

INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES

ULB-VUB, BRUSSELS - ANNUAL REPORT 1984

J. LEMONNE and J. SACTON

January 1985

I. INTRODUCTION

The physicists whose names are listed below have contributed to the different activities of the laboratory during the year 1985.

U.L.B.

M. Barth (maître de recherche FNRS)
D. Bertrand (chercheur qualifié FNRS)
G. Bertrand-Coremans (chef de travaux associé)
P. Marage (chercheur ARC)
J. Sacton (professeur associé)
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 (logistiek medewerker IIKW)
D. Geiregat (vorser IIKW)
J. Lemonne (gewoon hoogleraar)
J. Moreels (vorser IIKW)

R. Roosen (bevoegdverklaard navorser NFWO)
 S. Tavernier (bevoegdverklaard navorser NFWO)
 R. Vandenbroucke-Tassin (informaticus IIKW)
 W. Van Doninck (bevoegdverklaard navorser NFWO)
 L. Van Hamme (vorser IIKW since August 1984)
 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. A. Michalowska joined the UIA group for a period of 11 months, on leave of absence from the Institute for Nuclear Physics, Kraków.

II. RESEARCH

II.1. Neutrino Physics

II.1.1. Neutrino and antineutrino interactions in BEBC filled with a heavy H_2/Ne mixture

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

- a) The cross section for coherent interactions of $\bar{\nu}$ on neon nuclei has been measured to be $(1.4 \pm 0.1)\%$ of the total $\bar{\nu}$ cross section in the conditions of this experiment. The coherent production of a single pion has a cross section of $(148 \pm 19) 10^{-40} \text{ cm}^2/\text{neon nucleus}$, i.e. 60% of the observed coherent signal. This absolute cross section as well as the kinematic variable distributions are in excellent agreement with the predictions of a model based on PCAC, providing the first test of PCAC at high energy. In the case of events containing a single pion and gammas, a good agreement is found with the predictions of a model based on vector-meson dominance.
- b) Dilepton events have been observed both in ν and $\bar{\nu}$ interactions : $45 \mu^+ e^-$ events with muon momentum $> 4 \text{ GeV}/c$ and electron

momentum > 0.8 GeV/c; 45 $\mu^+\mu^-$ events in the $\bar{\nu}$ run and 41 $\mu^+\mu^-$ events in the ν run, with the leading muon momentum > 4 GeV/c and the second muon momentum > 3 GeV/c. In all cases, the production rates and the kinematical characteristics of the events agree with a charm production and decay model. No signal has been found for like-sign dilepton events, which leads to the following 90% C.L. upper limits.

$$\frac{\sigma(\bar{\nu}N \rightarrow \mu^+e^-X)}{\sigma(\bar{\nu}N \rightarrow \mu^+X)} < 2 \times 10^{-4}; \quad \frac{\sigma(\bar{\nu}N \rightarrow \mu^+\mu^+X)}{\sigma(\bar{\nu}N \rightarrow \mu^+X)} < 3.5 \times 10^{-4};$$

$$\frac{\sigma(\bar{\nu}N \rightarrow \mu^-\mu^-X)}{\sigma(\bar{\nu}N \rightarrow \mu^-X)} < 8 \times 10^{-4}.$$

- c) Evidence has been found for a significant scale-breaking contribution to the semi-inclusive $\bar{\nu}$ cross-section for high $z\pi^-$ production. It is found to be consistent with the $z-Q^2$ correlations predicted from pion bound state effect in the hadronic final state. It cannot be adequately described by leading order QCD as modelled by the Lund Monte Carlo.
- d) Muon inner bremsstrahlung has been observed in the study of the production angle of gammas which cannot be paired with other gammas to make π^0 mesons.
- e) Further work is still in progress, especially for :
 - the measurement of $\langle \bar{\nu} \rangle$ absolute cross sections, and the comparison of cross sections on neon and H_2 ;
 - the measurement of the nucleon structure functions;
 - various studies of the fragmentation processes.

II.1.2. Study of neutrino interactions in the 15' bubble chamber using holographic optics

(E. De Wolf, P. Marage, J. Moreels, J. Sacton; European-American collaboration (E632) : Birmingham, Brussels, CERN, I.C. London, Munich, Oxford, Rutherford, Saclay, Berkeley, Fermilab, Hawaii, Illinois I.T., Rutgers, Tufts)

This experiment which is due to take data in the first half of 1985 will take profit of the upgrade of the Fermilab accelerator up to a proton energy of 800 GeV, to explore a new domain of ν physics. The beam will be a quadrupole triplet beam, with mean ν energy of ~ 150 GeV, extending up to 400 GeV. The 15' bubble chamber has been equipped with a new muon identifier (EMI) and an internal picket fence (IPF) the latter having been built in Europe. In order to achieve a resolution of $\sim 100\mu\text{m}$ for detecting short-lived particles, much effort has been devoted to the development of holographic optics, covering a useful volume of several m^3 ; 2 holographic replay machines, based on different approaches, have been built in Hawaii and by the European groups.

The analysis effort will be devoted mainly to the search for new particles, for like-sign dilepton events and for coherent interactions (looking especially for F and F^* coherent production).

