

INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES

ULB-VUB, BRUSSELS - ANNUAL REPORT 1983

J.LEMONNE and J.SACTON
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I. INTRODUCTION

The physicists whose names are listed below have contributed to the different activities of the Laboratory during the year 1983.

U.L.B

M. Barth (maître de recherche FNRS)
D. Bertrand (chercheur qualifié FNRS)
G. Bertrand-Coremans (chef de travaux associé)
P. Marage (boursier IRSIA)
J. Sacton (professeur associé)
G. Schorochoff (on leave from the University of Zaire)
P. Van Binst (informaticien IISN)
P. Vilain (chercheur qualifié FNRS)
J. Wickens (chercheur IISN)
G. Wilquet (chercheur qualifié FNRS)
C. Wilquet-Vander Velde (chef de travaux associé)

V.U.B

H. Cobbaert (vorser IIKW)
C. De Clercq-Vincent (vorser IIKW)
D. Geiregat (vorser IIKW since October 1983)
M. Gysen (vorser IIKW - CERN fellow up to September 1983)
D. Johnson (vorser IIKW)
J. Lemonne (gewoon hoogleraar)
J. Moreels (vorser IIKW)
P. Peeters (werkleider)
R. Roosen (bevoegdverklaard navorser NFWO)
S. Tavernier (bevoegdverklaard navorser NFWO)
P. Theocharopoulos (vorser IIKW up to August 1983)
R. Vandenbroucke-Tassin (informaticus IIKW)
W. Van Doninck (bevoegdverklaard navorser NFWO)
B. Vonck (vorser IIKW)

F. Verbeure, A. De Roeck, E. De Wolf, J. Gaudaen and M. Van Immerseel from the UIA are working in close collaboration with the Institute.

II. RESEARCH.

II.1. Neutrino physics.

II.1.1. Neutrino -----

(D. Bertrand, J. Moreels, J. Sacton, W. Van Doninck and C. Vander Velde-Wilquet; WA 24 Collaboration : Bari, Birmingham, Brussels, E. Polytechnique Palaiseau, Rutherford, Saclay, U.C. London).

a. Charged current cross sections and structure functions of hydrogen and neon targets traversed by the same neutrinos and antineutrinos have been compared directly :

i. the ratios of the cross sections per nucleon on an isoscalar neon target (σ_I) to that on a free proton (σ_p) were measured to be

$$\frac{\sigma_{\nu I}}{\sigma_{\nu p}} = 1.44 \pm 0.09 \quad \text{and} \quad \frac{\sigma_{\bar{\nu} I}}{\sigma_{\bar{\nu} p}} = 0.81 \pm 0.07$$

ii. total cross sections for hydrogen have been inferred

$$\frac{\sigma_{\bar{\nu} p}}{\sigma_{\nu p}} = 0.78 \pm 0.08$$

iii. ν and $\bar{\nu}$ hydrogen data have been used to extract the quark distributions in free nucleons, parameterized as a function of the variable $\xi = 2x/(1 + (1 + 4 m^2 x^2/q^2)^{1/2})$

iv. this free-nucleon parameterization has been compared directly with the neon data; only small nuclear effects were detected, in agreement with recent SLAC data in similar A and q^2 ranges

b. About 700 neutral induced interactions on hydrogen have been observed in the antineutrino run and separated into charged current, neutral current and neutral hadron interactions using a multivariate discriminant analysis based on the kinematics of the events. The neutral to charged current cross section ratio has been determined to be $R_p^{\nu} = 0.33 \pm 0.04$. When combined with the value of R_p^{ν} previously determined in the same experiment, the result is compatible with the prediction of the standard $SU(2) \times U(1)$ model for $\sin^2 \theta_W = 0.24 \pm 0.06$.

II.1.2. Neutrino and Antineutrino interactions in BEBC filled ----- with a heavy H₂/Ne mixture -----

(D. Bertrand, P. Marage and J. Sacton; WA 59 Collaboration : Athens, Bari, Birmingham, Brussels, CERN, Cracow, E. Polytechnique Palaiseau, I.C. London, U.C. London, Munich, Oxford, Rutherford and Saclay).

All film have now been measured yielding 15000 $\bar{\nu}$ and 10000 ν charged current interactions above 10 GeV

a. Evidence has been found for semi-inclusive coherent diffractive charged current interactions of antineutrinos on neon nuclei. A sharp peaking towards zero has been observed in the $|t|$ distribution of interactions for which the total charge is zero and from which only one negative hadron is emitted, unaccompanied by any evidence for fragmentation or reinteraction. For the events in the peak the values of the variables x and q^2 are small and the outgoing hadron has high momentum.

b. A detailed Monte Carlo simulation of neutrino and antineutrino interactions on nucleons and nuclei has been developed and carefully tested. It includes hadron fragmentation following the Lund model.

c. Antineutrino interactions in BEBC have been compared to look for differences between structure functions of neon and deuterium (data from this collaboration and from the WA 25 collaboration).

The identical geometries, beam spectra and muon identification criteria and acceptances allow comparison with very small systematic errors. The results, while not incompatible in the medium x region ($0.2 < x < 0.6$), are in strong disagreement with any rise at low x ($x < 0.15$), as reported by the EMC. Excellent agreement is found with the SLAC electroproduction data .

d. A study of the effects of the passage of particles through nuclear matter has been made by comparing the hadronic systems produced in $\bar{\nu}$ Ne (this Collaboration) and $\bar{\nu}$ p (WA 21 Collaboration) interactions in BEBC. The results are consistent with models in which low energy emitted particles reinteract inside the nucleus whilst high energy emitted particles reinteract very rarely inside the nucleus. This can be considered consistent with the ideas of a formation length to create hadrons.

II.1.3. Proposal to install a solid Neon or Argon electromagnetic ----- Calorimeter inside BEBC. -----

(W. Van Doninck, P. Vilain).

This proposal was put forward in 1980 by a collaboration grouping laboratories from Bari, Bruxelles, Ecole Polytechnique and University College London as the best solution to the critical problem of hadron shower measurement in interactions in BEBC. Although this project had originally not been recommended by the SPS Committee, technical tests and Monte Carlo studies were actively pursued. In December 82, at the SPS Fixed Target Workshop organized at CERN, a large fraction of the BEBC users expressed a strong interest for this project and a reinforced proposal was submitted to the SPSC, demonstrating the advantages of the device for several important problems : accurate measurement of the Weinberg angle, determination of the free nucleon structure functions at high Bjorken X values, model-independent measurement of the neutral current coupling constants, etc...

