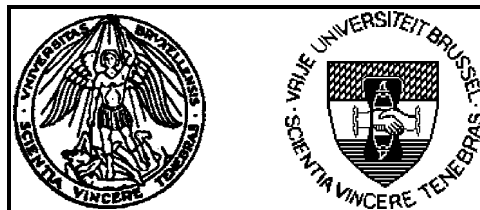


INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES

ULB-VUB, BRUSSELS

ANNUAL REPORT 2000



INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES

ULB-VUB, BRUSSELS

ANNUAL REPORT 2000

D. BERTRAND and J. LEMONNE,

April 2000.

CONTENTS

I.	INTRODUCTION	p. 1
II.	RESEARCH ACTIVITIES IN PARTICLE PHYSICS	p. 2
	II.1. NEUTRINO PHYSICS	p. 2
	II.2. STUDY OF e^+e^- ANNIHILATIONS AT LEP - THE DELPHI EXPERIMENT	p. 4
	II.3. STUDY OF ep COLLISIONS AT HERA - THE H1 EXPERIMENT	p. 7
	II.4. STUDY OF pp COLLISIONS AT LHC - THE CMS EXPERIMENT	p. 9
III.	TECHNICAL R & D	p.10
	III.1. DEVELOPMENT OF INSTRUMENTATION FOR POSITRON EMISSION TOMOGRAPHY	p.10
	III.2. R & D ON HEAVY SCINTILLATORS	p.10
	III.3. THE MICADO PROJECT	p.11
	III.4. R & D ON HIGH RESOLUTION TRACKING	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 1999-2000)	p.16
	VII.2. Ph.D. THESES "MEMOIRES DE LICENCE" AND "LICENTIAATSVERHANDELING" COMPLETED DURING 2000.....	p.17
VIII.	SEMINARS AND ORAL PRESENTATIONS AT CONFERENCES, SCHOOLS AND COLLABORATION MEETINGS	p.18
	VIII.1 SEMINARS	p.18
	VIII.2. ORAL PRESENTATIONS AT CONFERENCES, SCHOOLS AND COLLABORATION MEETINGS	p.18
IX.	SCIENTIFIC VULGARISATION	p.20
X.	ATTENDANCE TO CONFERENCES, WORKSHOPS AND SCHOOLS	p.21
	X.1 CONFERENCES AND WORKSHOPS	p.21
	X.2. SCHOOLS	p.22
	X.3. TECHNICAL FORMATIONS	p.22
XI.	LIST OF PUBLICATIONS, REPORTS AND ORAL CONTRIBUTIONS TO CONFERENCES BY MEMBES OF THE IIHE	p.23
	XI.1. PUBLICATIONS	p.23
	XI.2. CONFERENCE PROCEEDINGS.....	p.27
	XI.3. REPORTS	p.27
	XI.4. PATENTS	p.27
XII.	ILLUSTRATIONS	p.28

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 2000.

U.L.B.

P. Annis (doctorant)
L. Benussi (TMR fellow until May 2000)
D. Bertrand (directeur de recherche FNRS; chargé de cours temps partiel)
C. Collard (boursière FRIA)
G. De Lentdecker (boursier FRIA)
R. El Aidi (doctorant)
L. Favart (chercheur qualifié FNRS; since October 2000)
S. Ghazryan (boursier post-doctoral ULB; since October 2000)
X. Janssen (boursier FRIA)
P. Marage (chargé de cours)
J. Sacton (Professeur Emérite)
R. Stamen (doctorant)
J. Stefanescu (doctorant)
F. Tallouf (doctorant)
M. Vander Donckt (collaborateur scientifique IISN; until September 2000)
C. Vander Velde (chargé de cours associé)
P. Vanlaer (chargé de recherche FNRS)
P. Vilain (chercheur qualifié FNRS; chargé de cours temps partiel)
J. Wickens (chercheur IISN)
G. Wilquet (chercheur qualifié FNRS; chargé de cours temps partiel)
V. Zhukov (boursier post-doctoral FNRS; until September 2000)

V.U.B.

P. Bruyndonckx (wetenschappelijk medewerker FWO)
R. Chen (VUBAROS fellow until May)
C. De Clercq (hoofddocent)
O. Devroede (wetenschappelijk medewerker FWO)
J. D'Hondt (IWT scholarship)
A. Fremout (IWT scholarship)
R. Heremans (wetenschappelijk medewerker FWO)
D. Johnson (doctor-assistent VUB)
J. Lemonne (gewoon hoogleraar)
S. Leonard (wetenschappelijk medewerker FWO from December 2000)
J.G. Liu (wetenschappelijk medewerker Bilateraal akkoord Vlaanderen-China from November 2000)
C. Mommaert (E.U.until January, post-doc FWO from February until June 2000)
P. Olbrechts (overbruggingsbeurs IWT from October until December 2000)
R. Roosen (onderzoeksdirecteur FWO)
S. Tavernier (gewoon hoogleraar)
F. Udo (gastprofessor - deeltijds 20 %)
W. Van den Boeck (wetenschappelijk medewerker FWO until April 2000)
R. Vandenbroucke (logistiek medewerker FWO)
B. Van de Vyver (aspirant FWO until September, wetenschappelijk medewerker FWO from October 2000)
W. Van Doninck (onderzoeksdirecteur FWO)
A. Van Lysebetten (wetenschappelijk medewerker FWO until September 2000)
F. Zanca (doctoraatsbeurs VUB until June)
Y.G. Wang (wetenschappelijk medewerker Bilateraal akkoord Vlaanderen-China until February 2000)
D. Wisniewski (wetenschappelijk medewerker Bilateraal akkoord Vlaanderen-Polen from July 2000)

B. Van de Vyver stayed at CERN until July 2000 in the framework of the CHORUS Collaboration

A. Van Lysebetten stayed at CERN from May to July 2000 as responsible person for the DELPHI forward muon chambers.

T. Anthonis (as from 1/10/99), W. Beaumont, T. Beckers, J. De Troy, E. De Wolf, Liu Hao, Ch. Van Dyck, P. Van Mechelen, F. Moortgat, N. Pukhaeva, N. Van Remortel, F. Verbeure and V. Zhukhov (from 01.10.2000) 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 CHORUS experiment.

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

The first phase of analysis of the data collected from 1994 to 1997 has now been completed. More than a million neutrino interactions were recorded in the 770 kg emulsion target. After reconstruction of the trajectories in the electronic detectors, about 440000 events were selected for emulsion scanning. Fully automated microscopes equipped with CCD cameras and fast processors for track recognition were used to locate 167000 neutrino vertices and select those with a possible sign of a decay topology close to the primary vertex. On these 13500 events, more precise measurements were performed manually and kinematical selection criteria were applied to reduce the contribution of the various background sources. No signal of $\nu_\mu - \nu_\tau$ oscillation remained after this selection while the residual background was estimated to 1.1 event.

The 90 % confidence level upper limit on the $\nu_\mu - \nu_\tau$ transition probability derived from this null result corresponds to :

$$\begin{array}{ll} P(\nu_\mu \rightarrow \nu_\tau) < 3.4 \cdot 10^{-4} & \text{at large } \Delta m^2 \\ \text{or } \Delta m^2 < 0.6 \text{ eV}^2 & \text{at large mixing} \end{array}$$

The neutrinos interactions occurring in the CHORUS calorimeter were also analyzed. A first result was published on the measurement of the J/ψ meson production cross section :

$$\sigma(J/\psi) = (5.8 \pm 2.4) \cdot 10^{-41} \text{ cm}^2/\text{nucleon}$$

Only the CDHS experiment had observed this rare process up to now.

The second analysis phase of the CHORUS emulsion data is in progress. With faster microscopes and less restrictive selection criteria, it will be possible within one year to improve by a factor 2 the oscillation limit and to collect an unbiased sample of charm decays about one order of magnitude larger than presently available.

B. The AMANDA experiment.

(D. Bertrand, C. De Clercq, P. Olbrechts, M. Vander Donckt, J.P. Dewulf and L. Etienne)

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

i) Physics results.

During the austral summer 1999-2000, the telescope was completed with 6 new strings of 48 optical modules deployed in the Antarctic ice at the south pole at a depth range running from 1500 m to 2100 m.

An important milestone was reached this year with the identification of 200 cosmic neutrinos originating from the northern hemisphere. The trajectory of the muons resulting from the interaction of these neutrinos with the earth nuclei was reconstructed using a complex likelihood method. A careful analysis allowed to select this signal out of a background which is 6 order of magnitude greater. The angular distribution of the events corresponds to their cosmic origin. No event was observed above 10 TeV. A higher limit on the flux of such particles was established taking into account their origin (extragalactic diffuse or point like) and a E^{-2} dependence for the flux.

A search for neutralinos was performed. Under the hypothesis that they are the lightest supersymmetric particles they could be at the origin of the dark matter of the universe. The AMANDA could detect an accumulation of these particles at the center of the sun or at the center of the earth. An upper limit was derived.

The negative results obtained for the search of super novae and of neutrinos associated to gamma ray bursts were submitted for publication.

The preparation of the future ICE³ experiment was pursued. This telescope of a total volume of 1 km³ occupied by 5000 optical modules will extend the investigation field of the AMANDA detector by allowing, for example, the identification of τ neutrinos. The main budget of the experiment has to be approved by the summer 2001.

ii) Activities of the Brussels group.

The laboratory contributed to the calibration of the optical modules. A special test bench allows to measure the gain of the photomultipliers at low temperature (-30°C) by detecting the light emitted by photodiodes or by a measure of the dark noise of the tubes. The study was completed by test of the transmission of signals along a twisted pair of 2 km to reduce as much as possible the electronic noise.

Another set-up was mounted in order to control the transmission of the Cherenkov photons through the vessel of the optical modules. It will be used to design a polymer coating performing a wave length shift which will increase the efficiency of the photon detection in the ice.

