roosen** : representative of "Belgium" in the Collaboration Board and of the H1 Executive board at DESY.
- **P. Van Mechelen** : librarian of the H1 PHAN software package for physics analyses and co-convenor of the working group on diffraction since February 1999.

3) of the *CMS* experiment :

- **W. Van Doninck** : member of the management board, of the collaboration board, of the finance board and of the tracker institution board.
- **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, the finance board, the tracker institution board, the tracker finance board and the tracker project office.
- **P. Vanlaer** : coordinator of the CMS vertex reconstruction package and quality assurance responsible for the tracker endcap modules in Brussels
- **W. Beaumont** : member of the tracker institution board

4) of the *CHORUS* experiment :

- **P. Vilain** : representative of the IIHE at the Collaboration Board.

- **G. Wilquet** : convener of the committee "Detector and Emulsion".
- 5) of the *OPERA experiment* :
- **G. Wilquet** : member of the collaboration board, convener of the working group on electronic detectors.
- 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.
- 7) of the *Crystal Clear Collaboration* :
- **S. Tavernier** : spokesman of the collaboration, member of the collaboration board and convener for the photo-detector working group.
 - **A. Fremout** : member of the "photodetector" and "electronics" working groups of the Crystal Clear PET project
 - **D. Wisniewski** is member of Crystal Clear Collaboration working group "Crystals".

VII. TEACHING ACTIVITIES.

VII.1. TEACHING ACTIVITIES (academic year 2000-2001).

- **D. Bertrand**
 - PHYS 109 "Physique des Particules" (0-0-75)
 - commissaire de deux mémoires de licence
 - membre du jury de trois thèses de doctorat
 - STAT606 "Computer Principles" (39-0-13) – 1ère candidature en anglais
 - "Description des ordinateurs (aspects matériels et logiciels)" (45-0-15)
Année préparatoire à la première licence en informatique (orientation gestion) UMH-Charleroi.
 - "Astroparticle physics" – cours donné dans le cadre de la "Joint Belgian-Dutch-German Graduate School for Particle Physics, October 2001
- **P. Bruyndonckx**
 - "Medisch gerichte fysica" (15h - 4de jaar arts)
 - "Fysische modellen in de geneeskunde" (15h 2de licentie Natuurkunde en 4de jaar Toegepaste Wetenschappen)
 - "Inleiding tot mathematica (15h - part of informatica in 1K Natuurkunde)
- **C. Declercq**
 - for VUB students :
 - . contribution (12h) to the Practicum of the course "Fysica van de Elementaire Deeltjes", taught by J. Lemonne in the 1ste jaar licentiaat Natuurkunde
 - . Practicum "Algemene Natuurkunde" (30h, 1ste Kandidatuur Natuurkunde)
 - for high school teachers and students :
 - . organisation of guided tours for Flemish school classes in the ULB Experimentarium
 - . organisation of the visit to CERN for the VUB-Physics and Engineering students
 - supervision of the PhD thesis of J. D'Hondt, Ph. Olbrechts and A. Van Lysebetten
- **G. De Lentdecker**
 - Contribution to the practical work for ULB students of the 3rd year in physics.
- **O. Devroede**
 - Exercices (30h) of the course "Algemene Natuurkunde" taught by J. Lemonne for the students of the 1ste kandidatuur Wis- en Natuurkunde.
- **J. D'Hondt**
 - "Algemene natuurkunde II", taught by J. Lemonne : Electro-magnetisme, kristallografie en quantum mechanica (40 h exercices, 2^{de} kandidatuur Natuurkunde, Scheikunde en Geologie - VUB)

- **L. Favart**
"Physique des Particules", laboratoires associés au cours de P. Vilain, 2 weeks
- **A. Fremout**
- Brugcursus Natuurkunde (introductory courses on physics for new students)
- **X. Janssen**
- Laboratoires du cours de P. Vilain "Physique des particules élémentaires" et du cours de G. Wilquet-P. Broeckaert

