INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES

ULB-VUB, BRUSSELS

ANNUAL REPORT 1995

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J. LEMONNE and J. SACTON,

March 1996.

CONTENTS

I. INTRODUCTION

The physicists, engineers and computer scientists whose names are listed below have contributed to the different activities of the Institute during the year 1995.

U.L.B.

P. Annis (boursier, région Sardaigne)
M. Barth (maître de recherche FNRS)
D. Bertrand (maître de recherche FNRS)
G. Bertrand-Coremans (chef de travaux)
O. Bouhali (doctorant)
C. Bricman (maître de recherche FNRS - until October 95)
B. Clerbaux (boursière IRSIA-FRIA)
M. Elamiri (doctorant - since May 95)
L. Favart (boursier IRSIA-FRIA)
M. Gruwé (Grant FNRS - until October 95)
V. Lefébure (boursier IRSIA-FRIA)
P. Marage (agrégé de faculté; maître d'enseignement)
A. Panitch (boursier ULB)
J. Sacton (professeur ordinaire)
J. Stefanescu (boursier IRSIA-FRIA)
F. Tallouf (doctorant - since July 95)
M. Vander Donckt (boursier IRSIA-FRIA)
C. Vander Velde (chargé de cours associé)
P. Vanlaer (boursier IRSIA-FRIA)
P. Vilain (chercheur qualifié FNRS)
J. Wickens (chercheur IISN)
G. Wallenborn (aspirant FNRS - objecteur de conscience; until March 1995)
G. Wilquet (chercheur qualifié FNRS)

V.U.B.

Cao Fang (VUBAROS fellow)
S. Claes (Wetenschappelijk meedewerker till April 1995, vorser IIKW since May 1995)
C. De Clercq (logistiek medewerker IIKW)
E. Evrard (vorser IIKW - till June 1995)
T. Heiremans (vorser IIKW - till April 1995)
D. Johnson (hoogleraar VESALIUS College)
J. Lemonne (gewoon hoogleraar)
X. Liu (VUBAROS beurs)
C. Mommaert (vorser IIKW)
J. Nelissen (IWT-beurs)
S. Rajeswaran (vorser EEG-contract)
R. Roosen (onderzoeksleider NFWO)
W. Smolik (visiting scientist for one month from Warsaw University of Technology)
S. Tavernier (onderzoeksdirecteur NFWO)
R. Vandenbroucke (logistiek medewerker IIKW)
W. Van Doninck (onderzoeksleider NFWO)
P. Van Esch (vorser IIKW)
A. Van Lysebetten (VUB beurs - since October 1995)
J. Wulleman (OZR-vorser)
Zhang Shuping (Rectorale beurs)

F. Verbeure, T. Beckers, F. Botterweck, R. Chen, S. De Brabandere, E. De Wolf, Z. Garutchava, P. Van Mechelen en A. Tomaradze from the Universitaire Instelling Antwerpen have been working in close collaboration with the Institute.

Research in the field of telecommunications and data is conducted at IIHE/VUB by R. Vandenbroucke, Z. Cekro and N. Meulemans in collaboration with "Service Télématique et Communication" at the ULB by P. Van Binst, Y. Brants, J. Castera, A. Cohen, M. Colin, L. Franck, A. Guillen, Hyoung-Jun Kim, E. Mannie, N. Messori, R. Najmabadi Kia, O. Paridaens, N. Paroni, B. Sales, E. Tsigros and J.-M. Verbergt.

II. RESEARCH ACTIVITIES.

II.1. NEUTRINO PHYSICS.

II.1.1. Bubble chamber experiments.

(M. Barth, P. Marage, J. Sacton).

The production rate per neutrino charged-current event of $D^{*+}(2010)$ mesons is seen to increase from SPS to Tevatron neutrino beam energies; it was measured to be ~ 1 % at 50 GeV and ~ 6 % at 140 GeV. The mean fractional hadronic energy of the D^{*+} mesons was found to be $59 \pm 3 \pm 8$ % and $55 \pm 5 \pm 4$ % respectively.

