

INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES

ULB-VUB, BRUSSELS - ANNUAL REPORT 1986

J. LEMONNE AND J. SACTON  
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I. INTRODUCTION

The physicists and computer scientists whose names are listed below have contributed to the different activities of the laboratory during the year 1986.

U.L.B.

M. Barth (maître de recherche FNRS)  
D. Bertrand (chercheur qualifié FNRS)  
G. Bertrand-Coremans (chef de travaux associé)  
A. Cohen (Assistante)  
M. De Jode (boursier IRSIA)  
P. Marage (chercheur ARC)  
T. Massart (Assistant de recherche - since may 1986)  
J. Sacton (professeur associé)  
F. Stichelbaut (boursier IRSIA since october 1986)  
P. Van Binst (chargé de cours associé)  
C. Vander Velde (chef de travaux associé)  
P. Vilain (chercheur qualifié FNRS)  
J. Wickens (chercheur IISN)  
G. Wilquet (chercheur qualifié FNRS)  
S. Willocq (doctorant)  
Z. Xing Ciang (stagiaire-doctorant since November 1986)

V.U.B.

H. Cobbaert (vorser IIKW)  
C. De Clercq-Vincent (logistiek medewerker IIKW)  
K. De Winter (assistent)  
D. Geiregat (vorser IIKW)  
D. Johnson (vorser IIKW)  
J. Lemonne (gewoon hoogleraar)  
N. Meulemans (vorser VUB - since september 1986)  
J. Moreels (vorser IIKW)  
R. Roosen (bevoegdverklaard Navorser NFWO)  
S. Tavernier (onderzoeksleider NFWO)  
R. Vandenbroucke-Tassin (informaticus IIKW)  
W. Van Doninck (bevoegdverklaard Navorser NFWO)  
L. Van hamme (aspirant NFWO)  
B. Vonck (vorser IIKW)

F. Verbeure, M. Breusers (until June 30, 1986), A. De Roeck, E. De Wolf, A. Michalowska and L. Verluyten from the UIA are working in close collaboration with the Institute.

## II. RESEARCH ACTIVITIES

### II.1. Neutrino Physics

#### II.1.1. CERN WA59 experiment

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

For this experiment, the bubble chamber BEBC, filled with a heavy neon hydrogen mixture, was exposed to the CERN to the wide band  $\nu$  and  $\bar{\nu}$  beams. Data were taken in 1980. About 16.500  $\nu_\mu$  and 10.000  $\bar{\nu}_\mu$  charged current interactions were measured. Final results have been published in 1986 by the collaboration on :

- i) Measurement of total cross sections for  $\nu$  and  $\bar{\nu}$  charged current interactions, obtained by comparison of this experiment with an experiment using BEBC filled with hydrogen and exposed to the same beams (WA21).
- ii) Single pion production by coherent interactions of antineutrinos on neon nuclei; the results offered a detailed test of PCAC hypothesis, and the meson dominance model at high energy.
- iii) Higher twist effects in fast  $\pi^-$  production by antineutrinos.

One of the major goals of the experiment was the measurement of the nuclear structure functions, down to low  $W^2$ , in order to test QCD predictions, and in particular to study the kinematical and dynamical higher twist effects. This long and careful analysis has now come to the end, and is ready for publication. In contrast to previous analyses in this kinematical region, it is found that a low  $\Lambda_{MS}$  value in the neighbourhood of 100 MeV describes the data adequately, and that the contribution of dynamical higher twist effects is small and negative.

The study of the hadronic component in  $\nu$  and  $\bar{\nu}$  interactions, mostly an original contribution of this experiment, has been pursued. The coherent production of  $\rho$  mesons on the neon nuclei by  $\nu$  interactions has been studied : the total cross section and the differential distributions are in agreement with the CVC (Conserved Vector Current) hypothesis and the vector meson dominance model. For the first time, shadowing, - which is another manifestation of the hadronic component -, has been observed in  $\nu$  and  $\bar{\nu}$  interactions, by comparison of this experiment with an experiment using BEBC filled with deuterium and exposed to the same beams (WA25). Work is still in progress on two other manifestations of the hadronic component : the coherent production of the axial vector  $A_1$  mesons, and the comparison of the total  $\nu$ -N and  $\pi$ -N cross sections, which tests the PCAC (Partial Conservation Axial-vector Current) hypothesis.

Several analyses are still actively pursued by the collaboration, a.o. on the "EMC effect" (by comparison with

the results of the WA25 experiment), the gluon fragmentation effects as predicted by QCD, and asymmetries in the direction of leading pions ("cos  $\phi$ " effects).

### II.1.2. FNAL E-632 experiment

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(M. Barth, E. De Wolf, P. Marage, J. Moreels, J. Sacton, L. Verluyten and S. Willocq; Birmingham, Brussels, Cern, I.C. London, Munich, Oxford, Rutherford, Saclay, Berkeley, Fermilab, Hawaii, Illinois I.T., Rutgers, Tufts).

For this experiment the 15' bubble chamber filled with a heavy neon hydrogen mixture was exposed to the Tevatron Quaudrupole Triplet Beam. The chamber was equipped with 3 conventional cameras, a high resolution ( $\sim 200 \mu\text{m}$ ) camera and a holographic camera. A total of 150 000 pictures were taken in 1985, corresponding to  $\sim 12$  000 charge current  $\nu$  interactions. The quality of the holograms for this first run is not satisfactory. A new run, which should provide twice as many data, is foreseen for 5 months, starting in March 1987.

All the film has been scanned, and the interaction vertices measured. The 2- and 4-prong events have been completely measured, in view of the study of coherent interactions. All the tracks of particles leaving the chamber without interacting have been measured in a subsample of the events ( $\sim 15\%$ ) selected on basis of the vertex position and of the external muon identifier (EMI) information, in view of the study of dimuon events. A carefull scanning has been initiated of the region around the interaction vertex - on the conventional and on the high resolution views - to search for decays of charmed particles; at Brussels, this scanning has been completed, and 10 charm candidates were found, among which 2  $\mu\text{e}$  events. Finally, an unbiased sample of at least 100 events is being measured in each laboratory.

At Brussels, a considerable effort was also made to provide to the collaboration the chain of programs needed for the treatment of the data, to contribute to the data collection for the european laboratories, to coordinate the effort for the 2- and 4- prong measurements, and to study to coherent interaction.

A communication was presented at the XII Neutrino Conference, Sendai, June 1986, reporting the observation, on half of the statistics, of a coherent signal among 2-prong interaction.