"Techniques de la physique expérimentale".
- **D. Johnson**
- Practica "Algemene en Proefondervindelijke Natuurkunde" (32 h - 1^{ste} kandidatuur met polyvalentie)
- "Gevorderd practicum Natuurkunde" (20 h - 2^{de} kandidatuur natuurkunde)
- Practicum of the course "Algemene Natuurkunde" taught by J. Lemonne (20 h - 2^{de} kandidatuur natuurkunde)
- "Practicum Algemene Natuurkunde" (7 h - 2^{de} licentie natuurkunde)
- **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" (30 h + 30 h of practical work - 1^{ste} licentie natuurkunde - VUB)
- Supervision of the Ph.D thesis B. Van de Vyver
- **P. Marage**
- "Histoire des sciences" (2^{ème} licence en sciences physiques et sciences mathématiques - ULB)
- "Histoire des sciences et épistémologie" (agrégation de l'enseignement secondaire supérieur - orientation sciences physiques - ULB)
- Supervision of the Ph.D thesis of C. Collard and X. Janssen
- **Ph. Olbrechts**
Exercices following the lectures "Algemene Natuurkunde II" given by Prof. J. Lemonne (2 Kandidatuur Natuurkunde). The exercises were given in partial replacement of J. D'Hondt.
- **R. Roosen**
- "Elementaire deeltjes fysica", deel IIb (15 h - 2^{de} licentie)
- "Geschiedenis van de natuurkunde" deel III (10 h - 2^{de} licentie)
- Contribution to the 30 h of practicum for the course : "Fysica van de Elementaire Deeltjes", taught by J. Lemonne

(1 Licentie Natuurkunde, VUB).
- Supervision of the Ph.D thesis of R. Heremans
- **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).
- Supervision of the Ph.D thesis of A. Fremout, S. Léonard and M. Krieguer
- **C. Vander Velde**
- Physique du secondaire (45h + 45h practical work) – agrégation de physique
- Physique expérimentale (26h) – 1ère candidature informatique
- Electronique (16h practical work + 16h lab) – 2ème candidature informatique
- Travaux pratique de 75h (étude d'un MSGC+GEM) : 2 students – 1ère licence en Physique
- Supervision of the Ph.D. thesis of G. De Lentdecker
- **W. Van Doninck**
- "Elementaire deeltjes II a - Standard model van electrozwakke wisselwerkingen" (15 h - 2^{de} licentie natuurkunde VUB)
- "Elementaire deeltjes - Inleiding" (2 h; 1^{ste} kandidatuur burgerlijk ingenieur VUB).
- **B. Van de Vyver**
Oefeningen(6h) for the course "Elementaire deeltjes" taught by J. Lemonne (1ste Licentie Natuurkunde)

- **P. Vanlaer**
 - "Travaux pratiques du cours d'Electronique" (4 x 4 h; 2^{ème} candidature informaticiens)
- **P. Vilain**
 - "Questions Approfondies de Physique des Particules" (2^{ème} licence en physique - ULB)
 - "Physique des Particules" (26 h - 1^{ère} licence en physique - ULB)
 - "Practical works associated to these 2 courses"
 - "Co-promotor of the PhD thesis of P. Annis (ULB), R. El Aidi (ULB) and B. Van de Vyver (VUB)
- **G. Wilquet**
 - "Technique de la physique expérimentale" (PHYS106) - 1^{ère} licence en sciences physiques ULB (14 h partim de 26 h)
 - " Simulation, prise et analyse de données expérimentales" (PHYS142) - 2^{ème} licence en sciences physiques et DEA en physique théorique ULB (10 h partim de 30 h)
 - Laboratoires de 1^{ère} licence en sciences physique ULB (PHYS105) (2 x 30 h)
 - Organisation des laboratoires de licence et DEA du Service de physique des particules de l'ULB.
 - Organisation de la visite du CERN pour la 1^{ère} licence en sciences physique, ULB
 - Supervision of the Ph.D thesis of R. El Aidi

VII.2. PhD THESES, "MEMOIRES DE LICENCE" AND "LICENTIAATSVERHANDELINGEN" COMPLETED IN 2001.

* PhD thesis.

- *P. Annis* : "Contribution to the search for $\nu_\mu \rightarrow \nu_\tau$ oscillation in the CHORUS experiment
Promotor : P. Vilain
- *A. Van Lysebetten* : "Contribution to the study of the Triple Gauge Boson Couplings in fully hadronic WW final states at LEP2.
Promotor : C. De Clercq
- *F. Tallouf* : "Etude d'un tomographe à émission de positons basé sur l'utilisation de nouveaux scintillateurs denses et de photodiodes à avalanche".
Promotor : C. Vander Velde
- *R. Stamen* : "Measurement of deeply virtual compton scattering at HERA"
Promotor : L. Favart

* Mémoires de licence" and "licentiaatverhandelingen.