II.2. Hadron Physics

II.2.1. Hadronic interactions in EHS with K^+ and π^+ beams at 250 GeV/c

(A. De Roeck, M. Van Immerseel, F. Verbeure and A. Michalowska, NA-22 collaboration : Aachen, Antwerp-Brussels, Berlin, Helsinki, Kraków, Moscow State University, Nijmegen, Rio de Janeiro, Serpukhov, Warsaw, Yerevan).

The experimental set-up consisted of the EHS with RCBC as vertex and slow particle detector. RCBC is also equipped with an Al and a Au foil wherein about 5% of the interactions occur. The data taking was finished in August 1983, with a total of 220K interactions in 700K pictures.

The IIHE has scanned and measured all events of run A (K^+ and π^+ induced; both on H_2 and on the foils) in 12K pictures. All K^+ events of run B (10K pictures) are scanned and checked and 20% of the measurements are done. Scanning of one roll of π^+ events is being done.

A final version of the geometry program was prepared by the collaboration and about 22K events produced by π^+ and K^+ on H_2 are reconstructed as well as 400 events on Al or Au.

More development work is needed on post-geometry programs such as HANG, PARTID and use of the neutral calorimeters. Nevertheless, preliminary physics analysis can start on the present statistics.

On the basis of scanning of about 1500 interactions of π^+ and K^+ on Al and Au, the rate of multiplications of particle production versus the number of intranuclear collisions was determined. Surprisingly this rate increases faster for K^+ induced reactions than for π^+ (and proton) induced ones. If this effect is confirmed after measurement and reconstruction it will pose a challenging problem in the phenomenology of hadron-nucleus interactions.

II.2.2. Study of $p\bar{p}$ -interactions at $\sqrt{s} = 540$ GeV at the CERN collider

(C. De Clercq, J. Gaudaen, L. Van hamme, G. Wilquet; UA5-collaboration : Bonn, Brussels, Cambridge, CERN, Stockholm)

This year has been devoted to the completion of the analysis of the data taken during the 1982 runs, and to the preparation of the forthcoming runs, foreseen in march 1985.

Results have been published on the overall multiplicity distribution for charged particles in non-diffractive interactions; they show a clear violation of KNO scaling, with a growing proportion of high multiplicity events. A detailed study of the multiplicity distribution in limited regions of pseudo-rapidity is almost completed. A new type of regularity has been observed where these distributions can remarkably well be fitted by negative binomial distributions, departing more and more from a Poisson distribution when the $|\Delta\eta|$ domain becomes narrower. The parameters of the distributions themselves vary linearly with the width $|\Delta\eta|$.

Results have been presented for the first time at those energies on E^- production. For $p_t > 1.0$ GeV/c the rate of E^- is 0.04 ± 0.01 per event. Assuming an exponential p_t distribution, a high value is found for $\langle p_t \rangle$, namely $1.1^{+0.3}_{-0.2}$ GeV/c. The E^-/Λ ratio at production is hard to estimate, but a lower limit of 0.30 at 95% C.L. is found, and a value of 1.0 is quite possible. This considerable increase in the E^- production, compared to ISR energies (0.06 ± 0.02) and e^+e^- annihilations at $\sqrt{s} \sim 34$ GeV (0.09 ± 0.03) renders a clean study of the Λ production almost possible. The inclusive p_t distribution of the K-mesons (based on the observation of K_S^0 and $K_{\pi 3}^\pm$) has been measured in the range $0.1 < p_T < 3.0$ GeV/c. The value of $\langle p_t \rangle$ obtained, 0.57 ± 0.03 GeV/c, is larger than those obtained at ISR energies, 0.44 GeV/c for charged particles, essentially pions, and by UA1 0.424 GeV/c. The K/π^\pm and the K-production cross section also show significant increase with respect to the ISR energies.

Next year, the Sp \bar{p} S will operate in pulsed mode, with a flat top and a flat bottom at 450 and 100 GeV respectively, the duration of the cycle being of 21.6 sec. The possibility of taking data continuously during the ramps is also envisaged. Machine tests have been successfully achieved during 1984. The primary physics motivation of this new experiment is the search for the unusual events observed in cosmic rays experiments. The general features of hadronic interactions at both 200 and 900 GeV, will be compared with those obtained previously at 53 and 540 GeV, with the same equipment. The experimental set-up has been rebuilt in the garage of the LSS4 interaction region. Upgrading of the optics and the high voltage system of the chambers will allow to increase the event rate from 1 to 2.3 Hz. The trigger logics and the data acquisition system have been completely redesigned in order to take the new operation mode of the collider into account.

II.2.3. Charmed particle production by 360 GeV/c π^- and p in a rapid cycling hydrogen bubble chamber

(G. Bertrand-Coremans (π^- part only), J. Lemonne, P. Vilain, B. Vonck, J. Wickens; NA-27 collaboration : Aachen, Bombay, Brussels, CERN, Genova, Liverpool, Madrid, Mons, Nijmegen, Oxford, Padova, Paris, Collège de France, Rome, Rutherford, Rutgers, Serpukhov, Stockholm, Strasbourg, Tennessee, Tokyo, Trieste, Vienna).

