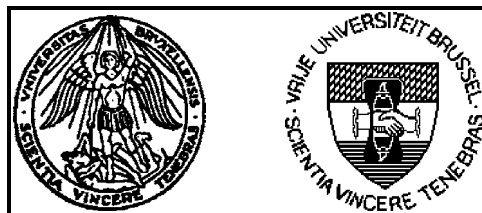


INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES

ULB-VUB, BRUSSELS

ANNUAL REPORT 2002



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D. BERTRAND and J. LEMONNE,
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CONTENTS

I.	INTRODUCTION	p. 3
II.	RESEARCH ACTIVITIES IN PARTICLE PHYSICS	p. 4
	II.1. NEUTRINO PHYSICS	p. 4
	II.2. STUDY OF e^+e^- ANNIHILATIONS AT LEP - THE DELPHI EXPERIMENT	p. 7
	II.3. STUDY OF ep COLLISIONS AT HERA - THE H1 EXPERIMENT	p. 8
	II.4. STUDY OF pp COLLISIONS AT LHC - THE CMS EXPERIMENT	p. 10
III.	APPLIED R&D AND SPIN-OFF	p. 11
	III.1. DEVELOPMENT OF NEW SCINTILLATION MATERIALS AND OF RADIATION DETECTORS FOR BIOMEDICAL IMAGING APPLICATIONS - THE CRYSTAL CLEAR PROJECT	p. 11
	III.2. RESEARCH PROGRAM RD46	p. 12
IV.	COMPUTING AND NETWORKING	p. 12
V.	TECHNICAL AND ADMINISTRATIVE WORK	p. 13
VI.	REPRESENTATION IN COUNCILS AND COMMITTEES	p. 14
VII.	TEACHING ACTIVITIES	p. 16
	VII.1. TEACHING ACTIVITIES (academic year 2001-2002)	p. 16
	VII.2. Ph.D. THESES, "MEMOIRES DE LICENCE" AND "LICENTIAATSVERHANDELINGEN" COMPLETED IN 2002	p. 18
VIII.	SEMINARS AND ORAL PRESENTATIONS AT CONFERENCES, SCHOOLS AND COLLABORATION MEETINGS	p. 18
	VIII.1 SEMINARS AT IIHE	p. 18
	VIII.2. ORAL PRESENTATIONS AT CONFERENCES, SCHOOLS AND COLLABORATION MEETINGS	p. 20
IX.	SCIENTIFIC VULGARISATION AND OUTREACH ACTIVITIES	p. 21
X.	ATTENDANCE TO CONFERENCES, WORKSHOPS AND SCHOOLS	p. 22
	X.1 CONFERENCES AND WORKSHOPS	p. 22
	X.2. SCHOOLS	p. 25
	X.3. TECHNICAL FORMATIONS	p. 25
XI.	LIST OF PUBLICATIONS, REPORTS AND ORAL CONTRIBUTIONS TO CONFERENCES BY MEMBERS OF THE IIHE	p. 25
	XI.1. PUBLICATIONS	p. 25
	XI.2. CONFERENCE PROCEEDINGS	p. 28
	XI.3. REPORTS	p. 29
XII.	ILLUSTRATIONS	p. 29

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)**, the **Vlaams Instituut voor de bevordering van het wetenschappelijk-technologisch onderzoek in de industrie (IWT)** and the **Belgian Federal Office for Scientific and Cultural Affairs (OSTC)**. 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 2002.

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 S. Lowette (wetenschappelijk medewerker FWO since October 2001)
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 F. Udo (wetenschappelijk medewerker - deeltijds 20 %)
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 W. Van Doninck (onderzoeksdirecteur FWO, on leave of absence at CERN since January 2000)
 D. Wisniewski (wetenschappelijk medewerker Bilateraal akkoord Vlaanderen-Polen till January 2002)
 C. Yu (wetenschappelijk medewerker FWO since July 2002)

T. Anthonis, W. Beaumont, T. Beckers, E. De Wolf, 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 communication is conducted at IHE/VUB by R. Vandembroucke and A. Isaac 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).

(R. El Aidi, P. Vilain, B. Van de Vijver, 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 optimized 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 event.

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

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

where $E(\text{GeV})$ and $L(\text{km})$ are the neutrino energy and flight length, $\Delta m^2(\text{eV})$ is the squared mass difference of the mass eigenstates and $\theta_{\mu\tau}$ their 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 corrections on the fiber trackers alignment;
- 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 opens, in addition, new possibilities in the study of charmed particle production. Two results were recently published on this subject : the D^0 meson production rate and the observation of a charm-anticharm pair in a charged current interaction. More analyses are in progress and will be published in 2003.

B. OPERA experiment (CNGS1).

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

In 2000, the CERN Council approved the construction of the CNGS beam, from SPS towards Gran Sasso. The OPERA project, based on this beam, was approved in February 2001.

The motivation of this experiment is rather simple : there is now a clear evidence, mainly in the Super Kamiokande experiment, of a deficit in the flux of upward-going 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 $\sin^2 2\theta > 0.8$. OPERA aims to cover this range of parameters and demonstrate the ν_μ - ν_τ oscillation hypothesis through the direct observation of ν_τ interactions.

The detector design is 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 in CHORUS. The proposed solution consists in stacking 1 mm thick Pb foils interleaved with 200 μm plastic sheets covered on both sides by 50 μm emulsion layers. Detailed simulations of this configuration have shown that a high τ detection efficiency can be preserved while keeping the background at a tolerable level.

The detector structure is very modular :

- 56 Pb sheets of about 120 cm^2 area form a 8.5 kg "brick";
- 3264 bricks are assembled in a vertical "wall". Each wall, of about 40 m^2 area, is followed by 2 tracker planes made of plastic scintillator strips;
- a "supermodule" is made of 33 walls followed by a muon spectrometer;
- the detector contains 2 supermodules to reach an effective target mass of 2000 tons.

Our laboratory is more specifically engaged in the conception, construction and installation of the Target Trackers (TT) together with IReS at Strasbourg and the universities of Bern, Lyon and Neuchatel. A tracker plane will consist of 4 modules, each composed of 64 scintillator strips equipped with wavelength shifting fibers. The optical signals transmitted by the fibers will be readout at both ends by multichannel photomultipliers.

Intensive R&D work has been performed to establish the performances and the detailed design of these detectors, leading the OPERA collaboration to approve the choice of this technology. We also participated in the development of an alternative solution based on liquid scintillators. Very efficient and economical, this solution was however discarded, mainly for safety reasons.

Today, 6 prototype modules have been built in order to test different scintillator materials, different assembly schemes and installation procedures. The contracts with the producers of the various detector elements are about to be signed and the production of the 528 modules will start in summer 2003. The OPERA detector should be completed in 2006 when the CNGS beam is foreseen to enter in operation.

C. Neutrino astronomy with AMANDA.

(D. Bertrand, O. Bouhali, C. De Clercq, D. Hubert, 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).

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 photomultiplier 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 crucial test of the performance of the detector is the detection of atmospheric neutrinos. An analysis was performed with the data taken in 1997 with AMANDA-B10 (302 PMTs in 10 strings on an array of diameter 120m and height 500m). A total of about 300 events were found. The distribution of the cosine of the zenith angle was consistent with the expectation from the simulation of atmospheric neutrinos. The distribution of celestial coordinates was consistent with the assumption of being random. A first analysis of the data taken in 2000 with the full detector configuration (AMANDA-II) allowed to select about 1500 muon-neutrino events with zenith angle and energy distribution compatible with what is expected for atmospheric neutrinos.

The data taken in 1997 were also used for the following analyses, which were published in 2002:

- *Search for diffuse fluxes of high energy extraterrestrial neutrinos*

This study is based on the shape of the neutrino energy spectrum which showed no excess of events in a sample corresponding to 130 days of data taking. Assuming an E^{-2} flux behaviour the following upper limit on the flux

was obtained:

$$E^2 \Phi_{90\%}(E) \leq 8.4 \times 10^{-7} \text{ cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1} \text{ GeV}$$

- *Search for point sources of high energy neutrinos*

A search was performed for pointlike sources of high energy neutrinos. The absolute pointing accuracy and angular resolution of AMANDA-B10 was obtained from a study of coincident events between AMANDA and two independent telescopes on the surface, the GASP air Cherenkov telescope and the SPACE extensive shower array. The angular resolution was found to be around 3 degrees. No statistically significant excess of events was detected from any direction. Upper limits on neutrino fluxes from sources with E^{-2} spectra were derived as function of the declination angle.

- *Indirect Dark Matter searches*

A search was performed for nearly vertical up-going muon-neutrinos from neutralino annihilations in the centre of the Earth. No excess over the expected atmospheric neutrino background was found. An upper limit was derived on the annihilation rate of neutralinos in the centre of the Earth, as well as the corresponding muon flux limit, both as function of the neutralino mass in the range 100 GeV – 5000 GeV. In the high mass region these first AMANDA results are competitive with those obtained by eg the MACRO detector in much longer livetime.

- *Search for SuperNova (SN) neutrino bursts*

The core collapse of a massive star in the Milky Way will produce a neutrino burst intense enough to be detected in underground detectors. Such collapses produce MeV neutrinos which produce a collective rate increase in all PMTs on top of dark noise. A first search for SN neutrinos was conducted with the data taken in 1997 and 1998 (215 days livetime) with AMANDA-B10. No candidate events resulted from this search. An upper limit at the 90% c.l. on the rate of stellar collapses in the Milky Way was derived, yielding 4.3 events per year.