- *A. Reichner* : "Analyse du détecteur à fibres scintillantes prévu pour le spectromètre à protons de l'expérience H1 à HERA "
Promotor : L. Favart
- *Sabrina Wenig* : "Etude Expérimentale des Caractéristiques des Photomultiplicateurs pour l'expérience AMANDA".
Promotor : D. Bertrand

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

VIII.1. SEMINARS AT IIHE (organised by P. Vilain) :

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

- **P. Niessen** (DESY IfH Zeuthen) : "Search for relativistic magnetic monopoles with the AMANDA Cherenkov telescope".
- **H. Lacker** (LAL Orsay) : "Recent results from BaBar".
- **R. Stamen** (Dortmund University and ULB) : "Measurement of deeply virtual compton scattering at HERA".
- **A. Sevrin** (Vrije Universiteit Brussel) : "Strings, D-branes and black holes : a primer".

The following seminars were given by members of the IIHE :

- **D. Bertrand** :
- "The neutrino telescopes" – séminaire de l'Ecole doctorale MICAS (ULB), april 2001
- **S. Tavernier** : "The ClearPET project", seminar in UZ-Leuven, June 8, 2001

VIII.2. ORAL PRESENTATIONS AT CONFERENCES, SCHOOLS AND COLLABORATION MEETINGS.

- **C. Collard** :
- "Density matrix elements for ρ electroproduction as a function of t " – talk presented at DIS 2001, Bologna (Italy),
27 April – 1 May, 2001
- "Polarisation study in ρ vector meson electroproduction at high t at HERA" – talk presented at the BNV-SBP,
Leuven, 16-17 May 2001
- "La diffraction à HERA" – talk presented at "la journée des doctorants de l'école doctorale MICAS, Parentville
(Belgium), 16 January 2001
- "Production de mesons vecteurs à HERA – poster presentation at the doctoriales de Lille, France, september 2001
- **C. De Clercq** :
- "Status report on the DELPHI SDM analysis" – WW physics workshop, WWMMI, Cetraro (Italy), 12-17 October
2001
- "SDM and W-polarisation at LEP : a report from the 4 experiments" - WW physics workshop, WWMMI,
Cetraro, (Italy), 12-17 October 2001
- "Spin density matrix analysis of the reaction $e^+e^- \rightarrow W^+W^-$ at 189 GeV" – talk given at the General meeting of
Belgian Physical Society, Leuven, 16 May 2001
- **G. De Lentdecker** :
- "Experimental and simulation study of the MSGC+GEM detectors" – talk given at the General meeting of the
Belgian Physical Society, Leuven, 16 May 2001
- "Experimental and simulation study of the MSGC+GEM detectors" – talk presented at the International Conf.
on High Energy Physics, Budapest (Hungary), 12-18 July 2001
- "3D simulation of Gas Electron Multipliers ((GEM))" – poster presented during 2001 European School of
High Energy Physics, Beatenberg (Switzerland), 26 August-8 September 2001
- **J. D'Hondt** :
- "PYTHIA/LUBOEI tuning : Gaussian and exponential parametrization of the correlation function and the
problems of resonances" – talk at WW LEP workshop meeting (CERN), Geneve – january 2001
- "W mass and width at LEP" – talk at the conference about Frontiers in Contemporary Physics, Nashville (USA)
- "W mass from DELPHI's qqQQ events" – talk at the Forum for Young Researchers in the Moriond Electroweak
Conference, Les Arcs (France)
- "Tuning studies in DELPHI" – talk at the plenary session of the WW Workshop, CERN (Geneve) – April 2001
- "Possible reduction of colour reconnection systematics on the W mass" – talk at the WW LEP workshop meeting,
CERN (Geneve) – August 2001
- "W mass and colour reconnection : overview" – talk at the WW Workshop plenary session, Cetraro (Italy)

