

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

ANNUAL REPORT 1994

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J. LEMONNE and J. SACTON
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I. INTRODUCTION

The physicists, engineers and computer scientists whose names are listed below have contributed to the different activities of the Institute during the year 1994.

U.L.B.

P. Annis (boursier, région Sardaigne)
 M. Barth (maître de recherche FNRS)
 D. Bertrand (maître de recherche FNRS)
 G. Bertrand-Coremans (chef de travaux)
 O. Bouhali (doctorant)
 C. Bricman (maître de recherche FNRS)
 B. Clerbaux (boursière IRSIA since 1/10/1994)
 L. Favart (boursier IRSIA)
 M. Gruwé (Grant NFWO)
 V. Lefébure (boursier IRSIA)
 P. Marage (agrégé de faculté; maître d'enseignement)
 A. Panitch (boursier ULB)
 J. Sacton (professeur ordinaire)
 J. Stefanescu (boursier IRSIA)
 M. Vanderdonckt (boursier IRSIA)
 C. Vander Velde (chargé de cours associé)
 P. Van Laer (boursier IRSIA)
 P. Vilain (chercheur qualifié FNRS)
 J. Wickens (chercheur IRSN)
 G. Wilquet (chercheur qualifié FNRS)
 V. Zhukov (visiting scientist from Moscow State University - 3 months)

V.U.B.

Cao Fang (VUBAROS fellow)
 S. Claes (wetenschappelijk medewerker since 1.09.1994)
 C. De Clercq (logistiek medewerker IIKW)
 E. Evrard (vorser IIKW)
 M. Goldberg (NFWO Sabatical from SOREQ-Israël, till February 1994)
 T. Heiremans (vorser IIKW)
 D. Johnson (hoogleraar VESALIUS College)
 J. Lemonne (gewoon hoogleraar) *X. diu (VUBAROS fellow)*
 C. Mommaert (vorser IIKW)
 J. Nelissen (IWT-beurs sinds 1.10.1994)
 S. Rajeswaran (EEG-bursaal) *post-doc EU contract*
 R. Roosen (onderzoeksleider NFWO)
 S. Tavernier (onderzoeksdirecteur NFWO)
 R. Vandenbroucke (logistiek medewerker IIKW)
 W. Van Doninck (onderzoeksleider NFWO)
 P. Van Esch (vorser IIKW)
 J. Wulleman (OZR-vorser)
 Zhang Shuping (Rectorale beurs)

F. Verbeure, T. Beckers (from 1.10.94), F. Botterweck, R. Chen, H. De Boeck (till 30/9/94), S. De Brabandere, E. De Wolf, Z. Garutchava, P. Van Mechelen en A. Tomaradze from the Universitaire Instelling Antwerpen have been working in close collaboration with the Institute.

Research in the field of data and telecommunications has been conducted by P. Van Binst, A. Cohen, O. Paridaens, P. Paridans, J.M. Verbergt, E. Tsigros, R. Mzabet, E. Mannie, R. Najmabadi, B. Sales, A. Maimo, M. Colin, T. Nguyen, A. Guillen, S. Sattari from the ULB and by R. Vandenbroucke, N. Meulemans and Z. Czekro from the VUB. These activities are reported in a separate document.

II. RESEARCH ACTIVITIES

II.1. NEUTRINO PHYSICS

II.1. 1. NEUTRINO AND ANTI-NEUTRINO INTERACTIONS IN THE BEBC BUBBLE CHAMBER

(P. Marage, J. Sacton)

Three BEBC Collaborations : WA21 (hydrogen), WA25 (deuterium) and WA59 (heavy neon-hydrogen mixture) combined their data, in collaboration with Russian groups from ITEP (Moscow) and IHEP (Serpukhov). The combined analysis led to the observation of the D_s^{**} (2536) charmed strange meson, with a mass of $(2534 \pm 1.2)\text{MeV}$. The production rate is 0.011 ± 0.005 per neutrino charged current interaction at a mean neutrino energy of 61 GeV.

II. 1.2. NEUTRINO AND ANTINEUTRINO INTERACTIONS IN THE 15' BUBBLE CHAMBER FILLED WITH A HEAVY H₂/NE MIXTURE AND EXPOSED TO THE TEVATRON HIGH ENERGY NEUTRINO BEAM

(M. Barth, E. De Wolf, P. Marage, J. Sacton,; E632 Collaboration : Berkeley, Birmingham, Brussels, CERN, Chandigarh, Fermilab, Hawaii, Illinois Institute of Technology, I.C. London, Jammu, Munich, Oxford, Rutgers, Stevens Institute of Technology, Tufts).

A study has been performed of neutral strange particle production in ν_μ Ne and $\bar{\nu}_\mu$ Ne charged current interactions at the high energy (average $\langle E_\nu \rangle = 80$ GeV and $\langle E_{\bar{\nu}} \rangle = 70$ GeV) Tevatron beams. The average multiplicities of K^0 , Λ and $\bar{\Lambda}$ are significantly greater than for lower energy experiments, especially for $\bar{\Lambda}$ hyperons. The dependence of rates on kinematical variables has been measured. The Lund model agrees qualitatively with the data, but does not reproduce single-particle distributions in detail, - especially for forward Λ production. The Λ hyperons are polarized in the production plane.

II.1.3. NEUTRINO AND ANTINEUTRINO SCATTERING ON ELECTRONS : THE CHARM-II EXPERIMENT (WA79)

(M. Gruwé, P. Vilain, G. Wilquet; CHARM-II or WA79 Collaboration : Brussels, CERN, Ferrara, Hamburg, Louvain-la-Neuve, ITEP-Moscow, Munich, Naples, Rome, Zeuthen)

The data accumulated between 1987 and 91 continue to be the source of various analyses :

- The combination of CHARM-II results on muon-neutrino electron scattering with the LEP results on the electron coupling to the Z boson has allowed the first determination of the muonic neutrino coupling to the Z. This measurement provides direct evidence for neutrino flavour universality in NC coupling.
- After several publications on partial statistics, the final values of the electroweak parameters from ν_μ -e scattering were obtained

$$\sin^2\theta_W = 0.2324 \pm 0.0083$$

$$g_V^e = -0.035 \pm 0.017$$

$$g_A^e = -0.503 \pm 0.017$$

- The same data were also analysed in the context of possible extensions of the Standard Model, providing constraints on additional Z bosons.
- The excellent electron identification capability of the CHARM II detector was also used to set new upper limits on the $\nu_\mu \rightarrow \nu_e$ oscillation parameters.

In addition to these published results, five other topics are being finalized :

- Electromagnetic properties of ν_μ 's
- Search for heavy Isosinglet Neutrinos
- Study of the inverse muon decay $\nu_\mu + e^- \rightarrow \mu^- + \nu_e$
- Study of the "trident" reaction $\nu_\mu N \rightarrow \nu_\mu \mu^+ \mu^- N$
- Study of charm production from dimuon events

II.1.4. SEARCH FOR ν_μ - ν_τ OSCILLATIONS : THE CHORUS EXPERIMENT

(P. Annis, M. Gruwé, C. Mommaert, M. Vanderdonckt, P. Vilain, G. Wilquet; WA95 Collaboration : Amsterdam, Ankara, Bari, Berlin, Brussels, CERN, Ferrara, Haifa, Japan (8 groups), Korea (2 groups), Louvain-la-Neuve, Moscow, Munster, Naples, Rome, Salerno).

This experiment aims at improving by more than one order of magnitude the existing upper limits on the parameters Δm^2 , the difference between the ν_μ and ν_τ mass squared, and $\phi_{\mu\tau}$, the mixing angle between the 2 neutrino species, by detecting a few examples of the reaction $\nu_\tau + \text{nucleon} \rightarrow \tau^- + \text{hadrons}$ in a nuclear emulsion target. The localisation of the

neutrino interactions in the target is performed by the accurate measurement of the trajectories of the outgoing charged products in several arrays of scintillating fibers.

The detector installation in the wide band neutrino beam of the CERN SPS was completed in November 93. After a short debugging period, it was exposed to various calibration beams, allowing a first measurement of the calorimeter and spectrometer resolution. In May 94, the 800kg emulsion target was installed and valuable neutrino data were accumulated until October, corresponding to about $7 \cdot 10^{18}$ protons on target. Mainly due to SPS inefficiencies, this represents only 60% of the anticipated amount. More than 2000 IBM cartridges, each of about 150 Gbytes, were recorded and are being analysed. To reach the required track reconstruction precision, many factors had to be corrected for : misalignment of detector elements, image distortions in the optoelectronic chains, temperature or high voltage fluctuations, etc. In parallel, the software has been strongly developed to improve the event reconstruction performance.

A quarter of the emulsion has been removed after the 94 running period and developed in December. Soon after, the first neutrino events could be located at about the predicted positions. In 1995, this search will enter a production phase, while the target will be exposed for a second running period of about 180 days.

A two years extension of the experiment, with a new emulsion target and some detector improvements, has been approved by the CERN Research Board and will take place in 1996-97.

II.2. STUDY OF e^+e^- ANNIHILATIONS AT LEP.

(D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, C. Vander Velde, W. Van Doninck, F. Verbeure, J. Wickens ; Delphi Collaboration : Ames-Iowa, Athens, Athens Demokritos, Athens-NTU, Belgium, Bergen, CERN, Collège de France, Copenhagen, Cracow, Dubna, Grenoble, Helsinki, IN22P3-CNRS/ULP, INFN-Bologna, INFN-Genova, INFN-Milano, INFN-Padua, INFN-Roma, Roma Sanita, INFN-Torino, INFN-Trieste, JINR-Moscom, Karlsruhe, Krakow, LAL-Orsay, Lancaster, LIP (Lisboa), Liverpool, Ljubljana, Lund, Lyon Madrid, Marseille, NC-Praha, NIKHEF-Amsterdam, Orsay, Oslo, Oxford, Paris-LPNHE, Rutherford, Saclay, Salerno, Santander, Serpukhov, Stockholm, Strasbourg, Uppsala, Valencia, Vienna, Warsaw, Wuppertal)

The collaboration between Belgium (IIHE/ULB-VUB, Mons, UIA) and the laboratories of Oxford and Rutherford is responsible for the muon part of the DELPHI detector.