C. The OPERA experiment.

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

The construction of the CNGS beam, a new neutrino beam pointing from the CERN-SPS to the underground Gran Sasso laboratory (LNGS) has been officially approved and should be completed by mid-2005.

After intense R & D work, a detailed proposal (CERN/SPSC 2000-028) of the OPERA experiment was presented in September 2000 to the CERN and LNGS scientific committees. The detector design is based on a modular structure of lead-emulsion "bricks" interspaced with electronic trackers and complemented by muon spectrometers. The experiment aims to fully cover, in 5 years exposure, the region of oscillation parameters pointed out by the atmospheric neutrinos experiments.

Apart from contributions to the analysis and simulation software, our main activity in the coming years will be the construction and installation of the trackers of the target region. In their present design, still in the prototyping phase, these detectors are made of planar modules 1 cm thick, 7 m long and 1.5 m wide. Each module consists of 64 scintillator bars equipped with a WLS fibre connected at both ends to a multichannel photodetector. About 600 such modules will be built in collaboration with Bern, CERN, Lyon and Strasbourg.

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

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

1. Performance of DELPHI and MUF.

The forward muon chamber system MUF of DELPHI, which were built and are maintained by the Belgian groups, functioned efficiently without major problems.

During the year 2000 the LEP worked essentially at an energy larger than 200 GeV accumulating an integrated luminosity of 224 pb⁻¹ at the DELPHI detector.

2. Physics results.

The main results published in 2000 can be summarized as follows (54 papers in international review with referee committees) :

i) *At the Z⁰ resonance.*

A final compilation on the global statistics of events accumulated from 1993 to 1995 at energies around the Z⁰ mass lead to the determination of the following parameters :

$$\begin{aligned} M_Z &= 91.1863 \pm 0.0028 \text{ GeV} \\ \Gamma_Z &= 2.4876 \pm 0.0041 \text{ GeV} \\ \sigma_0 &= 41.578 \pm 0.069 \text{ nb} \\ R_1 &= 20.730 \pm 0.060 \\ A_{\text{FB}}^0 &= 0.0187 \pm 0.0019 \end{aligned}$$

These high precision results were obtained using a model independent adjustment method. The identification of semileptonic disintegrations of the B hadron resulting of the Z decay allowed to estimate the ratio of two elements of the CKM matrice :

$$|V_{\text{ub}}/V_{\text{cb}}| = 0.103_{-0.012}^{+0.011} \text{ (stat)} \pm 0.016 \text{ (syst)} \pm 0.010 \text{ (mod)}$$

The analysis of the τ lepton decays resulted in the determination of the Michel parameters describing their Lorentz structure :

$$\begin{aligned} \eta &= -0.005 \pm 0.036 \pm 0.037; \rho = 0.775 \pm 0.023 \pm 0.020; \\ \zeta &= 0.929 \pm 0.070 \pm 0.030; \zeta\delta = 0.779 \pm 0.070 \pm 0.028; \\ h_{\nu\tau} &= -0.997 \pm 0.027 \pm 0.011 \end{aligned}$$

These results are consistent with a V-A structure for the charged currents. An exhaustive measurement of the τ lepton polarisation was also performed leading to the determination of the following parameters :

$$\begin{aligned} A_\tau &= 0.1359 \pm 0.0096 \\ A_e &= 0.1382 \pm 0.0116 \end{aligned}$$

These parameters allowed to determined the ratios of the vector and axial vector couplings :

$$\begin{aligned} \frac{\bar{v}_\tau}{a_\tau} &= 0.0683 \pm 0.048 \\ \frac{\bar{v}_e}{a_e} &= 0.0694 \pm 0.0058 \end{aligned}$$

These results confirm the hypothesis of leptonic universality with a precise determination of the effective electro weak mixing angle :

$$\sin^2 \theta_{\text{eff}}^{\text{lept}} = 0.23282 \pm 0.00092$$

The α_s constant was precisely determined at the Z^0 centre of mass energy :

$$\alpha_s \left(M_Z^2 \right) = 0.1180 \pm 0.0006 \text{ (exp.)} \pm 0.0013 \text{ (hadr.)} \pm 0.0008 \text{ (scale)} \pm 0.0007 \text{ (mass)}$$

The longitudinal polarization of the Λ_b baryon was determined from the charged lepton and neutrino energy spectra resulting from its semileptonic decays :

$$P_{\Lambda_b} = 0.49_{-0.30}^{+0.32} \text{ (stat.)} \pm 0.17 \text{ (syst.)}$$

The strange quark forward-backward asymmetry was measured :

$$A_{\text{ss}}^{\circ} = 0.1008 \pm 0.0113 \text{ (stat.)} \pm 0.0040 \text{ (syst.)}$$

resulting in the determination of the electroweak mixing angle :

$$\sin^2 \theta_{\text{eff}}^{\text{lept}} = 0.2321 \pm 0.0029$$

and the parity violating coupling of the s quark to the Z was determined to be :

$$A_s = 0.909 \pm 0.102 \text{ (stat.)} \pm 0.036 \text{ (syst.)}$$

The fragmentation functions of quarks and gluons were measured in various three-jet topologies in Z decays leading to the determination of the colour factor ratio C_A/C_F :

$$\frac{C_A}{C_F} = 2.26 \pm 0.09 \text{ (stat.)} \pm 0.06 \text{ (syst.)} \pm 0.12 \text{ (clus., scale)}$$

The inclusive production rates of Σ^- and $\Lambda(1520)$ has been measured, relying on particle identification performed using the barrel Ring Imaging Cherenkov detector :

$$\langle N_{\Sigma^-} / N_Z^{\text{had}} \rangle = 0.81 \pm 0.002 \pm 0.010$$

$$\langle N_{\Lambda(1520)} / N_Z^{\text{had}} \rangle = 0.029 \pm 0.005 \pm 0.006$$

The partial decay width R_c of the Z into $c\bar{c}$ and the number of charm quarks n_c per b decay were measured using the particle identification abilities of DELPHI :

$$R_c = 0.1665 \pm 0.0095$$

$$n_c = 1.166 \pm 0.086$$

A study of b semileptonic decays into D, $D\pi^+$ and $D\pi^\pm$ was performed and various branching fractions were determined :

$$\text{BR} (b \rightarrow D^0 \Gamma \bar{\nu}_1 X) = (7.04 \pm 0.34 \text{ (stat.)} \pm 0.36 \text{ (syst.)} \pm 0.17 \text{ (BR}_D)) \%$$

$$\text{BR} (b \rightarrow D^+ \Gamma \bar{\nu}_1 X) = (2.72 \pm 0.19 \text{ (stat.)} \pm 0.16 \text{ (syst.)} \pm 0.18 \text{ (BR}_D)) \%$$

$$\text{BR} (b \rightarrow D^{*+} \Gamma \bar{\nu}_1 X) = (2.75 \pm 0.17 \text{ (stat.)} \pm 0.13 \text{ (syst.)} \pm 0.09 \text{ (BR}_D)) \%$$

$$\text{BR} (\bar{B} \rightarrow D \pi \Gamma \bar{\nu}_1) + \text{BR} (\bar{B} \rightarrow D^* \pi \Gamma \bar{\nu}_1) = (3.40 \pm 0.52 \text{ (stat.)} \pm 0.32 \text{ (syst.)}) \%$$

The study of the directional dependence of two-particle correlations in the hadronic decays of the Z^0 boson, confirmed the string model prediction :

The transverse correlation length : $R_{\perp} = 0.53 \pm 0.08$ fm is smaller than the longitudinal one : $R_{\parallel} = 0.85 \pm 0.08$ fm

ii) *At high energy (> 183 GeV).*

The main effort during 2000 was devoted to the search of a Higgs boson within the framework of the Standard Model at a center of mass energy larger than 200 GeV. No clear evidence was found leading to a lower limit determination :

$$M_H > 114.1 \text{ GeV}^2 \quad \text{at a confidence level of 95 \%}.$$

In parallel, the cross sections of the hadronic and leptonic pair production as well as the forward-backward asymmetries and angular distributions were determined at center of mass energies of 183 and 189 GeV. Overall, the data agree with the Standard Model predictions as calculated with the ZFITTER and TOPAZO programs. The data were used to update previous searches for physics beyond the Standard Model and to investigate the possible effects of gravity in extra dimensions. No evidence for new physics was found (contact interactions between fermions; R-parity violating sneutrinos exchange; Z' boson production).

The various searches for supersymmetric particles were also negative.

3. Activities of the Brussels-Antwerp group.

At the IIHE we concentrated our efforts on :

- *The study of $\tau^+ \tau^-$ pairs.*
We actively participated to the determination of the Lorentz structure of the decay and to the final determination of the polarisation of the τ produced by $e^+ e^-$ interactions.
- *The determination of the W boson mass and width.*
The measurements of the W-boson mass and width were performed with a sample of fully hadronic WW final states taken at centre-of-mass energies in the range between 189 and 202 GeV. An ideogram technique was used to extract the W boson mass and width. The systematic error on the W mass measurement is dominated by Gross talk effects between both W boson systems, namely Bose-Einstein correlation and colour reconnection effects.
- *The determination of the WW cross section.*
The WW cross section at 189 GeV was determined with a sample of fully hadronic WW final states. A Neural Network technique was used to select the events.
- *The determination of the triple gauge boson couplings (TGC).*
A measurement of the anomalous TGC couplings (γWW , ZWW) was performed with a sample of fully hadronic WW final states taken at 183 and 189 GeV. The method used was an extended maximum likelihood fit of the data to predictions of the Bilenky model, which gives a general description of anomalous couplings.
- *Spin density matrix analysis of WW final states.*
The spin density matrix elements were measured for semi-inclusive single W production using $\mu^+ \nu q \bar{q}$ final states. These matrix elements were obtained from the measurement of the W decay products by the application of suitable projection operators.
- *Bose-Einstein correlations (BEC).*
Measurements were done to look for possible BEC between the W boson systems in hadronic decaying WW events. An event mixing technique was used and selection cuts were studied to improve the sensitivity of the measurement.