Extensive calculations on these questions were performed in the Laboratory.

After a thorough study by the SPS Committee this proposal was recommended for approval to the Research Board. In view of the long term implications of the project it was decided to leave it to the Scientific Policy Committee to take the final decisions which proved to be negative for budgetary reasons.

II.2. Hadron physics

II.2.1. K^+p interactions at 32 GeV/c in Mirabelle.

(M. Barth, E.A. De Wolf, M. Van Immerseel, F. Verbeure; Brussels, Serpukhov, Tbilissi Collaboration).

Whereas the technical analysis of this experiment is completed since 1982, an active program of physics analyses is continuing, based on the very large statistics on strange neutral particles accumulated in the experiment : 35000, 5500 and 3500 events with K_S^0 , Λ and $\bar{\Lambda}$, respectively.

A comprehensive study of inclusive K^{0S} , Λ and $\bar{\Lambda}$ production was completed as well as an analysis of ϕ production in association with K^+ , K^0 , π^+ . A quite accurate value of $\lambda = 0.26 \pm 0.02$, the strange sea ($s\bar{s}$) production probability relative to ($u\bar{u}$) or ($d\bar{d}$) creation, has been derived. The ratio of prompt $K^{*+}(890)$ ($K^{*0}(890)$) to prompt K^0 cross sections was measured for the first time and found to be 1.03 ± 0.12 (0.98 ± 0.17).

The production properties of meson resonances $K^{*+,0}(890)$, $K^{*+,0}(1430)$, $\bar{K}^{*-}(890)$, and the baryon resonances Σ^{*+} (1385), $\bar{\Sigma}^{*+}$ (1385), $\Delta^{++}(1232)$ have been studied.

A systematic comparison of our data with the Lund Model for low- P_T collisions supports in most cases the model prescriptions for the redistribution of initial state valence quark quantum numbers along the colour string. However, the model fails in predicting the cross sections and Feynman-x

distributions of the reactions $K^+p \rightarrow K^{*+}(890) + X$ and $K^+p \rightarrow K^{*0}(890) + X$.

The data on the former reaction seem to indicate that diagrams where the two valence quarks of the incident K^+ "recombine" into the same state (in casu K^{*+}) are strongly suppressed. This result would definitely exclude modes of the LUND type in favour of models based on Dual Topological Unitarization that are quite similar, in practice, to the Lund approach but assume, on reasonable theoretical grounds, that two-valence recombination diagrams are forbidden in meson fragmentation processes. Further tests of these models are in progress.

II.2.2. The K^+p -experiment at 70 GeV/c.

(M. Barth, C. De Clercq, E.A. De Wolf, J.J. Dumont, D.P. Johnson, J. Lemonne and P. Teocharopoulos; WA 27 Collaboration : Brussels, CERN, Genova, Mons, Nijmegen, Serpukhov).

The data of this experiment were obtained in exposures of BEBC to a separated K^+ beam of 70 GeV/c nominal momentum. A final sample of about 92000 events was collected on DST. A detailed analysis of inclusive $K^*(890)$, $K^*(1420)$, ϕ , ρ^0 and $f(1270)$ resonance production has been performed. An interpretation of the results in terms of the recombination model mainly leads to the finding that fast $K^*(890)$, ϕ and ρ^0 production can be interpreted in either single \bar{s} or single u kaon valence quark recombination. It appears that the valence quarks carry about 50 % of the K^+ momentum, with the strange \bar{s} -quark carrying approximately twice the momentum of the u -quark. The inclusive γ and π^0 -cross sections have been measured and compared to the Lund model. The model describes correctly the inclusive x - and p_T^2 spectra of γ 's in the forward centre-of-mass hemisphere, but fails for $x \lesssim 0$.

The π^0 -spectra are not so well reproduced, especially for large $|x|$ -values. Technical details have been published on the large multicell ionization detector EPI-constructed for this experiment.

II.2.3. Hadronic Interactions in EHS with K^+ and π^+ beams at 250 GeV/c.

(A. De Roeck, E. De Wolf, P. Teocharopoulos, M. Van Immerseel, F. Verbeure; NA 22 Collaboration : Aachen, Berlin, Brussels, Cracow, Helsinki, Nijmegen, Rio de Janeiro, Serpukhov, Warsaw).

The experimental set-up used is the EHS with RCBC as vertex detector. Furthermore RCBC is equipped with an Al and an Au foil near the entrance window. The thickness of the foils was chosen in such a way that about 5 % of the interactions occur in the foils. After a first run in 1982 yielding 125 K pictures, the data taking was finished in August 1983 with a total of 700 K pictures, containing about 150 K π^+p , about 50 K K^+p and 16 K meson-nucleus interactions.

During 1983, the scan and measurement procedures have been set up, the scanning of part A (the 1982 run) is finished and the measurements of the K^+p interactions are well advanced. About 1000 events have been measured, the majority on POLLY. Geometrical reconstruction with a preliminary version of GEOHYB was done for some hundred events to perform quality checks.

Monte Carlo studies (SIMIN, SIMOUT) yielded the trigger efficiencies versus charged multiplicity. The multiplicity distribution, corrected for this trigger efficiency and calculated on part A, is fully in agreement with extrapolations from lower energy data, indicating that we understand our trigger. First, very qualitative, results were obtained from the scanning of foil interactions.

II.2.4. A study of $p\bar{p}$ interactions at 70 GeV/c in BEBC equipped with a track sensitive target.

(J. Lemonne and J. Wickens; WA 31 Collaboration : Brussels, Liverpool, Mons, Serpukhov, Stockholm).