The π^- data collected in 1982 consist of 850 000 pictures which were double scanned for decay topologies. Out of the 265.000 interactions in the fiducial volume, 118 events, containing 202 charm decays, were retained in the final sample. For about half of the observed decays, the kinematical constraints are sufficient to retain one or several interpretations of the decay. The ambiguities are further reduced when information from the particle identification detectors ISIS and SAD are taken into account.

Results on D-meson lifetimes and production cross sections have been published. Several letters are now in preparation on the following subjects :

- F^\pm production cross section
- $D-\bar{D}$ correlations
- D^* production
- Semi-leptonic D branching ratios

The second part of the experiment is based on an exposure of HOLEBC to a 400 GeV/c proton beam. This run, which ended in June 84, has provided 2.3 million pictures, which correspond to a sensitivity of 45 events per μb . About 2/5 of these pictures have been double scanned up to now and the measurement of the interesting topologies is in progress. It is expected that this work will be completed at the end of 1985.

II.2.4. 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; NA-25 collaboration : Bari, Brussels, CERN, Mons, Paris VI, UCL, London, Vienna)

The scanning of the holograms for the NA-25 experiment was finished during 1984. The holograms were carefully scanned and charm decay candidates are required to satisfy suitable cuts on transverse decay distance, impact parameter of the decay tracks relative to the primary vertex and decay angles. Preliminary results, based on 2/3 of the statistics, concern the events with two decay candidates at the same primary vertex. In this sample the background can be evaluated under the assumption that the probability that a secondary interaction simulates a charm decay candidate is independent of the fact that there is already such a decay present in the event. A total of 16 events were observed in pp interactions at 360 GeV/c (background 3.8) and 3 events at 200 GeV/c (background 1.7). The corresponding cross sections are $(17^{+5.5}_{-5.1})\mu\text{b}$ and $(3.9 \pm 5.5)\mu\text{b}$ at 360 GeV and 200 GeV respectively.

II.2.5. 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; WA-75 collaboration : Bari, Brussels, CERN, Dublin, Kariya, Kobe, UC London, Nagoya, Roma, Torino, Utsunomiya, Yokohama)

The analysis of the hybrid emulsion-counter experiment made to observe beauty particles, produced by 360 GeV/c π^- ($\pi^- N \rightarrow B\bar{B} + X$), decaying via their muonic mode, is in progress. A first run concerning the exposure of 48 litres of emulsion (Ilford and Fudji types) was completed at the end of 1983. This year a second run has been achieved, where the dump in the set-up was replaced by a dump calorimeter which will allow to add to the p_T cut on the muon a cut on high missing energy in the inter-

action. By extrapolation from a part of the data of the first run, analysed in the spectrometer and in the vertex detector, one expects to have to scan in both runs ~ 13.000 predictions with 1 μ of $p_{T\mu} > 1.2$ GeV/c and ~ 3.000 predictions with 2 μ of a $p_{T\mu} > 1$ GeV/c. Improvements in the selection of interesting events to scan among this sample in order to reduce the scanning and measuring time is under study. At present the interaction vertices in emulsion are localized with a precision of ± 50 μ m accross the beam direction and of the order of ± 0.8 mm along the beam direction.

The full exposure, with a 3 mm track following in order to find the decay vertices gives a sensitivity of 1.5 $B\bar{B}$ pair per nanobarn cross section.

II.2.6. Study of the production of beauty particles in a calorimeter

(H. Cobbaert, R. Roosen; WA-78 collaboration : Bari, Brussels, CERN, U.C. London, Rome, Turin)

This experiment is a purely electronic experiment, the main aim of which being the detection of beauty particles. Part of the experimental setup, the muon spectrometer, is similar to the one of WA-75. The main new detector is a calorimeter fully segmented and expandable (variable density). Part of the segment material can be changes (U, Al and Fe are used). As the calorimeter not only measures missing energy but also serves as target, the different segment materials mean different targets. The on-line missing energy cut is made by a dedicated hardware processor. With this setup several physics topics can be investigated :

- a) determination of the $\sigma_{B\bar{B}}$ (π N) : using a 2 muon trigger and a missing energy cut of 30 GeV.
- b) A-dependence of the $\sigma_{C\bar{C}}$ (π N) : using a single muon trigger and no missing energy cut. Three different materials U, Fe and Al will be used.
- c) D^0 - \bar{D}^0 mixing : this is similar to topic b) studying only the like-sign signal

- d) Prompt dimuon production : this is still a controversial subject and we will have good statistics to investigate this channel
- e) Prompt di-tau production : the muon detection and the missing energy information allows us to estimate the $\sigma_{\tau\bar{\tau}}(\pi N)$ cross section

In all these studies the variable density is used to estimate the pion and kaon decay contribution. At present, topics a) and b) are under study using data taken last summer. The main part of the statistics will be taken in the summer of 1985.