### II.1.3. Study of neutrino and antineutrino scattering on electrons

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(K. De Winter, D. Geiregat, P. Vilain and G. Wilquet; CHARM-II or WA79 Collaboration : Brussels, CERN, Hamburg, Louvain-la-Neuve, Moscow ITEP, Munich, Naples, Rome)

During the first half of 86, the efforts of the collaboration were devoted to the detector installation and testing. Besides various stays at CERN to contribute to this installation, the Brussels group was in charge of mounting and soldering a series of electronic cards (under the supervision of J.P. Dewulf) and was involved in the development of the on-line monitoring of the detector.

The neutrino beam became available in June and, after a few weeks of debugging, the experiment has run successfully up to november. About 600 magnetic tapes, representing of the order of 20 millions events, were recorded. The analysis chain which will handle this enormous amount of data is now being prepared : the event selection criteria are checked with Monte Carlo data, the calibration coefficients of the various detector elements are defined and the proposed algorithms are optimized for efficiency and computer time.

During the last 10 days of the running period, calibration data were taken with a mixed electron-pion beam of energy adjustable between 3 and 40 GeV. Electrons are discriminated from pions using a Cerenkov counter. These data will allow to study the performances of the detector in terms of angular resolution, energy resolution and efficiency of separating electromagnetic from hadronic showers.

It is foreseen to start the DST production around february 1987. A big effort is now being made to install all the necessary programs on a Microvax computer.

## II.2. Hadron physics

### II.2.1. Hadronic interactions in EHS with $K^+$ and $\pi^+$ meson beams of 250 GeV/C

(A. De Roeck, E. De Wolf, A.B. Michalowska and F. Verbeure; NA22 Collaboration : Aachen, Antwerp-Brussels, Berlin, Helsinki, Krakow, Moscow State University, Nijmegen, Rio de Janeiro, Serpukhov, Warsaw, Yerevan).

The experimental set-up consisted of the European Hybrid Spectrometer with a hydrogen filled rapid cycling bubble chamber RCBC, as vertex and slow particle detector. The chamber was equipped with an Al and an Au foil wherein about 5% of the interactions occur. A total of 700 000 pictures with 220 000 interactions are to be analysed. At the IIHE, the film scanning is finished, as well as all measurements of  $K^+$  interactions on  $H_2$  and on the foils. A limited amount of  $\pi^+$  interactions is still to be measured. Data Summary Tapes are available with the present statistics of 45 000  $K^+p$ , 45 000  $\pi^+p$ , 3000  $K^+A$  and 2500  $\pi^+A$  events.

Results on topological cross sections and on the rapidity dependence of multiplicities have been published. It was shown that the negative binomial distribution describes the data in different rapidity interval with differences between  $\pi^+p$  and  $pp$ . It was also shown that in  $\pi^+p$  interactions, the beam valence quarks do not recombine after the interaction to form  $p$  mesons.

Submitted papers pertain to elastic scattering cross sections and an interesting observation of very large particle density in rapidity space. Indeed  $\pi^+p$  interaction with a local particle density of 100 (10 particles in a rapidity interval of 0.098) was observed, whereas the expected number of such events is a few times  $10^{-3}$ . Analyses are under way on the following topics : inclusive particle production, the transverse momentum structure of the interactions, diffraction dissociation, strange meson production, stopping power in nuclei, and the possible presence of high momentum protons in interactions on nuclei.

## II.2.2. Study of $\bar{p}p$ interactions at the CERN S $\bar{p}p$ S collider

(D.P. Johnson, L. Van hamme, G. Wilquet; UA5 Collaboration : Bonn, Brussels, Cambridge, CERN, Stockholm).

A large fraction of the data collected in the spring of 1985 on  $pp$  interactions at the world record energy of  $\sqrt{s} = 900$  GeV and also at 200 GeV has been analysed, and a comparison has been made with the results previously obtained at 53 and 543 GeV, thus providing a wide domain for energy dependence studies.

The following results have been obtained

- i) The non-single diffractive single, diffractive, double-diffractive and total cross-section ratios at 200 and 900 GeV have been measured. Absolute cross-sections have been inferred; they exhibit a smooth evolution with energy. No sign of saturation for the total cross-section is seen. The mechanisms responsible for the decay of the heavy diffractive states produced at those energies are seen to obey a limited transverse momentum fragmentation.

- ii) A study of the inelastic pseudo-rapidity distributions at the energies mentioned above has demonstrated that, in the central region, the normalised plateau density  $\rho_n(0)/p(0)|_{\eta=0}$  for multiplicity  $n$  scales when expressed as a function of  $z = n/\langle n \rangle$ . In the fragmentation region, the breaking of the scale invariance can be accounted for when taking into account the variation with energy, of the mean transverse momentum and the reaction inelasticity.

- iii) KNO violation of the multiplicity distributions is confirmed at all collider energies; these can be fitted by negative binomial distributions, the parameters of which exhibit a smooth evolution with energy.

iv) A negative search for the Centauro phenomenon has been made; an upper limit for the production of a few per thousand inelastic events is obtained.

v) Strange particle production (K,  $\Lambda$ ,  $\Xi$ ) is under study.

### II.2.3. Charmed particle production by 360 GeV/c $\pi^-$ mesons and 400 GeV/c p in a rapid cycling hydrogen bubble chamber

(G. Bertrand-Coremans ( $\pi^-$  part only), K. De Winter, J. Lemonne, P. Vilain, B. Vonck and J. Wickens; NA27 Collaboration : Aachen, Bombay, Brussels, CERN, Duke, Genova, Japan, Liverpool, Madrid, Mons, Oxford, Padova, Paris, Collège de France, Rome, Rutgers, Rutherford, Serpukhov, Stockholm, Strasbourg, Tennessee, Torino, Trieste, Vienna, Zeuthen).

The small high resolution bubble chamber LEBC was exposed in front of the European Hybrid Spectrometer in 1982 to a 360 GeV/c  $\pi^-$  meson beam and in 1984 to a 400 GeV/c p beam. These runs have provided 850000 and 2300000 pictures respectively which were double scanned for decay topologies.

The selection of charmed particle decays was then performed on the basis of an accurate measurement of the events on the HPD machine of Strasbourg followed by the track reconstruction in the downstream spectrometer. The data sample consists of 183 charm decays from the  $\pi^-$  run and 592 from the p run, corresponding to a sensitivity of 15.8 and 31.2 events per  $\mu\text{b}$  respectively.