- October 2001
- "The big test of Mixed Lorentz boosted Z^0 's" – talk at the WW Workshop plenary session, Cetraro (Italy), October 2001
 - "Technical aspects in colour reconnection studies" – talk at the WW workshop parallel session, Cetraro (Italy), October 2001
 - "Monte Carlo tuning : overview" – talk at the WW workshop parallel session, Cetraro (Italy), October 2001
 - "Comparison of LEP data distributions used for Monte Carlo tuning" – talk at the WW LEP workshop meeting, CERN (Geneve), November 2001
- **E. De Wolf :**
 - "Diffraction and structure functions" – invited review talk at the Ringberg Workshop "New trends in HERA Physics 2001", Germany, 17-22 June 2001
 - "Genuine correlations of like-sign and all-charged particles in hadronic Z^0 decays at LEP" – invited talk at the 31th International Symposium on Multiparticle Dynamics, Da Tong (China) 1-7 September 2001
 - "Bose-Einstein and color-reconnection effects in W^+W^- production at LEP" - seminar at Jagellonian University of Krakow (Poland), 26 October 2001
 - **L. Favart :**
 - "Deeply inelastic compton scattering at H1 and ZEUS" – talk at the 9th International Workshop on Deep-Inelastic Scattering (DIS2001),
 - **A. Fremout :**
 - "Feasibility studies with PET detector modules based on an APD array and LSO" – talk presented at the IEEE nuclear science-medical imaging 2001 Conference, San Diego (USA), November 2001
 - "Evaluation of different types of avalanche photodiodes from hamamatsu and perkin-elmer" – poster presentation at the IEEE nuclear science-medical imaging 2001 Conference, San Diego (USA), November 2001
 - **R. Heremans :**
 - "Diffractive dissociation in photoproduction at HERA" – talk given at the General meeting of the Belgian Physical Society, Leuven, 16 May 2001
 - **P. Marage :**
 - "What does diffraction tell us about the proton ?" – 9th International Workshop on Deep-Inelastic Scattering and QCD – DIS01, Bologna (Italy), april 2001
 - "Vector meson production, diffraction and pQCD" – H1 collaboration meeting, Hamburg (Germany), 14 december 2001
 - **F. Moortgat :**
 - "Observability of MSSM Higgs bosons decaying to sparticles at the LHC" – talk at the 36th Recontres de Moriond on QCD, Les Arcs (France), 17-24 March 2001
 - "Sparticle decay modes of heav Higgs bosons at CMS" – talk at the Les Houches Workshop on TEV Colliders, Les Houches (France) Mamy 21-June 1, 2001
 - "Progress on A/H decays to gaugino-gaugino" – talk at the Workshop on Physics with CMS at the LHC, Catania (Italy) 18-22 June, 2001
 - **Ph. Olbrechts :**
 - "On the angular sensitivity of the AMANDA optical modules in the ice" – 13th annual graduate school for high energy physics, Couvin (Belgium), October 2001
 - "On the angular sensitivity of the AMANDA optical modules in the ice" – talk presented at the BNV-SBP, Leuven, May 2001
 - **R. Roosen :**
 - "Presentation of the VFPS proposal" in the Physics Review Committee closed session, DESY, Hambourg, 17-18 May, 2001
 - "Presentation of the VFPS proposal" in the Physics Review Committee closed session, DESY, Hambourg, 24-25 October 2001
 - "Diffraction and Roman Pots in H1" – seminar at the Workshop on Low x physics 2001, Krakow (Poland), 26 June 2001

- **S. Tavernier :**
 - The Crystal Clear project, talk at LIP workshop on position emission tomography, University of Coimbra Portugal, June 8, 2001
 - High resolution PET for small animal imaging, talk presented at the meeting on nuclear imaging in drug development, Brussel, March 2001

- **P. Vanlaer :**
 - “Tracking in CMS : software framework and tracker performance” – Vienna Conference on Instrumentation, 19-23 February 2001
 - “Quelques développements récents de l’instrumentation en physique des hautes énergies” – Journées Jeunes Chercheurs, La Hume, Arcachon, 10-14 December 2001
 - “Status of the CMS experiment” – invited talk at the International Conference on New Trends in High Energy Physics, Yalta (Ukraine), 22-29 September 2001
 - “CMS vertex reconstruction performances” – miniworkshop on b- and tau tagging, CERN (Geneve), 6-9 June 2001
 - “Vertex reconstruction framework in ORCA” – miniworkshop on track and vertex reconstruction, CERN (Geneve), 29 January-2 February 2001

- **P. Vilain :**

Present and future neutrino experiments at CERN – international school of nuclear physics, Ettore Majorana Center for Scientific Culture, Erice (Italy), 18-20 September 2001

- **G. Wilquet :**
 - Rencontre du Vietnam, Hanoi, Vietnam : review talk on "Neutrino Oscillation at Reactors and Accelerators"
 - Symposium in Honorem J. Sacton : organisation and invited talk on "Neutrino Oscillation"
 - General Scientific Meeting of the Belgian Physical Society : organisation and convener of the HEP session.
 - Report on “History and Perspectives of Networks Usage in High Energy Physics” for the “4th Workshop of the European Union of Physics Research Organisations.