The main results presented at conferences or published during 1994 can be summarised as follows :

✓ A. Measurement of the Z^0 resonance parameters and electroweak coupling based on the analysis of a sample of approximately 1 730 000 Z^0 -decays accumulated until the end of 1993 were reported at the ICHEP 94 - Conference (Glasgow). Allowing for independent couplings for the different lepton species a 9 parameter fit to the hadronic cross sections and to the leptonic cross sections and asymmetries yields the following parameters :

$$M_Z = (91.1870 \pm 0.0052) \text{ GeV}$$

$$\Gamma_Z = (2.4951 \pm 0.0059) \text{ GeV}$$

$$\sigma_0^h = (41.26 \pm 0.17) \text{ nb}$$

$$R_e = \frac{\Gamma_h}{\Gamma_e} = 20.96 \pm 0.16$$

$$R_\mu = \frac{\Gamma_h}{\Gamma_\mu} = 20.60 \pm 0.12$$

$$R_\tau = \frac{\Gamma_h}{\Gamma_\tau} = 20.64 \pm 0.16$$

$$A_{FB}^{oe} = 0.0207 \pm 0.0073$$

$$A_{FB}^{o\mu} = 0.0128 \pm 0.0050$$

$$A_{FB}^{o\tau} = 0.0209 \pm 0.0057$$

✓ B. A study of radiative muon-pair events at Z^0 -energies allowed to determine :

i) Differential cross sections of the radiative photons

ii) Muon-pair production cross section and asymmetry below the Z^0 peak ($20 \leq \sqrt{s} \leq 85$ GeV)

iii) Limits on the Z^0 - Z' mixing angle and on the Z' -mass.

✓ C. Charged kaon production in one prong τ -decays has been studied using the Barrel Ring Imaging Cherenkov detector. The following branching ratios have been determined

$$BR(\tau^\pm \rightarrow K^\pm \overset{(-)}{\nu}_\tau) = (.85 \pm .18) \%$$

$$BR(\tau^\pm \rightarrow K^\pm \overset{(-)}{\nu}_\tau + \text{neutrals}) = (.69 \pm .25) \%$$

$$BR(\tau^- \rightarrow K^{*-} \nu_\tau) \times BR(K^{*-} \rightarrow K^- \pi^0) = (.57 \pm .23) \%$$

D. The following topics were studied in hadronic Z^0 -decay :

- i) $K_S^0 - \bar{K}_S^0$ Bose-Einstein correlations
- ii) The production of multihadronic states in $\gamma\gamma$ -collisions. It was found necessary to introduce an interaction component due to hard scattering of the partonic constituents of the photon in order to describe the data
- iii) Two particle correlations in invariant mass for like-sign and unlike-sign pions manifesting different particle dynamics. Good agreement is obtained with the production of a modified version of the JETSET 7.3 parton shower model if the production of the η' and ρ^0 -mesons is reduced and Bose-Einstein correlations are included.
- iv) Various aspects of $B - \bar{B}$ production and B -decays :⁽⁻⁾
 - production rate and decay lifetime measurements $((.96 \pm .37)\text{ps})$ of B_s^0 mesons using D_s - and ϕ -mesons
 - the average $B^0 - \bar{B}^0$ mixing using :
 - the average electric charge of hadron-jets giving :

$$\bar{\chi} = .144 \pm .014^{+.017}_{-.011}$$
 - events with leptons with the result :

$$\bar{\chi} = .121 \pm .016 \pm .006$$
 - A measurement of time dependent $B_d^0 - \bar{B}_d^0$ mixing leading to a mass difference of the two B_d^0 -mass eigenstates $\Delta\mu = [3.29 \pm .79 \pm .39] 10^{-4} \text{ eV}/c^2$
 - A measurement of the B_s^0 -mass = $(5374 \pm 16 \pm 2) \text{ MeV}/c^2$
 - Precision measurements of the average lifetime of B-hadrons using two different methods leading to the combined result

$$\tau_B = (1.528 \pm .012 \pm .032) \text{ ps.}$$

E. Finally let us mention measurements of :

- the $e^+e^- \rightarrow \gamma\gamma(\gamma)$ cross section in agreement with QED-predictions without evidence for non standard channels with the same experimental signature
- a lower limit on the mass of the Standard Model Higgs boson of $55.7 \text{ GeV}/c^2$ at 95 % confidence level
- a lower limit on the mass of charged Higgs bosons of $43.5 \text{ GeV}/c^2$ at 95 % confidence level

In addition to the classical topics implying the study of $Z^0 \rightarrow \mu^+ \mu^-$ and $Z^0 \rightarrow \tau^+ \tau^-$ line shape and asymmetries the interest of the Delphi members of the IIHE was mainly oriented towards the following physics subjects :

- i) radiative $e^+e^- \rightarrow \mu^+ \mu^- \gamma$ processes
- ii) τ -polarisation and decay properties
- iii) particle correlations in hadronic interactions

Initial state radiation has been isolated in the radiative processes $e^+e^- \rightarrow \mu^+ \mu^- \gamma$ with the aim of improving the cross-section and asymmetry measurements in $e^+e^- \rightarrow \mu^+ \mu^-$ interactions below the Z^0 -peak ($20 \leq \sqrt{s} \leq 87$ GeV). The analysis of the data collected until 1994 is optimised by Monte-Carlo methods.

The τ -lepton analysis consists in evaluating the τ polarisation after the Z^0 boson decay. The kinematical characteristics of the decay particles of the lepton are used as a polarimeter. The decay branching fractions of the τ have also been determined. An original method of selection of the τ decay channels and of identification of the decay particles based on a neural network system was elaborated. The charged particle decay topologies are determined using a first network. The analysis results in an average efficiency bigger than 90% for an average purity greater than 80%. These numbers are 15% higher than those obtained from a classification based on the visible multiplicity criteria. A second neural network has been trained in order to identify exclusively the decay channels with 1 charged particle in the final state selected during the first step. Preliminary exclusive branching fractions were determined for five of those channel : $\tau \rightarrow e \nu \nu$; $\tau \rightarrow \mu \nu \nu$; $\tau \rightarrow \pi/K \nu$; $\tau \rightarrow \rho \nu$; $\tau \rightarrow a_1 \nu \rightarrow \pi \pi^0 \pi^0 \nu$. The result obtained for the last one ($9.7\% \pm 0.3\%$) is particularly promising since it was the first time it could be derived using the Delphi detector at LEP. The statistical error is lower than the total error of the corresponding world average.

The study of particle correlations has been pursued. Strong short range three-particle correlations have been observed which are at least partly explainable as Bose-Einstein correlations.

General hardware and software tasks were performed by the Delphi members of the IIHE in order to ensure successful data taking runs.

A new set of muon detectors, the "Surround Muon Chambers (MUS)", were added to DELPHI in 1994 to cover the polar angle region $0.6 \leq |\cos\theta| \leq 0.74$ where muon identification was poor, specially for muons in jets. Up to 1994 this region was only partially covered by the barrel and endcap muon chambers. These new muon chambers consist of plastic streamer tubes of the same design as those tubes used in the hadron calorimeter. In each endcap there are 8 modules placed symmetrically around the forward/backward muon chambers. For a charged particle traversing the detector, 2 space points can be determined. For this, one coordinate is obtained from the anode wires in the tubes, the other one from cathode strips placed at right angles to the tubes.

One module consists of 2 planes, each with a tube and a strip layer. The detector was installed in the winter of 1994 and the electronics for signal processing and data readout was completed in august 1994. The first complete data were recorded in september. From the total sample of events taken in 1994 about 35% contain information from the MUS. A first analysis of the data revealed that the space point reconstruction efficiency in a plane is about 83%. By the addition of the MUS the muon identification efficiency is now above 90% in all regions of the detector. The IIHE was responsible for developping and maintaining the software for the offline reconstruction of the MUS raw data. The software for detector simulation was developped and is maintained by Oxford. The detector construction was undertaken by colleagues from Dubna, Prague and Oxford, who also took care of the alignment. The electronics was developped and built by the Dubna and Helsinki groups.

II.3. STUDY OF e^+p COLLISIONS AT HERA.

(M. Barth, G. Bertrand-Coremans, B. Clerbaux, F. Botterweck, E. De Wolf, E. Evrard, D. Johnson, L. Favart, P. Marage, A. Panitch, R. Roosen, J. Sacton, P. Van Esch, P. Van Mechelen : H1 Collaboration : RWTH-Aachen, Birmingham, IIHE (ULB-VUB), Rutherford Appleton Laboratory, Cracow, University of California-Davis, Dortmund, DAPNIA-Saclay, Glasgow, DESY-Hamburg, Universität Hamburg, HeidelbergKiel, Kosice, Lancaster, Liverpool, Queen Mary and Westfield College-London, Lund, Manchester, ITEP-Moscow, Lebedev Institute-Moscow, Max-Planck-Institut für Physik-Munchen, LAL-Orsay, Ecole Polytechnique-Palaiseau, Université Paris VI and VII, Prag, Université "La Sapienza"-Roma, Wuppertal, Zeuthen, ETH-Zürich, Universität Zürich)

When the HERA machine started in 1994, it was found that due to positive ions resulting from problems with the vacuum pump systems, high beam intensities with electrons could not be reached. Therefore it was decided to run the machine with positrons for the rest of the year. In total an integrated luminosity of $\approx 300 \text{ nb}^{-1}$ was collected with electrons and $\approx 2.5 \text{ pb}^{-1}$ with positrons.

The COP detector built in the IIHE has been working as in 1993, with 3 sectors grounded as no repair time was granted during the winter shutdown.

The MWPC Data Acquisition system, designed and constructed in the IIHE, has been running without failure. The IIHE group participates in the analysis of the proton structure function, diffractive and non diffractive. Furthermore, during 1995 running, a new detector (Roman Pots) will be installed in the H1 detector in which the IIHE is actively taking part by providing the simulation and reconstruction software. The results presented below are obtained from the data collected during the 1992 and 1993 runnings.

DEEP INELASTIC SCATTERING

The F_2 proton structure function, obtained from the 1992 data was analysed to look for scaling violations in the low x_{Bjorken} region ($3 \cdot 10^{-4} - 10^{-2}$). It was found that for $Q^2 \geq 8.7 \text{ GeV}^2$, $F_2(x, Q^2)$ rises linearly with $\ln Q^2$. Assuming that the scaling violations at small x are described by QCD, a gluon distribution function at small x was obtained showing a rising gluon density with decreasing x .