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

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

1. Performances of HERA, H1 and COP.

After the shutdown from August 1999 to January 2000, HERA, colliding 920 GeV protons on 27.5 GeV positrons had a very good year of luminosity which lasted until October during which H1 accumulated about 60 pb^{-1} .

During the shutdown of 1999-2000, the wires of CJC1 and CJC2 of the central tracking unit, which broke during the last months of 1999, due to a water leak in the forward tracking detector have successfully been replaced. During most of the data taking period the H1 detector has been working extremely well. The main worry presently is the slow but continuous signal loss observed in the lower part of the CJC, a problem for which up to now no good explanation in terms of gas contamination could be found. The CJC1/CJC2 are presently opened and the problem is under investigation.

The COP multiwire proportional chamber, which has been built at the IIHE remains as far as maintenance and running is concerned under the responsibility of the Brussels-Antwerp group. The chamber has been running smoothly during 2000, as in the previous years with 2 inefficient sectors on a total of 32. In addition 6 channels were lost after the last repair intervention. This problem has recently been investigated after COP was removed from the central tracking unit. The reason for the 6 dead channels has been identified as due a ground connection between the detector pins and the Cu coated kapton shielding foil and has been repaired.

2. Physics analyses in H1.

In the year 2000 a total of 10 papers were published⁽¹⁾ and 4 were submitted to international journals. A total of 54 papers were submitted to the International Conference on High Energy Physics 2000 (ICHEP 2000 at Osaka, Japan).

The main results obtained in 2000 are summarized below.

i) Perturbative and non-perturbative QCD studies.

Based on recent data, two publications report on precise QCD studies from large Q^2 events.

- A large Q^2 data sample, $Q^2 > 150$, corresponding to a luminosity of 33 pb^{-1} has been analysed. In this analysis the strong coupling constant has been determined ($\alpha_s(M_Z) = 0.1186 \pm 0.0059$) and the gluon density in the proton been extracted. The gluon density is found to be in good agreement with results from other experiments.
- Using charged current (CC) and neutral current (NC) event samples; dijet production has been studied in a Q^2 range between 640 and 35000 GeV^2 , thereby probing QCD to the smallest distances presently possible. The CC dijet cross section has been measured for the first time. Perturbative calculations based on the electroweak and strong matrix elements are found to give a consistent description of both NC and CC up to the highest dijet masses and highest Q^2 .

ii) Vector Meson production in diffraction..

In the year 2000, new measurements of exclusive diffractive vector meson production have been performed :

- The first time, the elastic Υ photoproduction cross section has been measured. The measurement is in agreement with a QCD-based prediction, in which it is essential that the contribution of non-diagonal parton distribution (or skewed parton density) has to be included.
- The J/Ψ cross section in photoproduction has been measured in an extended photon-proton center of mass energy range, $26 < W_{\gamma p} < 285 \text{ GeV}$.

The measured cross section is in agreement with a QCD prediction based on two gluon exchange model.

(1) Among them four papers submitted last year have already been reported in last year annual report, they will not be included here.

- The electroproduction of the ϕ meson has been measured and studied in detail, including the determination of the full set of ϕ spin density matrix elements. Evidence for a non zero helicity flip amplitude is found. A QCD based prediction is in qualitative agreement with the measurement of the 15 matrix elements. A compilation of the elastic ρ , ω , ϕ , J/Ψ and Υ meson cross sections, presented as a function of $(Q^2 + M_V^2)$, where M_V is the vector meson mass, show a common behaviour.

iii) Photon structure function.

An effective leading order parton density for the photon has been extracted from the dijet cross section in photoproduction. This quantity is dominated by the gluon density, which is strongly rising towards small values of the momentum fraction carried by the photon.

iv) New phenomena.

Based on a e^+p luminosity of about 35 pb^{-1} , two new analyses searching for new phenomena have been published :

- No evidence for excited fermions f^* of the first generation has been found. Exclusion limits have been derived.
- No evidence is observed for electron-quark compositeness, quark form factors or exchange of virtual leptoquark. New limits are set. Lower limits on the effective Planck scale are found from the search of possible low scale quantum gravity, with gravitons coupling to Standard Model particles and propagating into extra dimensions.

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

i) Project of a new proton spectrometer.

During the Physics Research Council sessions of April/October 2000, the new project proposed by the Belgian group (IIHE-UIA), DESY (Zeuthen) and the University of Hamburg II and Lund which consists in the construction of a new proton spectrometer, has been approved. The essence of the project is to build and install a proton spectrometer 200 m upstream of the H1 main detector to study diffraction after the H1 luminosity upgrade.

With the project being in its initial phase, the following activities have started :

- **Bypass** One of the most incisive and costly operations in the realisation of the project is the removal of part of a drift space in the cold section of the HERA accelerator ring. The cold lines (He 1-phase and 2-phase lines and conductors) in this drift section have to be deviated by a U-shaped turn, called hereafter bypass. This bypass, because of the low temperatures involved, is a critical item. A pre-design study by an external firm has been finalised and has now entered the complete design phase. Every substructure will be drawn and discussed with the responsible groups at DESY (Vacuum- and Cryo-groups). It is expected that a full detailed design, consisting of some 200 drawings, will be ready within 6 months. In the mean time, meetings have been and are being organised with external firms which will construct the bypass. As the purchasing for the specific items is time consuming, we try to speed up the design/construction process as much as possible.
- **The scintillating fibre detectors** which will be used are very similar to existing ones. The group responsible for the construction (Zeuthen), will start the detector building beginning January 2001. Detectors similar to those that will be built have been operational in the last 6 months. These data are presently analysed, the result of which can be used to optimise the detector readout.
- **Roman Pot Vessel.** The scintillating detector will be housed in a plunger vessel which will move inside the proton beam pipe to approach the beam as close as possible. This Roman pot vessel is very similar to the existing FPS plunger vessel. However, being in the cold section of the beam line, additional safety has to be built in to protect the beam line vacuum in case a thin plunger vessel window would break. This pre-vacuum complicates the existing design and at present the requested modifications are under study with the help of an external firm.
- **Software.** Apart from the off-line software which has to be adapted to the new detectors, the online data acquisition has to be written. The group of Lund has expressed interest and will further investigate these problems in an imminent future.
- **Various.** It is clear that in this stage of the project not all steps have been evaluated in detail. For instance it is clear that the new detectors need testing, which is foreseen in September 2001, but the extent of these tests has not been established yet.

The present deadline by which the complete project has to be ready is March-April 2002. This date is approximate and set by the big shutdown in 2002. This will be the period where enough time will be available for the

installation of the bypass. A preliminary time schedule, listing the at present though most critical items is attached below. As can be observed, optimisation of the various bypass operations is highly needed.

ii) Physics analysis.

The main activities of the Belgian group have been centred on the study of diffraction.

- Deeply virtual Compton Scattering (DVCS) : the elastic cross section has been measured for the first time at HERA and shown at several international summer conferences. A publication is in preparation.
- High Q^2 of electroproduction ρ and ϕ meson : 1997 data have been analyzed (background estimate, acceptance and efficiency studies). Upgrade of a simulation program including QED radiative corrections (note in preparation).
- ρ meson photo- and electroproduction at high t : data have been taken with special triggers previously developed and their quality checked. Data from 1997 have been selected and analyzed (background, acceptance and efficiency studies).
- Inclusive diffractive production : the efficiencies and acceptance studies, a Regge analysis of the total cross section is being conducted.

Other activities have been pursued :

- Several contributions to the study of the characteristics of the hadronic final states have been provided in the framework of the corresponding H1 working group.
- Preparation of a publication of the proton structure function F_2 measurement at low Q^2 and moderate x using radiative events.
- A first trial to measure the longitudinal ep cross section using radiative events.

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

(W. Beaumont, T. Beckers, D. Bertrand, G. De Lentdecker, O. Devroede, J. Lemonne, Ch. Mommaerts, Ph. 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.

The Compact Muon Solenoid (CMS) collaboration consists of more than 1700 physicists and engineers from 150 institutes 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 Antwerpen laboratories received the following responsibilities : coordination of the design and production of 17000 carbon fibers frames to support the Si detector modules, 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.

A silicon detector prototype has been built and tested in a high intensity pion beam at the Paul Scherrer Institute (PSI). A clean room has been built and a Gantry robot installed to assemble the Si detector modules. The 8 electronic boxes needed to control the Gantry machines of the whole tracker collaboration have been built in Brussels together with some mechanical pieces. A small test station has been built in Antwerpen to perform long term test of two Si modules. It will be extended to be able to test more modules at a time. Carbon fibers plates were produced together with samples of frames in view of a preseries production of 200 Si modules.

In parallel the CMS physicists of the IIHE contribute to the track and vertex reconstruction software and to the high level track trigger. In particular they will concentrate on the selection of muon candidates combining the data of the muon chambers and of the tracker, allowing to refine the transverse momentum cut. This trigger is essential for all the physics channels of interest : Higgs searches and study, supersymmetric particles searches, CP violation studies, etc ...

III. TECHNICAL R & D.

III.1. DEVELOPMENT OF INSTRUMENTATION FOR POSITRON EMISSION TOMOGRAPHY.