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

(D. Bertrand, C. De Clercq, J. Gaudaen, J. Lemonne, J. Sacton, S. Tavernier, C. Vander Velde, W. Van Doninck, F. Verbeure, J. Wickens; DELPHI collaboration : Ames-Iowa, Athens, Athens-NTU, Belgium, Bergen, CERN, Collège de France, Copenhagen, Cracow, Dubna, Ecole Polytechnique Palaiseau, Helsinki, INFN-Bologna, INFN-Genova, INFN-Milano, INFN-Padua, INFN-Rome, INFN-Trieste, INFN-Torino, Karlsruhe, LAL-Orsay, Liverpool, Lund, NIKHEF-Amsterdam, Orsay, Oslo, Oxford, Paris-LPNHE, Rutherford, Saclay, 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 on the muon part of the DELPHI detector proceeds as planned.

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 on the outer surface of the calorimeter. The drift 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 wound solenoid type delay lines which also function as central field shaping electrodes. A spatial resolution better than 1cm can

be achieved with TDC measurements performed at each end of those 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-lines provide 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.

The barrel chambers will be operated in the proportional mode and constructed by Oxford and R.A.L. The endcap chambers will be operated in the limited streamer mode and constructed by the Belgian teams.

The endcap chambers will be assembled into 4×4 quadrants, each quadrant being roughly square ($\sim 4.6\text{m} \times 4.6\text{m}$) and containing 22×22 drift tubes crossed at right angles.

The operation of the endcap drift chambers in the streamer mode offers several advantages over the proportional mode⁽⁺⁾ which have strongly influenced their final design. The main advantages are :

- A large pulse height (about two orders of magnitude above that of the proportional mode) which allows a simplification of the front end electronics and reduces the sensitivity of the delay line to absorption;
- The very fast rise time ($< 5 \text{ ns}$) of the streamer pulses minimises the anode time slewing whereas their saturated nature makes the gain relatively insensitive to variations in both gas mixture or anode potential.
- Thick ($\sim 100 \text{ }\mu\text{m}$) anode wires are used for which spacers become unnecessary. The use of extruded tubes could thus be envisaged simplifying the mechanical construction and reducing considerably the gas tightness problems.

It should be pointed out that these considerable improvements over the initial project are partly a technical novelty

(+) The proportional mode was maintained for the barrel part of the detector for geometrical design reasons, combined with space and access limitations.

and were the result of an extensive prototype work which highlighted in the summer of 1984 with the successful operation in the streamer mode of a 4m long by 20cm wide chamber. This chamber was operated in an $\text{Ar}/\text{C}_4\text{H}_{10}$ 50/50 gas mixture and showed excellent high voltage behaviour, efficiency and drift properties. More recent prototype work, using cosmic ray muons, has successfully concentrated on the use of gas mixtures containing less hydrocarbons, down to $\sim 5\%$. The gas mixtures adequate for streamer operation are all rather slow ($< 2\text{cm/s}$), which is a benefit to the endcap muon detector where magnetic fields up to .12T will be present.

The mechanical design of the endcap chambers and quadrants is now frozen and orders for the main parts, in particular extruded aluminium tubes and plastic extrusions with co-extruded field grading copper strips, have been placed in industry. Slow ($\sim 450\text{ ns/m}$) solenoid delay lines will be wound at the IIHE and the end plugs of the tubes will be made at Mons. The design of the front end electronics is almost finalised.

The final assembly of the chambers and their mounting into quadrants will be performed at the IIHE, partly in a construction hall specially provided by the VUB. This hall is being equipped with a special lifting system for the gluing operation and displacement of the quadrants. Moreover, a computer controlled test-rig will be produced and installed. The whole production plan should be operational next spring and the actual production work is foreseen to start before the summer of 1985.

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.
- G. Bertrand-Coremans has "suppléer" J. Sacton in his lectures (30h) on "Introduction to Elementary Particle Physics".

- P. Van Binst has given the following lectures at the ULB :
 "Notions pratiques d'informatique (15h - Faculté des Sciences)
 "Introduction à l'informatique", "Informatique (pratique)" and
 "Télématique" (30h, 60h and 15h - Licence in Informatique et
 Sciences Humaines - Centre Régional Wallon, ULB, Nivelles)
- 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 has completed his "Licentiaatsverhandeling" at
 the IIHE; "Bijdrage tot de studie van de vreemde-deeltjesproduk-
 tie in $p\bar{p}$ -wisselwerkingen bij $\sqrt{s} = 540$ GeV.
- E. Steinert has completed his "Mémoire de fin d'études" at the
 IIHE; "Etude d'implantation d'une couche "transport" dans un
 environnement de réseau X.25 HDLC"
- T. Massart has completed his "Mémoire de fin d'études" at the
 IIHE; "Etude de l'implantation d'un réseau local au L.I.T."
- P. Van Binst has been invited to give a seminar at the Société
 Générale de Banque and ULB-Nivelles on "Télématique : évolution
 récente des techniques et des services"
- P. Van Binst has been invited to give a seminar (16h) at the
 "Ministère des Affaires Economiques" on "Videotex"
- P. Marage has been invited to give a seminar at the University
 of Michigan, Ann Arbor (USA) on "Coherent interactions of anti-
 neutrinos on neon nuclei in BEBC"
- P. Marage has presented an invited talk entitled "Coherent effects
 in neutrino interactions" at the Joint Spring Meeting of Belgian,
 Dutch and German Physics Societies (Elementary Particle Physics),
 Bielefeld (D)
- S. Tavernier has presented an invited review talk entitled :
 "Hadroproduction of charm" at the 22nd International Conference
 on High Energy Physics, Leipzig, DDR
- S. Tavernier has given a seminar in the Academic Hospital Jette
 entitled : "Dradenkamers : een nieuwe techniek om ioniserende
 stralingen te detecteren"