The analysis of the data taken with AMANDA-B10 in 1998 and 1999 is now underway. In parallel the data taken with AMANDA II from 2000 onwards are being processed and analysed. A lot of effort has been invested in a better parametrisation of the detector response in the simulation: the ice properties (dust layers, ...) and the PMT response. Work is also going on in the modelling of muon propagation through rock and ice, and the modelling of the atmospheric neutrino and muon fluxes. Both efforts aim at reducing the systematic errors which are now of the order of 25%.

2) Activities of the IIHE group

The IIHE group took a large responsibility in the analysis 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 performed in 2002 and gave already preliminary results:

- study of WIMP (neutralino) annihilations in the center of the earth
 - search for high energy pointlike neutrino sources inside and outside our galaxy
- These analyses gave the opportunity to refine and to test the Monte Carlo simulation programs. In particular a careful study was done of the angular sensitivity of the PMTs.

From the hardware point of view the tests which were started in 2001 have been pursued:

- tests of different polymers to be used as wave length shifters (WLS) on the glass spheres surrounding the PMTs, with the aim of improving the light transmission for wavelengths around 300 nm. As most of the Cherenkov light emitted by relativistic muons has this wavelength, a better transmission would result in an overall better efficiency of detection. The WLS will be put on the PMT glass for the future IceCube detector. Many products have been tested up to now, but no satisfactory solution has been found yet. These tests are done in close collaboration with the group at the UMH, where a similar station was built.
- measurement of the sensitivity of the PMTs for illumination at different polar and azimuthal angles. A special setup was built at the IIHE for this purpose. The results of these measurements have been incorporated in the AMANDA detector simulation and reduced the discrepancy between the real and simulated data by a couple of percent.

The IIHE has contributed to the upgrading and maintenance of the AMANDA reconstruction and simulation software. For example a novel technique has been designed to speed up the simulation of the transport of the Cherenkov light in the ice. The IIHE was also responsible for the coordination of the online data monitoring in 2002 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. Pukhaeva, C. Vander Velde, 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, 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 in progress. In the following paragraphs the main results published in 2002 are discussed with special emphasis on the contributions from the physicists of the Brussels-Antwerp group.

1) Physics results at the Z^0 resonance

The analysis of correlations between particles produced in hadronic Z^0 -decays is an effective tool for studying the parton fragmentation processes.

The predictions of two fragmentation models, the "string model" used in Jetset 7.3 and the "cluster model" used in Herwig 5.9, were compared. The data on K^+K^- and $p\bar{p}$ rapidity-alignment are consistent with the string model whereas the non-perturbative process of "gluon splitting to di-quarks" had to be incorporated in the cluster model to bring it in agreement with the data. Also particle correlations in p_T for $\pi^+\pi^-$, K^+K^- and $p\bar{p}$ pairs were found to be in much better agreement with Jetset than with the Herwig 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.

The precise determination of the W-boson mass M_W and Γ_W was pursued during 2002, leading to the latest preliminary DELPHI results :

$$m_W = (80.414 \pm .074(\text{stat}) \pm .048(\text{syst})) \text{ GeV}/c^2$$

$$\Gamma_W = (2.158 \pm .189(\text{stat}) \pm .082(\text{syst})) \text{ GeV}/c^2$$

for the semileptonic $W^+W^- \rightarrow q\bar{q} l \bar{\nu}$ channel and :

$$m_W = (80.371 \pm .053(\text{stat}) \pm .111(\text{syst})) \text{ GeV}/c^2$$

$$\Gamma_W = (2.192 \pm .107(\text{stat}) \pm .134(\text{syst})) \text{ GeV}/c^2$$

for the fully hadronic $W^+W^- \rightarrow q\bar{q} q\bar{q}$ channel.

The combined DELPHI result is :

$$m_W = (80.404 \pm .053(\text{stat}) \pm .053(\text{syst})) \text{ GeV}/c^2$$

$$\Gamma_W = (2.179 \pm .100(\text{stat}) \pm .093(\text{syst})) \text{ GeV}/c^2$$

These results are in good agreement with those of other LEP experiments.

Searches for neutral Higgs Bosons of the Standard Model (SM) and the Minimal Supersymmetric Standard Model (MSSM) were extended up to the highest available energies.

From the results obtained for e^+e^- annihilation energies below 202 GeV, 95 % confidence level lower mass bounds of 107.03 GeV/c^2 could be set on the mass of the SM Higgs-boson and of 85.9 GeV/c^2 and 86.5 GeV/c^2 on the MSSM masses of the lightest neutral scalar and pseudo-scalar respectively.

The information presently available on the allowed range for the SM-Higgs-mass m_H , which is dominated by the results of the LEP-experiments, is displayed in figure 2. The 95 % confidence upper limit on $m_H = 211$ GeV, whereas a lower limit of 114 GeV is obtained from direct searches.

No candidates were found in a search for pair-produced charged Higgs bosons at center-of-mass energies from 189 to 202 GeV leading a lower limit on the mass of such hypothetical particles of 71.5 GeV/c² at the 95 % confidence level.

More exotic searches were performed for supersymmetric particles but no signals were found at LEP II.

3) 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 (BEBC)*
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).
- *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 at $\sqrt{s} = 189$ GeV.

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

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

During the year 2001-2002 HERA initiated the phase II collider upgrades which will enable a gain of 4 in collider luminosity. Several obstacles and problems were incurred during the realization of these upgrades. The new supra-conducting magnets presented huge collider background problems associated with their out-gassing. Further, the newly installed collimators also created background induced particle sources in the bunched proton beam. These and related upgrade problems delayed data taking until September, 2002. During 2002 however, HERA was also able to register its first data taking with beams of polarised positrons.

In addition to collider upgrading several other ameliorations occurred with the H1 detector. Amongst these was an upgrade of the liquid Ar calorimeter electronics as well as a new track detector for tracks emanating at the production vertex. Overall the H1 detector has continued to function well.

Our multi-wire proportional COP chamber has continued to function well over the last year with still only 2 out of 32 sectors inefficient. A new monitoring scheme has been installed which automatically monitors our chamber's efficiency over the most recent data taken.

During the HERA phase II ongoing projects the Belgian H1 group (IIHE, UIA) has proposed and had approved at DESY the operation of a new proton spectrometer, the VFPS, which will be installed during the spring 2003 shutdown. The VFPS (Very Forward Proton Spectrometer) has incorporated two Roman Pot detectors utilising scintillating fibre registering of particle hits. The Roman Pot detectors are inserted inside the beam pipe and are retracted during particle injection and tuning of the proton beam, then entered very close to the passing circulating proton beam during stable running conditions and diffraction data taking. A pair of pots are separated by 3.7 meters and are installed in a long magnet free region of the beam line 6.2 meters in length. The pots are located at some 220 meters forward in the proton direction from the nominal interaction point in the H1 detector. The location of the Roman pots is in the "cold" section of the HERA ring; namely that part of the beam line reserved for supra-conducting magnets maintained at low temperature by liquid helium circulation. It was necessary to reroute the circulating liquid helium conduction in the cold regions in order to operate the pots at ambient temperature.

The most recent tests concerning this rerouting of the liquid helium cooling, done by the firm DEMACO at DESY in January 2003, were successful. The mechanical infrastructure of the Roman Pot assembly is now 80 % finished. The scintillating fibre detectors were constructed by the DESY-Zeuthen group and assembly was aided by the IIHE Brussels group in May, 2002. The pot detector electronics and the temperature as well as the positioning control have been developed by the Hamburg II group. Some of the electronics and parts of the pot detectors have been transported to Brussels for further assembly and testing. Tests in Brussels including motors, temperature probes, data acquisition, beam conditions, interactions rates etc. are now almost completed.

Some H1 recent results :

- *Jet production*

Further studies of Jet production cross sections were made in DIS ep scattering. Data representing an integrated luminosity of 21.1 pb^{-1} were used in presenting these results with photon virtualities of Q^2 between 5 and 100 GeV^2 . Cross sections were published differentially in Q^2 , in jet transverse energy E_T , in (E_T^2 / Q^2) and in η , the lab pseudo rapidity. Perturbative QCD calculations in NLO give a good description of the data in most of the phase space with significant discrepancies only for jets for which $E_T < 20 \text{ GeV}$ and $Q^2 < 20 \text{ GeV}^2$ which correspond to a region in which NLO corrections are the largest.

- *Inelastic J/ψ photoproduction*

From ep data of 80 pb^{-1} differential and double differential diffractive cross sections were measured and presented for $60 < W_{\gamma p} < 260 \text{ GeV}$, $1 < p_T^2 < 60 \text{ GeV}^2$ and $0.05 < z < 0.9$. One notes that the data are well described in the framework of the Colour Singlet Model at NLO for direct photon processes in the region $0.3 < z < 0.9$ and up to the highest p_T^2 values. A calculation using a k_t factorisation approach in LO in the Colour Singlet Model is also able to describe the data. Data in the full z range were also compared to LO calculations within a non-relativistic QCD framework including colour octet and colour singlet contribution for direct and resolved photons. The J/ψ meson polarisation as a function of z where z is the fraction of the photon energy transferred to the J/ψ in the proton rest frame and $p_{T\psi}$ is reasonably described by theoretical predictions.