(P. Bruyndonckx, L. Etienne, A. Fremout, S. Leonard, S. Tavernier and Liu Jiangu)

Positron Emission Tomography (PET) is a unique imaging tool allowing a vast range of biological processes to be measured quantitatively in vivo. Unlike other imaging techniques such as radiography, MRI or ultrasound, it is well suited to obtain metabolic and molecular images. Improvements in PET technology and in radiochemistry have now made it possible to use PET imaging in laboratory animals during the early phases of drug development. This possibility has generated considerable interest both in academic research groups and in pharmaceutical industry.

In response to this our research group has decided to use its long expertise in the development of instrumentation for the detection of ionising radiation to undertake the design of a dedicated high resolution small animal PET scanner.

Our design will be based on the use of avalanche photodiodes to read out LSO, a new fast ($\tau \approx 40$ ns) scintillator with a high light-yield. A first step is to build a system with only two detector modules, mounted on a gantry, which allows them to rotate independently of each other. Thus, it will be possible to simulate a complete PET system. Each module consists of an APD array coupled to LSO. In order to understand more thoroughly how APD's work, some fundamental studies on the characteristics of APD's have been performed. Experimental results on gain, dark current, capacitance, excess noise factor and quantum efficiency were used to compare the theoretical noise formulae with the measured electronic noise. These studies were done with individual APD's of different sizes (3 mm diameter and 5 mm diameter) as well as with arrays ($2 \times 8 \times 3$ mm²) APD's, all of which were supplied by Hamamatsu. The main conclusion from these studies is that APD's are a valid alternative for photomultiplier tubes in PET.

Several possible coupling schemes of APD's and crystals have been studied using the Hamamatsu array: 1-1 coupling using $4 \times 4 \times 10$ mm³ LSO crystals, a light sharing scheme using $2 \times 2 \times 10$ mm³ LSO crystals and a readout based on light spreading in a $32 \times 8 \times 10$ mm³ LSO block with a saw-shaped top. The obtained FWHM resolutions are 4 mm, 2.2 mm and 2.4 mm.

To reduce parallax errors a Depth-of-Interaction (DOI) scheme was investigated using a dual layer of LSO crystals, shifted by half a crystal in one or two dimensions. The identification of the bottom layer had an accuracy of 90%. The top layer was identified correctly in 70% of the cases.

In parallel with the construction, Monte-Carlo simulations are developed for this system. After matching the simulations with the real performance, they will be used as a starting point to develop simulations for a complete PET scanner based on the same principles.

III.2. R & D ON HEAVY SCINTILLATORS.

(P. Bruyndonckx, F. Tallouf, S. Tavernier and D. Wisniewski - the Crystal Clear Collaboration).

The Crystal Clear Collaboration (RD-18) is an interdisciplinary network set up by CERN and involving solid state physicists with expertise in the study of scintillating phenomena, and instrument builders with expertise in several of the areas where scintillating materials are used, with the aim of finding new fast scintillators. In the beginning, the main aim of the project was to find a scintillating material which could be used at the new large hadron collider (LHC). The main materials studied were CeF₃, PbWO₄ and cerium doped glasses. On the basis of this study, the CERN management decided to equip the CMS experiment with an electromagnetic calorimeter using about 80 tons of PbWO₄ scintillator.

In many other applications the scintillating materials are used to detect low energy gamma rays in the range 100 keV to 1 MeV. This is the case in gamma ray astrophysics, in nuclear medicine, and in most industrial uses of scintillators. Because of the low energy of the gamma rays, a high light yield scintillator is mandatory in such applications. There is also a need for faster scintillators. Traditional scintillators have a decay time of several 100 ns, which is slow compared to the possibilities of modern electronics. For example Bi₄(GeO₄)₃ (BGO), which is one of the commonly used heavy scintillators today, has a decay time of 300 ns.

Partly as a result of our thorough study of CeF_3 scintillator as a candidate material for LHC, the scintillation properties of CeF_3 and of Ce^{3+} doped materials are now much better understood. We can predict that several heavy rare earth oxides doped with cerium or praseodymium are likely to be dense, fast and luminous scintillators. Indeed, excited Ce^{3+} ions exhibit a $4d \rightarrow 3f$ allowed transition which gives rise to a fast, near UV or blue luminescence with a decay time of a few 10 ns.

The Crystal Clear Network is investigating a number of dense rare earth perovskites, garnets and complex orthosilicates doped with cerium and praseodymium. One interesting material which is presently under study is $\text{LuAlO}_3:\text{Ce}$ (LuAP). It is very dense (8.34 g/cc) and fast (17 ns decay time), but its light yield is, in our present samples, only comparable to BGO. We will have to see if this is an intrinsic property of the material, or simply due to defects in our present samples.

III.3. THE MICADO PROJECT.

(P. Bruyndonckx, L. Etienne, S. Tavernier and F. Zanca).

In the frame of the "INNOVATION" programme of the European commission, a new project was launched under the name of MICADO, with the VUB as project-coordinator. The official starting date was August 1998 and a first term is set for 21 months.

The aim of the project is to validate the MicroGAP Chamber (MGC) technology for digital radiography, specifically mammography applications as a replacement for photographic films or storage phosphor screens (SPS). This new detector will allow for more efficient mammography with possible dose reduction, high throughput, high resolution, digital storage and on-line inspection abilities. It fits within the new approach of bringing medical files in a centralised hospital information system.

A demonstration radiographic imaging detector of $5 \times 5 \text{ cm}^2$ will be built, with newly developed blue light photocathode for operation in gaseous environment of the MGC and with appropriate low noise readout electronics. The pre-production investigation for large area (commercialisable) systems will be executed as well. The development is a joint effort between IMEC, VUB, INFN Pisa and the Weizmann Institute of Science, with AGFA-Gevaert and Electron Tube limited as industrial collaborators. The specifications for the medical validation study are given by AGFA-Gevaert.

In addition we are studying the possibility to improve the image quality in digital radiography by increasing the detector Quantum Efficiency (QE) and the light Collection Efficiency (CE), in the current readout system of storage phosphor screens (SPS) produced and commercialised by AGFA-Gevaert. We have evaluated the use of Avalanche Photodiodes (APD) (produced by Hamamatsu) as replacement for a photomultiplier tube (PM) and optical fibres. APD's were put forward as a solution for improved detection efficiency of fluorescent light because of their high quantum efficiency at the wavelength of interest ($\lambda=390\text{nm}$). The quantum efficiency QE of APD, at $\lambda=390\text{nm}$, is 70%, to be compared with a 28% in case of PM.

For the integration of the APD readout and the AGFA readout system, a theoretical study for a special very low noise amplifier has been done. To set an upper limit on the tolerable electronics noise, the intrinsic image noise was computed using a Monte Carlo simulation. For a minimal X-ray dose found in mammography, we obtained an intrinsic image noise of $2 \cdot 10^6$ photons/s. Assuming a collection efficiency of 50%, an APD QE of 70% and an APD gain of 50, the equivalent noise current at the input of the amplifier is 0.6 nA.

To increase the amount of light emitted from the phosphor plate, a design study of an optical system using an elliptical mirror was investigated. Theoretical studies have been done with the help of a ray-tracing program, Solstis. This study predicted a light collection efficiency of about 50%, (considering the active surface area of the APD's we have now and the geometrical loss), to be compared with the present 25% in the system using optical fibre and a PMT. Moreover this 50% could be increased to 60% if we would use new APD's arrays proposed by Hamamatsu, with an average active area of 92% instead of the present 75%. Actual measurements of the light collection efficiency of the constructed elliptical light cavity is only 30%. This sub optimal value is due to the fact that one of the reflectors shells isn't focusing very well.

The SNR and modulation transfer function were measured by irradiating medical SPS with different x-ray doses. The results were comparable with identical measurement performed on a commercial system of Agfa-Gevaert. The noise power spectrum showed two clear peaks due to electronic pick-up which degrade the visual quality of the image. For frequencies above 2.5 lp/mm, the frequency components of the modulation transfer function decrease

faster in comparison to the noise power spectrum.

III.4. R & D ON HIGH RESOLUTION TRACKING.

(L. Benussi - until May 2000, P. Vilain and G. Wilquet).

This year, two publications summarize the development work on capillary detectors filled with liquid scintillators. At the mid-term review of the European TMR contract under which this research was performed, the progress was judged very positively and the contract was extended until February 2002. A possible application of the liquid scintillator technology to the OPERA detector is being worked out as an alternative solution to the baseline plastic scintillator design.

IV. COMPUTING AND NETWORKING.

Management : R. Vandenbroucke

Research staff : Alain Isaac, Ines Moreno

Logistic and technical staff : Y. Brants (till 30 September 2000), G. Depiesse, D. Pirnay, G. Rousseau.

A. 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 their follow-up. She was responsible for all maintenance contracts as well for the insurance of all computer related equipment. She planned for 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 has taken over from C. Declercq the membership in the HTASC Committee, that looks at ITC related problems for HEP in Europe.

B. Operations.

Y.Brants, G. Depiesse and G. Rousseau were 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, 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 Y. Brants took care of software installation for all UNIX flavoured machines (workstations and PCs) and gave high-level support for PCs and UNIX. Y. Brants, G. Rousseau and R. Vandenbroucke install Windows NT PCs and PC applications.

Y. Brants has left at the end of September leaving a serious problem for the ICT operations till the end of the year.

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

C. Systems.

The number of PCs in the laboratory has consistently grown during 2000. Most of the black and white X-terminals are now replaced by PCs. PCs are also more and more used for real-time data acquisition (e.g. for the AMANDA experiment and for several student set-ups).

Existing PCs have been upgraded with more disk space in order to enhance the performance of local calculation.

The central diskspace has also been upgraded and amounts to 235 Gbyte spread over the experiments and general user space.

D. Networking.

Local area networking.

The 100 Mbps part of the IIHE LAN has been extended to include more connections. All new computer equipment is attached to this part of the LAN. To satisfy all requests for a fast ethernet connection a fourth 10/100 Mbps card has been added to the XYLAN switch.