This analysis was repeated on the 1993 data, with a tenfold increase in statistics. The kinematic domain was enlarged by extending the analysis in Q^2 and by using the so-called shifted vertex event sample such that the data cover a Q^2 range from 4.5 GeV^2 to 1600 GeV^2 and an x range from $1.8 \cdot 10^{-4}$ to 0.13 . The F_2 determination with considerable smaller errors (systematics dominated) confirmed the rise of the F_2 structure function by a factor of 2 in going from $x \approx 10^{-2}$ to 10^{-3} . Also, and for the first time, the measurement extended to reach the high precision kinematical region of the fixed target experiments, revealing a smooth transition. These data are presently subjected to detailed QCD model fitting.

In about 6% of the events in the above analysis no energy deposition was found in the forward detector part. These events can be described by a diffractive scattering process where the virtual photon probes a colorless component of the proton, the Pomeron. Analysis of the $F_2^D(x, Q^2)$ structure function shows that it is flat in Q^2 at fixed x and not much different from $F_2(x, Q^2)$. This event sample can shed further light on the partonic structure of the Pomeron.

PHOTOPRODUCTION

The ep interactions at very low ($Q^2 \leq 10^{-2} \text{ GeV}^2$) allow to study photoproduction processes at a centre of mass energy ($\sqrt{s} = 200 \text{ GeV}$) 50 times higher than previous fixed target experiments.

Analysis of the inclusive charged particle production based on an integrated luminosity of 19 nb^{-1} has shown that the transverse momentum distribution extends up to $8 \text{ GeV}/c$, which is much higher than observed in $p\bar{p}$ collisions at comparable energy. Leading order QCD calculations show that this is a reflection of the direct anomalous γp processes, which are absent in $p\bar{p}$ interactions.

Based on the same statistics, a QCD analysis of the inclusive jet production as a function of the transverse energy E_T indicates that the data are compatible with what might be expected from hard scattering initiated by quarks in the photon allowing for a substantial contribution from gluon initiated processes.

In the photoproduction processes, as in the case of deep inelastic events, events with a large rapidity gap with respect to the proton direction have been observed. Interpreted as diffractive dissociation, these events exhibit the features of hard scattering : jets and high p_T data in the inclusive charged particle spectra. These features can be well explained by a model which includes hard scattering between the partons in the proton and partons in the pomeron.

J/ ψ PHOTOPRODUCTION

For the first time the J/ ψ photoproduction cross section has been measured at a photon-proton centre of mass energy of $W_{\gamma p} \approx 90$ GeV which is about 3 times higher than the centre of mass energies at fixed target experiments. J/ ψ events were observed via their leptonic decay into leptons, electrons and muons. Based on 88 events, the cross section was determined to be $\sigma(ep \rightarrow J/\psi + X) = (8.8 \pm 2.0 \pm 2.2)\text{nb}$ for $Q^2 \leq 4 \text{ GeV}^2$ and $30 \leq W_{\gamma p} \leq 180 \text{ GeV}$. Using the flux of quasi real photons this cross section can be transformed into a photoproduction cross section leading to a value $\sigma(\gamma p \rightarrow J/\psi + X) = (56 \pm 13 \pm 14)\text{nb}$. This value is compatible with the value obtained from the extrapolation from low energy data and agrees reasonably well with the QCD predictions. Additional measurements are needed to disentangle the elastic from the inelastic component.

SEARCH FOR EXOTIC PARTICLES

A search for new heavy leptons (mass range of (10-225) GeV), leptoquarks, leptogluons and squarks, assuming various decay channels, was made in a data sample corresponding to an integrated luminosity of approximately 500 nb^{-1} . No evidence for a candidate was found.

CHARGED CURRENT CROSS SECTION

With the higher luminosity in 1993, it became possible to measure the total charged current cross section. Based on a total of 14 events, with $p_{\perp}^Y \geq 25 \text{ GeV}/c$, a total charged current cross section of $\sigma(p_{\perp} \geq 25 \text{ GeV}) = (55 \pm 15 \pm 6)\text{nb}$ was obtained in good agreement with the theoretical value. With the high energy provided by HERA the effect of the W propagator in deep inelastic CC events is visible for the first time.

III. TEACHING ACTIVITIES AND SEMINARS

III.1. TEACHING ACTIVITIES

1. **G. Coremans-Bertrand, L. Favart, V. Lefébure, P. Marage, A. Panitch and G. Wilquet** have contributed to the practical work for students attending the lectures of J. Sacton on "Physique des Particules Élémentaires" and organized specific practical work for students of the 3rd year in physics at the ULB.

2. **D. Bertrand**

- "Computer Principles" (26h + 13h exercise - 1st year University Studies in Sciences - ULB)
- "Prise, analyse et simulation de données expérimentales" (10h - Licence Spéciale en Physique Théorique - 2ème Licence en Physique - ULB)
- "Laboratoire et séminaire de Physique" (60h - 1 cand. Polytechnique ULB)

3. **G. Bertrand-Coremans**

- ~~Participation to the practical work of the 1ère candidature polyvalente en médecine et pharmacie~~ - 120h

4. **C. De Clercq, S. Tavernier, W. Van Doninck and P. Van Esch**

have contributed to the practical work for students attending the lectures of J. Lemonne on "Elementaire Deeltjes" - Lic. Natuurkunde VUB.

5. **E. De Wolf**

- ~~"Aanvullingen der wiskunde"~~ Waarschijnlijkheidsrekening en statistiek - 1ste licentie Natuurkunde UIA (30u)
- "Fundamentele wisselwerkingen tussen elementaire deeltjes" - 2de licentie Natuurkunde UIA (30u)
- "Experimentele studie van wisselwerkingen tussen elementaire deeltjes" - 2de licentie Natuurkunde UIA (15u)

7. **D. Johnson**

- "Introduction to Physics II - Physics 103" (45h - Vesalius College - VUB)
- "Introduction to Physics I - Physics 101" (45h - Vesalius College - VUB)
- "Solid State Physics - Physics 202" (45h - Vesalius College - VUB)

All these lectures are accompanied by student consultation and regular interval student exercises.

D. Johnson also assisted in the teaching and laboratory planning for the course "Physics Laboratory I - Physics 102" (Vesalius College - VUB)

8. **J. Lemonne**

- "Elementaire Deeltjes" (60h + 60h of practical work - 1ste and 2de licentie natuurkunde - VUB)

- "Algemene Natuurkunde" 2de kandidatuur Natuurkunde en Scheikunde VUB (60h + 60h of practical work and Geologie (30h + 30h of practical work at the VUB)
- "Statistische Analyse van Experimentele Gegevens" (15h + 15h exercises - licentie Natuurkunde - VUB)

4 • **P. Marage**

"Physique" - 60h -

- Participation to the practical work (general physics) of the 1ère candidature Ecole de Commerce Solvay (60h) - ULB)
- "Histoire des sciences" (15h) - 2ème licence en Sciences Physiques et 2ème Licence en Sciences Mathématiques - ULB)

OUT - Lecture on "HERA Physics" - Joint Belgian Dutch, German School on Particle Physics, Bonnholz, Germany

- ✓ - Animator of the "Atelier - Histoire des Sciences et pédagogie de la physique", formation continuée pour professeurs de physique de l'enseignement secondaire.

6 • **E. Evrard and P. Van Esch**

- "Algemene Natuurkunde" (30h exercises) - 2de kandidatuur Natuurkunde, Scheikunde - 1ste Lic. Geologie - Prof. J. Lemonne - VUB)

10 • **J. Sacton**

- "Physique des Particules Élémentaires" (30h - 1ère licence en sciences physique - ULB)
- Local coordinator of an ERASMUS exchange programme at the level of the 3rd and 4th year of Physics

11 • **S. Tavernier**

- "Detectie van Ioniserende Stralingen" (15h + 15h of practical work - 2de licentie Natuurkunde and Bijzondere Licentie Medische Fysica - VUB)
- Local coordinator of the ERASMUS-TEMPUS exchange program : European Mobility scheme for Physics Students

• **T. Heiremans and S. Tavernier**

- Practical work 2de Kandidatuur Natuurkunde, VUB

12 • **C. Vander Velde**

- "Mechanics 2" (26h + 13h of exercises) - 1st year University Studies in Sciences - ULB)
- "Prise, analyse et simulation de données expérimentales" (10h + 75h of exercises - licence spéciale en Physique Théorique - ULB)
- "Laboratory" - 1st year in University Studies in Sciences (20h) ULB)
- "Physique Générale" - 1ère Cand. Polytechnique ULB - (60h of practical work)
- "Physique Générale" (14h + 20h of exercises - 1ère candidature ULB)

13 • **W. Van Doninck**

- "Industrial Physics" (45h - Vesalius College VUB)
- Visit of CERN with students of the Faculties Wetenschappen and Toegepaste Wetenschappen of the VUB

14 • **F. Verbeure**

- "Introduction to elementary particle and nuclear physics"
- "Elementary particle physics"
- "Numerical analysis"
- "Radioactivity"
- "Simulations in physics"

15 • **P. Vilain**

- "Questions Approfondies de Physique des Particules" (part time 10h + 15h of practical work - 2ème licence en sciences physique - ULB)
- "Participation to the practical work (general physics) 1ère cand. Ecole de Commerce Solvay (60h)

16 • **G. Wilquet**

- "Prise, analyse et simulation de données expérimentales" (10h - Licence Spéciale en Physique Théorique - 2ème Licence en Physique - ULB)
- Lecture on "Neutrino Physics" - Joint Belgian Dutch, German School on Particle Physics, Bommerholz, Germany

The following Ph.D. theses, ^e ~~mémoire de licence~~ ^{and} ~~"licentieverhandelingen"~~ and final year research works in applied sciences were completed during 1994.

voir document annexe

PH.D. THESIS

- **Cao Fang** (VUB) : "A study of the Z^0 lineshape at LEP through the reaction $e^+e^- \rightarrow \mu^+ \mu^-$ "
- **H. De Boeck** (UIA) : "Determination of the partial width and forward-backward asymmetry of the Z^0 boson into $b\bar{b}$ final states"