The  $\pi^-p$  data have allowed to determine with good accuracy the lifetime of the D mesons :

$$\tau(D^0) = (4.1^{+0.7}_{-0.6}) 10^{-13} \text{ s}$$

$$\tau(D^\pm) = (10.7^{+2.8}_{-1.8}) 10^{-13} \text{ s}$$

The inclusive cross sections for D-meson production have been determined to be :

$$\sigma(\pi^-p \rightarrow D^0/D^+ + X \text{ at } 360 \text{ GeV/c; } X_F > 0) = 10.1 \pm 2.2 \mu\text{b}$$

$$\sigma(\pi^-p \rightarrow D^\pm + X \text{ at } 360 \text{ GeV/c; } X_F > 0) = 5.7 \pm 1.5 \mu\text{b}$$

$$\sigma(pp \rightarrow D^0/D^+ + X \text{ at } 400 \text{ GeV/c; } X_F > 0) = 8.6 \pm 0.9 \mu\text{b}$$

$$\sigma(pp \rightarrow D^\pm + X \text{ at } 400 \text{ GeV/c; } X_F > 0) = 5.9 \pm 0.6 \mu\text{b}$$

A detailed analysis of  $x_F$  and  $p_T$  distributions has also been performed showing the so called leading particle effect in the  $\pi^-p$  interactions i.e. the D mesons containing a valence quark also contained in the  $\pi^-$  meson, have a harder  $x_F$  spectrum than the others. Also the correlations between members of DD pairs produced in  $\pi^-p$  interactions as well as charged and neutral  $D^*$  production have been studied. These data compare well with predictions from various phenomenological models of charm quark production, but are

still not accurate enough to select among them. Topological and inclusive branching ratios of D mesons extracted from the  $\pi^+ p$  data have been published. A few examples of  $\Lambda_c$  baryon decays have been observed, 3 in the  $\pi^+ p$  interactions and 7 in the pp interactions.

The lifetime estimated from these events is  $(1.3^{+0.6}_{-0.4}) \cdot 10^{-13}$  s.

The analysis remaining to be done, concerning  $D^*$  production and  $D\bar{D}$  correlations as well as lifetimes and branching ratios for the pp data, is expected to be finished by the summer of 87.

#### II.2.4. Charm production in pp interactions at 800 GeV

(J. Lemonne, B. Vonck and J. Wickens; E743 Collaboration : Aachen, Berlin, Brussels, CERN, Duke, Fermilab, Kansas, Michigan (Ann Arbor), MSU, Mons, Notre Dame, Bombay, Vanderbilt, Vienna).

The main aim of this experiment is to measure differential and total cross-sections for the production of charmed particles in pp interactions at an incident momentum of 800 GeV/c. For this purpose the bubble chamber LEBE and elements of the EHS spectrometer previously used at CERN in the EHS set-up have been transported to Fermilab to adapt the existing MPS-spectrometer to the special needs of charmed particle searches. Moreover, the identification of  $K^+$  mesons within a large momentum domain, essential for the identification of the charmed particle decays, has been made possible by the construction and installation in the MPS of two especially designed Cerenkov counters.

The run took place from May to August 1986. A total of 1.2 million pictures were taken containing  $\sim 0.5$  million pp interactions selected by an interaction trigger.

Moreover, a complementary sample of  $\sim 80000$  pictures containing 16000 pp interactions were taken with a simple beam trigger. The charged particle multiplicity in this sample was studied and the results have already been published. The global multiplicity distribution is in reasonable agreement with KNO-scaling. The distribution for  $n_{ch} \gg 8$  is however also compatible with a negative binomial whose predictions fall below the data points at lower multiplicity. This difference can be interpreted in terms of single diffractive events.

Charm particle production has been studied in the data sample with interaction trigger and preliminary results based on  $\sim 275000$  pictures have been obtained on the total inclusive cross-section for  $D/\bar{D}$  production was found to be :

$$\sigma_{D/\bar{D}}(\sqrt{s} = 38.8 \text{ GeV}) = (59^{+22}_{-15}) \mu\text{b}$$

This result can be interpreted in terms of charm creation models without requiring a contribution of charm excitation processes. This experiment should be completed in the course of 1987.

### II.2.5. Direct observation, in emulsion, of the decay of beauty particles selected by their muonic decay

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

About 60% of the total amount of data ( $3 \times 10^8$  interactions in 80 litres of emulsion) have been analysed so far and one example (published last year) of an associated production of a pair of beauty particles  $B^+$  and  $B^0$  has been observed in the emulsion.

Within the sample of about 200 interactions, induced by 350 GeV/c  $\pi^-$ , with candidates for charmed particles, 2 interactions have been found containing each four charmed particles.

A search for the production and subsequent decay of R-hadrons has been performed in a subsample of interactions, where the events were selected on the basis of a "missing energy" trigger. The negative result obtained sets an upper limit to the production cross-section of light gluinos.

### II.2.6. Study of the production of beauty particles using a muon spectrometer and a hadron calorimeter

(H. Cobbaert and R. Roosen; CERN WA78 Collaboration : Bari, Brussels, CERN, U.C.-London, Rome and Turin)

The WA78 collaboration has measured the  $B\bar{B}$  hadronic production cross section in  $\pi^-$ -induced interactions at 360 GeV/c. The main set-up components are a muon spectrometer and a Uranium/scintillator sandwich calorimeter, equipped with a hardware processor. The trigger requested two muons in the final state and a missing energy of 30 GeV. Off-line analysis of the 3-muon final state sample, imposing the cuts  $E_{\text{miss}} > 50$  GeV and  $\Sigma p_t > 3.2$  GeV/c, showed an excess of 13 events with a background of 2. This translates into a cross section of

$$\sigma(\pi N) = (4.5 \pm 1.5 \pm 1.5) \text{ nb}$$

assuming a linear A-dependence.

Similar results have now been obtained using the same sign dimuon sample.

The experimental set-up also allowed a measurement of the A-dependence of the charm production cross section in proton and pion induced interactions. The analysis of the pion data is nearly finished and leads to the following values for  $\alpha$

$$\alpha(\mu^+) = 0.76 \pm 0.08$$

$$\alpha(\mu^-) = 0.83 \pm 0.06$$



$\alpha$  being defined as  $\sigma(\pi A) = \sigma_0 A^\alpha$ .  
The analysis of the proton data is in progress.

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

(D. Bertrand, M. Breusers, C. De Clercq, M. De Jode, J. Lemonne, J. Sacton, F. Stichelbaut, 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-Roma, 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 is responsible for the muon part of the DELPHI detector.

The DELPHI muon chamber system is designed to identify muons by recording two spatial points on the tracks of those charged particles which penetrate the iron of 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 0,2m, a second layer being fixed on the outer surface of the calorimeter.