- *Diffractive of light meson production*

The helicity structure of diffractive electroproduction of ρ mesons $ep \rightarrow e \rho Y$ was studied in a heretofore unexplored region of 4 momentum transfer squared at the proton vertex, $0 < t' < 3 \text{ GeV}^2$, where $t' = t - t_{\min}$. No t dependence of the r_{00}^{04} spin density matrix element was observed. A significant t dependant helicity non-conservation from virtual photon to ρ meson was found for spin density matrix element contributions $r_{00}^{05} + 2r_{11}^5$ and $r_{00}^1 + r_{11}^1$. The t dependencies are consistent with that predicted by a perturbative QCD model based upon the exchange of 2 gluons.

- *Diffractive photoproduction of $\psi(2S)$ mesons*

The results on diffraction photo-produced $\psi(2S)$ mesons was presented using data collected from 1996-2000 in H1 and using an integrated luminosity sample of 77 pb^{-1} . The energy dependence of diffractive $\psi(2S)$ cross sections are found to be similar although somewhat steeper than that seen for J/ψ meson production. The t dependence for elastic $\psi(2S)$ production was found to be compatible to that seen for J/ψ . For the proton dissociative channel, $b_{\text{pd}\psi(2S)}$ is some 2.3 σ smaller than for J/ψ production. With a proper account made for individual $\psi(2S)$ wavefunctions, perturbative QCD predictions are found to describe well the measurements.

- *Search for Exotica*

Excited Electrons : The search for $e^* \rightarrow e\gamma$, $e^* \rightarrow eZ$, $e^* \rightarrow \nu W$ in the CM energy range of 300-318 GeV has yielded no signal found. The present limits extend the excluded region to higher mass than formerly explored.

Odderons : $ep \rightarrow e \pi^0 N^*$ from γp CM energies $\sim 215 \text{ GeV}$ has been reported. An upper limit of $< 49 \text{ nb}$ at the 94 % confidence level is derived and integrated over the experimentally accessible range of squared four momentum transfer at the nucleon vertex, $0.02 < |t| < 0.3 \text{ GeV}^2$. This result excluded then a non-perturbative QCD model prediction of photon-Odderon fusion above 200 nb.

Excited Neutrinos : Using 15 pb^{-1} of integrated luminosity data in the CM energy range of 318 GeV no evidence can be reported for observing excited neutrino production.

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

(W. Beaumont, T. Beckers, D. Bertrand, O. Bouhali, B. Clerbaux, G. De Lentdecker, O. Devroede, E. De Wolf, J. Lemonne, S. Lowette, F. Moortgat, L. Neukermans, J. Stefanescu, S. Tavernier, F. Udo, C. Vander Velde, W. Van Doninck, P. Vanlaer, F. Verbeure, J. Wickens, Yu Chunxu 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 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 48 support structures in the shape of a sector of a wheel (so called petals), long term tests of the modules and the petals.

The laboratory at the IIHE is now ready to start the production of its part in the CMS detector. The clean rooms are ready, the automatic module assembly gantry is operational; a probe station with a X-Y-Z stage to test Si sensors is ready, a set-up to test electronics hybrids is ready, a set-up to test frame deformation after temperature cycles is ready. The system to test fully assembled petals is being set-up. The clean room and the module test station at the UIA are also ready. All major contracts with industry are placed : the pitch adapters reordered, the carbon fiber plates and graphite plates are ordered, and for most of it, delivered to the IIHE.

The 200 pitch-adapters 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. The IIHE physicists also actively take part in the development of the new, object oriented reconstruction software (FAMOS). 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 $H^0, A^0 \rightarrow \chi_2 \chi_2 \rightarrow 4 l^\pm$ 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, M. Krieguer, S. Leonard, L. Jianguai, P. Szupryczynski, D. Wiesniewski)
Technical support : J. Debryne and Ch. Wastiels

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 cancer 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 germinate (BGO), and more recently superior materials such as lutetium orthosilicate or aluminates, faster and more effective than BGO.

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. We are also negotiating licence 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) is being set-up.

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 8x8 mm while the quality control and assembly of the detector modules, a number of tools have been developed.

To check several thousand crystals, a crystal evaluation set-up was developed. This set-up automatically measures the light yield and decay time of crystal batches. The results are stored in a database and used for crystal selection. To precisely mount an assembled crystal matrix onto the pixels of the PSPMT, a two-camera guided system was developed. This allows us to view the bottom of the crystal matrix and the top of the PSPMT relative to one another during the mounting phase. The imaging software computes the relative displacement and rotation to align both components.

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.

In preparation for the design of the next generation small animal PET scanner, studies to further increase sensitivity and spatial resolution 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 or statistically based methods.

III.2. RESEARCH PROGRAM RD46.

(L. Benussi, P. Vilain, G. Wilquet)

This R and D activity started in the nineties by the study of new liquid scintillators, the construction techniques of very thin glass capillary fibers and the readout optoelectronic devices. A new type of image intensifier tube called EBCCD (for **E**lectron **B**ombarded **C**CD) has been developed, showing excellent performances. Between March 98 and February 2002, this program has received the support of a TMR (**T**rainning and **M**obility of **R**esearchers) contract of the European Communities, allowing 3 foreign researchers to be engaged for various periods.

In the last phase of the program, the use of liquid scintillator in large dimension polycarbonate cells was investigated as a promising technique for the target trackers of the OPERA experiment (see II.1.B.). Real size prototypes were built and tested in different beams, with a EBCCD readout. Although the performances were very satisfactory (cf. p. 26 Opera Publication) and the construction easy and quite cheap, this solution was however not adopted by the OPERA collaboration : the risk of liquid leakage was considered too high and the long readout time of the EBCCD was hardly compatible with the auto-triggering scheme designed for the OPERA detector.

IV. COMPUTING AND NETWORKING

Management: R. Vandenbroucke

Research staff: Alain Isaac

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

Management

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

Operations

G. Rousseau and E. Torisaen were sharing the day-to-day logistic tasks necessary to be done in the IIHE computing environment; these tasks included backups, printers maintenance and management of the redistribution of user equipment, follow-up of repairs and the very important user support. G. Rousseau took care of the network infrastructure and realised all cabling and network connections needed for the maintenance and extension of the IIHE local area network. He gave a first level support for Macs, PCs, VMS and Unix machines. He did the day-to-day verification work for the Antivirus and anti-spam mail software. E. Torisaen took care of software installation for all UNIX flavoured machines (workstations and PCs) and gave high-level support for PCs and UNIX. G. Rousseau, E. Torisaen and R. Vandenbroucke installed Windows NT PC's and PC applications.

Next to administrative tasks D. Pirnay created web pages, as well those for the IIHE as those for CUO BELUX and BTA.

Systems

The number of PCs in the laboratory has continued to grow during 2002. 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 new storagesystem. In total more than a Terabyte of disk is now used in the centralised storagesystem. A first Linux cluster of 10 Intel Pentium 4 systems has been set up.

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.

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.

Projects

NGNLAB : New Generations Networks Demonstrations, project in the frame of the 5th framework programma of the European Commission.

EuroV6 : IPv6 demonstrations, project in the frame of the 5th framework programma of the European Commission.

V. TECHNICAL AND ADMINISTRATIVE WORK.

Technical and Administrative work.

The members of the workshop staff in 2002 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 M. Pins and R. Pins. The quality of the pitch adapters was and will be checked during all the production on special machine at CERN by P. 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 and H. De Nil 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. 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 was in charge of the design of the pitch adapters which will interface the modules to the amplification electronics, M. Pins and R. Pins collaborated with the DESY-Zeuthen group to the construction of the scintillating fibre detectors for the VFPS. The CMS team working on the electronics was recently joined by J.-P. Dewulf and he will contribute to the development of the CMS readout 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.

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 with the help of 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. Luypaert-Peymans. 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-Vancauwenberge 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 physics council, member of the Doctoral commission of the ULB Physics Department, 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 external rapporteur for the PhD thesis of David Fayolle, Université Blaise Pascal, Clermont Ferrand, France (04.10.02), Vice-chairperson of the IUAP/PAI P5/27 "Fundamental interactions", representative of the physics department in the "PR commissie faculteit wetenschappen VUB".

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

E. Dewolf organized the 10th Workshop on Low x Physics which was held in Antwerpen from 16 to 19 September 2002 and acted as member of the FWO-committee "Subatomaire Fysica".

L. Favart was "secrétaire du département de physique de l'ULB". He was also "discussion leader" at the Workshop on Low x Physics, Antwerp (B), 16-19 September 2002.

X. Janssen acted at the ULB as member of : the ULB Science Faculty Council, the ULB Commission of Student discipline, the ULB Commission of the Student social affairs, the ULB Cultural Commission and the ULB Library Council.

J. Lemonne was Vice-President of the "Nationaal Comité voor Natuurkunde" of the Belgian Academy of Sciences, member of board of the "Vlaams Interuniversitair Instituut voor Biotechnologie" (VIB) until June 2002, member of the Scientific Commission "Hautes et Basses Energies" of the IISN until September 2002, president of the Belgian Selection Committee of CERN fellows and representative of the FWO in the Resources Review Board for the CMS experiment.

P. Marage is dean of the Faculty of Sciences of the ULB.

R. Roosen acted as representative of the physics department in "Commissie Doctorale Opleidingen (CDO)", secretary of the "Doctorale Examen Commissie" of the VUB, representative of the physics department in "Commissie internationalisering, European Mobility Shem, EMSPS" and member of the "Executive Committee (PRC)" until September 2002.