- **V. Zhukov :**

CMS silicon module in the PSI test – talk and contribution to the proceedings of the 7th International Conference on advanced technology and particle physics, Como (Italy), October 2001

IX. SCIENTIFIC VULGARISATION AND OUTREACH ACTIVITIES.

C. De Clercq :

- Organisation of visit to CERN for 45 high school students – July 2001

L. Favart :

- “Quand la particule de Higgs montre sa queue”, article for Objectif Recherche, June 2001

P. Marage :

- “L’affaire Galilei”, conférence à Altaïr, ASBL d’histoire des sciences de l’ULB, ULB, 17 March 2001, extension de l’ULB, Tubize, 19 March 2001, extension de l’ULB, Dour, 17 December 2001
- “L’histoire du vide”, congrès pluraliste des Sciences, ULB, 23 August 2001, Elève de rhétorique, Collège de Basse-Wavre, 17 December 2001, bulletin de l’Association Belge des Professeurs de physique et de chimie, nr 151 (2001), pp. 207-220, physicalia, organe de la Société Belge de Physique, nr. (2001), pp. 191-206
- Participation au panel de discussion suivant l’avant-première de la pièce “Copenhague” au théâtre Jean Vilar, Louvain-la-Neuve, 12 February 2001
- Interview journal RTBF1 , à propos du Printemps des Sciences, March 2001
- Interview Le Soir, à propos de la Recherche en Europe, June 2001
- “Carte Blanche et intervenant invité au Forum “enseignement” du parti Ecolo”, October 2001 – thème : comment motiver l’enseignement des sciences
- “Faut-il avoir peur de Bologne” – cahiers marxistes nr. 220 (2001), pp. 43-53

G. Wilquet :

- “L’Univers des Neutrinos, les Neutrinos de l’Univers” for the Club 51

X. ATTENDANCE TO CONFERENCES, WORKSHOPS AND SCHOOLS.

X.1. CONFERENCES AND WORKSHOPS.

- International Europhysics Conference on High Energy Physics – Budapest (Hungary) – 12-18 July 2001
G. De Lentdecker, E. De Wolf, L. Favart, C. Vander Velde, P. Vilain, G. Wilquet
- XXth International Symposium on Lepton and Photon Interactions at High Energies – Rome (Italy) – 23-28 July 2001
D. Bertrand, J. Lemonne
- XXXth International Symposium on Multiparticle Dynamics, Datong, China, Sept. 1-7, 2001
E. De Wolf, N. Van Remortel, F. Verbeure
- 9th International Workshop on Deep-Inelastic Scattering (DIS 2001) – Bologna (Italy) - April 2001
C. Collard, X. Janssen, L. Favart, P. Marage,
- Belgian Physical Society – Leuven (B) – 16-17 May 2001
C. De Clercq, C. Collard, G. De Lentdecker, O. Devroede, J. Lemonne, X. Janssen, Ph. Olbrechts, B. Van de Vyver
- IEEE 2001 Nuclear Science Symposium and medical imaging conference, San Diego, november 2001
S. Tavernier
- Hires meeting, Washington (USA) – 9-11 September 2001
P. Bruyndonckx, S. Tavernier
- Medical Imaging Brussels, 22-23 March 2001
S. Léonard, S. Tavernier
- International Conference on inorganic scintillators and their applications, Chamonix (France), 2001
D. Wisniewski
- Workshop on the design of a new NEMA standard to evaluation of small animal PET scanners, Washington (USA), September 9, 2001
P. Bruyndonckx
- High Resolution Small Animal PET meeting, Rockville (USA), September 9-11, 2001
P. Bruyndonckx
- Vienna Conference on Instrumentation, Vienna (Austria) 19-23 February, 2001
P. Vanlaer
- WW physics workshop, WWMMI, Cetraro (Italy), 12-17 October 2001
C. De Clercq, J. D’Hondt
- International Conference on New Trends in High Energy Physics, Yalta (Ukraine) 22-29 September 2001
P. Vanlaer
- Journées Jeunes Chercheurs, La Hume, Arcachon, 10-14 December 2001
P. Vanlaer, G. Wilquet
- Mini-workshop on b- and tau-tagging, CERN, Geneve, 6-8 June 2001
P. Vanlaer
- Mini-workshop on track and vertex reconstruction, CERN, Geneve, June 6-8, 2001