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 drift fields are 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 solenoidal type delay lines which also function as central field shaping electrodes. The high pulses recorded in the limited streamer mode have allowed the design of very slow (inverse velocity  $\sim 620$  ns/m) and accurate (spatial resolution  $\sim 3$  mm) lines for the endcap chambers. In the barrel of DELPHI, the chambers are arranged in two staggered double layers, with 4 points measured for each track. The delay-lines provide z-measurements with  $\sim 1$  cm accuracy in this case.

The endcap chambers will be assembled into 4 x 4 quadrants, each quadrant being square (4.6m x 4.6m) and containing 22 + 22 drift tubes crossed at right angles so that time measurements in both directions provide 1 mm accuracy. In this case, the delay-line will often only be used to resolve left-right ambiguities.

The design of these endcap detectors is essentially the result of a study made by the Belgian groups involved and the use of the limited streamer mode when drifting electrons over distances up to 10 cm is a technical novelty.

During the past year, the investigation for gas mixtures adequate for streamer operation have progressed well. It was found that efficient chamber operation could be obtained with a rather low isobutane content. The tripple mixture of argon, carbon dioxide and isobutane in the proportions 15,70,15 yields a working plateau of about 150V. A major improvement was then obtained by adding a few % of methylal or alcohol vapour to this mixture, the major benefits being :

- An increase of the working plateau to about 700V.
- An important reduction of the afterpulses.
- Prevention of precocious ageing through a vast reduction of the polymerisation rate of isobutane radicals.

In october 1986 a 1 m long drift chamber was tested for the first time in a magnetic field. This test was performed in a particle beam at CERN. It was found that an efficiency loss at maximum drift distance only occurs for fields parallel to the anode wire at field strengths exceeding 2 kGauss. The expected strength of this component of the return field in the DELPHI magnet is below 0,5 kGauss. A test of the chamber with a magnetic field perpendicular to the anode yielded the expected displacements along the delay line. These systematic shifts can be corrected and will in any case not exceed 7 mm.

The construction of two full size quadrants revealed some problems related to their large size, to the production methods and to the gas mixtures used.

- Wire supports (spacers) had to be installed to allow operation under deformed conditions.
- A more stringent quality control of the construction items improved the high voltage behaviour.
- The use of less hydrocarbon quencher and especially the adjunction of some alcohol vapour prevented precocious ageing.

Since these improvements the first detector quadrant was completed, tested, and found to work satisfactory. Two further quadrants are already in construction and a production schedule of one quadrant per month should be maintained during 1987. The completion of the construction phase is thus foreseen towards the middle of 1988 which fits within the installation scheme of the DELPHI detector at CERN.

In parallel to the construction, studies are still pursued on :

- Gas purity requirements and pressure monitoring
- Detector response for particles incident at large angles.
- Data acquisition and detector control
- A muon trigger utilising both the barrel and endcap muon chambers as well as the scintillator counters and the hadron calorimeter
- Event simulation and muon tracking algorithms
- Graphical event display and software procedures designed to unravel complicated track patterns expected from the DELPHI detector
- General purpose software for DELPHI

### III. TEACHING ACTIVITIES AND SEMINARS

- The practical work for students attending the lectures on particle physics 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 and Informatics.
- J. Lemonne assured the lectures on "Algemene Natuurkunde" (1ste Kandidatuur Natuurkunde, Scheikunde, Wiskunde en Geologie)
- G. Bertrand has deputized J. Sacton for his lectures (30h) on "Introduction to Elementary Particle Physics".
- S. Tavernier has deputized J. Lemonne for his lectures (15h) on "Detektie van ionizerende stralingen"
- P. Van Binst has given the following lectures :
  - "Notions pratiques d'informatique" (15h - Faculté des Sciences)
  - "Introduction à l'informatique" (30h - Licence in Informatique et Sciences Humaines - Nivelles)
  - "Télématique" (30h - Licence en Informatique et Sciences Humaines - Nivelles)
  - "Informatique" (25 + 25h, partim 10L - Faculté des Sciences Physique, Chimie, Biologie, Géographie, Géologie)
- R. Vandenbroucke has deputized J. Lemonne for 30h of "programmatische oefeningen"
- C. Vander Velde has contributed to "Travaux pratiques de Physique Générale" (135h; 1ère candidature Institut Solvay).
- K. De Winter has contributed to the "Practica van de kandidaturen Natuurkunde"
- E. De Wolf gave a course on "Fundamentele wisselwerkingen tussen Elementaire Deeltjes" (30h - UIA)
- P. Vilain provided 2 seminars on Particle Physics to 1st year students in Science of the ULB
- B. Vonck organized a study trip to CERN for students in physics and applied sciences of the VUB

The following "mémoires", "licentiaat verhandelingen" and "travaux de fin d'études" have been made at the IIHE :

- "Essai d'une nouvelle méthode pour lever l'ambiguïté gauche-droite dans des chambres à dérive fonctionnant en mode à dard"  
P. Jadot (Science Appl. - ULB)
- "Production de mesons  $K^0$  dans les interactions antiproton-proton à l'énergie de 900 GeV dans le système du centre de masse"  
F. Stichelbaut (Science Physique - ULB)

- "Studie en installatie van grafische programmatuur in het IIHE"  
C. Ghesquière (Informatica - VUB)
- "Etude de protocoles de haut niveau de messagerie électronique"  
C. Hanon (Informatique - ULB)
- "Première application utilisant le réseau LOCAN du laboratoire d'informatique théorique"  
M. Sacton (Informatique - ULB)
- J. Moreels obtained his Ph.D from the VUB. His work was entitled  
"A contribution to the determination of weak neutral current interaction coupling constants in high energy neutrino and antineutrino interactions"

The following seminars have been presented by members of the IIHE :

D. Bertrand

- The Brussels Graphics System (IIHE)

H. Cobbaert

- The CERN-experiment WA78 (IIHE)

E. De Wolf and J. Lemonne

- Reports on the XXth International Conference on High Energy Physics, Berkeley (IIHE)

J. Lemonne

- First results from the FNAL-800 GeV pp experiment in LEBC-MPS (NIKHEF-Amsterdam)

P. Marage

- Coherent interactions of neutrinos on nuclei (Tufts-USA, Rutgers-USA, KEK-Japan)
- Hadronic component in neutrino interactions (Max Planck, Munich-Germany)

J. Sacton

- ECFA status report (IIHE)
- ECFA and its recent activities (Institute for High Energy Physics, Beijing, China)
- Dileptons from  $\nu$  and  $\bar{\nu}$  interactions (Institute for High Energy Physics, Beijing, China)

S. Tavernier

- Drift chambers with delay line read-out (SIN-Switzerland)
- Van quarks naar nieuwe technologieën (Dag van de vorsers-VUB)

