INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES

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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 1982.

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)

H. Mulkens (chercheur agréé IISN - CERN fellow working on the UA5 experiment until October 1982 - Now at Ecole Polytechnique Fédérale de Lausanne)

J. Sacton (Professeur associé)

G. Schorochoff (on leave from the University of Zaïre since October 1982)

P. Van Binst (informaticien IISN)

P. Vilain (chercheur qualifié FNRS)

J. Wickens (chercheur IISN)

G. Wilquet (chercheur qualifié FNRS - at CERN for the UA5 experiment until September 1982

C. Wilquet-Vander Velde (Chef de travaux associé - CERN fellow working on the R607 experiment until August 1982)

V.U.B.

C. De Clercq-Vincent (vorser IIKW)
M. Gysen (vorser IIKW - CERN fellow since August 1981)
D. Johnson (vorser IIKW)
J. Lemonne (Gewoon hoogleraar)
J. Moreels (vorser IIKW)
P. Peeters (werkleider - on private leave until September 1982)
R. Roosen (bevoegdverklaard navorser NFWO)
S. Tavernier (bevoegdverklaard navorser NFWO)
P. Theocharopoulos (vorser IIKW)
R. Vandenbroucke-Tassin (informaticus IIKW)
W. Van Doninck (bevoegdverklaard navorser NFWO)
G. Vanhomwegen (vorser IIKW - on leave since August 1982)
B. Vonck (vorser IIKW - since August 1982)
F. Verbeure, A. De Roeck, E. De Wolf and M. Van Immerseel from the UIA are working in close collaboration with the Institute.
J. Gaudaen (UIA) is working at CERN on the experiment UA5.

II. RESEARCH

II.1. Neutrino Physics

II.1.1. Neutrino and antineutrino interactions in hydrogen using BEBC and the hydrogen filled TST.

(D. Bertrand, J. Moreels, J. Sacton, W. Van Doninck and C. Vander Velde-Wilquet; WA24 Collaboration : Bari, Birmingham, Brussels, E. Polytechnique Palaiseau, Rutherford, Saclay, U.C. London).

During the neutrino run (WB beam), about 2000 neutral induced interactions on free protons have been recorded. A separation of these events into neutrino charged-, neutrino neutral current and neutral hadron induced interactions has been achieved by using a multi dimensional kinematic analysis. The neutral to charged current cross section ratio for νp interactions on free protons has been determined avoiding the stringent cuts usually applied on the data to eliminate background. The result $R_p^{\nu} = 0.47 \pm 0.04$ is compatible with previous measurements and with the predictions of the standard model for $\sin^2 \theta_W = 0.18 \pm 0.04$.

A similar analysis is in progress for $\bar{\nu}p$ interactions λ.

II.1.2. Neutrino and antineutrino interactions in BEBC filled with a heavy H_2/Ne mixture.

(D. Bertrand, Gh. Bertrand, P. Marage, J. Sacton and W. Van Doninck; WA59 Collaboration : Athens, Bari, Birmingham, Brussels, CERN. E. Polytechnique Palaiseau, I.I. London, U.C. London, Munich, Oxford, Rutherford and Saclay).

All $\bar{\nu}$ film and about 2/3 of the ν film have been measured yielding some 15.000 and 12.000 $\bar{\nu}$ and ν charged current interactions above 10 GeV.

Dilepton production has been studied in the $\bar{\nu}$ film. For μ e events the main results are :

1. Prompt $\mu^+ e^-$ rate : 0.36 ± 0.07 % for $p_{e^-} > 800$ MeV/c
2. Prompt $\mu^+ e^+$ events : no signal for $p_{e^+} > 800$ MeV/c
3. All characteristics of the $\mu^+ e^-$ events confirm the hypothesis that dilepton events are mainly due to the production of charmed hadrons off strange quark-antiquark pairs followed by their semi leptonic decays. The observed rate is compatible with previous data based on much smaller statistics.
4. No evidence is found for a significant contribution of beautiful hadrons.

The μμ sample of events is still under investigation; their general characteristics seem to agree with these of the μe events.

Various parameters characterizing the hadronic shower in the $\bar{\nu}$ charged current interactions have been estimated : charged particle multiplicities, rapidity distributions, strange particle contents, ratio of $\bar{\nu}$ cross sections on protons and neutrons. Comparison are being made with theoretical predictions.

II.2. Hadron Physics

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

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

Contrary to the previous planning, 20 extra rolls of K^+p film (16K pictures) have been analysed in 1982. All technical work for this experiment is now completed. The Soviet-groups (Tbilissi and Serpukhov) have also finished their measurements of hadronic V°-events. The final V°-DST for the full experiment (960K pictures) contains 35.000 K°_S-events, 5.000 Λ-events and 2500 $\bar{\Lambda}$-events.

The physics analysis has continued during 1982 with studies of inclusive tensor meson production ($K^{*+\circ}_{1420}$, f(1250), and a comparison of strange antibaryon ($\bar{\Sigma}^*$, $\bar{\Lambda}$) and strange meson (K°_S, $K^*(890)$) production. Results were also published on fragmentation properties of resonant and non-resonant particle pairs in an attempt to discriminate among models of the recombination and fragmentation type.