Wide area networking.

The IIHE LAN is connected to the BELNET infrastructure via VUBnet, the VUB local area network. This connection has been upgraded to 100 Mbps. The connection within Europe has been very satisfactory during the whole year.

Use of multimedia.

Several types of multimedia use have entered the HEP world. More and more presentations are prepared and given via PowerPoint on the PC. The lab has acquired a portable PC and a portable videoprojector to cope with the demand of the physicists for giving multimedia presentations.

Videoconferencing is also becoming a need in the daily working environment of the physicist. A videoconferencing PC-based system has been installed that can cope with several types of videoconferencing (via ISDN, via Internet).

Project Activities

Alain Isaac worked on the creation and development of VERA, the Extranet for the Province Vlaams-Brabant.

Ines Moreno worked on the definition and implementation of the security part of the TRENDS project.

V. TECHNICAL AND ADMINISTRATIVE WORK.

The members of the workshop staff in 2000 were : J. De Bruyne, H. De Nil, J.-P. Dewulf, L. Etienne, R. Gindroz, R. Goorens, S. Hannaert (since October 2000), E. Lievens, G. Van Beek, R. Vanderhaege, L. Van Lancker, Ch. Wastiels with the help of R. Pins.

D. Bertrand was in charge of the general coordination.

In connection with the decision to use a full silicon solution for the CMS tracker, the IIHE took the responsibility to design part of the control electronic of the robots (GANTRY machines) which will be used to assemble the modules. This work was realised by H. De Nil, R. Vanderhaege and Ch. Wastiels. Ch. Wastiels realised the design of the printed circuit board cards and was responsible with L. Van Lancker of the supervision of the project. R. Goorens took the responsibility of the design of the pitch adapters which will interface the modules to the amplification electronic.

L. Van Lancker has the responsibility of the design and tests of the carbon fiber support of the modules and of the installation and operation of the GANTRY robot.

Guy Van Beek is involved in the preparation of the OPERA experiment (ν oscillation at Gran Sasso). He took part in the design of the spectrometer magnet and of the scintillators of the trackers.

J.P. Dewulf and L. Etienne participated to the building of a test station for the wave length shifter for the optical modules of the AMANDA detector. J.P. Dewulf had also the responsibility of a new design of the punch through system for optical fiber into the optical module vessel. He was also involved in the design of a new data acquisition system for the digital/analog optical modules.

The DELPHI experiment at the LEP collider at CERN has benefited from the contribution of J.P. Dewulf and R. Goorens. J.P. Dewulf was responsible for the maintenance of the central trigger and of the MUF read-out and trigger hardware. R. Goorens ensured the maintenance of the front-end electronics, trigger and slow control hardware of the MUF. At the end of the year, he took the responsibility of the dismantling of the detector as LEP stopped its activities in November.

In the framework of the spin-off activities related to detector developments for medical applications, J. De Bruyne was in charge, with the help of L. Etienne, of the technical support of the PET and of the MICADO project.

M. Goeman has given administrative support to the scientific coordination committee of the IEEE conference on nuclear science and medical imaging in Lyon (October 2000). She was assisted by R. Pins.

The secretarial work and the general administrative support of the experiments was accomplished by R. Alluyn-Lecluse and M. Garnier-Van Doninck assisted by M. De Schutter, M. Goeman, J. Liesen and D. Luypaert-Peymans. M. Pins has contributed to the maintenance of our documentation centre and has 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 and the running of the DELPHI data quality software.

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).

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

O. Devroede was representative for the "Assisterend academisch personeel" in the DNTK (Departement Natuurkunde - VUB).

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. 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 "8th International Workshop on Deep-Inelastic Scattering and QCD - DIS2000", Manchester, England, April 2000. He is Vice-président of the Comité scientifique du Musée des Sciences de Parentville. He is member of the Conseil d'Administration d'Altair, asbl d'Histoire des Sciences attachée à l'ULB and 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; 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. He was member of the scientific advisory committee of the 5th International Conference on positron sensitive detectors held in London – UK, of the International Scientific Committee SCINT 99

(Moscow). He was member of the organising committee of the IEEE conference on nuclear science and medical imaging in Lyon (October 2000). He was co-convenor of the session on novel detector technologies of the IEEE conference on nuclear science and medical imaging in Lyon (October 2000).

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. Vilain was member of the High Energy Particle Physics Board of the European Physical Society.

G. Wilquet is member of the scientific commission "Hautes et Basses Energies" of the FNRS, he is délégué belge à l'ECFA, délégué belge à l'ACCU du 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, member of the editor committee and of the committee in charge of selecting the conference speakers.
- **C. De Clercq** : project leader of the muon detector. She was Muon Project Leader in the DELPHI experiment during the year 2000 and Slow Control coordinator in the DELPHI experiment from 06-19 July 2000.
- **J. Lemonne** : representative of the FNRS-FWO in the Finance Committee.
- **J. Wickens** : project leader of Offline Software.

2) of the *H1 experiment* :

- **D. Bertrand** : FNRS representative at the Funding Agencies Board.
- **E. De Wolf** : convenor of the working group on energy flow and final states.
- **L. Favart** : convenor of the radiation corrections working group.
- **X. Janssen** : Diffractive data quality responsible.
- **R. Roosen** : representative of "Belgium" in the Collaboration Board and of the H1 Executive board at DESY.
- **J. Sacton** : representative of the IISN-IKW in the Finance Committee.
- **P. Van Mechelen** : librarian of the H1 PHAN software package for physics analyses and 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 tracker institution board, the tracker finance board and the tracker project office. Coordinator of the frames production.
- **P. Vanlaer** : coordinator of the CMS vertex reconstruction package.

4) of the *CHORUS experiment* :

- **B. Van De Vyver** : responsible for the CERN scanning laboratory
- **P. Vilain** : representative of the IIHE at the Collaboration Board.
- **G. Wilquet** : convenor of the committee "Detector and Emulsion". He is also member of the board of the OPERA collaboration and convenor of the electronics detectors committee.

5) of the *OPERA experiment* :

- **P. Vilain** : editor of the Proposal.
- **G. Wilquet** : member of the collaboration board, convenor 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.

7) of the *Crystal Clear Collaboration* :

- **S. Tavernier** : spokesman of the collaboration, member of the board and convenor for the photo-detector group.
- **D. Wisniewski** is member of Crystal Clear Collaboration working group "Crystals".

VII. TEACHING ACTIVITIES.

VII.1. TEACHING ACTIVITIES (academic year 1999-2000).

- **D. Bertrand**
 - PHYS 105 "Travaux Pratique de Physique" (0-0-30)
 - PHYS 109 "Physique des Particules" (0-75-0)
 - Promoteur d'un mémoire de licence
 - PHYS 142 "Prise, analyse et simulation de données expérimentales" (30-0-0)
 - STAT606 "Computer Principes" (39-0-13)
 - "Description des ordinateurs (aspects matériels et logiciels)" (45-0-15)
 - Année préparatoire à la première licence en informatique (orientation gestion) UMH-Charleroi.
- **C. Collard**
 - Laboratoires du cours P. Brouckaert - G. Wilquet "Techniques de la Physique expérimentale".
- **C. Declercq**
 - to VUB students :
 - . contribution to the 30 h of Practicum for the course "elementaire deeltjesfysica", taught by J. Lemonne in the 1st jaar licentiaat Natuurkunde
 - . contribution to the practicals for the course "Wetenschapsvoorlichting" taught by J.P. de Greve in the 2^{de} jaar Licentiaat Communicatiewetenschappen
 - to high school teachers and students :
 - . contribution to the training of the participants to the Belgian Physics Olympiads, 23.03.00
 - . contribution to the "navorming leraars natuurkunde", 19.01.00, VUB
 - . guided tours in the ULB Experimentarium for high school classes - 06.11.00, 09.11.00 and 13.11.00
 - . organisation of trips to CERN for Physics High School teachers : 05-08.03.00 and 29.10-01.11.00
 - . organisation of a trip to CERN for High School students : 09-13.07.00
- **G. De Lentdecker**
 - Contribution to the practical work for ULB students of the 3rd year in physics.
- **O. Devroede**
 - Exercices for the course "Algemene Natuurkunde" from J. Lemonne for the students of the 1st kandidatuur Wis- en Natuurkunde.
- **J. D'Hondt**
 - "Algemene natuurkunde II" : Electro-magnetisme, kristallografie en quantum mechanica (40 h exercices, 2^{de} kandidatuur Natuurkunde, Scheikunde en Geologie - VUB)
- **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 - 1ste kandidatuur met polyvalentie)
 - "Gevorderd practicum Natuurkunde" (20 h - 2^{de}e kandidatuur natuurkunde)
 - "Practicum Algemene Natuurkunde" (20 h - 2^{de}e kandidatuur natuurkunde)
 - "Practicum Algemene Natuurkunde" (7 h - 2^{de}e licentie natuurkunde)
- **J. Lemonne**
 - "Algemene Natuurkunde" (90 h + 60 h practical work - 1ste kandidatuur wis- en natuurkunde - VUB)
 - "Algemene Natuurkunde II" (60 h + 60 h of practical work - 2^{de}e kandidatuur natuurkunde en scheikunde VUB and 30 h + 30 h of practical work - 2^{de}e kandidatuur geologie VUB)
 - "Elementaire Deeltjes" (30 h + 30 h of practical work - 1ste licentie natuurkunde - VUB)
- **P. Marage**
 - "Histoire des sciences" (2^{ème} licence en sciences physiques et sciences mathématiques - ULB)
 - "Histoire des sciences appliquée à la pédagogie" (agrégation de l'enseignement secondaire supérieur - orientation sciences physiques - ULB)