In this experiment, BEBC equipped with a H_2 -filled track sensitive target surrounded by a H_2 -Ne blanket has been exposed

an RF-separated \bar{p} -beam of high purity. The analysis of V^0 -production has been completed during 1983. The data, based on an initial sample of 1500- V^0 decays indicate a cross-section excess for K^0 s and Λ or $\bar{\Lambda}$ production in $\bar{p}p$ as compared to pp interactions at the same energy amounting to $\Delta\sigma(K_S) = (1.52 \pm .31)\text{mb}$ and $\Delta\sigma(\Lambda/\bar{\Lambda}) = .82 \pm .20$. For K^0 -production, this difference is usually attributed to annihilation interactions for which the total cross-section at 70 GeV/c has been estimated to be of $(4.4 \pm .4)\text{mb}$. In the case of $\Lambda/\bar{\Lambda}$ production, the observed excess is found to correspond to central production and could be attributed to processes of the type $\bar{p}p \rightarrow \Lambda \bar{\Lambda} + \text{non strange mesons}$ which cannot occur in pp -interactions.

The study of π^0 -production, although completed from the purely technical point of view, is still in progress.

II.2.5. Study of $\bar{p}p$ collisions at the SPS collider

(C. De Clercq, J. Gaudaen, M. Gysen, D. Johnson, G. Wilquet; UA5 Collaboration : Bonn, Brussels, Cambridge, CERN, Stockholm).

In fall 1981, ~ 6000 pictures of $\bar{p}p$ interactions at 2×270 GeV had been taken in the two large streamer chambers of the UA5 detector at the CERN Collider.

The study of these events has been pursued and new results have been obtained on forward-backward short and long range correlations. The interactions appear as superpositions of random soft processes leading to the production of stable particles, low mass resonances and low multiplicity resonances. As a consequence of this picture, strong correlations between γ -rays and charged hadron productions are observed.

In fall 1982, a second set of data has been taken, consisting in 12000 pictures of $\bar{p}p$ interactions at the same energy. The experimental set-up had been upgraded, as follows :

- replacement of the steel beam pipe by a beryllium one, reducing the rate of electromagnetic showers by a factor of ~ 4
- mean luminosity of the collider increased by ~ 10 , reducing the rate of background interactions to the percent level
- installation of a small electromagnetic/hadronic calorimeter at 90°
- improvement of the minimum bias trigger.

So far, more than 6000 events have been measured and results have been obtained on the shape of the multiplicity distribution. A clear scaling violation has been observed, favouring events with high multiplicity. The increase in events with $n/\langle n \rangle > 2$ between ISR (~ 50 GeV) and collider (540 GeV) energies is of $\sim 5\%$.

Other subjects still under study are :

- short and long range correlations, production of anomalous events in the high multiplicity tail
- V^0 production
- B/\bar{B} and γ production using the calorimeter.

The calorimeter has been exposed for calibration to a large variety of low momentum beams (150 MeV/c to 3 GeV/c) during the summer 1983 at the CERN PS. The study of more than 800 different runs is currently in progress.

II.2.6. Charmed particle production by 360 GeV/c π^- and p in a rapid cycling bubble chamber.

(G. Bertrand-Coremans, J. Lemonne, S. Tavernier, M. Van Immerseel, P. Vilain, B. Vonck, J. Wickens; NA16 Collaboration : Amsterdam, Brussels, CERN, Madrid, Mons, Nijmegen, Oxford, Padova, Paris VI, Rome, Rutherford, Serpukhov, Trieste, Vienna).

The main results of this experiment, described in the 1982 report, have now been published. A new analysis of the data has been performed in order to determine the branching ratios for D meson decays into all charged particle final states. The

values obtained :

$$B(D^{\pm} \rightarrow K^{\pm} \pi^{\pm} \pi^{\pm}) = 14 \pm 6 \% \text{ and } B(\bar{D}^0/D^0 \rightarrow K^{\pm} \pi^{\mp} \pi^{\pm} \pi^{\mp}) = 10 \pm 4 \%$$

are higher than those currently accepted, although compatible within errors. If confirmed, this result implies a corresponding reduction of the previously published values of the inclusive D-meson production cross sections.

II.2.7. Study of charmed particle production with HOLEBC and EHS

(G. Bertrand-Coremans, J. Lemonne, P. Vilain, B. Vonck, J. Wickens; NA27 Collaboration : Aachen, Bombay, Brussels, CERN, Genova, Liverpool, Madrid, Mons, Oxford, Padova, Paris, College de France, Roma, Rutgers, Rutherford, Serpukhov, Stockholm, Strasbourg, Tennessee, Tokyo, Torino, Trieste, Vienna).

The scanning and measuring work for the first part of the experiment has now been completed. About 300000 π^- interactions in hydrogen at 360 GeV/c were examined, which corresponds to a sensitivity of 16 events per microbarn. The analysis is now concentrated on the small sample of decays (20 4-prongs, 35 3-prongs and 80 1 or 2-prongs) which show evidence of charm interpretation. Remeasurement of these events is in progress on the HPD device of Strasbourg.

The exposure of HOLEBC to a 400 GeV proton beam, which constitutes the second part of the experiment, has been pursued. About 650000 pictures were taken which, due to long periods of accelerator shutdown, represents only 2/3 of the aimed quantity.

Various improvements were brought to the spectrometer for this run :

- new chamber body and optical system providing better illumination and contrast and more accurate fiducial marks.
- implementation of an electronic fiducial volume trigger which increases the number of useful pictures.
- installation between HOLEBC and the first magnet of new tracking devices : a proportional inclined chamber (Mini PIC) and 2 high resolution drift chambers (MDC). The IIHE has participated in the realization and testing of the MDC.

II.2.8. Study of the hadroproduction of charmed particles using

 the CERN holographic heavy liquid bubble chamber HOBC.

(M. Barth, H. Cobbaert, D. Geiregat, R. Roosen, S. Tavernier;
 NA25 Collaboration : Bari, Brussels, CERN, Mons, Paris VI, U.C.
 London, Vienne).

This experiment is the first bubble chamber experiment to use holographic image recording. The holographic chamber HOBC located in front of a muon absorber (Wolfram and iron dump followed by a sandwich of iron plates, scintillators and wire chambers) has been exposed to proton beams of 200 and 360 GeV/c. Triggering on the presence of a muon of momentum greater than 6 GeV/c increases the charm content of the interactions by a factor 20. With this trigger 40000 holograms have been taken and are now scanned and measured. In Brussels this is done by directly projecting the image on a scan table. A comparison of the scanning results obtained in different laboratories demonstrates that this procedure is the most reliable. Up to now 8000 holograms have been analyzed providing 2030 interactions in which a signal of 14 examples of associated charmed particle production has been found.