Two analyses were performed using the combined data from the MIRABELLE and BEBC (70 GeV/c) experiments (see next section).

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

(M. Barth, C. De Clercq, E. De Wolf, D. Johnson, J. Lemonne, P. Peeters and P. Theocharopoulos; Brussels, CERN, Genova, Mons, Nijmegen and IHEP (USSR) Collaboration)

The final DST for this experiment (containing 92 432 beam tagged events) has been created by the Collaboration. Joint physical analyses have been done using the data of this experiment together with the data of the 32 GeV/c K^+p experiment (CERN-USSR Collaboration). New physics results published or presented at Conferences are the following :

1. Inclusive ϕ production in K^+p interactions at 70 GeV/c

A clear ϕ meson signal is observed in the kaon fragmentation $x > 0.2$ region. Comparison with other data in $K^\pm$ and p induced reactions provides evidence that the strange valence-quark fragmentation or recombination processes play a dominant role in the $K^\pm \to \phi$ transitions.

2. Inclusive $\bar{\Lambda}$ polarization in K^+p interactions

Using the 32 and 70 GeV/c K^+p data a large $\bar{\Lambda}$ polarization is observed in the kaon fragmentation region. The polarization

is energy independent and it increases strongly with increasing x up to 100 % for $x \to 1$.

3. Energy_and_quantum_number flow_in K^+p and π^+p interactions at_32 and 70_GeV/c_data.

Energy, charge and strangeness flow are studied. The ratios dQ/dE for meson "jets" are found to be independent either on incident energy or type of the beam particle. Comparison with $\nu(\bar{\nu})p$ data reveals interesting similarities. The data are in agreement with dual models or with models where the strange valence-quark carries significantly more momentum than the $\bar{u}$-valence quark.

II.2.3. Hadronic_interactions_in_EHS_with_a_K^+/π^+_beam_at_250_GeV/c

(A. De Roeck, E. De Wolf, P. Theocharopoulos, M. Van Immerseel, F. Verbeure; NA22 collaboration : Aachen, Brussels, Cracow, Helsinki, Nijmegen, Serpukhov, Haifa, Warsaw).

In June 1982 about 120K pictures were taken with RCBC and the EHS spectrometer, exposed to an enriched positive beam, containing $\sim$ 15 % K^+, $\sim$ 30 % π^+ and $\sim$ 55 % protons. Triggering was done on either K^+ or π^+ interactions. The data of the Optical First volume trigger were recorded but not used for on-line triggering. The various components of the spectrometer worked reasonably well during the june 82 run but both ISIS and TRD were down during the second part of the run and no positive beam data were taken anymore. About 35K interactions in the volume were recorded including $\sim$ 4K interactions in the Al and Au foils or the stainless steel support.

The IIHE has one roll of 9K frames of which 7K frames have been double scanned. Checking and premeasurements start in january 83. Both the POLLY and PROSAM measuring machines are now operational except for the appropriate film transport which are to be implemented early 1983.

II.2.4. A study of antiproton-proton interactions at 70 GeV/c in BEBC equipped with a track sensitive target

(J. Lemonne, G. Vanhomwegen, F. Verbeure, J.H. Wickens; WA31 collaboration : Brussels, Helsinki, Liverpool, Mons, Serpukhov, Stockholm)

This experiment, using BEBC equipped with a hydrogen filled track sensitive target surrounded by a hydrogen/neon blanket, was originally performed in a search for direct electron production in $\bar{p}p$ interactions at 70 GeV/c. The results of this study were published in 1981.

A further study of sub-samples of the 65.000 $\bar{p}p$ interactions located in the original scanning has lead to results concerning the charged particle and π° multiplicity distributions and the annihilation properties of $\bar{p}p$ interactions at 70 GeV/c.

The collaboration has now been extended to include Serpukhov, and analysis is continuing to study inclusive Λ° and K°_s production. In 1982, the measurement of the sample has been completed, resulting in some 1700 events with an associated V° on the data summary tape (DST). A preliminary analysis has been made and reprocessing of events to obtain the final sample is underway.

The extended collaboration is also studying inclusive γ (and hence π°) production using the high γ conversion probability of the hydrogen/neon blanket surrounding the TST. Measurement of the selected event sample is now complete and a DST should be available early in 1983.

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

(D. Bertrand, J. Gaudaen, M. Gysen, D. Johnson, H. Mulkens, G. Wilquet; Bonn, Brussels, Cambridge, CERN, Stockholm UA5 Collaboration).

The purpose of the UA5 experiment is to explore the gross features of hadronic physics at $\sqrt{s}$ = 540 GeV using $\bar{p}p$ interactions. The UA5 experiment has provided accurate first data on final

state particle multiplicities and pseudo-rapidity distributions, strange particle production, Centauro phenomena searches and photon production.