- **R. Roosen**
 - "Elementaire deeltjes fysica", deel II (15 h + 20 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 : "Exercices elementary particle physics" (3rd year).
- **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).
- **C. Vander Velde**
 - contribution to the practical work for the students attending the lectures of D. Bertrand, C. Vander Velde and G. Wilquet on "simulation prise et analyse de données" and of G. Wilquet on "Technique de la physique expérimentale,
 - "Physique générale" (partim 60h + 44 h practical work - 1^{ère} candidature en chimie, géologie, physique, mathématique et polyvalente - ULB)
 - "Physique générale" (électronique – 16h practical work – 2^{ème} candidature informatique - ULB)
 - "Simulation, prise et analyse de données expérimentales" (partim 10 h - DEA en physique théorique - 2^{ème} licence en physique - ULB)
 - "Experimentarium" (8 h - 1^{ère} candidature en chimie, géologie, physique, mathématique et polyvalente - ULB).
- **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).
- **P. Vanlaer**
 - PHYS 106 cours "Technique de la physique expérimentale" 1 week manip. μ
 - "Travaux pratiques du cours d'Electronique" (4 x 4 h; 2^{ème} candidature informaticiens)
- **A. Van Lysebetten**
 - Coördinatie laboratorium natuurkunde voor de cursus "Algemene en proefondervindelijke natuurkunde", titularis H. Eisendrath (1^{ste} kandidatuur wetenschappen)
 - Laboratorium natuurkunde voor de cursus "Fysica", titularis R. Luypaert (1^{ste} kandidatuur Biomedische wetenschappen)
- **P. Vilain**
 - "Questions Approfondies de Physique des Particules" (partim for 15 h + 35 h of practical work - 2^{ème} licence en physique - ULB)
 - "Physique des Particules" (26 h - 1^{ère} licence en physique - ULB)
 - Laboratoires associés à ce cours (3 x 30 h).
- **G. Wilquet**
 - "Technique de la physique expérimentale" (PHYS106) - 1^{ère} licence en sciences physiques ULB (14 h partim de 28 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) (3 x 30 h)
 - Laboratoires de DEA en physique théorique ULB (PHYS142) (40 h partim de 80 h)
 - Organisation des laboratoires de licence et DEA du Service de physique des particules de l'ULB.

VII.2. PhD THESES, "MEMOIRES DE LICENCE" AND "LICENTIAATSVERHANDELINGEN" COMPLETED IN 2000.

* Mémoires de licence" and "licentiaatverhandelingen.

- *Philip Olbrechts* : "Bepaling van W-boson massa via $e^+e^- \rightarrow W^+W^- \rightarrow \mu\nu \quad q\bar{q}$ processen bij een massamiddelpunts energie van 189 GeV"
Promotor : C. De Clercq

- *Sabrina Wenig* : "Etude Eexpérimentale des Caractéristiques des Photomultiplicateurs pour l'expérience AMANDA".
Promotor : D. Bertrand
- * **TFE d'ingénieur civil informaticien.**
- *M. Manolis* : "Le gestionnaire d'événements du système d'acquisition de données du faisceau-test X5, au CERN"
Promotor : P. Vanlaer

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

VIII.1. SEMINARS AT IIHE.

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

- *K. Hoepfner* (University of Hamburg) : "Hunting B's at HERA's Factory".
- *N.C.R. Makins* (DESY - HERMES Experiment) : "New results in spin physics".
- *G. Brooijmans* (Fermi National Accelerator Laboratory - D0 Collaboration) : "New Physics at Run II of the Tevatron".
- *C.P. de los Heros* (Uppsala University (AMANDA Collaboration) : "Recent results from the AMANDA Neutrino Telescope".

The following seminars were given by members of the IIHE :

- *D. Bertrand* :
- "The AMANDA experiment : present and future"
- "Journée de contact du FNRS en astrophysique", November 2000
- *C. Collard* : "Highlights from the DIS 2000 Workshop" (en collaboration avec X. Janssen) - IIHE/ULB-VUB, Bruxelles, May, 15, 2000
- *X. Janssen* : "Highlights from the DIS 2000 Workshop - Hadronic structure functions" (en collaboration avec C. Collard) - IIHE/ULB-VUB, Bruxelles, May, 15, 2000

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

- *C. Collard* :
- "The Regge Factorisation" presentation to the "Cross-Talk - The H1 Workshop-Seminar for H1 PhD and Diploma Students", Hamburg (D), October 5, 2000
- *G. De Lentdecker* :
- "3D Simulations of Gas Electron Multipliers (GEM)" - poster presented at the SBP-BNV, Louvain-la-Neuve, 25-26 May 2000
- "3D Simulations of Gas Electron Multipliers (GEM)" - talk given at the 12th Joint Graduate School on Particle Physics", Monschau, Germany, 15 September 2000
- *O. Devroede* :
- "Large scale test of MSGC + GEM detectors in a high intensity hadron beam" - talk presented at the SBP-BNV, Louvain-la-Neuve, 26 May 2000

- **J. D'Hondt :**
 - "2D Ideogram technique and first results for 1999 data" - talk during DELPHI week : W mass meeting, CERN (Geneva), January 2000
 - "Tuning results : Gaussian and exponential parametrization of $R_{32}(Q)$ " - talk during DELPHI week : W QCD meeting, CERN (Geneva), January 2000
 - "PYTHIA 6.156 for DELPHI and tuning results" - talk during DELPHI week : General Software meeting, CERN (Geneva), January 2000
 - "Hadronic W mass results for Moriond Conference" - talk during DELPHI week : W mass meeting, CERN (Geneva), February 2000
 - "The aspect ratio uncertainty in the hadronic W mass analysis" - talk during DELPHI week : W mass meeting, CERN (Geneva), June 2000
 - "Optimizing a bayesian inference method with Kalman filtering techniques" - talk during DELPHI week : W mass meeting, CERN (Geneva), July 2000
 - "Optimization of bayesian inference method by use of Kalman filters" - talk at DELPHI Forum, CERN (Geneva), August 2000
 - "Studies on Bose-Einstein and Colour reconnection systematic uncertainties and possibility to reduce this uncertainty by clever event selections cuts" - talk during DELPHI week : W systematic meeting, CERN (Geneva), October 2000
 - "Global PYTHIA 6.125 / LUBOEI B E_{32} tuning" - talk during DELPHI week : W systematic meeting, CERN (Geneva), December 2000
 - "Comparison of ADLO PYTHIA parameters" - talk during DELPHI week : W mass meeting, CERN (Geneva), December 2000
- **L. Favart :**
 - "Proton Spectrometer for H1 after 2000" - IIHE/ULB-VUB, Bruxelles, February 2000
 - "Radiative Corrections at HERA : An experimentalist view" - DESY-Forum, DESY, Hambourg (D), 14 novembre 2000
 - "The photon-proton interaction under HERA microscope" - Colloquium au Département de Physique de l'UFRGS, Porto Alegre (Brasil), 12 décembre 2000
 - "HERA results on : Elastic Hadronic and Sub-Hadronic Diffraction" - séminaire à l'UFRGS, Porto Alegre (Brasil), 13 décembre 2000
- **P. Marage :**
 - "The dipole picture of small x physics" - participation au séminaire restreint, Amirin, Israël, April 2000
 - "Diffraction at HERA" - communication à l'International Workshop on Low x Physics, Oxford, England, July 2000
 - "Low Q^2 , models, saturation" - co-animateur de la session de discussion on Low x Physics, Oxford, England, July 2000
 - "Diffraction at HERA and Prospects for H1" - International Workshop "Diffraction 2000", Cetraro, Italie, September 2000 (sera publié dans les comptes-rendu, hep-ph/0012042)
 - "Diffraction at HERA" International Workshop "Forward Physics and Luminosity Determination at LHC", Helsinki, Finland, November 2000
- **Ph. Olbrecht :**
 - "Unfolding detectoreffects for measurements of Bose-Einstein effects",
 - Student talk at the CERN summerschool, 11th July - 8th September 2000.
- **R. Roosen :**
 - "Presentation of the VFPS proposal" in the Physics Review Committee closed session, DESY, Hambourg, 2th May, 2000
 - "Presentation of the VFPS proposal" in the Physics Review Committee closed session, DESY, Hambourg, 18th October, 2000
- **R. Stamen :**
 - "Messung des DVCS Prozess mit dem H1 Detektor bei HERA" - seminar at the Deutsche Physics Society meeting (DPG) Dresden (D), 20-24 March 2000
 - " DVCS at HERA" - seminar and contribution to proceedings of 8th International Workshop on Deep-Inelastic Scattering DIS2000", Liverpool (UK), 25-30 April 2000
 - "Vector Particle Production" - seminar at the International Workshop on Low x Physics, Oxford (UK), 5-8 July 2000
 - " DVCS at HERA" - seminar and contribution to proceedings of 13th International Workshop on Photon-Photon Collissions, Ambleside (UK), 26-31 August 2000

- **S. Tavernier :**
 - "The rise and the fall of the bubble chamber" - seminar at the Symposium in honor of Professor J. Sacton, Brussels, 10th September 2000
 - "Detector for X-rays and gamma in medical imaging" - seminar at the University for Science and Technology, Hefei, China, September 2000
 - "Beeldvorming in de nucleaire geneeskunde en de radiology" - seminary voor de vereniging studenten natuurkunde en toegepaste natuurkunde van de RUB, 29th February 2000
 - "Status and further perspectives for small animal PET machines" - invited review talk at the Calorimetry in High Energy Physics, Annecy, France, October 2000
 - "Detectors for X-rays and gamma rays in medical imaging (part 1 : Scintillators and phosphors for X-ray and gamma ray detectors and their applications in PET and SPECT)" - lecture given in the short course program of the NSS-MIC IEEE2000 conference, Lyon, France, October 2000
- **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.
- **D. Wisniewski :**
 - "General properties and possibility of LuAlO₃ : Ce improvement" - presentation at Crystal Clear Collaboration meeting, Geneva, Switzerland, 18th December 2000

IX. SCIENTIFIC VULGARISATION.

D. Bertrand :

- Présentation de la physique des hautes énergies à l'émission "Semences de curieux" (RTBF 3) 3 émissions de 1 heure (April 2000).