P. Van Binst

- Computer architecture - Computer Networks (Bucharest-Roumania)

W. Van Doninck

- The DELPHI end-cap muon detector (UC-London)

F. Verbeure

- Report on the 1986 snowmass workshop on SSC physics (IIHE)

B. Vonck

- The production of charmed particles in 360 GeV/c  $\pi^-p$  interactions (IIHE)

In addition, the following lectures were given in the framework of the seminars on Elementary Particles organised by G. Wilquet :

B. Carpenter (CERN)

"Bridges and gateways : how to live with thirteen different networks"

V. Soergel (DESY-Hamburg)

"The HERA project"

T. Sjöstrand (Lund)

"Multiple parton-parton interactions in hadronic events"

G. Morfill (Max Planck-Munich)

"Cosmic rays and the structure of the galaxy"

T. Nakada (SIN-Switzerland)

"Particle physics at LEAR at present and in future"

M. Henneau (ULB)

"Introduction to superstrings (4 lectures)"

J. Panman (CERN)

"Experimental studies of  $\nu$  induced neutral current interactions with the CHARM detector"

P. Van Binst presented talks on :

- Le modèle OSI de l'ISO et ses couches supérieures (ASAB-VEBI, Brussels)
- Télécommunications sur les campus universitaires ULB et VUB; Le projet de transmission de données à haute vitesse par satellite (ABUT-BVT, Brussels)
- Introduction à l'informatique : l'outil et ses moyens (GECKEM, Brussels)
- Evolution à long terme des techniques et services télématiques (Générale de Banque, Brussels)

#### IV. COMPUTER MATTERS

##### IV.1. Computing and communication

The DECsystem10 is still the main computer being used in the laboratory for batch, interactive and real-time tasks, while more and more computing is done in a distributed way on other machines, either inside the IIHE or in other laboratories, namely CERN, which are accessed via the public packet switched network.

Two DEC MicroVAX II computers have been acquired during 1986, linked by an Ethernet local area network. Two computers dedicated to word processing and office tasks (a DECmate III and a

DEC Professional 380) were also acquired, under specially favourable financial conditions. The DECsystem10 was equipped with a supplementary mag tape unit, capable of handling high density tapes (6250 bpi).

At the ULB-VUB Computer Centre, use is still made of the CDC CYBER 750 and PRIME 9950 computers. The IIHE is also closely associated with the development of the new ULB and VUB networks, RESULB and VUBNET.

The numerous tasks associated with the provision and operation of a powerful computing and communication infrastructure, namely hardware and software implementation, documentation, logistics, administration, etc, are managed by P. Van Binst and realized in collaboration with R. Vandenbroucke, G. Depiesse, G. Rousseau and W. Van Droogenbroeck.

A new project in high speed data communication, HELIOS-B, was launched in 1986; it is managed by P. Van Binst, in collaboration with R. Vandenbroucke and also groups A. Cohen, T. Massart, N. Meulemans and Zhu Xing Ciang. In the scope of this project, a connection to the TELECOM 1 satellite service provided by the RTT was installed at the IIHE, together with a second connection to the DCS network. A Bull SPS/7 minicomputer has been acquired and the order of a DEC VAX 8200 is envisaged. Terminals were installed in the IIHE offices occupied by the HELIOS-B group in a building on the ULB campus. This project is conducted in collaboration with the DPhPE group and the CISI Télématicque company in Saclay. It has obtained a significant support from the ULB, the VUB and Digital Equipment Belgium, while research contracts with the RTT and a private company are nearly finalized.

#### IV.2. High performance graphics station development

D. Bertrand, M. De Jode, J.P. Dewulf and Ch. Wastiels have contributed to this project within the frame work of an ARC project.

Three dimension interactive software has been written for an high performance MEGATEK station coupled to a VERSATEK spectrum color printing device. An upgrade of the graphics station developed in the laboratory has been performed with the introduction of a Motorola 68020 microprocessor as a CPU and a Hitachi 63484 as a graphics controller.

#### V. TECHNOLOGICAL R AND D

##### V.1. Application of technology from elementary particle physics in medical imaging and the non-destructive testing of materials

S. Tavernier

In particle physics cheap, large area detectors for ionising radiation with good spatial resolution have been

available for many years. Several research workers have pointed out that this technique could also be useful in other fields. A particularly promising application seems to be the use of wire chambers in positron emission tomography (PET).

PET allows the three-dimensional image of the density distribution of a positron emitting radiation isotope to be determined. This technique has several important medical applications, but has also been used to study oil flow in internal combustion engines and to investigate electron fermi surfaces in solid state physics.

Photosensitive multiwire proportional chambers coupled to a fast scintillator such as  $\text{BaF}_2$  offer a particularly promising solution to realise a cheap high resolution PET camera.

A project was started to develop a PET camera based on this principle. The project is developed in collaboration with CERN (G. Charpak), Orsay (J. Jeanjean, H. Nguyen Ngoc), Ecole Polytechnique (P. Miné) and Brunel University (D. Imrie). Funding for this activity comes from a EC "pairing contract" supplemented by a contribution from the NFWO. S. Tavernier is the "scientific coordinator" for the EC contract. The funds for this work are available since november 1986 and the work has only started since.

## VI. TECHNICAL AND ADMINISTRATION WORK

The members of the workshop staff were : M. Beck, J. De Bruyne, E. De Clerck, J.P. Dewulf, J.P. Dolet, L. Etienne, R. Gindroz, R. Goorens, E. Lievens, C. Ophalvens, R. Ruidant, H. Turtelboom, G. Van Beek, J. Vanbegin, R. Vanderhaegen, J. Vandevoorde, L. Van Lancker, J. Van Vaerenbergh, G. Vincent and Ch. Wastiels.

J. Wickens was in charge of the general coordination and L. Etienne and G. Van Beek organised the work of the electronics and mechanics workshops respectively.

During 1986, the main occupation of the IIHE workshops has remained centered around the design and construction of the end cap muon detector for the DELPHI experiment. Installation of the infrastructure for this project having been mainly completed in 1985, this year has seen the final preparation for, and start of, the production of detector units. The workshop personnel have been heavily involved in this work, particularly in the following tasks :

- construction of a second  $4 \times 4 \text{ m}^2$  moveable work table for use in constructing detector units
- series production of detector components in house (winding of delay lines, cutting and cleaning of aluminium and PVC extrusions forming the chamber bodies, preparation of the gas distribution systems etc.)
- cabling of detector front end electronics
- installation of gas distribution manifolds and flow control racks for testing detector units

- implementation of a system for bench testing delay lines with readout via CAVIAR
- construction of units to bench test components of the front end electronics
- construction of a full scale model of a detector unit ( $4.5 \times 4.5 \text{ m}^2$ ) for use in tests during the pre-assembly of the overall detector at CERN, Geneva
- construction of units required to perform prototype tests of individual chambers in house and at CERN
- provision of manpower and supervision for the actual assembly of the final detector units

Heavy demands have been places on the engineers attached to the Delphi project, namely L. Etienne, R. Goorens, G. Van Beek and L. Van Lancker. With the exception of J.P. Dewulf and Ch. Wastiels, involved full time in other projects described below, all other workshop personnel have been involved in this work.