In September 1982 and using a new UA5 configuration including a neutral hadron detector some 48.000 pictures were taken under various trigger conditions. The average luminosity achieved was a factor 50-100 better than the 1981 run and was typically $\sim$ 4-7 x $10^{26}/cm^2$-sec. All the physics analysis published in 1981-1982 was obtained from the 1981 UA5 apparatus configuration. Some physics conclusions regarding the UA5 analysis of strange particles are :

- The $K^\circ/\overline{K^\circ}$ multiplicity for inelastic event is 2.0 ± 0.4 yielding a neutral kaon to charged pion fraction of 11 ± 2 %.
- The $K^\pm$ and $K^\circ/\overline{K^\circ}$ production rates are consistent with being equal.
- A higher $\langle p_T \rangle$ for neutral kaons is observed than that seen at ISR energies. The $\frac{1}{\sigma}\frac{d\sigma}{dp_T^2}$ distribution is consistent with an exponential of slope - 2.8 implying an average neutral kaon p_T of $\langle p_T \rangle$ = 0.70 ± 0.12 GeV/c.
- The $\Lambda/\overline{\Lambda}$ multiplicity/event is 0.35 ± 0.10 with an estimated $\langle p_T \rangle$ = 0.67 ± 0.20 GeV/c.

Based upon our search for Centauro-like phenomena at the collider (ie. high multiplicity events with little or no π° production), the following results were obtained :

- For observed pseudorapidities $|\eta| < 5$, the average number of photons is $\sim$ 30 % larger than the mean of charged particles. After removing the effects of kaons and nucleons on the charged particle pseudorapidity distribution, the ratio $\langle n_\gamma \rangle / \langle n_{\pi\,\mathrm{charged}} \rangle$ = 1.4 ± 0.1 indicating a strong disagreement with the expectation $\langle n_\gamma \rangle = \langle n_{\pi\,\mathrm{charged}} \rangle$

- The excess of photons could be accomodated by an η-meson production rate such that $n_{\eta^o}/n_{\pi^o} \sim 30$ %.
- The charged particle-photon correlation is strong and linear for $|\eta| < 4$ and can be expressed by

$$\langle n_\gamma \rangle = (0.90 \pm 0.08)\eta_{chged} + (8.0 \pm 3.0)$$

We note that the correlation strength $d\langle n_\gamma \rangle / d\langle n_{chg} \rangle$ is stronger than previously noted at ISR energies.

- No high multiplicity events exhibiting Centauro-like features have been seen amongst an analysed 3600 minimum bias triggered events.

II.2.6. Charmed particle production by 360 GeV/c π^-/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, IIHE-Brussels, CERN, Madrid, Mons, Nijmegen, Oxford, Padova, Paris VI, Rome,Rutherford, Serpukhov, Trieste, Vienna).

This experiment has been performed in the high resolution hydrogen bubble chamber LEBC in combination with a preliminary version of EHS which provided essentially no particle identification apart for $e^\pm$'s and γ's. In ∿ 850.000 π^- and p interactions at 360 GeV/c, 77 examples of primary interactions with production of charmed particles were observed in which 60 decays could be completely analysed. The results are :

$$\sigma(\pi^- p \to D/\bar{D} + X) = 40 \begin{smallmatrix} + 15 \\ - 8 \end{smallmatrix} \mu b \qquad (x > 0)$$

$$\sigma(pp \to D/\bar{D} + X) = 56 \begin{smallmatrix} + 25 \\ - 12 \end{smallmatrix} \mu b \qquad (\text{all } x)$$

The x and p_T-distributions for π^- and p-induced charmed particle production were studied and showed evidence for a leading component in the π^- interactions which could account for ∿ 30 % of the data.

Important results were obtained on decay characteristics of charmed mesons; namely :

$$\tau(D^{\pm}) = 8.4 \,^{+\,3.5}_{-\,2.5} \times 10^{-13}\,s$$

$$\tau(D^{\circ}) = 4.1 \,^{+\,1.3}_{-\,.9} \times 10^{-13}\,s$$

$$\tau(F^{\pm}) = 2.1 \,^{+\,3.6}_{-\,.8} \times 10^{-13}\,s$$

and $$\frac{\Gamma(D^{\circ} \to e^{\pm} X)}{\Gamma(D^{\circ} \to X)} = (5.1 \,^{+\,4.8}_{-\,1.4})\ \%$$

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, Collège de France, Roma, Rutgers, Rutherford, Serpukhov, Stockholm, Strasbourg, Tennessee, Tokyo, Torino, Trieste, Vienna)

In spite of its nice results, the previous experiment NA16 suffers from a lack of statistics and a very limited charged particle identification. With an improved set-up, this experiment should be able to accumulate several hundred fully reconstructed D decays and several tens of $F^{\pm}$ and Λ_c^+ decays produced by 360 GeV/c π^- and proton beams. The main modifications to the experimental configuration are :

- a new bubble chamber HOLEBC equipped with special lenses which allow to reach a spatial resolution of 20 μm with better contrast
- a set of detectors to provide particle identification for a large fraction of the charm decay products : SAD and ISIS2 in the first lever arm; FC (forward Cerenkov) and TRD (transition radiation detector) in the second lever arm
- additional wire and drift chambers (Wo, W1, PIC) to increase the reconstruction efficiency, especially for low momentum particles.

The π^- exposure was completed in 1982; about 10^6 pictures were taken, containing 340.000 interactions in hydrogen. This film was shared among the 23 laboratories of the collaboration and the scanning is now in progress.