C. De Clercq :

- Organisation of the "physics" pavillion at the Wetenschaps Festival des Sciences of Brussel 2000, 19-29 October 2000
- Organisation of the AMANDA collaboration meeting in Brussels on 19-22 May 2000.

P. Marage :

- Organisation de l'ensemble des opérations "Ville et science" proposées par la Faculté des Sciences de l'ULB en collaboration avec l'asbl Bruxelles-2000, 1999-2000
- Interview dans le journal Le Soir, à propos de la Journée des Sciences à la Foire du Livre, 17 février 2000
- Organisation et animation de la Table Ronde "Le défi des sciences", dans le cadre de la Journée des Sciences à la Foire du Livre, 23 février 2000
- "Physique des particules et cosmologie" - cours (2 h) dans le cadre du cycle "Initiation à la cosmologie", organisé par la Société Royale Belge d'Astronomie, de Météorologie et de Physique, l'Association Jeunesse et Sciences et le CEPULB, ULB, 8 avril 2000
- Participation émission "Tout autre chose" RTBF, premier programme (10-11 h), à l'occasion des "Semaines des Sciences", avril 2000
- Interview journal Vlan, à propos des études en sciences, août 2000
- Interview journal Télé-Bruxelles, à propos du Festival des Sciences, octobre 2000
- Interview Radio, à propos du Festival des Sciences, octobre 2000
- Participation émission "Tout autre chose" RTBF, premier programme (10-11 h), à l'occasion du "Festival des Sciences", 23 octobre 2000
- "Le centenaire de la mécanique quantique", participation à l'émission spéciale "Semence de Curieux" sur Radio-3, 14 décembre 2000 (20-23 h)
- "Que nous réserve le troisième millénaire ?", participation à l'émission "Controverses", RTL-TVI, 31 décembre 2000 (12-13 h).

X. ATTENDANCE TO CONFERENCES, WORKSHOPS AND SCHOOLS.

X.1. CONFERENCES AND WORKSHOPS.

- XXXth International Conference on High Energy Physics (ICHEP 2000) - Osaka (Japan) - July 27-August 2, 2000
D. Bertrand, C. De Clercq, L. Favart, J. Lemonne, A. Van Lysebetten
- 8th International Workshop on Deep-Inelastic Scattering (DIS 2000) - Liverpool (GB) - 25-30 April 2000
C. Collard, L. Favart, X. Janssen, R. Stamen
- Belgian Physical Society - Louvain-La-Neuve (B) - 25-26 May 2000
D. Bertrand, C. Collard, G. De Lentdecker, O. Devroede, L. Favart, J. D'Hondt, X. Janssen, J. Lemonne, M. Vander Donckt, P. Vanlaer, G. Wilquet
- Cross-Talk - The H1 Workshop-Seminar for H1 PdH and Diploma Students - Hamburg (D) - 5-6 October 2000
C. Collard
- 3^{ème} Atelier MICROMEGAS, IPHE, Lausanne, Suisse - 10-11 March 2000
G. De Lentdecker
- WW LEP Workshop - CERN (Geneva) - April 2000
J. D'Hondt
- DELPHI Week at Uppsala - Uppsala (Sweden) - September 2000
J. D'Hondt
- WW LEP Workshop - Lisbonne (Portugal) - November 2000
J. D'Hondt
- C++ Course : "Technical training" - CERN (Geneva) - November 2000
G. De Lentdecker, J. D'Hondt
- *P. Marage* : Présidence de sessions :
 - Session "HERA Physics", 8th International Workshop on Deep-Inelastic Scattering and QCD - DIS 2000, Liverpool, England, April 2000
 - Session "Low Q^2 , models, saturation", International Workshop on Low x Physics, Oxford, England, July 2000
 - Session "Diffraction in hadron-hadron collisions I", International Workshop Diffraction 2000, Cetraro, Italy, September 2000
- Symposium : Honderd Jaar Kwantummechanica, held at University Utrecht, 21th December 2000
R. Roosen
- Deutsche Physics Society meeting (DPG) Dresden (D), 20-24 March 2000
R. Stamen
- International Workshop on Low x Physics, Oxford (UK), 5-8 July 2000
R. Stamen
- 13th International Workshop on on Photon-Photon Collisions, Ambleside (UK), 26-31 August 2000
R. Stamen
- IEEE 2000 Nuclear Science Symposium and Medical Imaging Conference, October 15-20, 2000, Lyon, France
St. Tavernier, D. Wisniewski
- IXth International Conference on Calorimetry in High Energy Physics, October 13-19, 2000, Annecy, France
St. Tavernier
- "8th Pisa meeting on advanced detectors", Elba, Italy, May 2000
F. Udo, C. Vander Velde, W. Van Doninck and V. Zhukov

- "Workshop on Physics with CMS at the LHC", TIFR, Mumbai, Indes, December 2000
C. Vander Velde
- American Physical Society meeting, Long Beach, California, April 2000
P. Vanlaer
- CMS Silicon Module lay-out workshop, CERN, Geneva, 16-17 May 2000
P. Vanlaer
- "Physics in Collision XX", Lisbon, Portugal, June 29-July 1st 2000
presentation of a poster entitled "Trilinear Gauge Couplings at LEP2 with the DELPHI detector"
A. Van Lysebetten
- "Neutrino 2000", Sudbury, Canada
M. Vander Donckt, G. Wilquet
- Crystal Clear Collaboration meeting, Geneva, Switzerland, 18th December 2000
D. Wisniewski
- New Worlds in Astroparticle Physics, Faro, Portugal, 1-3 September 2000
D. Bertrand

X.2. SCHOOLS.

- 2000 European School of High-Energy Physics - Caramulo (Portugal) - August 20-September 2, 2000
C. Collard
- 12th Joint Graduate School on Particle Physics, Monschau, Germany, 03-15 September 2000
G. De Lentdecker
- CERN School of computing 2000, Marathon, Greece, 17-30 September 2000
O. Devroede, P. Vanlaer
- PSI Summer School on "Phenomenology of Gauge Interactions" - Zuoz (Switzerland) - August 2000
J. D'Hondt
- Summerschool in the European Centre for Particle Physics (CERN - Switzerland) from the 11th July until the 8th of September 2000
Ph. Olbrechts
- "CTEQ Summer School on QCD Analysis and Phenomenology", Lake Geneva, Wisconsin, USA from 30th May to 7th June 2000
X. Janssen

X.3. TECHNICAL FORMATIONS.

- "Formation ANSYS 5.5", Cril Technologie, Mendon la forêt-Paris, from 07 to 11 February 2000
G. Van Beek
- "ANSYS Emag", Cril Technologie, Mendon la forêt-Paris, from 27 to April 2000
G. Van Beek

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

XII.1. PUBLICATIONS.

Neutrino Physics

"Leading-order QCD analysis of neutrino-induced dimuon events"

P. Vilain et al.

Eur. Phys. J. C11 (1999) 19-34

"Observation of weak neutral current neutrino production of J/ψ "

CERN-EP/2000-154

Accepted for publication in Phys. Lett.

"New results from a search for ν_μ - ν_τ and ν_e - ν_τ oscillation"

E. Esku et al.

CERN-EP/2000-147

Accepted for publication in Phys. Lett.

"An appearance experiment to search for ν_μ - ν_τ oscillations in the CNGS beam"

OPERA experiment Proposal

M. Guler et al.

CERN-SPSC/2000-028

e^+e^- Physics

"Measurement of the Z partial decay width into $c\bar{c}$ and multiplicity of charm quarks per b decay"

P. Abreu et al.

Eur. Phys. J. C12 (2000) 225-241

"Measurement of the $\bar{B} \rightarrow D^{(*)}\pi\ell\bar{\nu}_\ell$ branching fraction"

P. Abreu et al.

Phys. Lett. B475 (2000) 407-428

"Two-dimensional analysis of the Bose-Einstein correlations in e^+e^- annihilation at the Z^0 peak"

P. Abreu et al.

Phys. Lett. B471 (2000) 460-470

"Measurement of Trilinear Gauge Boson Couplings in e^+e^- Collisions at 192 to 202 GeV"

A. Van Lysebetten et al. (24 authors)

DELPHI 2000-049 CONF 364

"Measurement of Trilinear Gauge Boson Couplings WWV ($V \equiv Z, \gamma$ in e^+e^- Collisions at 189 GeV"

A. Van Lysebetten et al. (24 authors)

DELPHI 2000-139 OSAKA CONF 438

"Measurement of Trilinear Gauge Boson Couplings in e^+e^- Collisions at 192 to 202 GeV"

A. Van Lysebetten et al. (24 authors)

DELPHI 2000-146 OSAKA CONF 445

"Measurements of the Z partial decay width into $c\bar{c}$ and multiplicity of charm quarks per b decay"

P. Abreu et al.

Eur. Phys. J. C12 (2000) 225-241

"Determination of $P(c \rightarrow D^{*+})$ and $BR(c \rightarrow l^+)$ at LEP 1"

P. Abreu et al.

Eur. Phys. J. C12 (2000) 209-224

"Consistent measurements of α_s from precise oriented event shape distributions"

P. Abreu et al.

Eur. Phys. J. C14 (2000) 557-584

"A precise measurement of the τ polarisation at LEP-1"

P. Abreu et al.

Eur. Phys. J. C14 (2000) 585-611

" Λ_b polarization in Z^0 decays at LEP"