- S. Tavernier has presented a talk entitled "Results from the holographic bubble chamber experiment NA25" at the 22nd International Conference on High Energy Physics, Leipzig, DDR
- E. De Wolf has presented an invited talk "Parton aspects of soft hadron interactions" at the Joint Spring Meeting of the DPG/NNV/BNV-SPP at Bielefeld, DDR
- E. De Wolf gave a review talk "Beam and target fragmentation in soft hadron interactions" at the XV International Symposium on Multiparticle Dynamics, Lund, Sweden
- F. Verbeure gave a mini-review talk "Recent results with kaon beams" at the XXIInd International Conference on High Energy Physics, Leipzig, DDR
- J. Lemonne has presented a talk entitled : "Comparison of inclusive K_S^0 and $\Lambda/\bar{\Lambda}$ production in $\bar{p}p$ and pp interactions at ~ 70 GeV/c at the XIX Rencontre de Moriond (New particle production at high energy", La Plagne, France
- J. Sacton has given an seminar on "dilepton production in $\bar{\nu}$ interactions" at Argonne National Laboratory.
- J. Sacton has presented an invited talk entitled "ECFA" at the Santa Fe meeting of the Division of Particles and Fields of the APS.
- The following talks were given at the Annual Scientific Meeting of the Belgian Physical Society in Louvain-la-Neuve :
 - B. Vonck : Charm production in π^-p interactions at 360 GeV/c
 - C. De Clercq : Study of inclusive strange particle production in $\bar{p}p$ interactions at $\sqrt{s} = 540$ GeV.
- The following reports have been presented at the General Delphi meetings :
 - Delphi group : Muon identifier - Delphi progress report, Delphi 84-60, 79 (1984)
 - W. Van Doninck : Muon chambers, Delphi 84-62, 119 (1984)
 - Delphi group : Results from prototype muon chambers operated in the limited streamer mode, Delphi bulletin nr 20, 18 (1984)
 - D. Bertrand, J. Wickens et al., : Final report of the Delphi software planning group, Delphi 84-3, prog.2; CERN/LEPC 84-11
 - D. Bertrand, L. Pape : Requirements of the Delphi experiment for a memory management system, Delphi 84-5, Prog-4

- In the framework of the Seminars on Elementary Particles at the IIHE the following lectures were given :
 - "First results from ARGUS at DORIS; e^+e^- physics in the Upsilon Region" : Dr. Schmidt-Parzefall
 - "Gluonium candidates in Ψ radiative decays" : Dr. C. Heusch
 - "Multiwire proportional chambers in physics and elsewhere : status of the art" : Dr. F. Sauli
 - "Elastic scattering, total cross-section and single diffractive dissociation at the CERN $p\bar{p}$ collider" : Dr. M. Haguenaue
 - "Searches for proton decay" : Dr. D. Cundy
 - "Report on the Dortmund Neutrino Conference" : Dr. D. Bertrand
 - "Summary of results presented at the 22nd International Conference on High Energy Physics :
 - . Part I : " $p\bar{p}$ collider results" : Prof. F. Verbeure
 - "Selected topics" : Dr. P. Vilain
 - . Part II : "Heavy quarks" : Dr. S. Tavernier
 - "The LEP project" : Dr. E. Picasso

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 has seen its configuration significantly enhanced in 1984 by the addition of central memory, terminal lines and a front-end computer, all provided by DEC Belgium in the scope of a research and development contract in the field of data communications (see below).

The DECsystem20 supports interactive and batch work as well as real-time tasks for a number of measuring machines and test devices, linked to this computer via two PDP-11 minicomputers and a set of microcomputers.

The older DECsystem10 computer is still in use for the control of the POLLY film measuring device.

New system and application software is regularly implemented and developed, on the DEC and CDC machines, by G. Depiesse, G. Rousseau, R. Vandenbroucke and W. Van Droogenbroeck, as well as by most physicists and engineers.

The management of most computing matters - hardware, software, administration, etc. - is under the responsibility of P. Van Binst.

IV.2. Data communication

This field has seen important developments during the year. The Belgian public data network, DCS, has become increasingly used by physicists and engineers, both for terminal access to remote computer centers (CERN as well as Oxford, Stockholm, Bonn, and many others) where electronic mail and other applications are in regular use, and also for file transfers (programs, documents, data, ...) between various computers in Europe and one of the IIHE PDP-11's.

Under a new research and development contract between the ULB (in the framework of the IIHE) and DEC Belgium, and with the support of the University of York, the DECsystem20 mainframe has been connected to DCS during the summer. First terminal access to remote centres from this computer, as well as first file transfers, have been realized during the second half of the year.