Of the 45.000 pictures allocated to Brussels, 30.000 have been already scanned twice and about 2/3 of these were checked by physicist. The end of the scanning and measuring work is anticipated for Easter 1983.

Hopefully, a sample of comparable size will be obtained in the second half of 1983 with a proton beam.

II.2.8. Study of the hadroproduction of charmed particles using the CERN holographic heavy liquid bubble chamber HOBC

(M. Barth, R. Roosen and S. Tavernier; Bari, Brussels, CERN, U.C. London, Mons, Paris, Strasbourg, Vienna Collaboration)

The experiment NA25 is the first experiment to use holographic image recording in a real bubble chamber experiment. In october 1982 a total of 40.000 holograms with a muon trigger were recorded. The data were taken with incident protons of 360 and 200 GeV/c.

A systematic study of the running conditions for holographic bubble chamber image recording has shown that the limiting phenomena in holographic bubble chamber image recording is the turbulences generated by the growth and recompression of the bubbles. It is necessary to use operating conditions which minimise this effect. This implies that a compromise must be made between cycling rate, bubble density and number of tracks per expansion. Typical running conditions used in NA25 are : 10 Hz cycling rate, 95 bubbles per cm and 80 tracks per expansion. The analysis of these holograms has just started. For this purpose we had to develop and build a holographic film analysis machine. This device is now commercially available from the Belgian company SINCRONI.

II.2.9. Search for $B\bar{B}$ production in 350 GeV/c π^--meson interactions in nuclear emulsion (NA19 experiment)

(M. Barth, D. Bertrand, G. Bertrand-Coremans, R. Roosen, J. Sacton, G. Schorochoff, J. Wickens; Bari, Brussels, CERN, U.C. Dublin, U.C. London, Open University London, Birkbeck College London, Rome, Turin, Japan Collaboration)

The experiment is an attempt for direct observation of the cascade decay of beauty particles, produced by π^- of 350 GeV/c leading to 3 muons or 4 muons in the final state, using an emulsion/counter hybrid experiment. Sixty-five stacks of Ilford emulsion (50 litres in total) were exposed, the pellicles being stacked horizontally. A further six litres of Fuji emulsion was exposed with the pellicles perpendicular to the beam. These emulsions were exposed to a total of $2.26\ 10^9$ 350 GeV/c π^--mesons. Of these approximately $3.2\ 10^8$ interacted. The position of an incident particle on entry to an emulsion stack was obtained by centroïd MWPC's with a precision of the order of 150 μm. A small vertex detector was placed close behind the emulsion stack to limit the actual emulsion volume to be scanned along the beam axis. Some 170 three muon candidate vertices in the emulsion were selected off-line of which 60 % has been searched in the emulsion.

No candidate for the cascade decays of beauty particles has been seen. Under the assumption that the lifetime of beauty particle is of the order of 10^{-13}s, the non observation of any candidates provides an upper limit for beauty production of $\sim$ 90 μb at the 90 % confidence level.

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-Wilquet, W. Van Doninck, F. Verbeure, J. Wickens; Delphi collaboration : Athens, Athens-NTU, Belgium Bergen, CERN, Collège de France, Cracow, Ecole Polytechnique-Palaiseau, INFN-Bologna, INFN-Genova, INFN-Milano, INFN-Padua, INFN-Rome, INFN-Torino, Karlsruhe, LAL-Orsay, Liverpool, Lund, NIKHEF-A'dam, Oslo, Oxford, Paris-LPNHE, Rutherford, Saclay, Santander, Stockholm, Strasbourg, Uppsala, Valencia, Vienna, Wuppertal).

DELPHI is one of the four detectors selected to operate at the CERN e^+e^--ring LEP. Experimentation near LEP will imply the use of large and complex multipurpose detectors, whose construction and operation will require considerable resources

in manpower and equipment. The importance of these requirements is such that the experimental teams of four Belgian universities active in high energy physixs, namely Mons, UIA, ULB and VUB, felt it necessary to join effort to ensure a valuable participation into one of the LEP projects.

This group is presently participating in close collaboration with groups of Oxford and Rutherford into the design and construction of an important component of the DELPHI detector : the muon chambers.

"External" muon detection is planned to be provided by the construction of two double layers of long ($\sim$ 4 m) narrow ($\sim$ 20 cm x 1 cm) single wire graded drift chambers covering almost the entire surface of the detector. Double layers are required to ensure almost 100 % detection efficiency, left-right ambiguity resolution and accurate (up to 1 mm) spatial resolution. Two sets of layers are necessary to provide the angular measurements needed to master the background arising from hadron punch through and $K^{\pm}$ and $\pi^{\pm}$-decays.

The prototype work on drift chambers has started including the study of the possible use of the central electrodes facing the anode wire as delay lines to allow for longitudinal coordinate measurements. A first 20 cm long prototype chamber has been constructed and succesfully operated in a muon beam at CERN.

The construction is now envisaged of hodoscopes allowing tests of new prototypes with either accelerator beams or cosmic ray muons. At the present time, the software effort related to this project is concentrated on the simulation and optimization of the muon detectors. It is intended that this study should lead to a firm proposal for the design of these detectors by April 1983.