P. Vanlaer

- WW LEP Workshop, CERN (Geneve), April 2001
J. D'Hondt
- Frontiers in Contemporary Physics II, Nashville (USA), March 2001
J. D'Hondt
- DELPHI symposium, Delfi (Greece), September 2001
D. Bertrand, J. D'Hondt, J. Wickens
- IX International Workshop on Neutrino Telescopes 2001, Venice (Italy), March 2001
G. Wilquet
- VIIth Workshop on electronics for LHC experiments, Stockholm (Sweden), 10-14 September 2001
W. Beaumont
- International Conference on advanced technology and particle physics, villa Olmo (Italy), 15-19 October 2001
V. Zhukov
- 29th SLAC Summer Institute : Exploring electroweak symmetry breaking, Stanford (California), 13-24 August 2001
F. Moortgat
- IEEE Nuclear Science-Medical Imaging 2001 Conference, San Diego (USA), November 2001
A. Fremout
- Ansys users meeting, Breda (the Netherlands), November 2001
L. Van Lancker
- CMS Workshop meeting, Lyon (France), January 2001
L. Van Lancker
- International Conference on Composites Engineering, Tenerife, 5-11 August 2001
L. Van Lancker

X.2. SCHOOLS.

- 2001 European School of High Energy Physics, Beatenberg (Zwitserland) – August 2001
G. De Lentdecker
- CERN Summer School on High Energy Physics, Rio de Janeiro (Brasil) – May 2001
J. D'Hondt
- European School of Medical Physics in Archamps (France) – November 2001
S. Leonard
- 13th Annual Graduate School for high energy physics, Couvin (Belgium) – October 2001
Ph. Olbrechts

X.3. TECHNICAL FORMATIONS.

- Composite exhibition, Paris, 27 March 2001
L. Van Lancker

- Rand-Axis User Pro-engineer Group Meeting, Louvain-la-Neuve, 13 December 2001
L. Van Lancker

XI. LIST OF PUBLICATIONS, REPORTS AND ORAL CONTRIBUTIONS TO CONFERENCES BY MEMBERS OF THE IIHE.

XII.1. PUBLICATIONS.

NEUTRINO PHYSICS : CHORUS

A high-resolution tracking hodoscope based on capillary layers filled with liquid scintillator
A. Bay et al.
Nucl. Inst. & Meth. A457 (2001) 107-116
CERN-EP/2000-074

The compact emulsion spectrometer
S. Buontempo et al.
Nucl. Inst. & Meth. A457 (2001) 464-470

New results from a search for $\nu_{\mu}-\nu_{\tau}$ and $\nu_e-\nu_{\tau}$ oscillation
E. Eskut et al.
Phys. Lett. B497 (2001) 8-22
CERN-FP/2000-147

Observation of weak neutral current neutrino production of J/Ψ
E. Eskut et al.
Phys. Lett. B503 (2001) 1-9

NEUTRINO PHYSICS : AMANDA

Observation of high-energy neutrinos using Cerenkov detectors embedded deep in Antarctic ice
E. Andr es et al.
Nature 410 (2001) 441-443

Results from the AMANDA High Energy Neutrino Detector
E. Andres et al.
Nucl. Phys. B91 (2001) 423-430

e^+e^- PHYSICS

Study of dimuon production in photon-photon collisions and measurement of QED photon structure functions at LEP
P. Abreu et al.
Eur. Phys. J. C19 (2001) 15-28

Search for neutralino pair production at $\sqrt{s} = 189$ GeV
P. Abreu et al.
Eur. Phys. J. C19 (2001) 201-212

Search for sleptons in e^+e^- collisions at $\sqrt{s} = 183$ to 189 GeV
P. Abreu et al.
Eur. Phys. J. C19 (2001) 29-42

Measurement of the semileptonic b branching fractions and average b mixing parameter in Z decays
P. Abreu et al.
Eur. Phys. J. C20 (2001) 455-478