MÉMOIRES

- **B. Clerbaux** (Faculté des Sciences)
Production diffractive de mésons ρ à grand Q^2 , avec le détecteur H1.
- **H. Azami** (Faculté des Sciences)
Mise en évidence des photons émis lors de la désintégration du lepton τ

AFSTUDEERWERKEN

- **L. De Meutter** (Faculteit Toegepaste Wetenschappen) : Bijdrage tot de studie van een Positron Emissie Tomograafkamer gesteund op een nieuw werkingsprincipe
- **J. Nelissen** (Faculteit Toegepaste Wetenschappen) : Studie van nieuwe organische scintillatie-kristallen voor de elektromagnetische calorimeter van de CMS detector

III.2. SEMINARS

The following seminars were given by members of the IIHE

- **W. Van Doninck**
De micro- en macrocosmos van "dichtbij" bekeken
Fysica - Demo Wetenschapsweek , VUB, 1994
- **C. Mommaert**
 - CCD cameras and their read-out in the Chorus experiment
CERN, April 1994
 - Chorus a la recherche des oscillations de neutrinos
Strasbourg, December 1994
- **P. Marage**
 - La structure du proton, à la lumière des expériences à HERA
Colloquium du Département de Physique, Fac. des Sciences, ULB (October 1994)
 - Culture Scientifique, cultures classique, culture humaniste
Réunion annuelle de l'Association des Professeurs de la Communauté française en langue ancienne (March 1994)
 - Enseignement supérieur : les enjeux des débats actuels
Journée de sensibilisation organised by "Objectif Recherche"(October 1994)
 - Les origines du calcul différentiel et intégral
Atelier "Histoire des Sciences" - groupe de contact du Département de Physique de l'ULB avec l'enseignement secondaire (January 1994)
 - L'astronomie et la révolution copernicienne
Atelier "Histoire des Sciences" - groupe de contact du Département de Physique de l'ULB avec l'enseignement secondaire (October 1994)
 - La mécanique et la révolution copernicienne
Atelier "Histoire des Sciences" - groupe de contact du Département de Physique de l'ULB avec l'enseignement secondaire (November 1994)
- **L. Favart**
Measurement of the proton structure function $F^2(x, Q^2)$ at HERA with the H1 detector
Annual meeting of the Belgian Physical Society, Mons, may 1994
- **S. Tavernier**
 - New scintillating material developments for nuclear medicine
Shanghai Institute of Ceramics, China, May 1994
 - Applications of technology from high energy physics to other fields
High Energy Physics Institute, Beijing, China, April 1994
 - A new type of positron mission tomograph scanner
University of Science and Technology China, Hefei, China (May 1994)
- **R. Vandenbroucke**
Inleiding tot de informatica
Cursus voor het Ministerie van Middenstand, december 1994
- **L. Van Lancker**
The forward tracker
Los Alamos-USA , April 1994

The following seminars took also place at the IIHE :

- **M. Jacob (CERN)**
Beamstrahlung
- **L. Pape (CERN)**
Topics in tau physics
- **D. Denegri (CERN & Saclay)**
Selected physics topics for the CMS detector at the LHC

IV. COMPUTER MATTERS

IV. 1. COMPUTING AND NETWORKING

(Management: R. Vandenbroucke; Scientific : Z. Cekro, N. Meulemans)

During 1994 a DEC Alpha 3000/600 was acquired to increase the processing power available at the IIHE, A DECstation 5200 originally bought in CERN will be used as a disk server for the DEC-RISC and DEC-Alpha stations. Two DECstations 3100 were taken over from another department of the ULB. New printers were bought to replace the old LN03 postscript printers. To satisfy the ever increasing need for disk space, due to the increasing amount of data to be handled, several Gigabytes of disk were acquired. After the successful try-out of X-window terminals bought in 1993, more X-terminals came in to enable more physicists to use graphical software. For design work in the LHC-CMS experiment, a PC with a Pentium processor was bought and equipped with software for mechanical design.

Work was continued on the local network of the IIHE to ensure its stability. A few repeaters and a bridge were installed to better cope with the increasing use of the local ethernet. Wide area networking gave performance problems during 1994. The situation for accessing CERN was rather good but the connections to DESY were bad. This was remedied partly at the end of September when a new 2 Mbit/sec line between the DFN-Düsseldorf node and DESY was installed. But this improvement was undone by the fact that BELnet restricted the VUB/ULB access to Europanet to 512 Kbit/sec. After complaints BELnet increased this access to 1 Mbit/sec. Nils Meulemans worked at the LIRN project. LIRN aims at realising a library information and referral service over networks by means of X.500. Zlatica Cekro started work on ATM, the emerging technology for high speed networks.

IV. 2. GRAPHICS DEVELOPMENT

(D. Bertrand, T. Heiremans)

The graphical interface in the context of an multidimensional analysis was made operational, using normal input files to the PAW software (Physics Analysis Workstation) developed at CERN and used by most of the community of high energy physicists.

The general interactive analysis program for the Delphi detector is being adapted to the requirements of LEP200 which will work at energies near to 100 GeV/beam. A better detector representation (with hidden surfaces) based on a time dependent data base is already implemented. The next step is to introduce an interactive interface to the pattern recognition program of the experiment in order to allow the user to evaluate in an easy way, new reconstruction methods.

V. TECHNOLOGICAL R&D

V.1. TECHNOLOGY TRANSFER FROM BASIC RESEARCH TO APPLICATIONS

(M. Goldberg, S. Tavernier and S. Zhang; S. Rajesrawan; Collaboration : Hammersmith hospital (London), Royal Marsden hospital (London), Deutsches Krebsforschungszentrum (Heidelberg), Ospedale San Raffaele (Milano), Ringshospitalet (Copenhagen))

The photosensitive wire chamber technology was developed over the last decade in a number of High Energy Physics research institutes. It allows to detect and localise very weak light signals over large areas. It is now used in a number of instruments like the DELPHI Ring Image Cherenkov detector. The aim of the present project is to use this technology to build a Positron Emission Tomograph camera with improved performances compared to present commercial systems.

Positron Emission Tomography (PET) is a non-invasive, atraumatic method which allows the in vivo determination of the three-dimensional density distribution of a radioactively labelled substance. It is an important medical research tool.

In a PET study the patient is administered a drug which is labelled with a positron emitting isotope. The positron annihilates with an electron into two back-to-back gamma rays of 511keV which can be detected. From the observation of a sufficiently large sample of such annihilations it is possible to reconstruct the three-dimensional density distribution of a radioactively labelled substance in the patient.

We have designed and built a small, high resolution PET-scanner to be used for laboratory animals, based on the wire chamber technology. This instrument contains 3060 BaF₂ crystals measuring 3x3x20mm³. It will allow a resolution in the image of better than 3mm in all space directions. Very first results with technical measurements on the performance of the device were presented at the IEEE conference on medical imaging 1994 (Norfolk, USA).

V.2. R&D PROGRAMME ON HIGH RESOLUTION TRACKING DEVICES BASED ON CAPILLARIES FILLED WITH LIQUID SCINTILLATOR.

(P. Annis, C. Mommaert, P. Vilain, G. Wilquet; Collaboration : Naples, CERN, Rome "La Sapienza", IHEP Protvino, Louvain, Humbolt Berlin, NIKHEF Amsterdam, JINR Dubna)

In 1994, the collaboration has concentrated on the construction and test of a long capillary target (180cm) with a large section (2x2 cm²) that is about the appropriate size to be assembled into a large mass target. The detector consisted of 5 10⁵ capillaries with 20 µm diameter and was read-out by a single highly performing optoelectronic chain. The capillaries were filled with a scintillator based on liquid 1 methylnaphtolene and doped with dyes newly produced in the laboratories of the collaboration and emitting in the green. The target has been exposed to the CERN neutrino WBB in front of the detector CHORUS. Tracks of beam muons and neutrino interactions have been observed. The data acquisition has progressively been integrated into that of CHORUS. The ultimate aim is to link events in the capillary target with the CHORUS detector used as tracker and spectrometer. Hit intensities of 8 mm⁻¹ at short distances and 3 mm⁻¹ at 2 meters from the read out, and attenuation's lengths of 4 meters have been observed with these devices. Capillaries produce around 3000 hits per radiation length, one order of magnitude better than any other detector. An R/D proposal is being prepared to be submitted to the LHC committee at CERN in order to pursue the effort and structure the collaboration in the forthcoming years. Support from the INAS has been obtained for the Russian partners.

V.3. CONTRIBUTION TO THE DESIGN OF PART OF THE CMS-DETECTOR FOR LHC

(T. Beckers, O. Bouhali, S. Claes, J. Nelissen, J. Stefanescu, S. Tavernier, W. Van Doninck, C. Vander Velde, P. Van Laer, L. Van Lancker, F. Verbeure and J. Wulleman, ; Collaboration : Athens, Baku, Belgium, Bhubaneshbar, Bombay, Bristol, Brunel, Budapest, CERN, CIEMAT Madrid, Ecole Polytechnique Palaiseau, ETH Zurich, Helsinki, HEPHY Vienna, IC London, IHEP Protvino, INFN Bari, INFN Bologna, INFN Cappito, INFN Firenze, INFN Genova, INFN Padova, INFN Pisa, INFN Roma, INR Moscow, Ioannina, ITEP Moscow, JINR Dubna, Iyvakyla, Kharkov, Kiel, LAPP Annecy, Lebedev Inst. Moscow, LIP Lisbon, Ljubljana, Lyon, Mannheim, Minsk, MSU Moscow, Oulu, PSI Villigen, Riga, Rutherford Appleton Laboratory, RWTH Aachen, Saclay,

Salaspils, SEFT Helsinki, Sofia, Split, Strasbourg, Tallinn, Tashkent, Tbilisi, UC Davis, UC Los Angeles, UC Riverside, UT Dallas, Vilnius, Warszawa)

Five Belgian research groups from the IIHE (VUB/ULB), UIA, UMH and UCL joined their efforts in view of their participation to the LHC experimental program. They are members of an international collaboration that proposed the Compact Muon Solenoid (CMS) detector. This project is one out of the two accepted multi purpose detectors (ATLAS, CMS) for pp physics at an interaction point of the Large Hadron Collider (LHC) planned in the LEP tunnel at CERN.