II.2.9. An experiment to observe directly beauty particles

 selected by muonic decay in emulsion and to estimate their

 lifetimes

(M. Barth, G. Bertrand-Coremans, R. Roosen and G. Schorochoff;
 WA75 Collaboration : Bari, Brussels, CERN, Dublin, Kariya, Kobe,
 U.C. London, Nagoya, Roma, Torino, Utsunomiya-Yokohama).

This hybrid experiment makes use of an emulsion target located in front of a 2 m iron dump equipped with a tungsten cone, followed by a 3Tm magnet and a muon analyser. The magnet is surrounded by a set of drift and multiwire proportionnal chambers for muon tracking.

360 GeV/c π^- mesons produce events of the type $\pi^- N \rightarrow B\bar{B}X$ in the emulsion. The muonic decays of B's (and subsequent C's)

are used to create a selective trigger (1 or more muons with angular and/or p_{\perp} cuts).

The precise location of the interaction vertices in the emulsion is done by using high precision (50 μm pitch) silicon microstrip detectors. A set of planes of such detectors measure the incoming particle; another set of detectors and 12 planes of MWPC's are placed behind the emulsion target to measure secondaries.

48 litres of emulsion (Ilford and Fuji) have been exposed in fall 1983 and are presently processed in CERN, Nagoya and Rome. The emulsion will be scanned and events will be analyzed using a recently developed automatized microscope.

The sensitivity of the experiment is expected to be 1,5 μB pairs per nanobarn cross section.

II.3. Study of e^+e^- annihilations at LEP

(D. Bertrand, C. De Clercq, J. Gaudaen, J. Lemonne, J. Sacton, S. Tavernier, C. Vander Velde-Wilquet, W. Van Doninck, F. Verbeure, J. Wickens; DELPHI Collaboration : Ames, Athens, Athens NTU, Belgium, Bergen, CERN, College de France, Cracow, Dubna, E.P. Palaiseau, Helsinki, INFN-Bologna, INFN-Genova, INFN-Milano, INFN-Padova, INFN-Roma, INFN-Torino, Karlsruhe, LAL-Orsay, Liverpool, Lund, NIKHEF-Amsterdam, Oslo, Oxford, Paris-LPNHE, Rutherford, Saclay, Santander, Serpukhov, Stockholm, Strasbourg, Uppsala, Valencia, Vienna, Wuppertal).

The collaboration between Belgium (IIHE/ULB-VUB, Mons, UIA) and the laboratories of Oxford and Rutherford on the muon part of the DELPHI detector proceeds as planned.

As outlined in the technical proposal produced in May 1983, the DELPHI muon chamber system is designed to select muons by recording two spatial points on the tracks of those charged particles which penetrate the hadron calorimeter over its full depth. Coordinates are measured by drift chambers, a first layer of which is inserted in the iron at a depth of approximately 0,9 m, a second layer being fixed to the outer surface of the calorimeter. Approximately 5 m long flat drift chambers with a

maximum drift distance of 10 cm to a central anode wire will be used. The chamber enclosure is an aluminium extrusion, the drifting field being provided by copper strips laid on plastic inserts inside the extrusion. The field is sufficiently uniform to achieve 1 mm accuracy in the direction perpendicular to the anode wire. Measurement of coordinates along the anode wire are performed with delay lines which also function as central field shaping electrodes. A spatial resolution $\lesssim 10$ mm can be achieved with TDC measurements performed at each end of these lines. All chambers lie lengthwise in the barrel of DELPHI and are arranged in two staggered double layers, with 4 points measured for both tracks. The delay-line provides z-measurements in this case. In the end-caps, chambers are "crossed" at 90° in two double layers so that drift time measurements in both directions provide 1 mm accuracy. In this case, the delay-line measurements are only used to resolve ambiguities. Some 2000 chambers are required of which ~ 700 should be constructed in Belgium.

All the announced chamber performances have been carefully tested in a series of prototype chambers operated in the proportional mode. Four of these chambers have been constructed in Belgium. Tests have been performed with radioactive sources, at the cyclotron of Louvain-La-Neuve (80 MeV protons) and in muon beams at CERN. Various electrode configurations, gas gaps (10 to 15 mm) and mixtures ($A-CH_4$ (10 %) and $A-CO_2$ (10 %)) have been tested. There remains no doubt on the feasibility of the project as described in the technical proposal. Moreover, tests have been undertaken aiming at the operation of the same chambers in the limited streamer mode. This alternative method promises still better performance at no extra or even lower cost. Pulse heights more than an order of magnitude greater than those obtained in the proportional mode have already been observed in preliminary tests in which novel gas mixtures have been successfully used. Extensive tests on the possible use of the limited streamer mode technique are still in progress. The final design of the chambers should be decided by the summer of 1984.

III. SEMINARS, LECTURES AND REPORTS.

. The practical work for students attending the lectures of J. Lemonne and J. Sacton (3rd and 4th year in physics) has been organized by the staff of the Institute as well as some optional practical work for students of the 3rd year in physics.

. P. Van Binst has given the following lectures at the ULB :

"Notions pratiques d'informatique" (15 h - Faculte des Sciences)

"Introduction à l'informatique", et "Informatique (pratique)" *and*
"Télématique" (30 h *et* 60 h *and 15 h* - Licence en Informatique et Sciences Humaines - Centre Régional Wallon, ULB, Nivelles).

OK . G. Bertrand-Coremans has contributed at the ULB to "stage de programmation" for students of the 1st year in computing sciences (225 hours).

L. VAN HAMME
 . G. t'Hooft has completed his *licent: coherency* "Memoire de fin d'etudes" at the IIHE ; "Etude d'interconnexion de deux protocoles de transport fonctionnellement similaires".

. E. De Wolf has presented an invited talk intituled "Testing Models for Soft Hadron Collisions" at the XIVth International Symposium on Multiparticle Dynamics, Lake Tahoe - USA.

. P. Marage has presented an invited talk intituled "Coherent interactions of $\bar{\nu}$ on neon nuclei" at the International Europhysics Conference on High Energy Physics, Brighton, U.K.

. J. Sacton has been invited to give two seminars at the Universita di Firenze on "Dilepton production in ν and $\bar{\nu}$ interactions in bubble chambers".