A measurement of the Tau topological branching ratios

P. Abreu et al.

Eur. Phys. J. C20 (2001) 617-637

Measurement of the ZZ cross-section in e^+e^- interactions at 183-189 GeV

P. Abreu et al.

Phys. Lett. B497 (2001) 199-213

Search for the Standard Model Higgs boson at LEP in the year 2000

P. Abreu et al.

Phys. Lett. B499 (2001) 23-37

Search for R-parity violation with a U bar D bar D bar coupling at $\sqrt{s} = 189$ GeV

P. Abreu et al.

Phys. Lett. B500 (2001) 22-36

Search for spontaneous R-parity violation at $\sqrt{s} = 183$ GeV and 189 GeV

P. Abreu et al.

Phys. Lett. B502 (2001) 24-36

Measurement of trilinear gauge boson couplings WWV, ($V \equiv Z, \gamma$) e^+e^- collisions at 189 GeV

P. Abreu et al.

Phys. Lett. B502 (2001) 9-23

Update of the search for supersymmetric particles in scenarios with gravitino LSP and sleptons NLSP

P. Abreu et al.

Phys. Lett. B503 (2001) 34-48

Search for a fermiophobic Higgs at LEP 2

P. Abreu et al.

Phys. Lett. B507 (2001) 89-103

Measurement of V_{cb} from the decay process $B\text{bar}^0 \rightarrow D^{*+} l \text{nbar}$

P. Abreu et al.

Phys. Lett. B510 (2001) 55-74

Measurement of the mass and width of the W boson in e^+e^- collisions at $\sqrt{s} = 189$ GeV

P. Abreu et al.

Phys. Lett. B511 (2001) 159-177

ep PHYSICS

Measurement of neutral and charged current cross sections in electron-proton collisions at high Q^2

C. Adloff et al.

Eur. Phys. J. C19 (2001) 269-288

Measurement and QCD analysis of jet cross sections in deep-inelastic positron-proton collisions at \sqrt{s} of 300 GeV

C. Adloff et al.

Eur. Phys. J. C19 (2001) 289-311

Dijet production in charged and neutral current e^+p interactions at high Q^2

C. Adloff et al.

Eur. Phys. J. C19 (2001) 429-440

Searches at HERA for squarks in R-parity violating supersymmetry

C. Adloff et al.

Eur. Phys. J. C20 (2001) 4, 639-657

Deep-inelastic inclusive ep scattering at low x and a determination of α_s
C. Adloff et al.
Eur. Phys. J. C21 (2001) 33-61

Three-jet production in deep-inelastic scattering at HERA
C. Adloff et al.
Phys. Lett. B515 (2001) 17-29

Measurement of deeply virtual Compton scattering at HERA
C. Adloff et al.
Phys.Lett. B517 (2001) 47-58

On the rise of the proton structure function F_2 towards low x
C. Adloff et al.
Phys.Lett. B520 (2001) 183

$D^{(*+-)}$ meson production in deep-inelastic diffractive interactions at HERA
C. Adloff et al.
Phys. Lett. B520 (2001) 191

EXPERIMENTAL TECHNIQUES

The microgem detector
O. Bouhali et al.
Nucl. Instr. & Meth. A459 (2001) 211-220

Large scale test of MSGC+GEM detectors in a high intensity hadron beam
V. Zhukov
Nucl. Instr. & Meth. A461 (2001) 118-120

Test of the CMS microstrip silicon tracker readout and control system
A. Zghiche et al.
Nucl. Instr. & Meth. A461 (2001)

Robustness test of a system of MSGC+GEM detectors at the cyclotron facility of the Paul Scherrer Institute
M. Argeron et al.
Nucl. Inst. & Meth. A471 (2001) 380-391

An optimized process for the production of advanced planar wire grid plates as detectors for high energy physics experiments
F. Iacopi et al.
Sensors and Actuators A 93 (2001) 76-83

"A high-resolution tracking hodoscope based on capillary layers filled with liquid scintillator"
A. Bay et al.
CERN-EP/2000-074
Nucl. Instr. & Meth. A457 (2001) 107

Design and performance of a data acquisition system for the VUB-PET
P. Bruyndonckx, W. Yonggang, S. Tavernier, P. Carnochan
IEEE Trans; Nucl. Science 48 (2001) 150-156

XI.2. CONFERENCE PROCEEDINGS.