The Belgian effort concentrates on the central tracking system of the CMS detector which mainly consists of an assembly of some 20 000 Micro Strip Gas Counters (MSGC's). In this respect, the Belgian groups contribute to both :

- the international generic R&D program concerning this novel technique (RD28)
- the specific CMS related R&D for the design of the central tracking system

So far the Belgian, and in particular the IIHE research efforts, have concentrated on generic R&D on substrate development, design of layout and mechanical support structures, MSGC prototype manufacturing, experimental test benches for MSGC prototypes, prototype tests, MSGC simulation studies and design of read-out electronics.

One of the known drawbacks of glass substrates commonly used for MSGC fabrication, is the polarisation and charging up of the glass in the presence of strong electric fields, resulting in a gain drop of the avalanche charge. An international research effort is devoted to ways of curing this drawback through the development of slightly conductive glasses, ion implantation and conductive coatings. In close collaboration with IMEC (Leuven), NIKHEF (Amsterdam) and the university of Pisa, different substrate production techniques are investigated (photo-lithography; lift-off; ion implantation and surface coatings). Also the very promising alternative to MSGC detector, the so called Micro Gap Counter MGC is being developed by a collaboration between the IIHE, IMEC and Pisa.

The Belgian groups being responsible for part of the forward tracking system of CMS have produced a first design of a forward "wheel". A back to back assembly of two discs made from a carbon fiber-honeycomb composite structure is envisaged to support 484 MSGC's in 10 concentric rings. First finite element analysis calculations indicate acceptable deformations due to gravity ($\leq 5 \mu\text{m}$). In collaboration with the engineering department of the VUB (Prof. P. De Wilde) two full size discs have been produced at the SABENA autoclave at the end of 1994. These mechanical support structures are now submitted to a series of non-destructive tests in the engineering department of the VUB to evaluate their strength, stiffness, vibration modes etc. A full size prototype of a forward wheel, equipped with dummy detectors, is being built to investigate and design the routing of services to the detectors (bias, high voltage, gas supply, cooling).

Benefiting from the tooling developed in NIKHEF, several MSGC counters have been built there by a IIHE technician. They are now operational at the IIHE. An infrastructure similar to the NIKHEF one is being set up at the IIHE including clean room, ultrasonic wire bonder, substrate inspection microscopes, projection table, etc. A batch of 20 substrates has been purchased from SRON to allow the construction of several 64 channel MSGC counters.

Several set-ups have been developed and built to allow the study of prototype MSGC counters. One is based on the modification of an existing cosmic tracking hodoscope equipped with drift chambers. It allows a detailed investigation of the MSGC efficiency for minimum ionising particles (cosmic muons) w.r.t. the angle of incidence. The second set-up is based on a pulsed N₂ laser. A precision x-y-z stage (1 μ m) allows the scanning of the entire MSGC surface to evaluate uniformity of response, dead space between adjacent substrates, etc.

Preliminary results obtained from the investigations of a wall-less assembly of adjacent MSGC substrates in the cosmic hodoscope show no significant drop of efficiency in the crack region. If confirmed, these results validate the wall-less " ϕ crack" assembly proposed by the Belgian groups for the forward tracker of CMS. A sector prototype detector containing 2 wedge shaped MSGC's with wall-less assembly inside a carbon fiber composite gasbox is being prepared for tests in a particle beam at CERN towards the fall of 1995. This sector prototype includes many of the features proposed for the final forward tracker such as direct cooling, parallel gas supply, wedge shaped counters and wall-less assembly.

Monte Carlo simulation studies are performed at the IIHE to investigate the response, and in particular the efficiency, of MSGC's to incident minimum ionising particles at various angles of incidence w.r.t. the substrate plane. The dependence upon the gas mixture and width of the gasgap have also been studied. A substantial drop of efficiency for large angles w.r.t. normal incidence, especially in the plane perpendicular to the strip orientation, is predicted and clearly observed in the first measurements. The integration of the MSGC response and the development of track reconstruction algorithms in the framework of the general software of the CMS tracker are also pursued at the IIHE.

A joint international R&D effort has been launched for the design and development of radiation hard read out chips for MSGC. Highly integrated 128 channel chips of preamplifier-shaper-pipeline buffer are envisaged to read out the numerous ($\sim 10^7$) channels of the CMS central tracker. In collaboration with IMEC, CERN, NIKHEF and Lyon, an adapted version of the Fastplex chip is under study. The IIHE contributed via the theoretical evaluation of a low noise preamplifier in the Thomson BiCMOS and Mietec 1,5 μ m CMOS processes. A 1,5 μ m CMOS Mietec 5 channel prototype is presently tested at the IIHE.

V.4. R&D ON NEW HEAVY SCINTILLATORS

(T. Beckers, S. Tavernier; Crystal Clear Collaboration (CERN) and EU Human Capital and Mobility Network "Search for new and better scintillators for radiation detection")

The main aim of the Crystal Clear Collaboration was to find the best possible scintillating material for an electromagnetic calorimeter at the LHC. A large number of materials was considered, but in '94 our search has mainly concentrated on CeF₃, PbWO₄ and HFG-glass. With his high density, good light yield, fast decay time and excellent radiation hardness CeF₃ is technically the best material known for this application. In a test beam, and using photodiodes (PD) for the readout, an energy resolution better than 0.5% was obtained for electrons with more than 50 GeV. Unfortunately no large scale production capability exists for CeF₃. For this reason, the collaboration has also studied PbWO₄ and HFG-glass. PbWO₄ has a higher density (allowing a more compact ECAL) but much lower L.Y., a problem that can be overcome by using avalanche photo-diodes for the read-out. Reasonable quality samples were obtained from Bogorodisk Russia, and measurements in a test beam gave a resolution of $\sigma(E)/E = 3.4\%/\sqrt{E} \oplus .35\%$ (PM-readout). With APD-readout this degrades to $\sigma(E)/E = 6.0\%/\sqrt{E} \oplus 0.5\%$. Higher LY crystals and an optimisation of the APD design will improve these results considerably. HFG glass is an attractive solution because of its potential lower cost, but there are still serious and unsolved problems of insufficient radiation hardness. On the basis of these results the CMS collaboration has chosen for an electromagnetic calorimeter using PbWO₄.

VI. TECHNICAL AND ADMINISTRATIVE WORK

The members of the workshop staff were : J. De Bruyne, H. De Nil, M. Devos, J.P. Dewulf, L. Etienne, R. Gindroz, R. Goorens, P. Lamonte, E. Lievens, E. Raspoet, R. Ruidant, G. Van Beek, J. Vanbegin, L. Van Lancker, G. Vincent and C. Wastiels with the help of A. De Coster, D. Luypaert-Peymans, R. Pins, and M. Pins.

W. Van Doninck was in charge of the general coordination; R. Goorens and G. Van Beek organised the work of the electronics and mechanics workshops respectively.

G. Van Beek has contributed to the design of the mechanics for the opto-electronic chains and to the construction procedure of the scintillating fibre trackers for CHORUS. He and P. Lamonte have taken responsibility for their construction and evaluation, the team consisting of G. Vincent, R. Ruidant, A. De Coster, E. Raspoet, M. Pins, D. Luypaert and R. Gindroz. At CERN, they have led the assembly of the trackers and their installation on the CHORUS detector, with the help of E. Raspoet and R. Gindroz. G. Van Beek has contributed to the assembly of the opto-

electronic chains in the lab and their installation on Chorus with the help of R. Gindroz. A series of test-up's for the measurement of image intensifiers has been constructed by G. Van Beek and P. Lamonte with the help of the mechanics and for the electronics by R. Goorens. J.P. Dewulf has taken full responsibility for the design, prototype constructions, test and production of two VME cards for the fast decision logics of the CHORUS trigger.

H. De Nil and C. Wastiels have taken care, in Hamburg-DESY, of the maintenance of the cabling of the Central Outer Proportional Chambers of the H1 detector. E. Raspoet and P. Lamonte have contributed, to an update of the grounding of the COP chambers. Under the responsibility of P. Lamonte, the mechanical workshop has built a dismounting device for the chambers, in view of the opening and repair of the broken wires at DESY.

L. Van Lancker has acted as consultant for the design of a Positron Emission Tomography camera prototype which has been constructed by J. De Bruyne, E. Lievens, G. Vincent, M. Pins and R. Pins. L. Etienne has designed and constructed the trigger card for the camera.

For the Delphi experiment, the main task has consisted in the maintenance of the detector at CERN. This has been the responsibility of R. Goorens who also has developed with J.P. Dewulf two cards for the forward muon chambers trigger systems.

The starting of the R&D program on Micro-strip gas chambers to be used in the central tracking of the CMS detector has involved various activities : the gas system has been installed by E. Lievens and a cosmic muon hodoscope by R. Gindroz and R. Ruidant, while M. Pins has contributed to the prototype assembly, mainly in NIKHEF-Amsterdam. L. Van Lancker has taken responsibilities in the design of the mechanical structure for the MSGC forward tracking system on the CMS detector; he has acquired the necessary expertise in the domain of the composite materials. E. Raspoet and E. Lievens have contributed to the colamination of the first full size composite discs at the SABENA plant under the responsibility of L. Van Lancker.

M. Devos has developed and built the APC CAMAC controller and the Station Interface for the Microstrip Data Acquisition.

R. Gindroz, R. Ruidant, C. Wastiels and R. Goorens have in charge the maintenance of the bubble chamber film measuring devices. R. Goorens takes also care of the pool of NIM/CAMAC material. New electricity networks have been installed by H. De Nil, E. Lievens and C. Wastiels in the computer room and throughout the complete institute.

G. Depiesse, G. Rousseau and L. Van Helleputte were active on computer matters. L. Van Helleputte managed the RISC/ULTRIX systems and installed the first Alpha/OSF1 computer

of the IIHE. G. Depiesse managed the VMS machines. G. Rousseau was responsible for the installation and maintenance of all network equipment.

D. Pirnay has performed computer related operational tasks and contributed to the organisation of the DECUS BELUX symposium. C. Carlier contributed to logistic tasks for the DELPHI experiment.

The secretarial work was accomplished by R. Alluyn-Lecluse and M. Garnier-Van Doninck - assisted by M. De Schutter, M. Goeman, J. Liesen and D. Luybaert-Peymans - and by J. Castera for the HELIOS-B program. M. Pins has contributed to the maintenance of a documentation centre and has provided figures for several publications and lectures of members of the laboratory. A. De Coster-Van Cauwenberge and M. De la Sorte took care of the library.