S. Tavernier was member of the "Onderzoeksraad" and chairman of the "Facultaire onderzoekscommissie Wetenschappen" van de Onderzoeksraad.

R. Vandenbroucke 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".

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.

P. Van Mechelen organized the 10th Workshop on Low x Physics which was held in Antwerpen from 16 to 19 September 2002.

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, China, 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 member of the European Committee for Future Accelerators (ECFA), delegate of Belgium at the Advisory Committee of CERN Users (ACU), member of the Board of the Belgian Physical Society (BPS), and member of the Organization Committee of the General Scientific Meeting of the BPS and of the Journées Jeunes Chercheurs of the BPS 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.
- **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 (CB), the Finance Board (FB), the Tracker Institution Board (TIB), the Tracker Finance Board (TFB) and the Tracker Project Office (TPO).
- **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
- **O. Bouhali** : coordinator of the Gantry Software group.

4) of the *CHORUS experiment* :

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

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, member of the collaboration board and convenor 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".
- **P. Bruyndonckx** : member of the Steering committee "Open Gate".

VII. TEACHING ACTIVITIES.

VII.1. TEACHING ACTIVITIES (academic year 2001-2002).

- **D. Bertrand**
 - PHYS 109 "Physique des Particules" (0-0-75)
 - Member or President of the Jurys of 4 PhD Thesis
 - STAT606 "Computer Principes" (39-0-13) – 1st year in English
 - "Description des ordinateurs (aspects matériels et logiciels)" (45-0-15)
 - Preliminary year of the "Licence en informatique" UMH-Charleroi
- **O. Bouhali**
 - "General Electronics", for the 2nd year in computer science, ULB
 - "Experimental Physics Techniques", practical work for the 3rd year in physics
- **P. Bruyndonckx**
 - "Beeldvormingstechnieken (Verplicht aanvullend practicum 1^{ste} licentie Natuurkunde)
 - Labo "Meting levensduur van het muon" (1^{ste} licentie Natuurkunde)
 - "Inleiding tot mathematica" (1K Natuurkunde)
- **C. Declercq**
 - Contribution to the 30 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.
- **G. De Lentdecker**
 - Contribution to the practical work for ULB students of the 3rd year in physics.
- **E. Dewolf**
 - Kanstheorie en Statistiek theory (30 h - 1^{ste} kandidatuur Natuurkunde) RUCA
 - Fundamentele Interacties, 30 h 2^{de} licentie Natuurkunde UIA.
- **J. D'Hondt**
 - "Algemene natuurkunde II", taught by J. Lemonne : Electro-magnetisme, kristallografie en quantum mechanics (40 h exercices, 2^{de} kandidatuur Natuurkunde, Scheikunde en Geologie - VUB)
- **L. Favart**
 - "Eléments d'électromagnétisme", séances d'exercices du cours de 1^{ère} candidature en informatique (titulaire : C. Vander Velde) - 30 heures
 - Contribution to the practical work for ULB students of 1^{ère} Licence Physique (~ 50 h)
- **A. Fremout**
 - Brugcursus Natuurkunde (introductory courses on physics for new students)
- **X. Janssen**
 - Practical work of the course "Physique des particules" (P. Vilain)
 - Practical work of the course "Techniques de la physique expérimentale" (G. Wilquet, P. Broeckaert)
- **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)

- **St. Lowette**
 - Exercice of the course "Algemene Natuurkunde" taught by Prof. J. Lemonne (1ste candidature 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 - ULB)
 - "METH083 : Histoire des sciences et épistémologie" (15 h - agrégation de l'enseignement secondaire supérieur - toutes sections Faculté des Sciences - ULB)
- **Ph. Olbrechts**
 - "Practicum Algemene Natuurkunde" - Prof. C. De Clercq (1ste candidature natuurkunde - VUB) 2001-2002
- **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)
 - Bijdrage tot the practica georganiseerd in kader van de cursus "Fysica van de elementaire deeltjes I", 1ste 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} candidature natuurkunde - VUB).
 - Supervision of the Ph.D thesis of A. Fremout, S. Léonard and M. Krieguer
- **C. Vander Velde**
 - Physique du secondaire (30 h + 110 h practical work) – agrégation de physique
 - Eléments d'électromagnétisme (30 h lecture) – 1^{ère} candidature informatique
 - Electronique (16 h practical work + 16 h lab) – 2^{ème} candidature informatique
 - Supervision of the mémoire of Hassan Imatouchan
 - 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; 1ste candidature burgerlijk ingenieur VUB).
- **B. Van de Vyver**
 - Oefeningen(6h) for the course "Elementaire deeltjes" taught by J. Lemonne (1ste Licentie Natuurkunde)
- **P. Vanlaer**
 - "PHYS026 : Physique générale et éléments de cristallographie" (32 h - 2^{ème} candi en physique - ULB) - Prof. Ph. Emplit - Apport personnel : mise en place et encadrement d'une nouvelle manipulation de 3 jours (construction d'un amplificateur audio simple)
 - "PHYS106 : Techniques de la physique expérimentale" (35 h - 1^{ère} licence en physique) - Prof. G. Wilquet
- **P. Van Mechelen**
 - Practicum Kanstheorie en Statistiek (15 h - 1ste candidature Natuurkunde) RUCA
 - Practicum Numerieke Technieken (15 h 1ste licentie Natuurkunde) RUCA.
- **P. Vilain**
 - "Questions Approfondies de Physique des Particules" (15 h - 2^{ème} licence en physique - ULB)
Practical works associated to this course (35 h)
 - "Physique des Particules" (26 h - 1^{ère} licence en physique - ULB)
Practical work associated to this course (~ 32 h)
 - Additional Practical works (à option) (37 h - 1^{ère} licence en physique - ULB)
 - Co-promotor of the PhD thesis of R. El Aidi (ULB) and B. Van de Vyver (VUB) until April 2002
 - Organization of the IIHE Seminars

- **F. Verbeure**
 - Sub-atomaire fysica, 30 h (30 h - 1^{ste} licentie Natuurkunde) UIA.
- **G. Wilquet**
 - "Technique de la physique expérimentale" (PHYS106) - 1^{ère} licence en sciences physiques ULB (14 h partim de 26 h)
 - Practical - 1^{ère} licence en sciences physiques ULB
 - Coordination of the practical in high-energy physics, ULB
 - Organisation de la visite du CERN pour la 1^{ère} licence en sciences physique, ULB

VII.2. PhD THESES, "MEMOIRES DE LICENCE" AND "LICENTIAATVERHANDELINGEN" COMPLETED IN 2002.

* PhD thesis.

- *C. Collard* : "Mesure de la structure en hélicité de la réaction $e + p \rightarrow e + \rho + Y$ en fonction de t à HERA"
Promotor : P. Marage
- *G. De Lentdecker* : "Contribution to the study of the central tracking system of the CMS detector at the LHC collider and to the elaboration of its online triggering system"
Promotor : C. Vander Velde
- *A. Fremout* : "Design study for a PET scanner based on the use of avalanche photodiodes and new scintillators"
Promotor : S. Tavernier
- *R. Heremans* : "Triple Regge analysis of single diffractive photoproduction at HERA"
Promotor : R. Roosen
- *B. Van de Vyver* : "Determination of the semi-leptonic branching fraction of neutrino - induced charm hadrons using nuclear emulsion"
Promotors : J. Lemonne, P. Vilain

* Mémoires de licence" and "licentiaatverhandelingen.

- *D. Hubert* : "Studie van supersymmetrische donkere materie en zoektocht naar neutralino's met de AMANDA-B10 detector"
Promotors : C. De Clercq (VUB), J.-M. Frère (ULB)
- *S. Cnockaert* : "Etude de la production diffractive de mésons vecteurs à HERA"
Promotors : L. Favart, P. Marage

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 :

- **L. Teodorescu** (INFN - Pisa) : "Kaon Electroproduction at Intermediate Energies" (E93018 Experiment at TJNAF).
- **Fr. Avignone** (University of South Carolina) : "Neutrinoless Double-Beta Decay, the Important Next Neutrino Experiments".

- **G. Bonneaud** (LLR Ecole Polytechnique) : "BABAR - recent results on CP violation in the B meson system".
- **L. Neukermans** (LAPP-IN2P3 Annecy - actually PAI-ULB) : "Calibration of the ATLAS electromagnetic calorimeter. Invisibly decaying Higgs boson search".
- **R. Fruehwirth** (HEPHY - Vienna) : "Recent developments in track reconstruction".
- **Chr. Royon** (CEA Saclay) : "Diffractive Higgs Production at Tevatron and LHC".