He has acted as discussion leader for the session "Heavy Quark Decays" at the IXth International Workshop on Weak Interactions and Neutrinos, Talloires - France.

. S. Tavernier has presented an invited review talk intitlled :
 "Holographic image recording in visual particle detectors" at the
 2nd PISA meeting on advanced detectors, Castiglione della Pescaia
 - Italia.

. F. Verbeure has presented two invited talks intitlled
 "Differential results from strange beams" and "Multiple
 collisions inside nuclei as observed in π^+ and K^+ interactions
 with Al and Au nuclei at 250 GeV/c" at the XIVth International
 Symposium on Multiparticle Dynamics, Lake Tahoe - USA.
 He has been invited to give seminars at MIT and the University of
 Washington - Seattle on "First results from EHS with RCBC".

. P. Van Binst has been invited to give a seminar at the
 University of Louvain-La-Neuve on "Les moyens télématiques
 nouveaux en physique des hautes énergies".
 At the request of the Conseil d'Education Permanente de l'ULB he
 has organized a cycle of four conferences (two given by himself)
 on "Informatique et télématique, aspects techniques et sociaux".

The following talks were given at the Annual Scientific
 Meeting of the Belgian Physical Society in Gent

. J. Moreels : NC/CC in ν and $\bar{\nu}$ interactions.

. P. Van Binst - R. Vandenbroucke : Data Communications inside
 and outside of the IIHE, present and future.

The following reports have been presented at the General
 DELPHI meetings :

The DELPHI muon identifier : DELPHI technical proposal, DELPHI
83-66/1, 111 (1983).

J. Wickens : The muon detector, DELPHI 83-92, 18 (1983)

J. Lemonne : Report on the muon working group, DELPHI 83-92, 119
 (1983)

C. Vander Velde : Muon detector progress report, DELPHI 83-116,
 35 (1983).

In the framework of the Seminars on Elementary Particles at the IIHE the following lectures were given :

- . Summary of the SPS Fixed Target Workshop
- W. Van Doninck : ν physics
- P. Vilain : Charm
- J. Sacton : Beauty Search
- S. Tavernier : Unconventional Ideas.

- . Computing and Data Communications in High Energy Physics in the next few Years : P. Van Binst.

- . Exotic Phenomena in Cosmic Ray - How Exotic are they :
N. Yamdagni (Stockholm).

- . Observation of a Narrow State at 2.46 GeV/c², a Candidate for the Charmed Strange Baryon Λ_c^+ : H.G. Burckhart (Heidelberg).

- . L'étude expérimentale de la diffusion élastique $\bar{\nu}_\mu e^- \rightarrow \bar{\nu}_\mu e^-$
: F. Jaquet (Ecole Polytechnique - Palaiseau).

- . Results of the W Search in the UAl Experiment : J. Tuominiemi (Helsinki).

- . Results from the Weak Bosons Hunt at the CERN Collider (UAl Experiment) : W. Kozanecki (Riverside).

- . A first study of Complete Hadronic Final States in 280 GeV Muon-Proton Scattering (EM Coll.) : R. Windmolders (Mons).

- . Observation in BEBC of Coherent Diffractive Charged Current $\bar{\nu}$ Interactions on Neon Nuclei : P. Marage.

- . Jets in High Transverse Energy Events produced in pp Collisions at the CERN ISR : D. Lissaueer (CERN).

- . γ - γ Reactions leading to Meson Resonances : G. Alexander (Tel Aviv - DESY).

IV. DATA PROCESSING AND DATA COMMUNICATIONS.

IV.1. Data processing.

The computing load of the laboratory is processed essentially on the DECsystem20 computer, as well as on the ULB-VUB Computer Centre CDC CYBER 750.

The IIHE DECsystem20 supports interactive and batch work as well as real-time tasks for a number of measuring machines or test devices which are linked to the mainframe via two PDP-11 minicomputers and a set of dedicated microcomputers. The older DECsystem10 computer is still in use to control the POLLY film reader.

New system and application software is regularly implemented and developed by the programmers G. Depiesse and G. Rousseau as well as by most physicists and engineers.

The management of most computing matters - hardware, software and administration - is under the responsibility of P. Van Binst, assisted by R. Vandenbroucke.

A. De Coster acts as a part-time operator.

D. Bertrand and J. Wickens have contributed to the activities of the Software Planning Group of the DELPHI Collaboration.

IV.2. Data communications.

This subject is getting ever more important, as more and more movement of information is needed, both inside and outside of the laboratory.

Inside the laboratory, there are now a number of processors linked together, for which adequate procedures have been designed and implemented.

Towards the external world the IIHE is using since this year the recently opened belgian public packet-switching network, DCS. Adequate hardware and software have been implemented in one of the PDP-11's, with the support of DEC Belgium. Higher-level software, conforming to some international standards, has been implemented in collaboration with the University of Strathclyde; this allows file transfers between the IIHE and a number of laboratories in different locations, including CERN. Another DCS connection in the laboratory allows terminal access to remote computers, throughout the world.

A new research contract has been negotiated with DEC Belgium under the terms of which the manufacturer will provide the necessary hardware and software to allow a connection of the DECsystem20 to the DCS network.

All data communication activities are managed and realized by P. Van Binst and R. Vandenbroucke. They are both members of the Belgian Association of Telecommunication Users (ABUT/BVT) which organises regular activities in Belgium. In this context, P. Van Binst has chaired a working group to study the videotex market in Belgium. Regular contact is also maintained with the RTT.

Inside both universities (ULB and VUB), studies are being conducted concerning the long-term evolution of computing and networking resources. Close contact is kept with the persons involved; P. Van Binst is a member of the technical working group set up by the ULB, which has produced two reports in 1983.

Coordination on networking activities is also maintained with the HEP groups in Antwerp (UIA) and Mons (UEM); a connection of the UIA VAX 780 computer to the DCS network is planned, in conjunction with the activities at the IIHE.

P. Vam Binst has drafted the 1983 status report of the ECFA Working Group on Data Processing Standards in HEP.

V. TECHNICAL AND ADMINISTRATION WORK.

R. Goorens and G. Van Beek are in charge of the coordination of the workshop for the electronical and mechanical parts respectively. The members of the workshop staff are : J.P. Dewulf, L. Etienne, R. Gindroz, R. Goorens, E. Lievens, R. Ruidant, G. Vam Beek, J. Vanbegin, R. Vanderhaegen, L. Van Lancker, G. Vincent and C. Wastiels.