In addition to the Delphi project, a large effort has been required of the workshop personnel in continuing the transformation of rooms previously occupied by bubble chamber scanning equipment in order to house the new activities of the IIHE, concerned with the preparation and analysis of electronic experiments. In particular, rooms have been prepared for the following :

- installation of graphics work stations
- tests of the FASTBUS work stations
- cabling and assembly of electronics components

Other important activities have included :

- maintenance of the equipment of the laboratory
- construction of a graphic display controller (J.P. Dewulf and Ch. Wastiels)
- participation in the WA79 experiment (CHARM II) involving the preparation of trigger cards, an analog test pulser and the testing of analog cards. During this year, J.P. Dewulf has spent some 3 months in CERN in order to prepare the data taking run.
- transfer of the UA5 experiment's cameras to the apparatus for the NA35 experiment (G. Van Beek)
- preparation of equipment for experiments designed for student practical work

During 1986, a group from the IIHE has been investigating a possible participation in the construction of a detector for HERA. Engineering support for this investigation has been provided by J.P. Dewulf and G. Van Beek.

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 consisted of : C. Carlier, A. De Coster-Van Cauwenberge, M. Delasorte, J. De Schutter-Gevers, M. De Schutter, C. Donis, C. Dumont, M.P. Galloy-Kips, Ch. Garnier-Stoffen, M. Goeman, D. Legrand-Mahaux, J. Liesen, M. Pins, R. Pins, D. Pirnay-Pauwels, M.L. Ronsmans, J. Thys-Raynard, M. Van Mechelen-Paulus, L. Vermeersch-Polderman, A. Vermijlen-Pels.

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



## VII. 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 86. In december 1986 his mandate has been extended up to the end of 1987. He also attended

- an ICFA meeting in Berkeley
- the meetings of the CERN Scientific Policy Committee, Finance Committee, Committee of Council and Council
- one meeting of the Extended Scientific Committee at DESY
- four meetings of the Working Group on the Scientific & Technological Long Term Future of CERN, chaired by C. Rubbia
- two meetings of the European Computing Coordinating Committee at CERN
- four meetings of the Board of the HEPP division of the EPS at Geneva

As chairman of ECFA, J. Sacton was invited by the Academia Sinica to visit the Beijing Institute of High Energy Physics, the Shanghai Institute of Nuclear Research and the Shanghai Institute of Ceramics.

J. Sacton was member of the International Advisory Committee of the 1987 International Symposium on Lepton and Photon Interactions at High Energies to be held in Hamburg and member of both the International Advisory Committee and International Organizing Committee of the Europhysics Conference on High Energy Physics to be held in Uppsala in 1987.

J. Sacton also acted as external adviser on a Search Committee to consider candidates for indefinite appointment as research physicists in the EP division at CERN.

J. Sacton has been nominated as "Advisor" of the Recteur of the ULB for all matters dealing with computing, he will deputize the Recteur as chairman of the Conseil de l'Informatique of the ULB.

P. Van Binst was the Secretary of the Board of the Computational Group of the European Physical Society. He was a member of the ECFA Working Group on Data Processing Standards, Subgroup 5, "Links and Networks", of the Board of DECUS-BELUX and of the European DECUS Council. He was chairman of the DECUS "At large" chapter. He was a member of the ABUT/BVT (Association belge des utilisateurs des télécommunication), member of the council of RARE (Belgian representative), of the commission of the European community, DG 13, ESPRIT programme (expert IES project) and DELTA (expert area 8, Tutoring and monitoring facilities).

R. Vandenbroucke acted as "chairperson" of the following DECUS committees :

- BELUX and EUROPE : Network special interest group
  - BELUX : Symposium planning committee
- She was also a member of the RARE-FTAM working group and participated in the Belgian DCS-club.

T. Massart was a member of the RARE information group, W63.

B. Vonck was a member of the redaction committee of "PHYSICALIA MAGAZINE"

The following responsibilities were taken in the organisation of the DELPHI experiments :

- D. Bertrand and J. Wickens : member of SCOOP
- J. Lemonne : representative of "Belgium" in the Board and representative of the IIKW-IISN in the Delphi Finance Committee
- W. Van Doninck : project leader Delphi muon detector

P. Marage acted as a representative of the Scientific Personnel at the Science Faculty of the ULB and as a member of the "Bureau" of this body.

C. Wastiels was the representative of the technical personnel in the Science Faculty of the VUB

#### VIII. ATTENDANCE TO CONFERENCES, SCHOOLS AND WORKSHOPS

- \* Physics in Collision VI (Chicago, USA)  
H. Cobbaert
- \* XXth International Conference on High Energy Physics (Berkeley, USA)  
E. De Wolf, J. Lemonne, J. Sacton
- \* Xth Warsaw Symposium on Elementary Particle Physics (Kazimierz, Poland)  
E. De Wolf
- \* XIIth Conference on Neutrino Physics and Astrophysics (Sendai, Japan)  
P. Marage
- \* XVIIth International Symposium on Multiparticle Dynamics (Seewinkel, Austria)  
C. De Clercq, A. De Roeck, P. Marage
- \* IVth International Wire Chamber Conference (Vienna, Austria)  
S. Tavernier, C. Vander Velde, W. Van Doninck
- \* VIth International Conference on proton-antiproton Physics (Aachen, Germany)  
L. Van hamme
- \* International Conference on a European Hadron Facility (Mainz, Germany)  
J. Sacton
- \* Seminar on International Research Facilities (London, U.K.)  
J. Sacton
- \* "Antiproton 86"--VIIIth European Symposium on nucleon-antinucleon Interactions (Thessaloniki - Greece)  
L. Van hamme