In the long term, it is envisaged that members of the Belgian groups will be involved in the planning and implementation of the more general software framework necessary to handle the information available from the different parts of the complete detector.

The construction of the drift chambers according to their final design should start in 1984. It will be partly ensured by industry, partly by the laboratories involved who will in particular take the responsibility of the final assembly and testing of the chambers.

III. SEMINARS AND LECTURES

- 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" (Faculté des Sciences) "Introduction à l'informatique" et "Informatique (pratique)" (Licence en Informatique et Sciences Humaines, Centre Régionale Wallon, ULB, Nivelles)
- M. Dewit (ULB) has obtained her PhD (Etude experimentale des violations d'invariance d'échelle dans les interactions de neutrinos et d'antineutrinos.)
- The following students have completed a "Mémoire" or "Verhandeling" at the IIHE in 1982 :
  -B. Vonck (VUB) : Bijdrage tot de studie van de werkzame doorsnede voor D-meson produktie in $\pi^- p$ en pp wisselwerkingen bij 360 GeV/c.
  -I. Van Parijs (VUB) : Bijdrage tot de studie van $\nu_\mu p$ neutrale stroomwisselwerkingen in BEBC uitgerust met een intern spoorgevoelig doel.
  -M.-A. De Smet (ULB) : Production de dileptons (μ^+, $e^\pm$) dans les interactions d'antineutrinos muoniques
  -C. Norman (ULB) : Quelques aspects de la gerbe hadronique obtenue par interactions d'antineutrinos sur cibles de Ne/H_2.
  -B. Beck (ULB) : Mesures de performances d'une liaison entre ordinateurs.
- E. De Wolf gave an invited talk at the XIIIth International Symp. on Multiparticle Dynamics, Volendam, June 1982
- J. Gaudaen presented a talk entitled "Results from the UA5 experiment" at the XIIIth International Symposium on Multiparticle Dynamics, Volendam, June 1982
- H. Mulkens presented a talk entitled "Further results from the UA5 Collaboration at the SPS-collider" at the Fifth International Conference on Novel Results in Particle Physics, Vanderbilt, Nashville, June 1982

- W. Van Doninck has presented a talk entitled "Benefits to ν-physics in BEBC if equipped with an internal E.M. calorimeter" ν-workshop CERN, December 1982
- J. Sacton has presented an invited talk on "Future of Beauty Search" at the "Workshop on Fixed Target Physics at the SPS" CERN, December 1982.
- E. De Wolf gave a seminar at the Institut f. Hochenergiephysik entitled "Inclusive particle production in soft and hard jets" Vienna, June 1982.
- The following talks were presented at the Annual Scientific Meeting of the Belgian Physical Society, Mons, June 1982 :
  -P. Marage : Aspect of the hadronic shower in antineutrino interactions at high energy
  -M. Van Immerseel : Lifetime determination of D-mesons
- In the framework of the Seminars on Elementary Particles at the IIHE :
  -D. Bertrand : Report on Tristan Workshop at KEK.
  -C. Wilquet-Vander Velde : Measurement of the $\bar{p}p$ total and elastic cross sections at the ISR.
  -D. Haidt (DESY-Hamburg) : Upper limit on beauty lifetime and lower limits on weak mixing angles.
  -W. Van Doninck : Recent results from the neutrino experiment in BEBC equipped with a H_2 TST.
  -E. De Wolf : Flavour characteristics of jets in lepton-hadron, hadron-hadron and e^+e^- interactions.
  -J. Lemonne : Dimuon and charmed particle production in hadron-hadron interactions
  -G. Bertrand-Coremans : Decays of charmed particles and proton decay searches
  -J. Wickens : Results from e^+e^--experiments
  -D. Bertrand : Results from $\bar{p}p$-collider experiments
  -F. Grard (Mons) : Nucleon-antinucleon interactions
  -F. Halzen (Wisconsin,USA) : Heavy quark production
  -S. Tavernier : Holography : where we are and where we would like to go.
  -M. Bosman (CERN) : Charm production in hadronic interactions : Results and future prospects of the NA11 experiments.

-H. Zaccone (Saclay) .: Mesure des sections efficaces inclusives de production de π, K et p et observation de jets de très haute énergie dans les interactions $\bar{p}p$ à $\sqrt{s}$ = 540 GeV

IV. COMPUTERS AND DATA PROCESSING

IV.1. General

The main computing load of the laboratory is processed on the DECsystem20 which is providing interactive and batch facilities, as well as real-time support for an array of measuring machines. These are controlled by a set of mini and microcomputers which are linked to the DEC-20. Newly acquired in this range of machines is a Apple II microcomputer equipped with floppy disk drives and various interfaces, which will be used to control a digitized microscope.

Some performance studies have been conducted during the year to monitor the data communication protocol used to transfer data between the DECsystem20 and two PDP-11's. Some improvements are being planned as a result of this study.

The older DECsystem10, in a reduced configuration, is being used to control the POLLY film reader and some measuring machines, as well as to process 7-track tapes.

Studies are being made to define the future computing needs of the laboratory, particularly in the LEP perspective : special attention is given to high performance graphics devices and associated software.