The following seminars were given by members of the IIHE :

- **C. Collard** :
 - "La diffraction à HERA", presented at the "laboratoire LLR de l'Ecole Polytechnique de Palaiseau, France", 17 June 2002
- **C. De Clercq** :
 - "De AMANDA neutrino detector : een ontmoeting tussen astronomie en deeltjesfysica op de Zuidpool - UPV & VUB, 23 October 2002
- **G. De Lentdecker** :
 - "Development of alternatives to the MSGC's for high rate experiments", RWTH Aachen, III. Physikalisches Institut A, Aachen (Germany) 10 July 2002
 - "Development of alternatives to the MSGC's for high rate experiments University of Wuppertal, Wuppertal (Germany) 08 August 2002
 - "Contribution to the study of the tracker of the CMS detector and to its High Level Trigger system" Fermilab, Batavia, IL, USA, 06 September 2002
- **E. Dewolf** :
 - "Workshop on Low x Physics", Antwerpen, 16-19 September 2002
- **J. D'Hondt** :
 - "Overview of W mass measurements at LEP2", University of Wuppertal, Wuppertal 2002 (UITN)
- **L. Favart** :
 - "L'étude du DVCS à HERA" - seminar at the Commissariat à l'Energie Atomique (CEA/DAPNIA/SPP), Saclay, France, 25 February 2002
 - "Ce que la diffusion diffractive de photons hautement virtuels peut nous apprendre sur la structure hadronique", seminar à l'Université de Liège, 1st July 2002
 - "La diffusion Compton à haute virtualité et les distributions de partons généralisées", seminar at the Centre de Physique des Particules de Marseille, France, 5th November 2002
- **R. Roosen** :
 - "Het inwendige van het proton", seminar first year : kaleidoscopische seminarie 30.01.2002
- **S. Tavernier** :
 - "The Crystal Clear collaboration activities" - talk at the LIP workshop on positron emission mammography, Lisboa, 1-2 July 2002
- **P. Van Mechelen** :
 - "A very forward proton spectrometer for H1", LAFEX International School on High Energy Physics (IISHEP 2002), Rio de Janeiro, Brazil, 4-8 February 2002
 - "New Roman Pot design from H1" - Common CMS/Totem working group, CERN, Geneva, 29-30 May 2002
 - Common CMS/Totem working group, CERN, Geneva, 29-30 May 2002
 - Workshop on Low x Physics, Antwerpen, 16-19 September 2002
- **P. Vilain** :
 - "Les oscillations de neutrinos", présenté à l'Ecole doctorale MICAS (ULB)
 - "Les résultats de SNO", présenté au Journal Club "neutrino" du network PAI

- **G. Wilquet :**
- "Neutrino masses and mixing, K. University of Leuven

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

- **O. Bouhali :**
- "Results from the AMANDA Telescope" - representing the AMANDA Collaboration at the XVIth International Conference on Particles and Nuclei, Osaka (Japan) October 2002
- **P. Bruyndonckx :**
- "HV power supplies" - talk presented at the Electronics and Front End Module Working Group meeting, Lausanne, 6 February 2002
- "Progress in front end module design and construction" - talk presented at Crystal Clear Collaboration, Lausanne (Suisse), 7 February 2002
- "Assembly device developed in Brussels", Crystal Clear Collaboration, CERN Geneva (Suisse), 26 June 2002
- "A test board for the Hamamatsu APD's", Crystal Clear Collaboration, CERN Geneva (Suisse), 27 June 2002
- "Performance of a detector module using APD's and LSO", Crystal Clear Collaboration, CERN Geneva (Suisse), 28 November 2002
- **C. Collard :**
"Diffraction at HERA", talk presented in name of H1 and ZEUS Collaborations, proceedings of the the Lake Louise Winter Institute on Fundamental Interactions Conference, Lake Louise, Canada, 17-23 February 2002
- **J. D'Hondt :**
- "Colour Reconnection in DELPHI", General Meeting DELPHI 2002
- "W mass measurements at LEP2 : general overview", DELPHI Conference, Prague 2002
- "Colour Reconnection at LEP2 : general overview", DELPHI Conference, Prague 2002
- "A selection of important LEP results", UIAP general meeting, Brussels 2002 (UITN)
- talk at XXXIth Multiparticle Symposium (Alushta)
- **L. Favart :**
- "Deeply inelastic compton scattering at H1 and ZEUS" – talk at the European Workshop on the QCD structure of the Nucleon (QCD-N'02), Ferrara (Italy), 3-6 April 2002
- "Diffractive Physics at HERA" – talk at the Workshop Hadrons Physics 2002, Bento Gon, Brazil, 14-19 April 2002
- **M. Krieguer :**
- "Implementation of LMF" - talk presented at the Simulation and Software Working Group meeting, Lausanne, 6 February 2002
- "From LMF to sinograms" - talk presented at the Simulation and Software Working Group meeting, Lausanne, 6 February 2002
- **S. Léonard :**
- "Status of module assembly facility in Brussels", Crystal Clear Collaboration meeting at CERN Geneva, 27-28 November 2002
- **J. Liu :**
- "First results from APD readout board developed in Brussels" - talk presented at the Electronics and Front End Module Working Group meeting, Lausanne, 6 February 2002
- **St. Lowette :**
- "Charged Higgs Searches at CMS" - talk presented at the 14th Annual Graduate School of Particle Physics (Joint Belgian-Dutch-German Summer School), Nijmegen (Netherlands), 16-27 September 2002
- "Search for Heavy Charged Higgs Bosons at the CMS experiment" - talk presented at the Journées Jeunes Chercheurs 2002, Aussois (France), 8-13 December 2002
- "Status Report on the $gb \rightarrow tH$ - Channel" - talk presented at the CMS PRS Tracker b-tau meeting, CERN Geneva (Switzerland), 26 November 2002

- **Ph. Olbrechts :**
 - "Results from the AMANDA telescope" - talk presented at the Particles and Nuclei International Conference, Osaka (Japan) - October 2002
- **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 :**
 - "Heavy MSSM Higgses at the LHC", for the ATLAS and CMS collaborations, orateur invité à la conférence SUSY02, 10th International Conference on Supersymmetry and Unification of Fundamental Interactions, DESY, Hambourg, 17-23 June 2002
 - "Vertex Reconstruction in CMS", orateur invité au Workshop on b and τ Physics at the LHC, Helsinki, 30 May-1st June 2002

IX. SCIENTIFIC VULGARISATION AND OUTREACH ACTIVITIES.

D. Bertrand :

- Organisation of a visit to CERN for secondary school teachers , April 2002

C. De Clercq :

- VUB responsible for the visits to the ULB Experimentarium for high school students
- Lesson about particle physics at the Middenschool SM9, Antwerpen, 25 March 2002
- Organisation of a visit to CERN for high school students, 8-12 July 2002
- Contribution to the organisation of the CERN travelling exhibition "De jacht of elementaire deeltjes", Technopolis, Mechelen, 8 Marth, 21 July 2002 - training of the edutainers
- Participation to the Vlaamse Wetenschapsweek, 21-25 October 2002

P. Marage :

- "Dans l'infiniment petit : la physique des particules élémentaires", at the "Cercle d'Astronomie de Bruxelles", January 17th 2002
- "L'histoire du vide", at the "Université du Temps Libre, Tournai", January 31st 2002
- "L'histoire du vide", at the "Extension de l'ULB, Libramont", February 28th 2002
- "L'affaire Galilée", at the "Extension de l'ULB, Maison de la Laïcité, Genappe", March 22th 2002
- Interview "Esprit libre" n° 1, 2002 : "L'ULB au fil des sciences"
- "L'affaire Galilée", at the "Extension de l'ULB, Manage", May 16th 2002
- "Les Conseils Solvay", at the "Congrès Pluraliste des Sciences, ULB", August 27th 2002
- "L'histoire du vide", at the "Extension de l'ULB Eau d'Heure, Parentville", October 4th 2002
- "Qu'est-ce que la sciences ?", at the "Bibliothèques scientifique de la Communauté Française, Parentville", October 15th 002
- "Les Conseils Solvay", at the "Athénée Royal Ernest Solvay, Charleroi", November 16th 2002
- "L'affaire Galilée", at the "Université du Temps Libre, Tournai", November 28th 2002
- "Les Conseils Solvay", at the "Journées françaises et belges des Doctorants en Physique Nucléaire, Physique des Particules et Astrophysique, Aussois (F)", December 10th 2002
- Participation to the "Antenne-Soir - RTBF-Hainaut", January 7th 2002
- Interview Vlan, June 12th 2002, concerning the career openings offered by the scientific studies
- Interview Le Soir, September 15th 2002, concerning the exhibition "Ma ville, un milieu vivant", Interview Matin "Première" (RTBF), September 20th 2002, concerning the role of sciences to solve the daily problems in the town

- Articles in *La Libre Belgique*, *Le Soir*, *La Dernière Heure*, *Vers l'Avenir* about "the Newtonia inquiry : the women in the scientific studies", October 9th 2002
- Interview at the RTBF (*Matin première*), *Radio Nostalgie*, *AB3-Télévision* about "the Newtonia inquiry" October 9th 2002
- Intervention "Les filles et les Sciences", study days "Digitales", Brussels, December 6th 2002
- "Femmes, écoles, formation" at the "Journée d'études Femmes et Sciences", PASS, Frameries", December 7th 2002
- President and rapporteur of the "groupe de travail - Le doctorat, et après" at the "International Workshop on PhD Studies", organised by Objectif Recherche, Brussels, December 15-16th 2002

C. Vander Velde :

- Introductory lecture to the CER N visit organised for teachers of high schools (4 h)

X. ATTENDANCE TO CONFERENCES, WORKSHOPS AND SCHOOLS.

X.1. CONFERENCES AND WORKSHOPS.