- \* Snowmass Workshop on Physics at the SSC (Snowmass, Colorado, USA)  
F. Verbeure
- \* LEP 200 Workshop (Aachen, Germany)  
M. De Jode, J. Lemonne, J. Sacton
- \* Physics with EHS (Balaton - Hungary)  
A. De Roeck, F. Verbeure
- \* Workshop "Optical Design - Code V" (Munich, Germany)  
L. Van Lancker
- \* Telecom 86 - International Conference on New Systems and Services in Telecommunication (Liège)  
N. Meulemans, P. Van Binst
- \* Colloque UTISAT (Paris, France)  
P. Van Binst
- \* 8th International Conference on Computer Communication (Munich, Germany)  
P. Van Binst, R. Vandenbroucke
- \* Colloque : La Sécurité et l'Informatique (Nivelles)  
P. Van Binst
- \* Fall joint computer conference (Dallas, USA)  
P. Van Binst
- \* 3ème Journées de réflexion sur l'informatique (Namur)  
P. Van Binst
- \* Network steering committee of DECUS Europe (Hamburg, Germany)  
R. Vandenbroucke
- \* DECUS BELUX Symposium (Antwerpen)  
R. Vandenbroucke
- \* DECUS Europe Symposium (Hamburg, Germany)  
R. Vandenbroucke
- \* CERN School of Computing (Renesse, Nederland)  
M. De Jode

## IX. LIST OF PUBLICATIONS AND CONTRIBUTIONS TO CONFERENCES

### IX.1. Publications

X "A measurement of the total charm cross section in 200 and 300 GeV/c pN interactions using a Holographic bubble chamber"  
O. Erriquez, ..., M. Barth, H. Cobbaert, D. Geiregat, R. Roosen, S.P.K. Tavernier et al.  
Phys. Scripta 33, 191 (1986)

"Evidence for higher twist effects in fast  $\pi^-$  production by antineutrinos in neon"

P.J. Fitch, ..., D. Bertrand, P. Marage  
Z.Phys.C, Particles and Fields 31, 51 (1986)

"Measurement of total cross sections for  $\nu_\mu$  and  $\bar{\nu}_\mu$  charged-current interactions in hydrogen and neon"

M. Aderholz, ..., D. Bertrand, P. Marage, J. Sacton  
Phys. Lett. B173, 211 (1986)

"Coherent single pion production by antineutrino charged-current interactions and test of PCAC"

P. Marage, ..., D. Bertrand, J. Sacton  
Z. Physik C, Particles and Fields 31, 191 (1986)

"The use of nuclear emulsion in hybrid detectors for high energy physics"

J. Sacton  
Int. Journal of Radiation : Applications & Instrumentation, PartD, vol.12, 449 (1986)

X "The double associated production of charmed particles by the interaction of 350 GeV/c  $\pi^-$  mesons with emulsion nuclei"

S. Aoki, ..., M. Barth, G. Bertrand-Coremans, R. Roosen,  
CERN-EP 86/97 (1986)

"Contribution à l'architecture de HELIOS"

A. Cohen, T. Massart, P. Van Binst, R. Vandenbroucke  
ULB-VUB/IIHE, 86-02 (1986)

X "Experimental study of Uranium-Scintillator and Iron-Scintillator calorimetry in the energy range 135-350 GeV/c"

M. De Vincenzi, ..., H. Cobbaert, R. Roosen  
Nucl.Instr. and Meth. A243, 348 (1986)

X "Performance of a sampling calorimeter with alternative U and  $F_e$  absorber"

M. De Vincenzi, ..., H. Cobbaert, R. Roosen  
Nucl.Instr. and Meth. A248, 326 (1986)

X "Drift chambers operated in the limited streamer mode"

C. De Clercq, J. Lemonne, S.P.K. Tavernier, C. Vander Velde, W. Van Doninck, J. Wickens  
Nucl.Instr. and Meth. A243, 77 (1986)

X "Drift chambers with delay line read-out operated in the limited streamer mode"

C. De Clercq, J. Lemonne, S.P.K. Tavernier, C. Vander Velde, W. Van Doninck, J. Wickens  
Nucl.Instr. and Meth. A252, 435 (1986)

X "Antiproton-proton cross sections at 200 and 900 GeV c.m. energy"

G.J. Alner, ..., C. De Clercq, L. Van hamme, G. Wilquet  
Z. Physik C, Particles and Fields 32, 153 (1986)

X "Scaling violations in multiplicity distributions at 200 and 900 GeV"

G.J. Alner, ..., C. De Clercq, L. Van hamme, G. Wilquet  
Phys. Lett. 167B, 476 (1986)

"Rapidity dependence of negative and all charged multiplicities in non-diffractive  $\pi^+p$  and  $pp$  collisions at 250 GeV/c"  
N. Adamus, ..., A. De Roeck, E. De Wolf  
Phys. Lett. 177B, 239 (1986)

"Cross sections and charged multiplicity distributions for  $\pi^+p$ ,  $K^+p$  and  $pp$  at 250 GeV/c"  
A. De Roeck  
Z. Physik C, Particles and Fields 32, 475 (1986)

"Upper limits on production cross sections of charmed particles in  $K^+p$  interactions at 32 GeV/c"  
I.V. Ajinenko, ..., E. De Wolf  
Yad. Fysika, 41, 1535 (1986)

"Study of the reaction  $K^+p \rightarrow \Lambda + p + X$  at 32 GeV/c"  
I.V. Ajinenko, ..., E. De Wolf  
Yad. Fysika, 43, 1195 (1986)

"Associated production of  $K^{*+}(890)$  with other particles and of  $\rho^0$  with other particles in inclusive  $K^+p$  reactions at 32 GeV/c"  
V. Kniazev, ..., E. De Wolf, ...  
Yad. Fysika, 43, 95 (1986)

" $K^+$  fragmentation and prompt kaon production in  $K^+p$  interactions at 70 GeV/c"  
E.A. De Wolf et al.  
Z. Physik C, Particles and Fields 31, 13 (1986)

X "Scaling of pseudorapidity distributions at c.m. energy up to 0.9 TeV"  
G.J. Alner, ..., D.P. Johnson, L. Van hamme, G. Wilquet  
Z. Physik C, Particles and Fields 33, 1 (1986)

X "An accelerator search at 900 GeV c.m. energy for the Centauro phenomenon"  
G.J. Alner, ..., D.P. Johnson, L. Van hamme, G. Wilquet  
Phys. Lett. 180B, 415 (1986)

X "Multiplicity of charged particles in 800 GeV  $pp$  interactions"  
R. Ammar, ..., J. Lemonne, B. Vonck, J. Wickens, ...  
Phys. Lett. 178B, 124 (1986)

X "A hardware processor for a missing energy trigger"  
A. Frenkel, ..., R. Roosen  
Nucl.Instr. and Meth. A245, 45 (1986)

X "A system of 4400 silicon microstrips readout with analog multiplexed electronics used in the WA75 experiment"  
R. Alberganti, ..., R. Roosen  
Nucl.Instr. and Meth. A248, 337 (1986)