VII. REPRESENTATION IN COUNCILS AND COMMITTEES

3 J. Lemonne has been the Belgian scientific representative in the CERN Council. He is a member of the EPS-HEP board. He is the president of the Department of Physics of the VUB. He is the representative of the Faculty of Science in the "Senate" of the VUB and chairman of the "Commissie Middelen en Personeel" of the Science Faculty.

J. Lemonne, J. Sacton and F. Verbeure contributed to the organization of the Joint Belgian, Dutch and German (Aachen) Summer School on Elementary Particle Physics at Bommerholz, Aachen (1994).

4 J. Lemonne, J. Sacton and F. Verbeure were members of the Scientific Committee "High Energies" of the IIKW-IISN and of the Belgian Selection Committee of CERN fellows.

"Hauts et Basses Energies" of the IISN and "Hoge Energie" of the IIKW
J. Sacton was also a member of the "Commission de Physique" at the FNRS and of the "Commissie voor Fysica" at the NFWO

J. Sacton was "Doyen de la Faculté des Sciences de l'ULB". He also acted as chairman of the C11 Commission (Particles and Fields) of the International Union for Pure and Applied Physics (IUPAP), as Chairman of the High Energy Physics Computer Coordinating Committee (HEPCCC) and as member of the International Committee for Future Accelerators (ICFA).

P. Vilain was the Belgian representative at Plenary ECFA and since 1993 at the RECFA (Restricted European Committee for Future Accelerators).

② **P. Marage** was a member of the "Commission du Patrimoine" and the "Commission d'évaluation Scientifique pour les nominations au titre de premier assistant" of the ULB.

ok **S. Tavernier** was member of the "~~Bureau van de Onderzoeksraad~~ ^{Facultaire onderzoekscommissie}" of the VUB and Chairman of the "~~Commissie voor Basis en Toegepaste Wetenschappen~~" van de Onderzoeksraad. He is spokesman of the ~~board of~~ the "Crystal Clear Collaboration (CERN, R&D18)" ^{Coordinator} of the "Human Capital and Mobility Network, Search for new and better scintillating materials for basic research" and member of

W. Van Doninck acted as a Belgian representative in plenary ECFA, is a member of the CMS management board and a member of the Board of the Belgian Physical Society.

12 The following responsibilities were taken in the organisation of the DELPHI experiment :

- ok - **D. Bertrand** : member of the editor committee
- ok - **C. De Clercq** : Muon project leader and responsible for the MUS off-line software
- **J. Lemonne** : Vice-chairman of the Collaboration Board and representative of "Belgium", representative of the IIKW-IISN in the DELPHI Finance Committee
- **C. Vander Velde** : responsible for the muon subtrigger
- ok - **J. Wickens** : member of Delphi Analysis Panel and of the on-line/off-line coordinator panel, project leader of Delphi off-line software

The following responsibilities were taken in the organisation of the H1 experiment :

- ok - **R. Roosen** : representative of "Belgium" in the Collaboration Board
- ok - **J. Sacton** : representative of the IISN-IIKW in the H1 Finance Committee

The following responsibilities were taken in the organisation of the CMS experiment

- **W. Van Doninck** : member of the management board and of the collaboration board; ^{defputy} NSC coordinator

R. Vandenbroucke represented the Belgian HEP-community in the Hepnet Technical Committee. She was the chairperson of the DECUS BELUX Networks SIG and acted as Communication Coordinator. She is the representative of Decus BELUX in the European Decus Council. She represents Belgium in the Public Procurement Group of the European Commission. She was a member of the DECUS Europe Network and integration SIG. She was also the alternate representative (of Prof. J. Tiberghien) in the Belnet Policy Board.

① **C. De Clercq** ^{was} represented the Belgian ^{representative at the HEPCCC} HEP-community in the HEPNET requirements committee. Technical Advisory Subcommittee (HTASC)

representative :

P. Vilain representative of the IINE at the Coll. Board

VIII. ATTENDANCE TO CONFERENCES, WORKSHOPS AND SCHOOLS

VIII. 1. CONFERENCES AND WORKSHOPS

- 27th International Conference on High Energy Physics (Glasgow, July 1994)
G. Coremans-Bertrand, J. Lemonne, J. Sacton, S. Tavernier, E. De Wolf
- CHEP'94 : Computing in High Energy Physics (San Fransisco-USA, April 1994)
T. Heiremans
- Workshop on "CMS Tracking" (Aachen-Germany, February 1994)
C. Vander Velde, P. Vanlaer
- Workshop on Microstrip Gas Counters (Legnaro-Italy, October 1994)
C. Vander Velde, W. Van Doninck, P. Vanlaer
- Materials Research Society - Scintillator and Phosphor Materials (San Fransisco-USA, April 1994)
S. Zang
- Third workshop on tau lepton physics (Montreux-Zwitzerland, September 1994)
D. Bertrand
- Neutrino '94 (Eilat-Israel, September 1994)
C. Mommaert, G. Wilquet
- VIème Rencontre de Blois (Blois-France, June 1994)
L. Favart, P. Marage
- 24th Int. Symposium on Multiparticle Dynamics (Vietri sul Mare-Italy, september 1994)
E. De Wolf
- Open Bus Systems (Paris - November 1994)
J.P. Dewulf
- FEA Ansys conference (Pittsburg-USA, May 1994)
L. Van Lancker
- Beijing Calorimetry Symposium (Beijing-China, October 1994)
T. Beckers
- EUTECH 94 (Genova-Italy, February 1994)
S. Tavernier
- International Wokshop on Advanced Teaching in Biomedical Radiation Physics (Archamps-France, October 1994)
S. Tavernier
- IEEE Nuclear Science Symposium and Medical Image Conference (Norfolk-USA, November 1994)
S. Tavernier
- Colloque "Instrumentation Physique et Biologie en Médecine" (Paris-France, November 1994)
S. Tavernier

- DECUS BELUX Symposium (Keerbergen, March 1994)
R. Vandenbroucke
- EPHOS Conference (Brussel, April 1994)
R. Vandenbroucke
- 5th Joint Network Conference/INET94 (Prague-Tjechië, June 1994)
R. Vandenbroucke
- IEEE Region 10's Ninth Annual International Conference (Singapore, August 1994)
R. Vandenbroucke
- DECUS Europe Symposium (Cannes-France, September 1994)
R. Vandenbroucke
- ICT Workshop (Genval, November 1994)
R. Vandenbroucke

VIII.2. SCHOOLS

- 6th Belgian-Dutch-German Summer School (Bommerholz-Dortmund, September 1994)
T. Beckers, V. Lefébure, A. Panitch, P. Vanlaer, M. Vander Donckt,
- CERN/JINR Summer School (Sorrento-Italy, September 1994)
P. Van Esch

IX. ORGANISATION OF THE 1995 INTERNATIONAL EPS CONFERENCE ON HIGH ENERGY PHYSICS

The European Physical Society asked the IIHE to organise in Brussels, the International Conference on High Energy Physics, to be held from July 27 to August 2, 1995. Of the order of 800 physicists from all over the world are expected to attend the Conference which will be organised on both University Campuses of the ULB and VUB. It is the first time that such a big Conference takes place in Belgium. Twenty parallel sessions and about the same number of plenary sessions are foreseen to cover as well the actual situation of the fundamental research in elementary particles as the recent technological developments related to that research.

The IIHE physicists members of the local organisation committee are : D. Bertrand , G. Coremans , C. De Clercq, E. De Wolf, D. Johnson, J. Lemonne (co-chairman/VUB), P. Marage, R. Roosen, J. Sacton (co-chairman/ULB), R. Vandenbroucke, C. Vander Velde, W. Van Doninck, F. Verbeure, P. Vilain, G. Wilquet.

They are involved in coordinating tasks relative to sponsoring, budget control, financial support to a limited number of participants, publicity, press and external communications, abstracts and contributed papers, scientific secretariat of plenary and parallel sessions, proceedings, auditoria, rooms and equipment, computer network, copyservices, scientific books, social events and exhibitions taking place during the conference. They started the long work of preparation of the Conference mid 1994, assisted by a few people of the technical staff of the Institute. G. Coremans coordinated the administrative work. Among the different tasks, the administrative secretariat, under the responsibility of M. Goeman, prepares the handling of the Conference database on MacIntosh computers and the needed accomodation for the Conference with the help of D. Luypaert, M. De Schutter, A. De Coster, M. Pins, D. Pirnay, R. Alluyn, M. Garnier, J. Lysen. Members of the team were also involved in the preparation of various social events.

X. LIST OF PUBLICATIONS, REPORTS AND CONTRIBUTION TO CONFERENCES

X.1. PUBLICATIONS

NEUTRINO PHYSICS

- 17 - Flavour universality of neutrino coupling with the Z
P. Vilain, G. Wilquet et al.
Phys. Lett. B320 (1994) 203-205
- 18 - Constraints on additional Z bosons derived from neutrino-electron scattering measurements
P. Vilain, G. Wilquet et al.
Phys. Lett. B322 (1994) 465-470
- 19 - Search for muon to electron neutrino oscillations
P. Vilain, G. Wilquet et al.
Zeitschrift für Physik, C64 (1994) 539-544
- 20 - Precision measurements of electroweak parameters from the scattering of muon-neutrinos on electrons
P. Vilain, G. Wilquet et al.
Phys. Lett. B335 (1994) 246-252
- 21 - Observation of D_s^{**} (2536) meson production by neutrino in BEBC
A.E. Asratyav, ..., P. Marage, J. Sacton, ..., et al.
Z. Phys. C61 (1994) 563-565
- 22 - Neutral strange particle production in neutrino and antineutrino charged-current interactions in neon
D. De Prospe, ..., M. Barth, E.A. De Wolf, P. Marage, J. Moreels, J. Sacton, L. Verluyten, ..., et al.
Phys. Rev. D50 (1994) 6691-1703