Some new interactive terminals have been acquired, including three DEC GIGI graphic terminals with local processing capabilities, and an associated DEC LA34 graphic printer.

The IIHE computers are under the management of P. Van Binst, assisted by A. De Coster, G. Depiesse, G. Rousseau and R. Vandenbroucke.

All programmers, physicists and engeneers are actively involved in the development and implementation of application software.

IV.2. New developments in data communications

In view of the evolving needs of the laboratory, a significant effort has been put into the study of modern data communication methods and the various levels of protocols currently in use or being defined. This includes the X.25 packet switching standard, the "triple X" protocols for asynchronous terminals and the various kinds of "local area networks" currently appearing on the market.

A first project has been started, in collaboration with Digital Equipment, the group "Electronica en Informatica" of the VUB (Professor J. Tiberghien) and the RTT, to implement an X.25 interface on the PDP-11 "BEBC" and use it for file transfers, either point-to-point or over the new belgian packet-switching network. The configuration of the PDP-11 "BEBC" has been modified accordingly : replacement of 96Kwords core memory by 128 Kwords MOS, replacement of the 5 Mbytes RL01 disk by a 10 Mbytes RL02, and installation of the DUP-11 synchronous line interface.

The persons involved in this project are P. Van Binst and R. Vandenbroucke. In the same context, P. Van Binst participates actively in the work of the ECFA Working Group on Data Processing Standards in HEP, subgroup 5, "Links and Networks", and is a member of the Belgian Association of Telecommunications Users (ABUT/BVT).

IV.3. Link with the Computer Centre

The IIHE still uses regularly the resources of the ULB-VUB Computer Centre, which involves the daily exchange of magnetic tapes between the respective computers. The installation in 1982 of a fiber optics link between the two campusses of the university has opened the possibility of establishing a fast link between the IIHE and the Computer Centre. Various meetings have taken place to study the feasability of such a project and these matters are being followed very closely, in collaboration with the Computer Centre and the other interested parties within both universities.

V. TECHNICAL AND ADMINISTRATION WORK

- The following work has been accomplished by the technical staff of the workshop (J.P. De Wulf, L. Etienne, R. Gindroz, R. Goorens, E. Lievens, J. Muller, R. Ruidant, G. Van Beek, J. Vanbegin, R. Vanderhaegen, L. Van Lancker, G. Vincent, C. Wastiels

  -Maintenance of the scanning and measuring devices of the IIHE
  -Tuning and calibration of the scanning-measuring device for holographic film (G. Van Beek, R. Goorens)
  -Tuning of the super fast routers for mini drift chambers to be used in the EHS facility at CERN (L. Etienne)
  -Installation, calibration and maintenance of the fast cycling cameras for the CERN collider UA5 experiment (G. Van Beek, 1 month work at CERN)
  -Realization of a semi-automatic device for track measuring in nuclear emulsion (J.P. De Wulf, L. Van Lancker)
  -Study of a new film transport for the PROSAM device (R. Goorens)
  -Contribution to the installation of the heavy liquid holographic bubble chamber HOBC (G. Van Beek : 1 month work at CERN)

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

- The scanning and measurement team of the Institute consisted of : C. Carlier, J. De Bruyne, A. De Coster-Vancauwenberge, L. De Langhe, M. Delasorte, J. De Schutter-Gevers, M. De Schutter, Cl. Donis, M. Dumont, J. Du Mortier-Liesen, M.P. Galloy-Kips, Ch. Garnier-Stoffen, M. Goeman, R. Kelders, D. Legrand-Mahaux, D. Luypaert-Peymans, M. Pins, R. Pins, D. Pirnay-Pauwels, M.L. Ronsmans, J. Thys-Raynard, M.L. Van Dale-Ollier, L. Martens, M. Van Mechelen-Paulus, L. Vermeersch-Polderman, A. Vermijlen-Pels.
- 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. Bertand 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.

VIII. ATTENDANCE TO CONFERENCES AND SCHOOLS

- J. Lemonne and S. Tavernier attended the "Moriond Meeting on New Particles, Les Arcs, February 1982.
- R. Vandenbroucke has taken part in the Symposium on local area networks, Florence, April 1982
- P. Marage and J. Moreels attended the '82 Neutrino Conference Balatonfüred, June 1982
- J. Gaudaen, D. Johnson and G. Wilquet attended the Conference on "Physics in Collisions", Stockholm, June 1982
- E. De Wolf, J. Gaudaen, P. Theocharopoulos and F. Verbeure attended the "XIII International Symposium on Multiparticle Dynamics", Volendam, June 1982
- P. Van Binst attended the Symposium on Super Computers, Utrecht, June 1982
- J. Sacton attended the "International Colloquium on the History of Particle Physics", Paris, July 1982
- D. Bertrand, G. Bertrand-Coremans, E. De Wolf, J. Lemonne, S. Tavernier and J. Wickens have attended the "XXI International Conference on High Energy Physics", Paris, July 1982.