"RARE. Réseaux Associé pour la Recherche Européenne"  
P. Van Binst  
ULB-VUB/IIHE, 86-08 (1986)

"Wide area networking for high energy physics in Brussels and Antwerp"

P. Van Binst, R. Vandenbroucke

Proceedings of "Computing in High Energy Physics - Amsterdam, 193 (1986) (North Holland)

"Possible solutions for HEP networking in Europe"

P. Van Binst

Proceedings of "Computing in High Energy Physics - Amsterdam, 173 (1986) (North Holland)

X "Charm hadron properties in 360 GeV/c  $\pi^-p$  interactions"

M. Aguilar-Benitez, ..., J. Lemonne, P. Vilain, B. Vonck, J. Wickens

Z. Physik C, Particles and Fields 31, 491 (1986)

X "Neutral and charged  $D^*$  production in 360 GeV/c  $\pi^-p$  interactions"

M. Aguilar-Benitez, ..., J. Lemonne, P. Vilain, B. Vonck, J. Wickens

Phys. Lett. 169B, 106 (1986)

X "Measurement of D meson branching ratios"

M. Aguilar-Benitez, ..., P. Vilain, B. Vonck

Phys. Lett. 168B, 170 (1986)

## IX.2. Contributions to Conferences

a) Presented by members of the IIHE

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H. Cobbaert (WA78 Collaboration)

"A dependence of charm cross sections in  $\pi^-N$  interactions at 320 GeV/c"

\* Physics in Collisions VI, Chicago (Poster session)

\* Annual meeting of the Belgian Physical Society - Brussels

A. De Roeck (NA22 Collaboration)

"Low  $p_T$  models in EHS"

Physics with EHS, Balton - Hungary

E. De Wolf (NA22 Collaboration)

"Multiplicity distributions in rapidity intervals"

Xth Warsaw symposium on elementary particle physics, Kazimierz, Poland

P. Marage (WA59 Collaboration)

-"Study of coherent production of  $\rho^-$ -mesons by charged current antineutrino interactions in BEBC"

\* XIIth International Conference on Neutrino Physics and Astrophysics, Sendai, Japan

\* XVIIth International Symposium on Multiparticle Dynamics, Seewinkel, Austria

-"Observation of coherent charged current neutrino interactions in the 15' bubble chamber"

\* XIIth International Conference on Neutrino Physics and Astrophysics, Sendai, Japan

\* XVIIth International Symposium on Multiparticle Dynamics  
Seewinkel, Austria

- "Hadronic component in neutrino interactions" Rapporteur review  
at :

\* XIIth International Conference on Neutrino Physics and  
Astrophysics, Sendai, Japan

\* XVIIth International Symposium on Mutliparticle Dynamics  
Seewinkel, Austria

P. Van Binst

(and A. Cohen, T. Massart, G. Rousseau, R. Vandenbroucke)

"Performance of open wide area networks"

Europe Networkshop, Copenhagen 1986 and IIHE 86-03

P. Van Binst

(and A. Cohen, T. Massart, R. Vandenbroucke)

"HELIOS-B : A research and development project in high speed data  
communication by satellite"

DECUS-Europe Symposium, Hamburg and IIHE 86-05

R. Vandenbroucke

(and A. Cohen, T. Massart and P. Van Binst)

"A first performance study of two implementation of the "Blue  
Book" protocol"

DECUS-Europe Symposium, Hamburg and IIHE 86-06

L. Van hamme (UA5 collaboration)

- "Recent results from the UA5 experiment - Part I"

VIth International Conference on pp physics, Aachen, Germany

- "Charged multiplicity distributions in pp interactions at  
energies up to 900 GeV"

Annual meeting of the Belgian Physical Society - Brussels

B. Vonck

"Charmed particle production in 360 GeV/c  $\pi^-p$  and 400 GeV/c pp  
interactions"

Annual meeting of the Belgian Physical Society - Brussels

G. Wilquet

"Antiproton-proton cross sections at 200 and 900 GeV CM energy"

Annual meeting of the Belgian Physical Society - Brussels

#### b) Others

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- Drift chambers with delay line readout operated in the limited  
streamer mode

Delphi collaboration

IVth International Wire Chamber Conference, Vienna, Austria

- The study of the reaction  $e^+e^- \rightarrow W^+W^-$

A. Blondel, ..., M. De Jode, J. Lemonne

LEP 200 Workshop, Aachen, Germany

- Test results of the streamer tube system of the CHARM II  
neutrino detector

Charm II collaboration

IVth International Wire Chamber Conference, Vienna, Austria

- Test results and conditioning procedure of a limited streamer tube calorimeter  
Charm II collaboration  
3th Pisa Meeting on Advanced Detectors, Castiglione della Pescaia, Italy
- Study of coherent production of  $p^-$  mesons by charged current antineutrino interactions  
WA59 collaboration  
XXIII International Conference on High Energy Physics, Berkeley, USA
- Observation of Coherent Charged Current Neutrino Interactions in the 15' Bubble Chamber  
E632 collaboration  
XXIII International Conference on High Energy Physics, Berkeley, USA
- Measurement of  $F_2$  and  $xF_3$  down to low  $W^2$  and comparison with QCD predictions including kinematical and dynamical higher twist effects"  
WA59 collaboration  
XXIII International Conference on High Energy Physics, Berkeley, USA
- Silicon positron sensitive detectors for HELIOS  
NA34 collaboration  
4th European Symposium on semi-conductor Detectors, Munich, Germany
- Inclusive charm cross sections in 800 GeV pp interactions  
E743 collaboration  
XXIII International Conference on High Energy Physics, Berkeley, USA
- Multiplicity distribution of charged particles in 800 GeV pp interactions  
E743 collaboration  
XXIII International Conference on High Energy Physics, Berkeley, USA
- Multiplicity distributions in  $\bar{p}p$  collisions at c.m. energies of 200, 546 and 900 GeV"  
UA5 collaboration  
XVII International Symposium on Multiparticle Dynamics, Seewinkel, Austria
- $K^0$  production in  $\bar{p}p$  collision at  $\sqrt{s} = 900$  GeV  
UA5 collaboration  
XVII International Symposium on Multiparticle Dynamics, Seewinkel, Austria
- Recent results from the UA5 experiment (part II)  
UA5 collaboration  
VI International Conference on pp physics, Aachen, Germany



- New results from the UA5 collaboration at 200 and 900 GeV c.m. energies  
UA5 collaboration  
VII European Symposium on Nucleon-Antinucleon Interactions,  
Thessaloniki, Greece