These various developments in the field of networking and data communications are essentially managed and realized by P. Van Binst and R. Vandenbroucke. P. Van Binst and R. Vandenbroucke are much involved in the activities of the ABUT/BVT (Belgian Telecommunication Users Association) and DECUS (DEC Users Society) at the Belgian and European levels.

In association with the IIHE, the UIA VAX 780 computer has been connected to DCS by the end of the year.

P. Van Binst is a member of the technical group set up by the ULB "Conseil de l'Informatique", which is connected with the development of computing and networking activities at the University, including the study and realization of a private "wide-area" network linking the various campuses.

V. TECHNICAL AND ADMINISTRATION WORK

S. Tavernier is in charge of the general coordination of the workshop and R. Goorens and G. Van Beek were in charge of the organisation 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, J. Van Bastelaere, G. Van 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 (all members of the workshop staff)
- Final setting up of a semi-automatic device for track measuring in nuclear emulsions (J.P. Dewulf, E. Lievens, R. Vanderhaegen, L. Van Lancker)
- Design study, prototype construction and prototype tests of muon detectors for the DELPHI experiment at LEP (L. Etienne, R. Gindroz, R. Goorens, E. Lievens, R. Ruidant, G. Van Beek, R. Vanderhaegen, L. Van Lancker, G. Vincent, C. Wastiels)
- Construction of scintillators for various applications (R. Ruidant)
- Design and construction of a delay line winding machine for the DELPHI experiment (E. Lievens, G. Vincent)
- Design and construction of a new film transport system with two views for one of the scanning tables for LEBC film (E. Lievens, C. Wastiels)
- Installation of the cameras of the UA5 experiment in CERN (J.P. Dewulf, G. Van Beek)
- Construction of a gaz distribution system for the DELPHI experiment at LEP (E. Lievens, R. Ruidant)
- Construction of low voltage power supplies (R. Vanderhaegen)
- Installation of a production line for the soldering of printed circuits with a soldering bath (J.P. Dewulf, C. Wastiels)
- Adaptations to a camera for the holographic experiment in the 15' bubble chamber (R. Goorens, J. Van Bastelaere, L. Van Lancker, G. Vincent)

- Adaptations to the BEBC tables to make them compatible with 50 mm film (G. Vincent)
- Construction and design drawings for a large number of items related to the DELPHI experiment (R. Gindroz)

In performing the experiments which are summarized in the present report, the physicists 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. Goeman, D. Legrand-Mahaux, D. Pirnay-Pauwels, M.L. Ronsmans, J. Thys-Raynard, M. Van Mechelen-Paulus, L. Vermeersch-Polderman, A. Vermijlen-Pels

C. Donis, Ch. Garnier-Stoffen, M. Pins have contributed to the preparation of the emulsion stacks and to the mounting of minimodule emulsion plates for the WA75 experiment.

The secretarial works was accomplished by R. Alluyn-Lecluse and M. Garnier-Van Doninck. 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. 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.

In his capacity of chairman of the European Committee for Future Accelerators, J. Sacton has organized and chaired the various meetings of the Committee during 84. He took part in the organization and attended a ECFA-CERN Workshop on Hadron Collider in the LEP tunnel. He attended:

- two ICFA meetings in Leningrad and Tokyo-KEK
- an ICFA seminar on Future Perspectives in High Energy Physics (Tokyo-KEK)
- a Workshop on Generation of Very High Fields for Particle Acceleration to Very High Energies, Frascati
- a discussion meeting on HERA experiment, Genoa

- a meeting of the Subpanel of the High Energy Physics Summit Committee, Oxford
- the various meetings of the CERN Scientific Policy Committee, Finance Committee, Committee of Council and Council
- a meeting of the Extended Scientific Committee at DESY
- the inauguration of HERA at DESY
- the celebration of the 30th Anniversary of CERN
- the 1984 summer study on the design and utilization of the superconducting super collider, Snowmass, Colorado, 13.07.1984

D. Bertrand is a member of the "Delphi Software planning group" (CERN) and the "Zebra specification group" (CERN).

J. Wickens is a member of the "Delphi Software planning group" (CERN), and of the "Delphi Software Coordination Panel" (CERN). He is coordinator of the group concerned with the specification and production of the Data Analysis Software for the experiment.

P. Van Binst is the secretary of the Board of the Computational Physics Group of the European Physical Society. He was the organizer and member of the Scientific Committee of the Europhysics Conference on Software Engineering, Methods and Tools in Computational Physics held in Brussels. In the frame of a Commission of the European Communities he has worked on the evaluation of the ESPRIT Information Exchange System proposals. He is a member of the ECFA Working Group on Data Processing Standards in High Energy Physics, Subgroup 5, "Links and Networks".