Physics results from the AMANDA Neutrino Detector
AMANDA Collaboration: J. Ahrens et al , Presented by M. Kowalski;
Proceedings of the International Europhysics Conference on High Energy Physics, Budapest,
Hungary, 12-18 July 2001; Journal of High Energy Physics, PRHEP-hep2001/207

Calibration and Survey of AMANDA with SPASE
SPASE and AMANDA Collaborations: X. Bai et al
Proceedings of the 27th International Cosmic Ray Conference, Hamburg, Germany, 7-15 August 2001
(HE 2.1 HE208)

Observation of High Energy Atmospheric Neutrinos with AMANDA
AMANDA Collaboration: J. Ahrens et al
Ref.: C. H. Wiebusch for the AMANDA Collaboration;
Proceedings of the 27th International Cosmic Ray Conference, Hamburg, Germany, 7-15 August 2001 (HE 2.3 18:12)

Search for Diffuse Flux from Sources of High Energy Neutrinos with AMANDA-B10
AMANDA Collaboration: J. Ahrens et al
Ref.: G. Hill for the AMANDA Collaboration;
Proceedings of the 27th International Cosmic Ray Conference, Hamburg, Germany, 7-15 August 2001 (HE 2.3 18:24)

Search for Cascade-like Events in the AMANDA-B10 Detector
AMANDA Collaboration: J. Ahrens et al
Ref.: I. Taboada and M. Kowalski for the AMANDA Collaboration;
Proceedings of the 27th International Cosmic Ray Conference, Hamburg, Germany, 7-15 August 2001 (HE 2.3 18:36)

Supernova Neutrino-Burst Search with the AMANDA Detector
AMANDA Collaboration: J. Ahrens et al
Ref.: T. Neuhöffer for the AMANDA Collaboration;
Proceedings of the 27th International Cosmic Ray Conference, Hamburg, Germany, 7-15 August 2001
(HE 2.3 HE231)

The AMANDA Search for High Energy Neutrinos from Gamma-Ray Bursts
AMANDA Collaboration: J. Ahrens et al
Ref.: R. Hardtke and G. Barouch for the AMANDA Collaboration;
Proceedings of the 27th International Cosmic Ray Conference, Hamburg, Germany, 7-15 August 2001
(HE 2.3 HE232)

The Performance of the Amanda-II 19 String Array
AMANDA Collaboration: J. Ahrens et al
Ref.: R. Wischnewski for the AMANDA Collaboration;
Proceedings of the 27th International Cosmic Ray Conference, Hamburg, Germany, 7-15 August 2001
(HE 2.3 HE233)

Search for UHE Neutrinos in AMANDA
AMANDA Collaboration: J. Ahrens et al
Ref.: S. Hundertmark for the AMANDA Collaboration;
Proceedings of the 27th International Cosmic Ray Conference, Hamburg, Germany, 7-1 August 2001 (HE 2.3 HE236)

Time Calibration of the AMANDA Neutrino Telescope with Cosmic Ray Muons
AMANDA Collaboration: J. Ahrens et al
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XI.4. PUBLICATIONS IN BOOKS.

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XII. ILLUSTRATIONS.

Fig. 1 Location of the AMANDA and the future ICE³ detectors at the South Pole.

Fig. 2 a) LEP average of the measurement of the W-boson mass with the fully hadronic final states; presented at the EPS-HEP 2001 conference.
b) Standard Model fit results in the (M_W , M_H) plane based on all LEP measurements except M_W (red contour); M_H region excluded by direct searches at LEP (yellow band); region allowed by the direct M_W measurements (green band).
c) Cross section measured at LEP2 (blue points = published; red points = preliminary) as a function of the center of mass energy. The bands show the theoretical calculations with RACOONWW and YFSWW

Fig. 3 *H1 experiment* :
Gluon distribution resulting from the NLO DGLAP QCD fit to H1 ep and BDCMS μ -p cross section data in the massive flavour scheme. The innermost error bands represent the experimental error for fixed $\alpha_s(M_Z)=0.1150$. The middle error bands include in addition the contribution due to the simultaneous fit of α_s . The outer error bands also include the uncertainties related to the QCD model and data range. The solid lines inside the error band represent the gluon distribution obtained in the fit to the H1 data alone.

Fig. 4 a) View of a CMS frame assembled at the IIHE
b) View of the set-up to measure CMS frame deformations

Fig. 5 The UIA set-up to test silicon detectors for the CMS experiment.

Fig. 6 *Crystal Clear collaboration* : Sample LuAP : Ce scintillator produced by Chocharlski method.