The main activities and realisations of the workshop have been :

- Maintenance of the equipment of the laboratory
- Final setting up of the holographic scanning system (G. Van Beek, R. Goorens, G. Vincent, C. Wastiels)
- Design of the fast electronic modules (super fast routers) needed to multiplex the signals of the mini drift chambers to be used in the EHS facility (L. Etienne); construction of these modules (L. Etienne, R. Vanderhaegen, W. Wastiels)
- Tests of the EHS mini drift chambers at CERN and DESY (L. Etienne)
- Realisation of a semi-automatic device for track measuring in nuclear emulsions (J.P. Dewulf, E. Lievens, L. Van Lancker)
- Design study and prototype tests (CERN - Louvain-La-Neuve) of muon detectors for the DELPHI experiment at LEP (L. Etienne, R. Goorens, G. Van Beek, L. Van Lancker)
- Construction of scintillators for various applications (R. Ruidant)
- Construction of prototype drift chambers for LEP (E. Lievens, R. Ruidant, R. Vanderhaegen)
- Design, construction and installation in CERN of a beam scanner (J.P. Dewulf, R. Gindroz, G. Van Beek, C. Wastiels).

In performing the experiments which are summarized in the present report, the phycisists have benefited from the efficient work of the scanning and measuring teams of the laboratory which consists of : C. Carlier, J. De Bruyne, A. De Coster-Vancauwenberge, M. Delasorte, J. De Schutter-Gevers, M. De Schutter, Cl. Donis, M. Dumont, J. Dumortier-Liesen, M.P. Galloy-Kips, Ch. Garnier-Stoffen, M. Goemam, D. Legrand-Mahaux, D. Luypaert-Peymans, L. Maertens, M. Pins, R. Pins, D. Pirnay-Pauwels, M.L. Ronsmans, J. Thys-Raynard, M.L. Van Dale-Ollier, M. Van Mechelen-Paulus, L. Vermeersch-Polderman, A. Vermijlen-Pels.

C. Donis, Chr. Garnier-Stoffen, M. Pins and R. Pins have contributed to the preparation and the processing of the emulsion stacks for the WA 75 experiment at CERN. C. Donis has participated also to the processing of these emulsions at the University of Rome.

The secretarial work was accomplished by R.Alluyn-Lecluse and M. Van Doninck-Garnier. Cl. Vorstermans-Hennebert took care of the library.

VI. REPRESENTATION IN COUNCILS AND COMMITTEES.

J. Lemonne has been one of the Belgian representatives in the CERN Council. ~~He was invited to attend the meetings of the CERN-Scientific Policy Committee as an observer.~~ J. Sacton has acted as a member of the SPS Committee at CERN. 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. P. Van Binst is a member of the ECFA Working Group on Data Processing Standards, Subgroup "Links and Networks". D. Bertrand is a member of the ECFA Working Group on Data Processing Standards, Subgroup "Bookkeeping/Data formats". P. Van Binst is secretary of the Board of the Computational Physics Group of the European Physical Society.

In December, J. Sacton has been elected as Chairman of the European Committee for Future Accelerators for a period of 3 years starting on January 1st 1984.

VII. ATTENDANCE TO CONFERENCES AND SCHOOLS.

- International Europhysics Conference on High Energy Physics, Brighton, UK : P. Marage.
- XIVth International Symposium on Multiparticle Dynamics, Lake Tahoe, USA : E. De Wolf, D. Johnson and F. Verbeure.
- 1983 International Symposium on Lepton and Photon Interactions at High Energies, Ithaca, USA : J. Sacton.
- 3rd International Conference on Physics in Collisions (ee/ep/pp interactions) and the Workshop on Search Heavy Flavours, Como, Italia : Gh. Bertrand-Coremans and J. Lemonne.
- International Symposium on Hadron Structure and Multiparticle Production, Kasimierz, Poland : F. Verbeure.
- IXth International Workshop on Weak Interactions and Neutrinos, Talloires, France : J. Sacton.
- Moriond Workshop on $\bar{p}p$ Physics and the W Discovery, La Plagne, France : G. Wilquet.
- Session "Electroweak of the XVIIIth Rencontre de Moriond, La Plagne, France : W. Van Doninck.
- 2nd Pisa meeting on advanced detectors, Castiglione della Pescaia, Italia : R. Roosen and S. Tavernier.
- Three Days in Depth review on the impact of specialized processes in elementary particle physic, Padova, Italia : C. De Clercq and P. Van Binst.

- IFIP World Computer Congress, Paris, France : R. Vandenbroucke and P. Van Binst.
- DECUS-Europe Symposium, Zurich, Suisse : R. Vandenbroucke and P. Van Binst.
- DECUS Holland Symposium, Utrecht, Holland : R. Vandenbroucke.
- New Systems and Services in Telecommunications, Liege, Belgium : P. Van Binst.
- 19th session of the International School of Elementary Particle Physic at Kupari, Dubrovnik, Yugoslavia : A. De Roeck and J. Moreels.
- 1983 JINR-CERN School of Physic, Tabor, Czechoslovakia : B. Vonck.

VIII. LIST OF PUBLICATIONS AND CONTRIBUTIONS TO CONFERENCES.

VIII.1. Publications.

1. "Determination of the neutral to charged current cross section ratio for neutrino interactions on protons"

N. ARMENISE, ... D. BERTRAND, J. MOREELS, J. SACTON, C. VANDER VELDE-WILQUET, W. VAN DONINCK

Physics Letters 122 B, 448, 1983.

2. "Hadron multiplicities in neutrino-Neon interactions"

H. MULKENS

Z. Physics C Particles and Fields 16, 319, 1983.

X 3. "Inclusive $\bar{\Lambda}$ polarisation in K^+p interactions at 32 and 70 GeV/c"

I.V. AJINENKO, ... M. BARTH, E.A. DE WOLF, D. JOHNSON, P. THEOCHAROPOULOS, ...

Physics Letters 121B, 183, 1983.

4. "The fate of K^+ valence quarks in low p_{\perp} K^+p interactions at 70 GeV/c"

P.V. CHLIAPNIKOV, ... and E.A. DE WOLF

Physics Letters 130B, 432, 1983.