P. Abreu et al.

Phys. Lett. B474 (2000) 205-222

"Measurement of the strange quark forward-backward asymmetry around the Z^0 peak"

P. Abreu et al.

Eur. Phys. J. C14 (2000) 613-631

"Measurement of the gluon fragmentation function and a comparison of the scaling violation in gluon and quark jets"

P. Abreu et al.

Eur. Phys. J. C13 (2000) 573-589

"Search for supersymmetry with R-parity violating LLEbar couplings at $\sqrt{s} = 183$ GeV"

P. Abreu et al.

Eur. Phys. J. C13 (2000) 591-608

"Inclusive Σ^- and $L(1520)$ production in hadronic Z decays"

P. Abreu et al.

Phys. Lett. B475 (2000) 429-447

"Search for heavy stable and long-lived particles in e^+e^- collisions at $\sqrt{s} = 189$ GeV"

P. Abreu et al.

Phys. Lett. B478 (2000) 65-72

"Search for supersymmetric particles in scenarios with a gravitino LSP and stau NLSP"

P. Abreu et al.

Eur. Phys. J. C16 (2000) 211-228

"A study of the Lorentz structure in tau decays"

P. Abreu et al.

Eur. Phys. J. C16 (2000) 229-252

"Determination of $|V_{ub}|/|V_{cb}|$ with DELPHI at LEP"

P. Abreu et al.

Phys. Lett. B478 (2000) 14-30

"Cross-sections and leptonic forward-backward asymmetries from the Z^0 running of LEP"

P. Abreu et al.

Eur. Phys. J. C16 (2000) 371-405

"Measurement and interpretation of fermion-pair production at LEP energies of 183 and 189 GeV"

P. Abreu et al.

Phys. Lett. B485 (2000) 45-61

"Search for charginos in e^+e^- interactions at $\sqrt{s} = 189$ GeV"

P. Abreu et al.

Phys. Lett. B479 (2000) 129-143

"Photon events with missing energy at $\sqrt{s} = 183$ to 189 GeV"

P. Abreu et al.

Eur. Phys. J. C17 (2000) 53

"Update of the search for charginos nearly mass-degenerate with the lightest neutralino"

P. Abreu et al.

Phys. Lett. B485 (2000) 95-106

"Measurement of B_s^0 lifetime and study of the $B_s^0 - \bar{B}_s^0$ oscillations using D_{s1} events"

P. Abreu et al.

Eur. Phys. J. C16 (2000) 555

"Rapidity-rank structure of $p\bar{p}$ pairs in hadronic Z^0 decays"

P. Abreu et al.

Phys. Lett. B490 (2000) 61

"Limits on the masses of supersymmetric particles at $\sqrt{s} = 189$ GeV"

P. Abreu et al.

Phys. Lett. B489 (2000) 38-54

"Determination of the $e^+e^- \gamma\gamma(\gamma)$ cross-section at centre of mass energies ranging from 189 GeV to 202 GeV"

P. Abreu et al.

Phys. Lett. B491 (2000) 67

"Search for SUZY with R-parity violating $LLE\bar{e}$ coupling at $\sqrt{s} = 189$ GeV"

P. Abreu et al.

Phys. Lett. B487 (2000) 36-52

"W pair production cross-section and W branching fractions in e^+e^- interactions at 189 GeV"

P. Abreu et al., DELPHI collaboration

Phys. Lett. B479 (2000) 89

"Robustness test of a system of MSGC + GEM detectors at the cyclotron facility of the Paul Scherrer Institute"

M. Ageron et al.

Accepted for publication in Nucl. Inst. & Meth.

"The micromegem detector"

O. Bouhali et al. et al.

Accepted for publication in Nucl. Inst. & Meth.

ep Physics

"Measurements of transverse energy flow in deep-inelastic scattering at HERA"

C. Adloff et al.

Eur. Phys. J. C12 (2000) 595-607

"Elastic Electroproduction of ρ Mesons at HERA"

C. Adloff et al.

Eur. Phys. J. C13 (2000) 371-396

"Measurement of dijet cross-sections at low Q^2 and the extraction of an effective parton density for the virtual photon"

C. Adloff et al.

Eur. Phys. J. C13 (2000) 397-414

"Di-Jet Event Rates in Deep-Inelastic Scattering at HERA"

C. Adloff et al.

Eur. Phys. J. C13 (2000) 415-426

"Measurement of Neutral and Charged Current Cross-Sections in Positron-Proton Collisions at Large Momentum Transfer"

C. Adloff et al.

Eur. Phys. J. C13 (2000) 609-639

"Investigation of Power Corrections to Event Shape Variables measured in Deep-Inelastic Scattering"

C. Adloff et al.

Eur. Phys. J. C14 (2000) 255-269

"Search for Compositeness, Leptoquark and Large Extra Dimensions in eq Contact Interaction at HERA"

C. Adloff et al.

Phys. Lett. B479 (2000) 358-370

"Elastic Photoproduction of J/ψ and U Mesons at HERA"

C. Adloff et al.

Phys. Lett. B483 (2000) 23-35

"Measurement of Di-jet Cross-Sections in photoproduction and Photon Structure"

C. Adloff et al.

Phys. Lett. B483 (2000) 36-48

"Measurement of elastic electroproduction of ϕ mesons at HERA"

C. Adloff et al.

Phys. Lett. B483 (2000) 360-372

Experimental techniques

"Design and performance of a Data Acquisition System for the VUB-PET"

P. Bruyndonckx, Yonggang WANG, S. Tavernier, P. Carnochan

Accepted for publication in IEEE Transactions on Nuclear Science

"Study of PET Detector Module with LSO scintillation Crystals and an APD array"

A. Fremout, R. Chen, P. Bruyndonckx, S. Tavernier

Presented at the IEEE-2000 conference in Lyon, France, October 2000, to be published in the proceedings

"Study of the readout of a storage phosphor screen with APD's"

P. Bruyndonckx, F. Zanca, S. Tavernier

Presented at the IEEE-2000 conference in Lyon, France, October 2000, to be published in the proceedings

"Préliminary evaluations of High Resolution Positron Emission Tomography for Brest Imaging"

L.L. White, B. Ott, M.A. Flower, K. Erlandsson, D.M. Duxbury, P. Bruyndonckx, S. Tavernier

Presented at the IEEE-2000 conference in Lyon, France, October 2000, to be published in the proceedings

"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

Submitted to IEEE Transactions on Nuclear Science

"The MICROME GEM detector"

O. Bouhali et al.

Nucl. Instr. & Meth. A459 (2001) 211-220

"A multichannel single-photon sensitive detector for high-energy physics : the megapixel EBCCD"

L. Benussi et al.

Nucl. Inst. & Meth. A442 (2000) 154-158

"High resolution tracking using large capillary bundles filled with liquid scintillator"

P. Annis et al.

Nucl. Inst. & Meth. A449 (2000) 60-80

"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

XI.2. CONFERENCE PROCEEDINGS.

"Proposal for a Very Forward Proton Spectrometer in H1 after 2000"

L. Favart

Talk and contribution to the Proceedings of the 8th International Workshop on Deep-Inelastic scattering (DIS 2000), and hep-ph/0006167

"Deeply Inelastic Compton Scattering at HERA"

L. Favart

Talk and contribution to the Proceedings of the XXXth International Conference on High Energy Physics (ICHEP 2000), and hep-ph/0101046

"Results from reactors and accelerators neutrino oscillation experiment"

G. Wilquet

To be published in the Proceedings of the IVth Rencontres du Vietnam, Hanoi, 2000

"Measurement of the W mass and width at CMS energies from 192 to 202 GeV", DELPHI 2000-144 Conf. 446,

J. D'Hondt

To be published in the proceedings of the XXXth International Conference on High Energy Physics (ICHEP 2000) - Osaka (Japan) - July 27-August 2, 2000

XI.3. REPORTS.

- "OPERA, an appearance experiment to search for $\nu_\mu \leftrightarrow \nu_\tau$ oscillation in the CNGS beam"
Experimental proposal
M. Guller et al.
CERN/SPSC 2000-028, SPSC/P318, LNGS P25/2000
- "Proposal for Installation of a Very Proton Spectrometer for H1 after 2000"
L. Favart, D. Johnson, P. Marage, R. Roosen et al.
PRC 00/01 and H1 Note H1-IN-582 (05/2000)

XI.4. PATENTS.

- "Imager or Particle detector and method of manufacturing the same"
E. Beyne, A. Breskin, R. Chechik, S. Tavernier, W. Van Doninck
Octrooi nb 6,121,622, September 2000
(in collaboration with IMEC and Weizmann Institute)
- "Radiation image readout method and apparatus"
S. Tavernier, P. Bruyndonckx, F. Zanca
Submitted 27/04/00, submission number 00201510.5
- "The MICROGEM detector"
G. De Lentdecker
talk given at the "3^{ème} Atelier MICROMEGAS" - IPHE, Lausanne, Suisse, 10 March 2000

XII. ILLUSTRATIONS.

Fig. 1 *AMANDA experiment* : presentation at DESY 2000 exhibition.

Fig. 2 *OPERA experiment* : the detector of Gran Sasso.

Fig. 3 *DELPHI experiment* :

a, b, c : LEP averages of the charged Triple Gauge Boson Couplings presented at the ICHEP 2000 conference,

d : LEP average of the measurement of the W-boson mass with the fully hadronic final states presented at the ICHEP 2000 conference.

Fig. 4 *H1 experiment* : Upgrade of the H1 detector

top : tracker removed to place the new forward and central trackers,

bottom : insertion of supraconducting magnet in the detector for future high luminosity regime.

Fig. 5 *CMS experiment* :

top : Gantry robot for the CMS Si modules assembly in Brussels,

bottom : Gantry control box built in Brussels.

Fig. 6 *Crystal Clear collaboration* : first production of LuAP scintillator.