R. Vandenbroucke is chairperson of the DECUS network special interest group Belgium-Luxembourg.

VII. ATTENDANCE TO CONFERENCES AND SCHOOLS

- XI International Conference on Neutrino Physics and Astrophysics, Nord Kirchen, Germany : J. Sacton, D. Bertrand.
- IVth Topical Workshop on Proton Antiproton Collider Physics, Bern, Switzerland : J. Sacton
- Meeting of the Division of Particles and Fields of the APS, Santa Fe : J. Sacton
- XXIIInd International Conference on High Energy Physics, Leipzig, DDR : S. Tavernier, F. Verbeure, P. Vilain

- XVth International Symposium on Multiparticle Dynamics, Lund, Sweden : E. De Wolf, F. Verbeure
- XXVIIth Scottish Universities Summer School in Physics", St. Andrews : H. Cobbaert
- XIXth Rencontre de Moriond; "Electroweak interactions and unified theories", La Plagne, France : J. Moreels
- Session "New particle production at High Energy" of the XIXth Rencontre de Moriond, La Plagne, France : J. Lemonne
- International School of Elementary Particle Physics, Kupari, Yugoslavia : D. Geiregat
- Joint Spring Meeting of Belgian, Dutch and German Physics Societies (Elementary Particle Physics), Bielefeld, Germany : P. Marage, E. De Wolf, F. Verbeure
- 8th Nordic meeting on Elementary Particle Physics, Spatind, Norway : C. Vander Velde
- Europhysics Conference on Software Engineering, Methods and Tools in Computational Physics, Brussels : P. Van Binst, R. Vandenbroucke
- Networkshop, Bath, England : P. Van Binst
- IBM Europe Institute on Highly Parallel architectures, Davos Switzerland : P. Van Binst
- International Conference on Computer Communications, Sydney, Australia : P. Van Binst
- Colloque "L'ordinateur, l'homme et l'organisation", Nivelles : P. Van Binst
- DECUS Europe Symposium, Amsterdam, The Netherlands : P. Van Binst
- Journées de Réflexion sur l'Informatique, Namur : P. Van Binst
- International Conference on Communications, Amsterdam, The Netherlands : R. Vandenbroucke

VIII. LIST OF PUBLICATIONS AND CONTRIBUTIONS TO CONFERENCES

XIII.1. Publications

1. "Determination of the neutral to charged current cross-section for antineutrino interactions on protons"
J. MOREELS, W. VAN DONINCK, D. BERTRAND, J. SACTON, C. VANDERVELDE,
Physics Letters 138B - 230⁴ 1984
2. "Observation of coherent diffractive charged current interactions of antineutrinos on neon nuclei"
P. MARAGE, D. BERTRAND, J. SACTON, ...
Physics Letters 140B - 137 - 1984

3. "An investigation of the EMC effect using antineutrino interactions in deuterium and neon"
A.M. COOPER, ... D. BERTRAND, P. MARAGE, J. SACTON, ...
Physics Letters 141B (1984) 133
4. "D meson branching ratios and hadronic charm production cross sections"
M. AGUILAR-BENITEZ, ..., G. BERTRAND-COREMANS, J. LEMONNE, P. VILAIN, B. VONCK, J. WICKENS, ...
Physics Letters 135B (1984) 237
5. "Evidence for two back-to-back high- p_T jets in K^+p interactions at 70 GeV/c"
M. BARTH, ...
Z. Physik C, Particles and Fields 22 (1984) 1
6. "Inclusive photon and π^0 production in K^+p interactions at 70 GeV/c"
M. BARTH, E. DE WOLF, ...
Z. Physik C, Particles and Fields 22 (1984) 23
7. "Scaling violation favouring high multiplicity events at 540 GeV CMS energy"
G.J. ALNER, ..., C. DE CLERCQ, J. GAUDAEN, G. WILQUET, ...
Physics Letters 138B (1984) 304
8. "Neutral strange particle production in K^+p interactions at 32 GeV/c"
I.V. AJINENKO, ..., M. BARTH, E. DE WOLF, M. VAN IMMERSEEL, F. VERBEURE, ...
Z. Physik C, Particles and Fields 23 (1984) 307
9. "Inclusive production of neutral strange particles in $\bar{p}p$ interactions at 70 GeV/c"
J. LEMONNE, J. WICKENS, ...
Z. Physik C, Particles and Fields 24 (1984) 103
10. "Inclusive $K^{*+}(890)$, $K^{*+}(1430)$ and $\bar{K}^{*-}(890)$ production in K^+p interactions at 32 GeV/c"
I.V. AJINENKO, ... M. BARTH, E. DE WOLF, M. VAN IMMERSEEL, F. VERBEURE, ...
Z. Physik C, Particles and Fields 25 (1984) 103

11. "Charge distributions and correlations in fragmentation models for soft hadron collisions"
E.A. DE WOLF, ...
Z. Physik C, Particles and Fields 22 (1984) 87
12. "Inclusive baryon production in K^+p interactions at 70 GeV/c"
E.A. DE WOLF, ...
Nuclear Physics B246 (1984) 431
13. "Neutral D-meson properties in 360 GeV/c π^-p interactions"
M. AGUILAR-BENITEZ, G. BERTRAND-COREMANS, J. LEMONNE, P. VILAIN, B. VONCK, ...
Physics Letters 146B, 3-4 (1984) 266
14. "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, W. VAN DONINCK, ...
Nuclear Physics B232 (1984) 1
15. "Study of μe events produced in antineutrino interactions"
P. MARAGE, D. BERTRAND, W. VAN DONINCK, ...
Z. Physik C, Particles and Fields 21 (1984) 307
16. "A scanning and measuring table for holographic bubble chamber or streamer chamber images"
M. BARTH, R. GOORENS, R. ROOSEN, S. TAVERNIER, G. WILQUET, ...
Nucl. Instr. and Meth. 226 (1984) 349
17. "Holographic image recording in visual particle detectors"
S. TAVERNIER
Nucl. Instr. and Meth. 225 (1984) 642
18. "Performance of the silica aerogel Cherenkov detector used in the European Hybrid spectrometer"
C. FERNANDEZ, ..., S. TAVERNIER, ...
Nucl. Inst. and Meth. 225 (1983) 313