X 5. "Energy and Quantum number flow in K^+p and π^+p interactions at 32 and 70 GeV/c"

D. JOHNSON, P. THEOCHAROPOULOS, ...

Z. Physik C Particles and Fields 16, 291, 1983.

X 6. "Inclusive meson resonance production in K^+p interactions at 70 GeV/c"

M. BARTH, C. DE CLERQ, E.A. DE WOLF, J.J. DUMONT, D. JOHNSON, J. LEMONNE, P. THEOCHAROPOULOS et al

Nuclear Physics 223B, 296, 1983.

7. "Study of inclusive boson resonances in $\bar{p}p$ interactions at 32 GeV/c"

E.A. STARCHENKO, ... E.A. DE WOLF, J.J. DUMONT and M.G. GYSEN

Z. Physik C Particles and Fields 16, 181, 1983.

X 8. "A global study of resonance production and of exchange processes in K^-p interactions at 6.5 GeV/c"

C. DE CLERCQ, D. JOHNSON, J. LEMONNE, P. PEETERS and J. WICKENS

Z. Physik C Particles and Fields 18, 101, 1983.

9. "Particle multiplicities in $\bar{p}p$ interactions at $\sqrt{s} = 540$ GeV"

K. ALPGARD, ... D. BERTRAND, J. GAUDAEN, M. GYSEN, D. JOHNSON, H. MULKENS, G. WILQUET et al

Physics Letters 121B, 209, 1983.

10. "Forward-Backward multiplicity correlations in $\bar{p}p$ collisions at $\sqrt{s} = 540$ GeV"

K. ALPGARD, ... D. BERTRAND, J. GAUDAEN, M. GYSEN, D. JOHNSON, H. MULKENS, G. WILQUET et al

Physics Letters 123B, 361, 1983.

11. "Lifetime measurement of charm mesons produced in π^-p and pp interactions at 360 GeV/c"

M. AGUILAR-BENITEZ, ... G. BERTRAND-COREMANS, M. VAN IMMERSEEL, P. VILAIN, J. WICKENS

Physics Letters 122B, 312, 1983.

X 12. "Charmed D-meson production in 360 GeV π^-p interactions, evidence for leading quarks"

M. AGUILAR-BENITEZ, ... J. LEMONNE, M. VAN IMMERSEEL, B. VONCK, J. WICKENS

Physics Letters 123B, 98, 1983.

13. "Charm D-meson production in 360 GeV/c pp interactions; comparison with π^-p at the same energy"

M. AGUILAR-BENITEZ, ... G. BERTRAND-COREMANS, J. LEMONNE, S. TAVERNIER, P. VILAIN

Physics Letters 123B, 103, 1983.

14. "An attempt to observe directly beauty particles in nuclear emulsions"

J.P. ALBANESE, ... M. BARTH, D. BERTRAND, G. BERTRAND-COREMANS, R. ROOSEN, J. SACTON, J. WICKENS et al

Physics Letters 122B, 197, 1983.

15. "Comparison of small angle pp and pp elastic scattering at 52.8 GeV centre-of-mass energy at the CERN ISR"

N. AMOS, ... C. VANDER VELDE-WILQUET et al

Physics Letters 120B, 460, 1983.

16. "Comparison of small angle pp and pp elastic scattering at the CERN ISR"

N. AMOS, ... C. VANDER VELDE-WILQUET et al

Physics Letters 128B, 343, 1983.

17. "The European Hybrid Spectrometer - A facility to study multihadron events produced in high energy interactions"

M. AGUILAR-BENITEZ, ... M. VAN IMMERSEEL

Nuclear Instruments and Methods 205, 79, 1983.

18. "Use of a large multicell-ionization detector - The external Particle Identifier - in experiments with the BEBC Hydrogen Bubble Chamber"

V. BARUZZI, ... D. JOHNSON, T. THEOCHAROPOULOS et al
Nuclear Instruments and Methods 207, 339, 1983.

19. "A study of bubble chamber operating conditions for holographic image recording"

J.L. BENICHOU, ... R. ROOSEN, S.P.K. TAVERNIER, G. VAN BEEK et al
Nuclear Instruments and Methods 214, 245, 1983.

20. "Performance of a prototype solid neon and solid argon calorimeter"

V. BRISSON ... W. VAN DONINCK et al
Nuclear Instruments and Methods 215, 79, 1983.

VIII. 2. Conference communications and reports

- "Study of μe events produced in antineutrino interactions"

P. MARAGE, D. BERTRAND, G. BERTRAND-COREMANS, J. SACTON,
W. VAN DONINCK, ...

Bulletin de l'IIHE 83/09.

- "A comparison of charged current cross sections and structure functions for neutrino and antineutrino beams on hydrogen and Neon"

M.A. PARKER, ... D. BERTRAND, J. MOREELS, J. SACTON, C. VANDER VELDE-WILQUET, W. VAN DONINCK

Rutherford Appleton Laboratory preprint RL 83-059 and contributed paper no 0364 to the Europhysics Conference on High Energy Physics, Brighton, 1983.

- "Evidence for charged current coherent interactions of antineutrinos on neon nuclei"

P. MARAGE, D. BERTRAND, J. SACTON et al

Bulletin de l'IIHE 83/10 and contributed paper no 0386 to the Europhysics Conference on High Energy Physics, Brighton, 1983.

- "Antineutrinos in nuclear matter - Evidence for strings"
D.R.O MORRISON, ... P. MARAGE, D. BERTRAND, J. SACTON et al
Proceedings of the International Europhysics Conference on High
Energy Physics - p. 164, Brighton, 1983.

- "A comparison of ν Ne and $\bar{\nu}D_2$ structure functions"
M.A. COOPER, ... P. MARAGE, D. BERTRAND, J. SACTON et al
Contributed paper to the International Europhysics Conference on
High Energy Physics, Brighton, 1983.

- "Cross sections and multiplicity distribution for K^+p and π^+p
interactions at 250 GeV/c"
Aachen, Berlin, Brussels, Helsinki, Krakow, Nymegen, Rio de
Janeiro, Serpukhov, Warsaw, Yerevan Collaboration
Contributed paper no 293 to the Europhysics International
Conference on High Energy Physics, Brighton, 1983.