ep PHYSICS

- (128) - Scaling Violations of the Proton Structure Function F_2 at Small x
I. Abt, ..., G. Coremans, F. Botterweck, E. De Wolf, E. Evrard, L. Favart, D. Johnson, P. Marage, A. Panich, R. Roosen, P. Van Esch, P. Van Mechelen, ..., et al.
Phys. Lett. B321 (1994) 161-167.
- (129) - A Measurement of Multi-Jet Rates in Deep-Inelastic Scattering at HERA
I. Abt, ..., G. Coremans, F. Botterweck, E. De Wolf, E. Evrard, L. Favart, D. Johnson, P. Marage, A. Panich, R. Roosen, P. Van Esch, P. Van Mechelen, ..., et al.
Z. Phys. C61 (1994) 59-66.
- (130) - First Measurement of the Charged Current Cross Section at HERA
I. Abt, ..., G. Coremans, F. Botterweck, E. De Wolf, E. Evrard, L. Favart, D. Johnson, P. Marage, A. Panich, R. Roosen, P. Van Esch, P. Van Mechelen, ..., et al.
Phys. Lett. B324 (1994) 241-248.
- (131) - Inclusive Charged Particle Cross Sections in Photoproduction at HERA
I. Abt, ..., G. Coremans, F. Botterweck, E. De Wolf, E. Evrard, L. Favart, D. Johnson, P. Marage, A. Panich, R. Roosen, P. Van Esch, P. Van Mechelen, ..., et al.
Phys. Lett. B328 (1994) 176-186.
- (132) - Energy Flow and Charged Particle Spectra in Deep Inelastic Scattering at HERA
T. Ahmed ..., G. Coremans, F. Botterweck, E. De Wolf, E. Evrard, L. Favart, D. Johnson, P. Marage, A. Panich, R. Roosen, P. Van Esch, P. Van Mechelen, ..., et al.
Z. Phys. C63 (1994) 377-389.
- (133) - Deep Inelastic Scattering Events with a Large Rapidity Gap at HERA
T. Ahmed, ..., B. Claurbaux, G. Coremans, F. Botterweck, E. De Wolf, E. Evrard, L. Favart, D. Johnson, P. Marage, A. Panich, R. Roosen, P. Van Esch, P. Van Mechelen, ..., et al.
Nucl. Phys. B429 (1994) 477-502
- (134) - A Search for Heavy Leptons at HERA
T. Ahmed, ..., G. Coremans, F. Botterweck, E. De Wolf, E. Evrard, L. Favart, D. Johnson, P. Marage, A. Panich, R. Roosen, P. Van Esch, P. Van Mechelen, ..., et al.
Phys. Lett. B340 (1994) 205-216
- (135) - Photoproduction of J/Ψ Mesons at HERA
T. Ahmed, ..., G. Coremans, F. Botterweck, E. De Wolf, E. Evrard, L. Favart, D. Johnson, P. Marage, A. Panich, R. Roosen, P. Van Esch, P. Van Mechelen, ..., et al.
Phys. Lett. B338 (1994) 507-518
- (136) - A search for leptoquarks and squarks at HERA
T. Ahmed, ..., G. Coremans, F. Botterweck, E. De Wolf, E. Evrard, L. Favart, D. Johnson, P. Marage, A. Panich, R. Roosen, P. Van Esch, P. Van Mechelen, ..., et al.
Z. Phys. C64 (1994) 545-558

Handwritten: + Nucl. Phys. B 429 (1994) 477-502

e⁺e⁻ PHYSICS

- (80) - Production rate and decay lifetime measurements of B_s^0 mesons at LEP using D_s and ϕ mesons
P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
Zeit. Phys. C61 (1994) 407-419

- (81) - Measurement of the $B^0\text{--}\bar{B}^0$ mixing using the average electric charge of hadron-jets in Z^0 -decays
 P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
 Phys. Lett. B322 (1994) 459-472
- (82) - Interference of neutral kaons in the hadronic decays of the Z^0
 P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
 Phys. Lett. B323 (1994) 242-252
- (83) - A measurement of the B_s^0 meson mass
 P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
 Phys. Lett. B324 (1994) 500-508
- (84) - Measurements of the lineshape of the Z^0 and determination of electroweak parameters from its hadronic and leptonic decays
 P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
 Nucl. Phys. B417 (1994) 3-57
- (85) - Measurement of the $e^+e^- \rightarrow \gamma\gamma$ (γ) cross section at LEP energies
 P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
 Phys. Lett. B327 (1994) 386-396
- (86) - Improved measurements of cross sections and asymmetries at the Z^0 resonance
 P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
 Nucl. Phys. B418 (1994) 403-427
- (87) - Study of hard scattering processes in multihadron production from $\gamma\gamma$ collisions at LEP
 P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
 Zeit. Phys. C62 (1994) 357-365
- (88) - A precision measurement of the average lifetime of B hadrons
 P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
 Zeit. Phys. C63 (1994) 3-15
- (89) - Invariant mass dependence of particle correlations in hadronic final states from the decay of the Z^0
 P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
 Zeit. Physik C63 (1994) 17-28
- (90) - Search for the standard model Higgs boson in Z^0 decays
 P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
 Nucl. Phys. B421 (1994) 3-37
- (91) - Measurement of the $B^0\text{--}\bar{B}^0$ mixing parameter in DELPHI
 P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
 Phys. Lett. B332 (1994) 488-500

- Search for pair-produced heavy scalars in Z^0 decays
P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
Zeit. Phys. C64 (1994) 183-193
- Charged kaon production in tau decays at LEP
P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
Phys. Lett. B334 (1994) 435-449
- Measurement of time dependent $B_d^0 - \bar{B}_d^0$ mixing
P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
Phys. Lett. B338 (1994) 409-420
- J/ψ production in the hadronic decays of the Z
P. Abreu, ..., D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, W. Van Doninck, F. Verbeure, J. Wickens, ..., et al.
Phys. Lett. B341 (1994) 109-122

HADRON-HADRON INTERACTIONS

- Collective sea-gull effect in π^+p interactions at 250 GeV/c
N.M. Agababyan, ..., E.A. De Wolf, F. Verbeure, ..., et al.
Phys. Lett. 320B (1994) 411-416
- Angular dependence of factorial moments in π^+/K^+p interactions at 250 GeV/c
N.M. Agababyan, ..., E.A. De Wolf, F. Verbeure, ..., et al.
Phys. Lett. 328B (1994) 199-206
- Genuine higher-order correlations in π^+p and K^+p collisions at 250 GeV/c
N.M. Agababyan, ..., E.A. De Wolf, F. Verbeure, ..., et al.
Phys. Lett. 332B (1994) 458-464
- Invariant mass dependence of particle correlations in π^+p and K^+p interactions at 250 GeV/c
I.V. Ajinenko, ..., E.A. De Wolf, F. Verbeure, ..., et al.;
Z. Physik C, Part. and Fields 61 (1994) 567-577
- Results on two-particle correlations in invariant mass
A. Tomaradze, F. Verbeure
Proc. XXIIIth Int. Symposium on Multiparticle Dynamics, Aspen, Colorado Sept. 1994
Eds. M.M. Block and A.R. White, WSPC, Singapore (1994) pp. 319-324
- Transverse momentum compensation in π^+p interactions at 250 GeV/c
N.M. Agababyan, ..., E.A. De Wolf, F. Verbeure, ..., et al.
Z. Physik C, Part. and Fields 64 (1994) 381-389

EXPERIMENTAL TECHNIQUES

- 184 ✓ - Study of inclined particle tracks in micro strip gas counters
F. O. van den Berg, ..., C. Vander Velde, ... et al.
Nucl. Instr. Methods A349 (1994) 438-446
- A measurement of the first Townsend coefficient as function of the electric field for a TMAE-He mixture
Zhang Shuping
IEEE Trans. Nucl. Sci. 41, 6 (1994)
- 30 ✓ - Scintillating fiber trackers with optoelectronic readout for the CHORUS neutrino experiment
S. Aoki, ..., M. Gruwé, G. Wilquet, ..., et al.
NIM, A344 (1994) 143-148
- 34 ✓ - The fiber trackers of CHORUS
M. Gruwé
Int. Journ. of Mod. Phys. C, Physics and Computers 5, 5 (1994) 835
- Optimisation of microstrip gas chamber design and operating conditions
T. Beckers et al.
Nucl. Instr. and Meth. A346 (1994) 95-101
- Applications of scintillators in security inspection systems
M. Goldberg
"Heavy Scintillators for Scientific and Industrial Applications", Ed. Frontières, p137-155
- A method for detection of explosives based on nuclear resonance absorption of gamma rays in ^{14}N
D. Vartsky, G. Engler, M. Goldberg
Nucl. Instr. and Meth. A348 (1994) 588-691
- Study of a high resolution 3D PET scanner
Z. Shuping, P. Bruyndonckx, M. Goldberg and S. Tavernier
Nucl. Instr. and Meth. A348 (1994) 607-612
- A measurement of the first Townsend coefficient as a function of the electric field for a TMAE-He mixture
Zhang Shuping, P. Bruyndonckx, S. Tavernier
IEEE, 41 (1994)

X.2. REPORTS

- F_2 measurements at x-values around 10^{-4} , using the satellite bunch
P. Marage, A. Panitch, F. Zomer
H1 note 07/94-369
- Integrated luminosity measurement using Bethe-Heitler overlapping events
L. Favart
H1 internal note, H1-06/94-366
- Vertex reconstruction and BPC efficiency determination for the 1993 structure function analysis
A. Panitch
H1 note H1-08/94-373

- Photoproduction as a background in deep inelastic scattering at low x
F. Charles, S. Reinghage, R. Roosen, P. Van Esch
H1-09/94-380

X.3. CONTRIBUTIONS TO CONFERENCES

a) Presented by members of the IIHE

- 9 - Measurement of the tau polarisation in Z^0 -decays at DELPHI
V. Lefébure
General Scientific meeting of the Belgian Physical Society (Mons, May 1994)
- Prototype tests and substrate studies for the CMS-forward tracker
X. Lauwerys, C. Vander Velde, W. Van Doninck, P. Vanlaer and V. Zhukov
Presented by P. Vanlaer at the International Workshop on Microstrip Gas Counters (Legnaro, October 1994) and on the Workshop on Vertex detection in CMS (PSI - Villigen, June 1994)
- MSGC test set-up with integrated preamplifiers
P. Vanlaer
Talk at the Workshop on "CMS-tracking" (Aachen, february 1994)
- CHORUS status report
C. Mommaert
Poster presentation at "Neutrino 94" (Eilat, May 1994)
- The fiber tracker of CHORUS
M. Gruwé
Contribution to the Topical Seminar on "WWW and beyond in Physics Research Applications" (San Miniato, Italy, 1994)
- New detectors for PET
S. Tavernier
Invited review talk at the "EUTECH 94" meeting (Genova-Italy, February 1994)
- Wire chambers in positron emission tomography
S. Tavernier
Invited review talk at the "International Workshop on Advanced Teaching in Biomedical Radiation Physics" (Archamps-France, October 1994)
- The search for new scintillating crystals for nuclear medecine
S. Tavernier
Invited review talk at the "International Workshop on Advanced Teaching in Biomedical Radiation Physics" (Archamps-France, October 1994)
- First results from a prototype PET scanner using BaF₂ scintillator and photosensitive wire chambers
S. Tavernier
Talk presented at the "IEEE Nuclear Science Symposium and Medical Image Conference" (Norfolk-USA, November 1994)
- Développement récents dans la technique de détection de rayons pour la TEP
S. Tavernier
Talk presented at the Colloque "Instrumentation Physique et Biologie en Médecine" (Paris-France, November 1994)