- C. De Clercq has attended the "International School of Subnuclear Physics - Ettore Majorana" - Erice, August 1982
- P. Marage attended the 1982 CERN School of Physics, Cambridge (U.K.), September 1982
- P. Van Binst and R. Vandenbroucke have attended the "DECUS Europe Symposium", Warwick, September 1982
- P. Van Binst attended the Workshop Software in HEP, CERN, October 1982
- J. Lemonne, J. Sacton, S. Tavernier and W. Van Doninck attended the CERN "Workshop on Fixed Target Physics at the SPS", December 1982
- P. Van Binst attended the Meeting on Computing for LEP, CERN December 1982

VIII. LIST OF PUBLICATIONS AND CONTRIBUTIONS TO CONFERENCES

- "Kaon Scattering and Charged Σ Hyperon Production in K^-p Interactions below 300 MeV/c"
  J. CIBOROWSKI, ..., G. WILQUET, ...
  Nuclear Physics 8 , 13 (1982)
- Comparison of Strange Antibaryons and Strange Meson Production in K^+p Interactions at 32 GeV/c"
  P.V. CHLIAPNIKOV, ..., M. BARTH, E.A. DE WOLF, F. VERBEURE, ...
  Z. Physik C, Particles and Fields 12, 99 (1982)
- "A Study of Multiparticle Fragmentation in K^+p Interactions at 32 GeV/c"
  E.A. DE WOLF, J.J. DUMONT, F. VERBEURE, ...
  Z. Physik C, Particles and Fields 12 (1982) 105
- "Multiparticle Fragmentation in K^+p Interactions at 32 GeV/c"
  E.A. DE WOLF,
  Proceedings of the XII International Symposium on Multiparticle Dynamics, Notre Dame, 189 (1982)
- "Inclusive $K^{*+}(1430)$, $K^{*\circ}(1430)$ and f(1270) Production in K^+p Interactions at 32 GeV/c"
  P.V. CHLIAPNIKOV, ..., E.A. DE WOLF, J.J. DUMONT, M. VAN IMMERSEEL, ...
  Z. Physik C, Particles and Fields 12, 113 (1982)

- "General Properties and Cluster Production of the Reaction $K^+p \to K^+p\ 2\pi^+\ 2\pi^-$ at 32 GeV/c"
  I.V. AJINENKO, ..., M. VAN IMMERSEEL, M. GYSEN, J.J. DUMONT, ...
  Sov. J. Nuclear Physics 34, 584 (1982)

- "Production of Particles and Resonances in the Six-Particle Reaction $K^+p \to K^+p\ K^+\ K^-\ \pi^+\ \pi^-$ at 32 GeV/c"
  I.V. AJINENKO, ..., M. VAN IMMERSEEL, M. GYSEN, J.J. DUMONT, ...
  Soviet J. of Nuclear Physics 35, 546 (1982)

- "Inclusive ϕ Production in K^+p Interactions at 70 GeV/c"
  M. BARTH, C. DE CLERCQ, E.A. DE WOLF, J.J. DUMONT, D.P. JOHNSON, J. LEMONNE, P. THEOCHAROPOULOS, ...
  Physics Letters 117B, 267 (1982)

- "Inclusive $\bar{\Lambda}$ Polarization in K^+p Interactions at 32 and 70 GeV/c"
  I.V. AJINENKO, ..., M. BARTH, E.A. DE WOLF, D.P. JOHNSON, P. THEOCHAROPOULOS, ...
  Contributions to the XIII Int. Symposium on Multiparticle Dynamics, Volendam, The Netherlands and to the XXI International Conference on High Energy Physics, Paris (3-777, # 384 (1982))

- "Energy and Quantum Number Flow in K^+p and π^+p Interactions at 32 and 70 GeV/c Data"
  I.V.AJINENKO, ..., M. BARTH, E.A. DE WOLF, D.P. JOHNSON, P. THEOCHAROPOULOS, ...
  Contribution to the XIII International Symposium on Multiparticle Dynamics, Volendam, The Netherlands and to the XXI International Conference on High Energy Physics, Paris (3-777, # 383 (1982))

- "Study of Inclusive Production of $\pi^\pm$ and Protons in $\bar{p}p$ Interactions at 32 GeV/c"
  E.V. VLASOW, ... M. BARTH, J.J. DUMONT, M. VAN IMMERSEEL, ...
  Z. Physik C, Particles and Fields 13, 94 (1982)

- "Charge-Particle Multiplicities in $\bar{p}p$ Interactions at 32 GeV/c"
  B. HANUMAIAH, ..., M. BARTH, M. GYSEN, M. VAN IMMERSEEL, ...
  Nuovo Cimento 68A, 161 (1982)

- "Charged Particle and π° Multiplicity Distributions and the Annihilation Properties of $\bar{p}p$ Interactions at 70 GeV/c"
  J.J. DUMONT, J. LEMONNE, G. VANHOMWEGEN, F. VERBEURE, J. WICKENS,...
  Z. Physik C, Particles and Fields 13, 1 (1982)

- "Comparison of $p\bar{p}$ and pp Interactions at $\sqrt{s}$ = 53 GeV"
  K. ALPGARD, ..., D. BERTRAND, J. GAUDAEN, M. GYSEN, D. JOHNSON, H. MULKENS, S. TAVERNIER, G. WILQUET, ...
  Physics Letters 112B, 183 (1982)