- "Multiple collisions inside the nucleus as observed in K^+p and
 π^+p interactions with Al and An nuclei at 250 GeV/c"
Aachen, Berlin, Brussels, Helsinki, Krakow, Nymegen, Rio de
Janeiro, Serpukhov, Warsaw, Yerevan Collaboration
Contributed paper no 294 to the Europhysics International
Conference on High Energy Physics, Brighton, 1983.

- "Neutral strange particle production in K^+p interactions at 32
GeV/c"
I.V. AJINENKO, ... M. BARTH, E.A. DE WOLF, M. VAN IMMERSEEL and
F. VERBEURE
Bulletin de l'IIHE 83/06 and contributed paper no 325 to the
Europhysics International Conference on High Energy Physics,
Brighton, 1983.

- "Charge distributions and correlations in fragmentation models
for soft hadron collisions"
E.A. DE WOLF
Bulletin de l'IIHE 83/04 and contributed paper no 327 to the
Europhysics International Conference on High Energy Physics,
Brighton, 1983.

- "Fragmentation model predictions for the reaction $pp \rightarrow ph^{\pm} X$ "

E.A. DE WOLF

Bulletin de l' IIHE 83/01 and contributed paper no 326 to the Europhysics International Conference on High Energy Physics, Brighton, 1983.

- "The fate of K^+ valence quarks in low p_T K^+p interactions at 32 GeV/c"

P.V. CHLIAPNIKOV, ... E.A. DE WOLF

Bulletin de l' IIHE 83/05 and contributed paper no 328 to the Europhysics International Conference on High Energy Physics, Brighton, 1983.

- "Inclusive photon and π^0 production in K^+p interactions at 70 GeV/c"

M. BARTH, E.A. DE WOLF, P. THEOCHAROPOULOS ...

Bulletin de l'IIHE 83/07 and contributed paper no 329 to the Europhysics International Conference on High Energy Physics, Brighton, 1983.

- "Testing the held-back effect in soft hadron collisions"

E.A. DE WOLF

Bulletin de l'IIHE 83/02 and contributed paper n0 330 to the Europhysics International Conference on High Energy Physics, Brighton, 1983.

- "Review of results from the UA5 experiment"

D.R. WAND, ... D. BERTRAND, J. GAUDAEN, M. GYSEN, D. JOHNSON, H. MULKENS, G. WILQUET et al

Proceedings of the 3rd Topical Workshop on pp Collider Physic, Rome - CERN 83/04 - p. 75.

- "Multiplicity correlations in $p\bar{p}$ collisions at 540 GeV"

G. EKSPONG, J. GAUDAEN, M. GYSEN, D. JOHNSON, H. MULKENS, G. WILQUET et al

Proceedings of the 3rd Topical Workshop on pp Collider Physics, Rome - CERN 83/04 - p. 112.

- "UA5 results"

B. ECKART, ... J. GAUDAEN, M. GYSEN, D. JOHNSON, H. MULKENS,
G. WILQUET et al

Contributed paper to the Moriond Workshop on pp Physic and the W discovery, La Plagne.

- "Strangeness suppression at Collider Energy"

TH. MULLER, ... J. GAUDAEN, M. GYSEN, D. JOHNSON, H. MULKENS,
G. WILQUET et al

Contributed paper to the XIVth International Symposium on Multiparticle Dynamics, Lake Tahoe.

- "Results from the UA5 experiment"

B. BOCKMAN, ... J. GAUDAEN, M. GYSEN, D. JOHNSON, H. MULKENS,
G. WILQUET et al

Contributed paper to Physics in Collisions, Como.

- "D meson branching ratios and hadronic cross-section"

G. ZUMERLE, ... G. BERTRAND-COREMANS, J. LEMONNE, S. TAVERNIER,
M. VAN IMMERSEEL, P. VILAIN, B. VONCK, J. WICKENS

Contributed paper to the International Europhysics Conference on High Energy Physics, Brighton and to the Workshop on Search for Heavy Flavours, Como.

- "Inclusive charm particle production cross-sections in π^-p and pp interactions at 360 GeV/c"

S. REUCROFT, ... G. BERTRAND-COREMANS, J. LEMONNE, S. TAVERNIER,
M. VAN IMMERSEEL, P. VILAIN, B. VONCK, J. WICKENS

Contributed paper to the XIVth International Symposium on Multiparticle Dynamics, Lake Tahoe.

- "Hadron production of charm particles in π^-p and pp interactions at 360 GeV/c"

G. CIAPETTI, ... G. BERTRAND-COREMANS, J. LEMONNE, S. TAVERNIER,
M. VAN IMMERSEEL, P. VILAIN, B. VONCK, J. WICKENS

XIth Inter-Winter Meeting on Fundamental Physic, Toledo.

- "Charmed meson lifetime measurements : the LEBC-EHS experiment"
 NA16 J. DUMARCHEZ, ... G. BERTRAND-COREMANS, J. LEMONNE,
 S. TAVERNIER, M. VAN IMMERSEEL, P. VILAIN, B. VONCK, J. WICKENS
 XIth Inter-Winter Meeting on Fundamental Physics, Toledo.

- " Preliminary results from the NA27 experiment "
 P, WRIGHT, ... G. BERTRAND-COREMANS, J. LEMONNE, P. VILAIN,
 B. VONCK, J, WICKENS
 Contributed paper to the Workshop on Search for Hevy Flavours,
 Como.

- "Search for Beauty particles at the CERN SPS"
 J. SACTON
 Bulletin de l' IIHE 83/03 and Proceedings of the Workshop on SPS
 fixed target physics in the years 1984-1989 - Ed. I. Mannelli -
 vol. II - p. 222 - CERN 83-02.

- "A scanning table for holographic bubble chamber or streamer
 chambers images"
 M. BARTH, J.J. DUMONT, R. GOORENS, R. ROOSEN, S. TAVERNIER,
 G. VAN BEEK and G. WILQUET
 Bulletin de l'IIHE 83/11.

- "Holographic image recording in visual particle detectors"
 S. TAVERNIER
 Bulletin de l'IIHE 83/08.

- "Using RSX/PSI over the Belgian packet switching network and
 implementing a network-independant file transfer protocol
 P. VAN BINST and R. VANDENBROUCKE
 Contributed paper to DECUS Europe Symposium 1983, Zurich.