VIII.2. Conference communications and reports

- "Inclusive baryon production in K^+p interactions at 70 GeV/c"
E.A. DE WOLF, ...
Bulletin IIHE 84.01 and contributed paper to the XXII International Conference on High Energy Physics, Leipzig, DDR, 1984
- "A measurement of the total charm production cross section in pp interactions at 200 and 360 GeV/c"
M.T. MUCIACCIA, ..., M. BARTH, H. COBBAERT, D. GEIREGAT, R. ROOSEN, S. TAVERNIER, ...
Contributed paper to the XXII International Conference on High Energy Physics, Leipzig, DDR, 1984 and bulleting IIHE 84.03
- "Particle production at the CERN $p\bar{p}$ -collider"
K. BOCKMANN, ..., L. VAN HAMME, G. WILQUET, ...
Proceedings of the XXII International Conference on High Energy Physics, Leipzig, DDR (1984)
- "Results on the production of charmed particles in 360 GeV/c π^-p interactions
J. LEMONNE, B. VONCK, P. VILAIN, J. WICKENS, ...
Contributed paper to the XXI International Conference on High Energy Physics, Leipzig, DDR (1984)
- "Inclusive production of baryon resonances in K^+p interactions at 32 GeV/c"
IIHE-Brussels - Serpukhov - Tbilissi collaboration
Contributed paper to the XXII International Conference on High Energy Physics, Leipzig, DDR (1984)
- "Production of direct soft photons in K^+p interactions at 70 GeV/c"
Brussels-CERN-Genova-Mons-Nijmegen-Serpukhov collaboration
Contributed paper to the XXII International Conference on High Energy Physics, Leipzig, DDR (1984)
- "Inclusive $K^{*+}(890)$, $K^{*+}(1430)$ and $\bar{K}^{*-}(890)$ production in K^+p interactions at 32 GeV/c"
I.V. AJINENKO, ..., M. BARTH, E. DE WOLF, M. VAN IMMERSEEL, F. VERBEURE
Bulletin IIHE 84.02

- "Hadroproduction of charm"
S. TAVERNIER
Bulletin IIHE 84.04
- "Experience in using the Belgian and international public packet switching networks"
P. VAN BINST, R. VANDENBROUCKE
Proceedings pp. 222 of the DECUS Europe Symposium, Amsterdam, 1984
- "Enseigner l'informatique aux adultes, le soir et le samedi matin ..."
M. PARKER, P. VAN BINST, L. WILKIN
Actes des Deuxièmes Journées de Réflexion sur l'Informatique, Namur, 1984. Ed. by J. Berleur et al.
- Observation of E^- production in $p\bar{p}$ interactions at 540 GeV CMS energy"
G.J. ALNER, ..., C. DE CLERCQ, J. GAUDAEN,
G. WILQUET, ...
CERN preprint, CERN/EP/84-111
- Strange particles and multiplicity distributions
UA5 collaboration (Bonn-Brussels-Cambridge-CERN-Stockholm)
Proceedings of the XV Symposium on Multiparticle Dynamics, Lund, Sweden (1984)
- New results from UA5 : strange particles, (K^0 , Λ , E^-) production and large fluctuations in multiplicities
UA5 collaboration, (Bonn-Brussels-Cambridge-CERN-Stockholm)
Proceedings of the IVth International Workshop on $p\bar{p}$ Collider physics, Bern, Switzerland (1984)
- Future plans for the UA5 experiment - $p\bar{p}$ interactions at 900 GeV cm energy
UA5 collaboration, (Bonn-Brussels-Cambridge-CERN-Stockholm)
Proceedings of the VIIth European Symposium on Antiproton Interactions, Durham, England (1984)
- Results from the UA5 experiment at the CERN $p\bar{p}$ -collider
UA5 collaboration, (Bonn-Brussels-Cambridge-CERN-Stockholm)
Proceedings of the VIIth European Symposium on Antiproton Interactions, Durham, England (1984)

- Comparison of inclusive K_s^0 and $\Lambda/\bar{\Lambda}$ production in $\bar{p}p$ interactions at 70 GeV/c

J. LEMONNE, J. WICKENS, ...

Contribution to the XIX Moriond Workshop - New particle production at high energy, La Plagne, France (1984)

- ECFA - The European Committee for Future Accelerators

J. SACTON

Invited talk at the Annual Meeting of the Division of Particles and Fields of the American Physical Society, Santa Fe - New Mexico.