- "Strange Particle Production at the CERN SPS Collider"
  K. ALPGARD, ..., D. BERTRAND, J. GAUDAEN, M. GYSEN, D. JOHNSON, H. MULKENS, G. WILQUET, ...
  Physics Letters 115B, 65 (1982)

- "Production of Photons and Search for Centauro Events at the SPS Collider"
  K. ALPGARD, ..., D. BERTRAND, J. GAUDAEN, M. GYSEN, H. MULKENS, D. JOHNSON, G. WILQUET, ...
  Physics Letters 115B, 71 (1982)

- "Further Results from the UA5 Collaboration at the SPS Collider"
  D. BERTRAND,
  Contribution to the Vth International Conference on Novel Results in Particle Physics, Vanderbilt Univ. (1982)

- "Results from the UA5 experiment"
  D. BERTRAND, J. GAUDAEN, M. GYSEN, H. MULKENS, D. JOHNSON, G. WILQUET, ...
  Contribution to the Symposium "Physics in Collision II, Stockholm (1982)

- "Results from the UA5 experiment
  D. BERTRAND, J. GAUDAEN, M. GYSEN, H. MULKENS, D. JOHNSON, G. WILQUET, ...
  Contribution to the XXI International Conference on High Energy Physics, Paris (1982), C3-593 and contributions # 463 to # 467 (C3-779)

- "Particle Multiplicities in $\bar{p}p$ Collisions at the Collider"
  D. BERTRAND, J. GAUDAEN, M. GYSEN, H. MULKENS, D. JOHNSON, G. WILQUET, ...
  Contribution to the XXI International Conference on High Energy Physics, Paris, C3-160 (1982)

- "Determination of the Neutral to Charged Current Cross Section Ratio for Neutrino Interaction on Protons"
  N. ARMENISE, ..., D. BERTRAND, J. MOREELS, J. SACTON, C. VANDER VELDE-WILQUET, W. VAN DONINCK, ...
  Proceedings of the XXI International Conference on High Energy Physics, Paris, C3-783, # 586 (1982) and Contribution to the ν 82 Conference, Balatonfüred, Hungaria (1982)

- "Results on the Identification of Protons produced in νp Interactions in BEBC equipped with a TST"
  N. ARMENISE, ..., D. BERTRAND, J. MOREELS, J. SACTON, C. VANDER VELDE-WILQUET, W. VAN DONINCK, ...
  Proceedings of the XXI International Conference on High Energy Physics, Paris, C3-783, # 612 (1982) and Contribution to the ν 82 Conference, Balatonfüred, Hungaria (1982)

- "Azimuthal Asymmetry of Hadrons produced in Antineutrino Reactions"
  BEBC Wide Band Neon Collaboration - D. BERTRAND, G. BERTRAND-COREMANS, P. MARAGE, J. SACTON, ...
  Paper contributed to the XXIst International Conference on High Energy Physics, Paris, C3-786, # 737 (1982)

- "Lifetime Measurements of Charm Particles Produced in 360 GeV/c π^-p and pp interactions with LEBC-EHS"
  LEBC-EHS Collaboration - G. BERTRAND-COREMANS, J. LEMONNE, M. VAN IMMERSEEL, P. VILAIN, B. VONCK, J. WICKENS
  Proceedings of the XXIst International Conference on High Energy Physics, Paris, p.105 and C3-782, # 569 (1982)

- "Charmed Particle Production in 360 GeV π^-p and 360 GeV pp Interactions"
  LEBC-EHS Collaboration - G. BERTRAND-COREMANS, J. LEMONNE, S. TAVERNIER, M. VAN IMMERSEEL, P. VILAIN, B. VONCK, J. WICKENS
  Proceedings of the XXIst International Conference on High Energy Physics, Paris, C3-787, # 788 (1982)

- "An On-Line System for the Analysis of Track Chamber Film"
  D. BERTRAND, J.P. DE WULF, L. ETIENNE, H. MULKENS, G. VAN BEEK, R. VANDENBROUCKE, P. VAN BINST
  Nuclear Instr. and Methods 192, 305 (1982)

- "Dependence of Transverse and Longitudinal Resolution on Some Parameters defining the set-up in Holography"
  G. VANHOMWEGEN
  Contribution to the European Hybrid Spectrometer Workshop on Holography and High Resolution Techniques, Strasbourg, CERN 82-01, 26 (1982)

- "Tests of an 18 module Silica Aerogel Cherenkov Detector to be used in the European Hybrid Spectrometer"
  P.J. CARLSON, ..., S. TAVERNIER, ...
  Nucl. Instr. and Meth. 192, 209 (1982)
- "Evaluation of Systematic errors in the avalanche localisation along the wire with cathode strips readout MWPC"
  R. ROOSEN, ...
  Nuclear Instr. and Meth. 196, 451 (1982)
- "Development of a file transfer capability between a PDP-11 under RSX-11M and a H-P1000 under RTE
  M. GOOSSENS, J. TIBERGHIEN, P. VAN BINST, R. VANDENBROUCKE
  DECUS Europe Symposium 1982, Warwick, England, Proceedings 79