- Crystal Clear Collaboration Executive Steering Committee, CERN, 11 January 2002
P. Bruyndonckx, M. Goeman, S. Tavernier
- Workgroup for the development of a Geant4-based PET simulation platform, Institute of High Energy, University of Lausanne (Suisse) 22-23 January 2002
M. Krieguer
- Colloquium "NNV Practicumdag Natuurkunde, LUC", with talk "Practicum in de kandidaturen Natuurkunde aan de VUB, 25 January 2002
C. De Clercq
- Crystal Clear Collaboration General Meeting, Lausanne, 6-7 February 2002
P. Bruyndonckx, M. Grieguer, S. Leonard, J. Liu, S. Tavernier
- Crystal Clear Collaboration Steering Meeting, Lausanne, 8 February 2002
P. Bruyndonckx, M. Goeman, S. Tavernier
- Open GATE technical meeting, Institute of High Energy, University of Lausanne (Suisse), 26-27 February 2002
M. Krieguer
- GSM World Conference, Cannes (France), 21-22 February 2002
R. Vandenbroucke
- European Ipv6 Summit, Madrid (Espagne), 12-15 March 2002
R. Vandenbroucke
- Crystal Clear Working Group Meeting, Lyon, 18 March 2002, Lausanne, 19 March 2002
P. Bruyndonckx
- Crystal Clear Collaboration meeting in Brussels (practical topics, ordering, activities planning), 21 March 2002
S. Léonard
- General meeting of the "IUAP/PAI P5/27, "Fundamental Interactions", UCL, Louvain-La-Neuve, 26 March 2002
D. Bertrand, C. De Clercq
- Workshop "WW physics at LEP2 - WWMMII", CERN, Genève, 17-18 April 2002
C. De Clercq, J. D'Hondt, J. Lemonne

- Crystal Clear Steering Committee, CERN, 18-19 April 2002
P. Bruyndonckx, S. Tavernier
- Crystal Clear Working Group, Lyon, 24-25 April 2002
S. Leonard
- Journée Scientifique d'imagerie du petit animal de laboratoire, CERMEP-Lyon, 29 April 2002
S. Tavernier
- 10th International Workshop on Deep-Inelastic Scattering (DIS 2002), Cracovie (Pologne), 30th April - 4th May 2002
C. Collard, R. Heremans, P. Marage
- Colloquium "Wetenschappers : luxe of noodzaak ?", VRWB, Brussel, 6 May 2002
C. De Clercq
- CUO Europe Symposium, Lyon (France), 14-15 May 2002
R. Vandenbroucke
- Open GATE technical meeting, Institute of High Energy, University of Lausanne (Suisse), 23-24 May 2002
M. Krieguer
- Crystal Clear Software Group, Medasys-Orsay, 28 May 2002
P. Bruyndonckx
- Dag van de onderwijsvernieuwing, VUB, Brussel, 28 May 2002
C. De Clercq
- XXth International Conference on Neutrino Physics and Astrophysics, Munich (Germany), 25-30 May 2002
P. Vilain, G. Wilquet
- Workshop on b and τ Physics at the LHC, Helsinki (Finlande), 30 May -1st June 2002
P. Vanlaer
- TERENA Networking Conference, 3-5 June 2002
R. Vandenbroucke
- Belgian Physical Society – Liège (B), 5-6 June 2002
C. Collard, C. De Clercq, L. Favart, X. Janssen, S. Léonard, St. Lowette, P. Niessen, Ph. Olbrechts
- 3rd Beaune Conference on New Developments in Photodetection, Beaune, June 17-21 2002
P. Bruyndonckx, S. Tavernier
- 10th International Conference on Supersymmetry and Unification of Fundamental Interactions (SUSY02), DESY Hamburg (Germany), 17-22 June 2002
St. Lowette, P. Vanlaer
- Crystal Clear Collaboration General Meeting, CERN, 26-27 June 2002
P. Bruyndonckx, M. Krieguer, S. Leonard, S. Tavernier
- Crystal Clear Collaboration Steering Committee, CERN, 28 June 2002
P. Bruyndonckx, M. Goeman, S. Tavernier
- Workshop on positron emission mammography, Lisboa (Portugal), 1-2 July 2002
S. Tavernier
- Open GATE technical meeting, Institute of High Energy, University of Lausanne (Suisse), 4 July 2002
M. Krieguer

- 31st International Conference on High Energy Physics, Amsterdam (Netherlands), 24-31st July 2002
J. Lemonne
- 2nd International Workshop on the Emulsion Technology, Nagoya (Japan), 2002
G. Wilquet
- XXXIth International Symposium on Multiparticle Dynamics, Alushta , 2002
J. D'Hondt
- IFIP World Congress 2002, Seoul (Corée du Sud), 18-23 August 2002
R. Vandenbroucke
- New Worlds in Astroparticle Physics, Faro (Portugal), 4-8 September 2002
D. Bertrand
- First meeting of the ApPEC (Astroparticle Physics European Coordination) committee, Paris, 10 September 2002
D. Bertrand , C. De Clercq
- International Workshop of Low X Physics, Antwerp (B) 16-19 September 2002
R. Heremans, L. Favart, P. Marage, B. Roland, R. Roosen
- International Workshop on Neutrinos and Subterranean Science, Washington (USA), 18-22 September 2002
D. Bertrand
- Second meeting of the ApPEC committee, London, 27 September 2002
D. Bertrand , C. De Clercq
- Montreux (France), 9-11 October 2002
R. Vandenbroucke
- Particles and Nuclei International Conference, Osaka (Japan), October 2002
O. Bouhali
- Rencontres de Moriond EW, Les Arcs (France), 2002
J. D'Hondt
- Belgian Day on Biomedical Imaging, Brussels 18 October 2002
S. Léonard
- Third meeting of the ApPEC committee, Rome, 4-5 November 2002
C. De Clercq
- Octrooiseminarie, AZ-VUB, Brussels, 5 November 2002
M. Goeman, S. Tavernier
- European Research 2002, Brussels, 11-13 November 2002
M. Goeman
- IEEE 2002 Nuclear Science Symposium and medical imaging conference, Norfolk, USA, 10-16 November 2002
P. Bruyndonckx
- Crystal Clear Collaboration General Meeting, CERN, 27-28 November 2002
P. Bruyndonckx, M. Krieguer, S. Leonard, P. Szupryczynski, S. Tavernier
- Crystal Clear Collaboration Steering Committee, CERN, 29 November 2002
P. Bruyndonckx, M. Goeman, S. Tavernier
- Journées Jeunes Chercheurs 2002, Aussois (France), 8-13 December 2002
St. Lowette

- Open GATE technical meeting, Against 494 INSERM, CHU Pitié-Salpêtrière, Paris (France), 20 December 2002
M. Krieguer

X.2. SCHOOLS.

- Journée des doctorants de l'école doctorale MICAS de l'ULB, 17 January 2002, Parentville
C. Collard, L. Favart,
- 14th Annual Graduate School for high energy physics, Nijmegen (Netherlands) – 16-27 September 2002
St. Lowette, Ph. Olbrechts

X.3. TECHNICAL FORMATIONS.

- Séminaires Altera sur processeur Nios : Paris (France) 23 April, 14 MAY, 25 May, 07 June and 07 November 2002
J.-P. Dewulf

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

XII.1. PUBLICATIONS.

NEUTRINO PHYSICS : CHORUS

Determination of the semi-leptonic branching fraction of charm hadrons produced in neutrino charged-current interactions

A. Kayis-Topaksu et al.

Accepted by Phys. Lett. B

CERN-EP/2002-075

The large area emulsion tracker of the CHORUS experiment

S. Aoki et al.

Nucl. Inst. & Meth. A488 (2002) 144-154

Measurement of D^0 production in ν_μ charged current interactions

A. Kayis-Topaksu et al.

Phys. Lett. B527 (2002) 173-181

Observation of one event with the characteristics of associated charm production in neutrino charged-current interactions

A. Kayis-Topaksu et al.

Phys. Lett. B539 (2002) 188-196

NEUTRINO PHYSICS : OPERA

Large liquid-scintillator trackers for neutrino experiments

L. Benussi et al.

Nucl. Instr. & Meth. A488 (2002) 503-516

NEUTRINO PHYSICS : AMANDA

Search for Supernova Neutrino Bursts with the AMANDA detector
AMANDA Collaboration
Astropharticle Physics 16 (2002) 345-359

Results from AMANDA
J. Ahrens et al.
Modern Phys. Lett. A Vol. 17 n° 31 (2002) 2019-2037

Observation of high energy atmospheric neutrinos with the Antarctic muon and neutrino detector array
X. Bai et al., AMANDA Collaboration
Phys. Rev. D66, 012005 (2002)

Limits to the muon flux from WIMP annihilation in the center of the Earth with the AMANDA detector
AMANDA Collaboration
Phys. Rev. D66, 032006 (2002)

ep PHYSICS : H1

Search for Excited Neutrinos at HERA
C. Adloff et al.
Phys. Lett. B525 (2002) 9-16

Measurement of Dijet Electroproduction at Small Jet Separation
C. Adloff et al.
Eur. Phys. J. C24 (2002) 1, 33-41

Measurement of Dijet Cross Sections in Photoproduction at HERA
C. Adloff et al.
Eur. Phys. J. C25 (2002) 1, 12-23

Energy Flow and Rapidity Gaps between Jets in Photoproduction at HERA
C. Adloff et al.
Eur. Phys. J. C24 (2002) 4, 517-527

A Measurement of the t Dependence of the Helicity Structure of Diffractive Rho Meson Electroproduction at HERA
C. Adloff et al.
Phys. Lett. B539 (2002) 25-

Inelastic Photoproduction of J/Psi Mesons at HERA
C. Adloff et al.
Eur. Phys. J. C25 (2002) 1, 25-39

Inelastic Leptoproduction of J/Psi Mesons at HERA
C. Adloff et al.
Eur. Phys. J. C25 (2002) 1, 41-53