- Scintillators emitting below 200 nm for PET
S. Tavernier
Talk presented at the "Crystal Clear Meeting" (Prague-Tjechie, October 1994)
- A crystal calorimeter for CMS
T. Beckers et al.
CMS-TN/95-007 (Beijing-China, October 1994)
- Presentation of the LIRN project
R. Vandenbroucke
Library Networking in Europe Conference (Brussels, October 1994)
- Bose-Einstein correlations - A review
E. De Wolf
Invited Review Talk at XXVIIth Int. Conference on High Energy Physics (Glasgow, July 1994)
- Correlations - A review
E. De Wolf
Invited Review Talk at XXIVth Int. Symposium on Multiparticle Dynamics (Vietri sul Mare-Italy, September 1994)

b) Others

- First results on large Cerium Fluoride Crystals in a test beam
T. Beckers, J. Nelissen et al.
CERN-PPE/94-112
- Scintillator and Phosphor Materials
T. Beckers et al.
ed. by M. Weber, MRS, 1994, 117-122
- Test beam results of a Cerium Fluoride crystal matrix for the CMS experiment
T. Beckers et al.
Contribution to the 5th International Conference on Calorimetry in High Energy Physics (Upton,NY-USA, September 1994)
- Test beam results of a Cerium crystal matrix
T. Beckers et al.
Contribution to the 4th International Conference on "Advanced Technology and Particle Physics (Como-Italy, October 1994)
- CMS : The compact Muon Solenoid/Technical Proposal
J. Sacton, P. Van Laer, C. Vander Velde, P. Vilain, G. Wilquet, J. Lemonne, S. Tavernier, W. Van Doninck, L. Van Lancker, J. Wulleman, T. eckers, F. Verbeure et al.
CERN-LHCC/94-38
- Proposal for a forward proton spectrometer for H1
D. Johnson et al.,
Physics Res. Council 09/94-381

CONTRIBUTIONS OF THE DELPHI COLLABORATION TO THE GLASGOW CONFERENCE (July 1994)

- Precision determination of the Z^0 resonance parameters
DELPHI 94-114 PHYS 431
- DELPHI results on electroweak physics with quarks contributed to Glasgow Conference
DELPHI 94-111 PHYS 428
- Improved measurements of cross sections and asymmetries at the Z^0 resonance
CERN-PPE/94-31
- Measurement of the $e^+e^- \rightarrow \gamma\gamma$ (γ) cross section at LEP energies
CERN-PPE/94-36
- A study of radiative muon-pair events at Z^0 energies, and limits on an additional Z' gauge boson
DELPHI 94-54 PHYS 375
- Measurements of the τ polarisation in Z^0 decays
DELPHI-121 PHYS 438
- Measurement of $\frac{\Gamma_{b\bar{b}}}{\Gamma_{\text{had}}}$ branching ratio of the Z by double hemisphere tagging
DELPHI 94-61 PHYS 382
- New measurement of $\frac{\Gamma_{b\bar{b}}}{\Gamma_{\text{had}}}$ with lifetime tag technique
DELPHI 94-90 PHYS 407
- Measurement of $\frac{\Gamma_{b\bar{b}}}{\Gamma_{\text{had}}}$ using micro-vertex and lepton tags
DELPHI 94-91 PHYS 408
- New measurement of the $\frac{\Gamma_{b\bar{b}}}{\Gamma_{\text{had}}}$ branching ratio of the Z with minimal model dependence
DELPHI 94-93 PHS 410
- Measurement of the forward-backward asymmetry of $e^+e^- \rightarrow Z \rightarrow b\bar{b}$ using prompt leptons and lifetime tag
DELPHI 94-62 PHYS 383
- Measurement of the forward-backward asymmetry of $e^+e^- \rightarrow Z \rightarrow b\bar{b}$ using prompt leptons
DELPHI 94-107 PHYS 424
- Measurement of the forward-backward asymmetry of charm and bottom quarks at the Z pole using $D^{*\pm}$ mesons
DELPHI 94-95 PHYS 412
- First measurement of the strange quark asymmetry at the Z^0 pole
DELPHI 94-96 PHYS 413
- Excited beauty at DELPHI
DELPHI 94-80 PHYS 397
- A measurement of the B_s^0 meson mass
CERN-PPE/94-22
- A precision measurement of the average lifetime of B hadrons
CERN-PPE/94-24

- Production of charged particles, K_s^0 , K^\pm , p and Λ in $Z^0 \rightarrow b\bar{b}$ events and in the decay of B-hadrons
DELPHI 94-94 PHYS 411
- Study of D, D* and D** production in Z^0 hadronic decays
DELPHI 94-103 PHYS 420
- J/ψ production in the hadronic decays of the Z
DELPHI 94-58 PHYS 379
- Lifetime and production rate of beauty baryons from Z^0 decays
DELPHI 94-117 PHYS 434
- Search for exclusive charmless B-mesons decays with the DELPHI detector at LEP
DELPHI 94-105 PHYS 422
- Search for exclusive decays channels of the Λ_b^0 baryon with DELPHI
DELPHI 94-30 PHYS 363
- A topological measurement of the lifetime of charged and neutral B-hadrons
DELPHI 94-97 PHYS 414
- Measurement of the production of $\Xi \ell$ pairs in jets at LEP and interpretation of their origin in terms of strange-beauty baryon decays
DELPHI 94-98 PHYS 415
- Measurement of B_s lifetime using D_s -lepton and inclusive D_s samples
DELPHI 94-116 PHYS 433
- Measurement of time dependent $B_d^0 - \bar{B}_d^0$ mixing
DELPHI 94-100 PHYS 417
- New measurements of time dependent $B_d^0 - \bar{B}_d^0$ mixing with D*-hemisphere charge correlations
DELPHI 94-101 PHYS 418
- Measurement of the B_d^0 oscillation frequency using kaons, leptons and jet charge
DELPHI 94-118 PHYS 435
- Measurement of the $B^0 - \bar{B}^0$ mixing parameter in DELPHI
CERN-PPE/94-67
- Update of the search for the standard model Higgs boson
DELPHI 94-85 PHYS 402
- Search for the standard model Higgs boson in Z^0 decays
CERN-PPE/94-46
- A search for the Z^0 decay into a Higgs boson and a photon with the DELPHI detector
DELPHI 94-119 PHYS 436
- Search for pair-produced heavy scalars in Z^0 decays
DELPHI 94-55 PHYS 376
- Z^0 decays to two leptons and a charged particle-antiparticle pair
DELPHI 94-73 PHYS 391
- Preliminary results of the search for $\ell^+ \ell^- \gamma\gamma$, $\nu\bar{\nu}\gamma\gamma$ and $q\bar{q}\gamma\gamma$, events in 1993

DELPHI 94-4 PHYS 401

- Study of $\tau\tau\gamma$ events using the DELPHI detector at LEP
DELPHI 94-89 PHYS 406
- Search for long lived neutral heavy particles using the DELPHI detector at LEP
DELPHI 94-86 PHYS 403
- Production characteristics of K^0 and light meson resonances in hadronic decays of the Z^0
DELPHI 94-60 PHYS 381
- Measurement of inclusive π^0 production in Z^0 decays
DELPHI 94-81 PHYS 398
- Invariant mass dependence of particle correlations in hadronic final states from the decay of the Z^0
CERN-PPE/94-02
- Interference of neutral kaons in the hadronic decays of the Z^0
CERN-PPE/94-03
- Study of prompt photon production in hadronic Z^0 decays
DELPHI 94-82 PHYS 399
- Measurement of the triple-gluon-vertex from 4-jet-events at LEP
DELPHI 94-65 PHYS 386
- Inclusive $K^{+/-}$ and p/\bar{p} production in Z^0 decays measured with the DELPHI detector
DELPHI 94-49 PHYS 371
- Strange baryon production in Z^0 hadronic decays
DELPHI 94-83 PHYS 400
- Measurement of the mean charged multiplicity in $Z^0 \rightarrow b\bar{b}$ events
DELPHI 94-64 PHYS 385
- A study of differences in quark and gluon jet fragmentation
DELPHI 94-79 PHYS 396
- Investigation of the splitting of quark and gluon jets
DELPHI 94-106 PHYS 423
- First evidence of hard scattering processes in single tagged $\gamma\gamma$ collisions
DELPHI 94-59 PHYS 380
- Charged kaon production in tau decays at LEP
DELPHI 94-56 PHYS 377
- Summary of τ branching ratio results from DELPHI for Glasgow 94
DELPHI 94-120 PHYS 437
- Analysis techniques for the Delphi Ring Imaging Cherenkov detector
DELPHI 94-112 PHYS 429
- Experience with the Ring Imaging Cherenkov detector of DELPHI
DELPHI 94-109 PHYS 426
- The DELPHI silicon strip microvertex detector with double sided readout
DELPHI 94-87 PHYS 404

- Study of hard scattering processes in multihadron production from $\gamma\gamma$ collisions at LEP
CERN-PPE/94-04
- Study of multihadronic production in $\gamma\gamma$ collisions at DELPHI
DELPHI 94-75 PHYS 392
- A measurement of the photon structure function $f_2^{\gamma}(x)$ at an average Q^2 of 12 GeV²
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- A study of single tagged multihadron $\gamma\gamma^*$ events at a $\langle Q^2 \rangle \approx 90$ GeV
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