Search for QCD Instanton-Induced Processes in Deep-Inelastic Scattering at HERA
C. Adloff et al.
Eur. Phys. J. C25 (2002), 495-

Diffractive Photoproduction of $\psi(2S)$ Mesons at HERA
C. Adloff et al.
Phys. Lett. B541 (2002) 251-

Measurement of Inclusive Jet Cross-Section in Deep-Inelastic ep Scattering at HERA
C. Adloff et al.
Phys. Lett. B542 (2002) 193-

Search for Odderon-Induced Contributions to Exclusive π^0 Photoproduction at HERA
C. Adloff et al.
Phys. Lett. B544 (2002) 35-

Search for Excited Electrons at HERA
C. Adloff et al.
Phys. Lett. B548 (2002) 35-

Measurement of $D^{(*+-)}$ meson production and F_c^2 in deep-inelastic scattering at HERA
C. Adloff et al.
Phys. Lett. B528 (2002) 199-214

Deeply Inelastic Compton Scattering at H1 and ZEUS on HERA
C. Adloff et al.
Nucl. Phys. A711(2002) 4, 165-170

e+e⁻ PHYSICS : DELPHI

Search for neutral Higgs bosons in $e^+ e^-$ collisions at $\sqrt{s} = 191.6$ to 201.7 GeV
J. Abdallah et al.
Eur. Phys. J. C23 (2002) 409-435

Search for charged Higgs bosons in $e^+ e^-$ collisions at $\sqrt{s} = 189$ - 202 GeV
J. Abdallah et al.
Phys. Lett. B525 (2002) 17-28

Rapidity-alignment and p_T compensation of particle pairs in hadronic Z^0 decays
J. Abdallah et al.
Phys. Lett. B533 (2002) 243-252

p-p PHYSICS : CMS

Simulation study of silicon and gaseous tracking detectors
W. Beaumont et al.
Nucl. Inst. & Meth.. A478 (2002) 448-451

Experimental and simulation study of the behaviour and operation modes of MSGC + GEM detectors
M. Ageron et al.
Nucl. Inst. & Meth.. A489(1-3) (2002) 121-139

EXPERIMENTAL TECHNIQUES

Simulation study of silicon and gaseous tracking detectors
W. Beaumont et al.
Nucl. Instr. & Meth. A478 (2002) 448-451

Tracking in CMS : software framework and tracker performance
A. Khanov et al.
Nucl. Instr. & Meth. A478 (2002) 460-

Experimental and simulation study of the behaviour and operation modes of MSGC+GEM detectors
M. Ageron et al.
Nucl. Instr. & Meth. A489 (2002) 121-139

Operations of MSGC+GEM detectors in a high rate environment
A. Nowack et al.
Nucl. Instr. & Meth. A478 (2002) 250-253

Spatial resolution and depth of interaction studies with a PET Detector module composed of LSO and an APD Array

A. Fremout, R. Chen, P. Bruyndonckx, S. Tavernier
IEEE Transactions on Nuclear Science, Vol. 49 (2002), 131-138

VUV scintillation of Lu PO₄:Nd and YPO₄:Nd

... P. Bruyndonckx, S. Tavernier
IEEE Transactions on Nuclear Science, Vol. 49 (2002), 937-994

LuPO₄:Nd and YPO₄:Nd - new promising VUV scintillation materials

... P. Bruyndonckx, S. Tavernier
Nucl. Instr. & Meth. A486 (2002) 239-243

Traps and recombination centers in YA10₃:Ce,Co

... P. Bruyndonckx, S. Tavernier
Nucl. Instr. & Meth. A486 (2002) 482-485

Performance measurements of small animal positron emission tomograph

... P. Bruyndonckx
Journal of Nuclear Medicine, 43 (5): 212 Suppl. S May 2002

Luminescence and scintillation properties of YAG:Pr

... S. Tavernier
Nuclear Science, IEEE Transactions on, Vol. 49 (3), June 2002, 926-930

XI.2. CONFERENCE PROCEEDINGS.

Deeply Inelastic Compton Scattering at H1 and ZEUS on HERA

L. Favart
Contribution to the Proceedings of the European Workshop on the QCD structure of the Nucleon (QCD-N'02)

Diffraction Physics at HERA

L. Favart
Contribution to the Proceedings of the Hadrons Physics 2002 Workshop (HADRON 2002), pages 229-238 and hep-ph/0208127

A very forward proton spectrometer for H1

Proceedings of the LAFEX International School on High Energy Physics (LISHEP 2002), Rio de Janeiro, Brazil, 4-8 February 2002
P. Van Mechelen

Recherche des bosons de Higgs chargés lourds avec l'expérience CMS

To be published in the Proceedings of the "Journées Jeunes Chercheurs 2002", Aussois (France), 8-13 December 2002
S. Lowette

Results from the AMANDA Telescope

O. Bouhali
Particles and Nuclei International Conference, Osaka (Japan), October 2002

Measurement of trilinear gauge boson couplings in e^+e^- collisions at 189-209 GeV

S. Andringa, C. De Clercq et al.
DELPHI note 2002-034 CONF 568, July 9, 2002 - submitted to the "31st International Conference on High Energy Physics ICHEP02", Amsterdam (2002)

Atmospheric Neutrinos, WIMP's and Monopoles : Physics with the AMANDA Neutrino telescope

The AMANDA Collaboration, J. Ahrens et al.
Proceedings of the Dark Matter Workshop, Cape Town, South Africa, January 2002' conference (2002)

ICECUBE - the next generation neutrino telescope at the South Pole

The IceCube Collaboration, J. Ahrens et al.

Proceedings of the Neutrino 2002, Munchen, Germany, May 2002' conference (2002)

Results from the Antarctic Muon and Neutrino Detector Array

The AMANDA Collaboration, J. Ahrens et al.

Proceedings of the Neutrino 2002, Munchen, Germany, May 2002' conference (2002)

Recent Results from AMANDA II

The AMANDA Collaboration, J. Ahrens et al.

Proceedings of the "31st International Conference on High Energy Physics ICHEP02", Amsterdam (2002)

Physics and Operation of the AMANDA-II High Energy Neutrino Telescope

The AMANDA Collaboration, J. Ahrens et al.

Proceedings of the "Conference on Astronomical Telescopes and Instruments", Kona, Hawaii, August 2002' conference - ArXiv; astro-ph/0211269 (2002)

GATE, a Geant4 based simulation platform for PET integration movement and time management

... M. Krieguer

Proceedings of IEEE 2002 Conference on Nuclear Science symposium and medical imaging conference, November 10-16 Norfolk, Virginia, USA

XI.3. REPORTS.

OPERA, An appearance experiment to search for ν_s in the CNGS beam

M. Guller et al.

CERN/SPSC-2000-028, SPSC/P318, LNGS P25/2000

Test of light injectors for the OPERA TT monitoring

L. Etienne, G. Van Beek, P. Vilain, G. Wilquet

OPERA note 32-2002

XII. ILLUSTRATIONS.

Fig. 1 Schematic view of the ICE³ implementation at the South Pole.

Fig. 2 $\Delta\chi^2 = \chi^2 - \chi_{\min}^2$ rooms m_H curve. The full line is the result of a fit using all presently available data. These precision electroweak measurements show that if the Higgs exists, its mass has to be lower than 211 GeV/c² at 95 % CL.

Fig. 3 One of the two VFPS station to be installed in the summer 2003 in the H1 experiment to detect scattered proton in the beam pipe with small energy loss.

Fig. 4 Detector module of the CMS end cap silicon tracker with 2 silicon sensors on front end readout electronics.

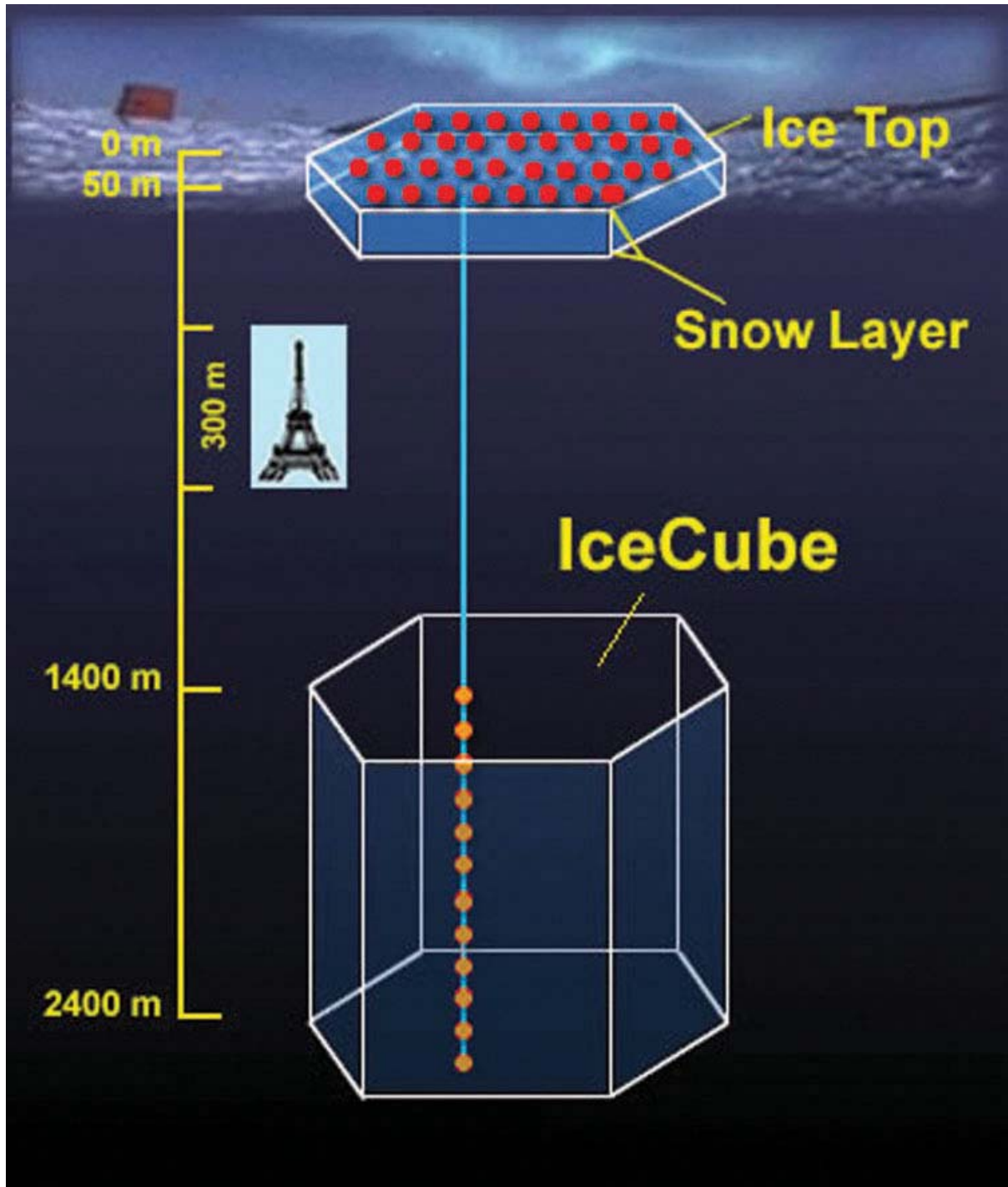


Figure 1

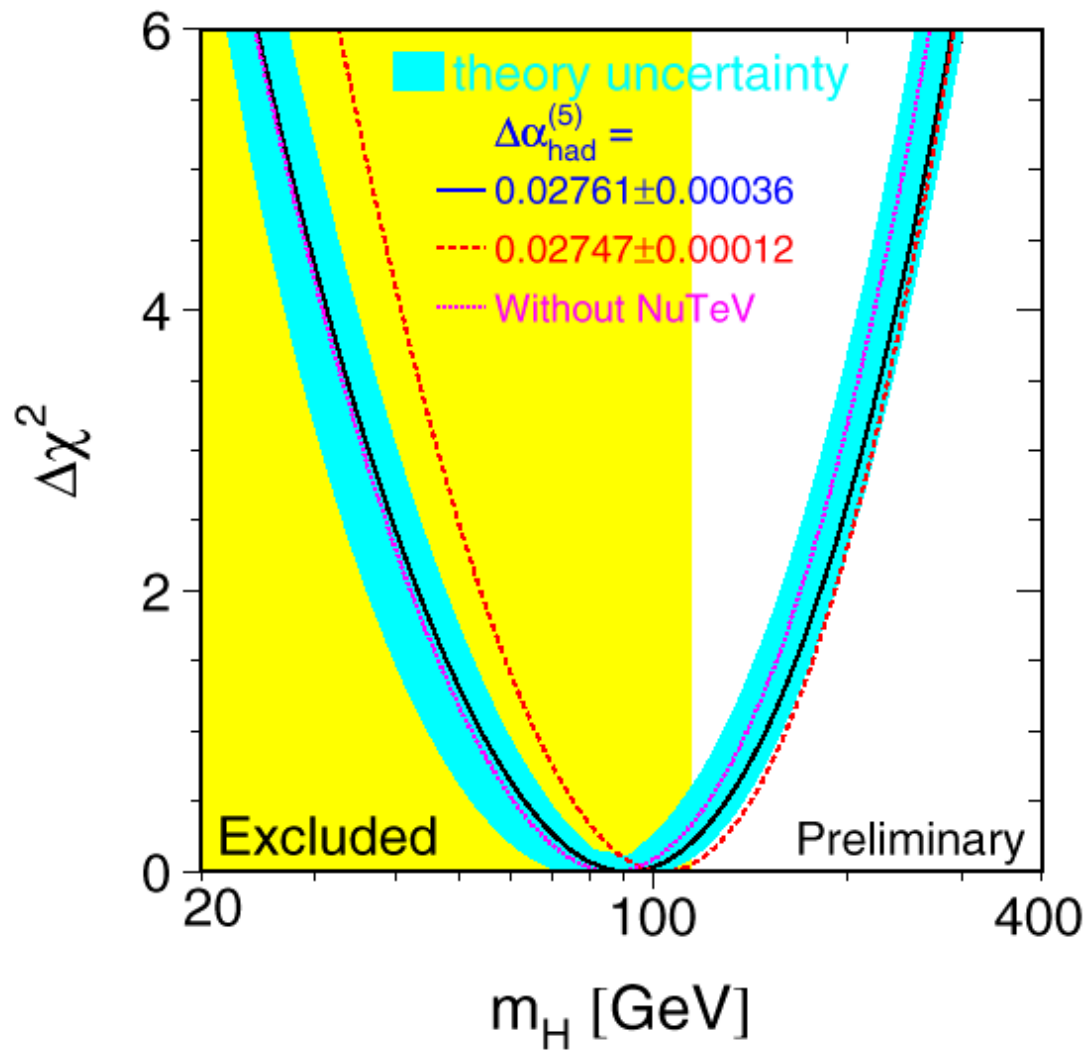


Figure 2

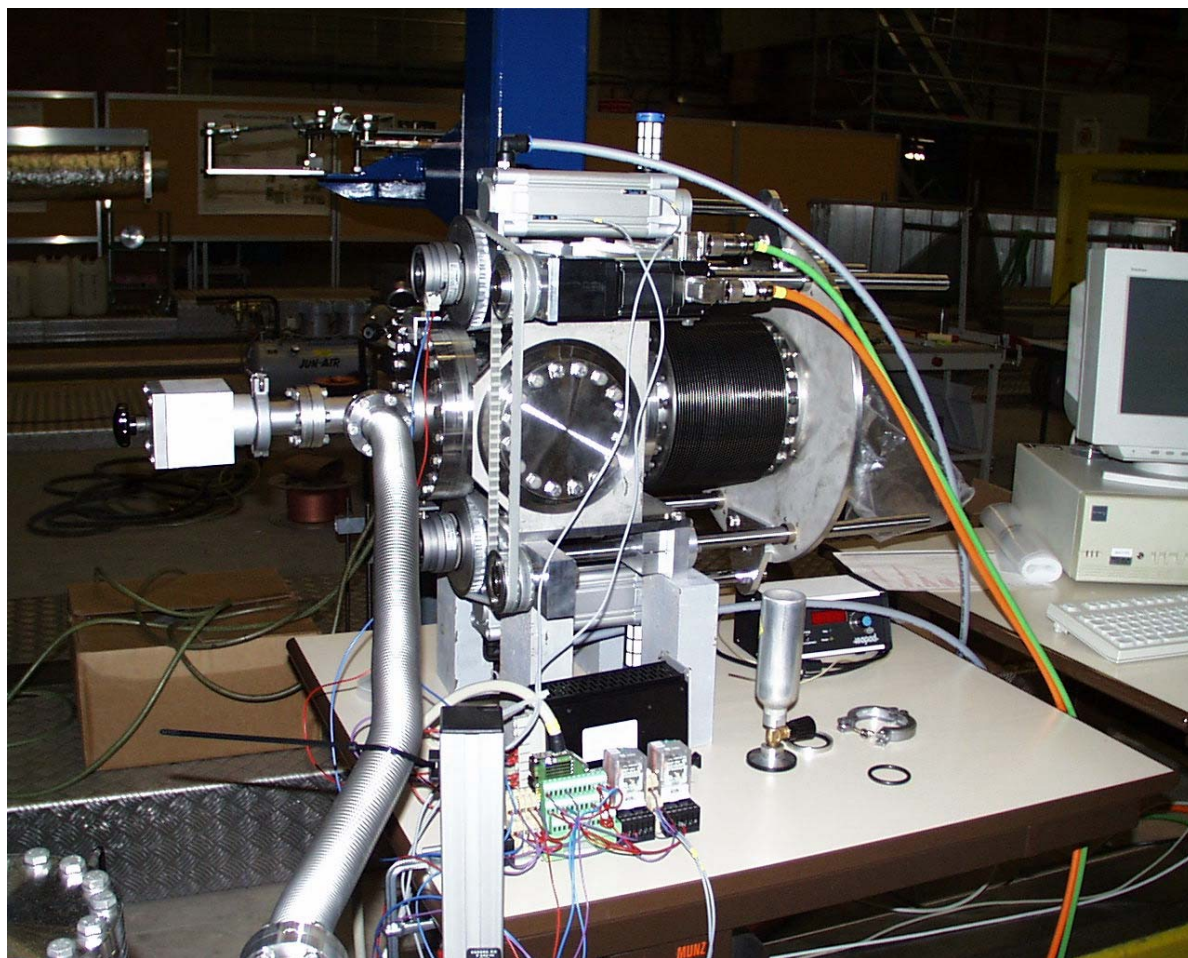


Figure 3



Figure 4