Charged-current neutrino and antineutrino interactions in hydrogen, deuterium and neon targets from BEBC at CERN and the 15-foot Bubble Chamber at Fermilab were used to study the spin-density matrix of ρ° mesons produced in the current fragmentation region. The spin-alignment parameter η was found to be 0.08 ± 0.11 for neutrino and 0.41 ± 0.11 for antineutrinos. The parity-odd density matrix element Im $(\rho_{10} + \rho_{-10})$ is consistent with zero in both reactions. In the combined neutrino and antineutrino data an indication of parity violation has been observed : $\mathrm{Im}\rho_{1-1} = 0.38 \pm 0.16$ at $x_B > 0.2$, $Q^2 > 8$ GeV^2 and $z > 0.6$.

II.1.2. The CHARM II experiment.

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

Using electron and muon quasi elastic events collected over a period of five years a new upper limit of 5.6×10^{-3} at 90 % CL has been obtained for the parameter $\sin^2 2\theta$ which characterizes the ν_μ-ν_e oscillation phenomenon.

From a signal of 15.758 ± 324 inverse muon decay events ($\nu_\mu + e^- \rightarrow \mu^- + \nu_e$) a value of $(16.51 \pm 0.93) \times 10^{-42}$ cm^2 GeV^{-1} has been derived in the Born approximation for the asymptotic cross section slope σ/E_ν, in fair agreement with the Standard Model prediction of 17.23×10^{-42} cm^2 GeV^{-1}. This result constraints the scalar coupling of the electron and the muon to $|g^S_{LL}|^2 < 0.475$ at 90 % CL.

A search for heavy neutrinos ν_h (in the mass range 0.3 to 2.4 GeV/c^2) decaying into $\mu^+\mu^-\nu_\mu$ and created by scattering muon neutrinos on nucleons has been made in a sample of 2×10^7 neutral-current interactions. No candidate were observed, which translates, for a ν_h mass around 2 GeV/$_{c2}$, into an upper limit on the mixing parameter : $|U_{\mu h}|^2 < 3 \times 10^{-5}$.

The analysis of the differential cross section of neutrino-electron scattering shows no deviation from the Standard Model prediction. From this observation, a limit of 3×10^{-9} μ_B at 90 % CL has been derived on the magnetic moment of the muon neutrino.

II.1.3. The CHORUS experiment.

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

This experiment aims at searching for ν_μ-ν_τ oscillations by detecting examples of the reaction ν_τ + nucleon $\rightarrow \tau^-$ + hadrons in a nuclear emulsion target exposed to the CERN SPS high energy neutrino beam. The localisation of the neutrino interactions in the emulsion is performed via the accurate measurement of the trajectories of the outgoing charged products in a downstream tracking system made of scintillating fibers. The tracker is followed by a magnetic spectrometer, a calorimeter and a muon spectrometer. Since April 1994, the experiment has run for some 400 days and 4.2 x 10^5 interactions have been accumulated in the 800 kg emulsion target. During 1995, the detector efficiency was of about 85 %, including dead time. In winter 94/95, one of the four emulsion targets was taken out for analysis, processed and replaced by fresh modules.

The main efforts have been devoted to :

1) the definition, on the basis of simulated events, of selection criteria aiming at enriching the event sample in ν_τ interactions,

2) the elaboration of pattern recognition and reconstruction algorithms for the various parts of the detector,

3) the definition of a list of events to be searched for in the emulsion modules taken off the target in the winter 94/95,

4) the development of the automatized microscopes needed for the analysis in the emulsion laboratories.

At this stage, the global rate of finding predicted events is of about 40 % because of excessive losses at various levels; however this rate reaches about 70 %, a value approaching the expected one, when the searched track is due to a muon. Further improvements are needed but the adopted strategy is not to be questioned. Presently, some 1000 neutrino interactions have been located in the emulsion of which 10 show the characteristic signature of the production and subsequent decay of a $D^\pm$ meson. The topology of these events is very similar to what is expected in the case of a τ lepton, showing the potentiality of the adopted search strategy.

In October 1995, the four emulsion targets have been dismantled and are presently being processed. New targets will be installed soon for further running during 1996 and 1997; some modifications of the tracking system will be made.

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

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

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

The main results presented at conferences or published during 1995 can be summarised as follows :

A. The Z° resonance parameters and electroweak couplings were determined from the analysis of a sample of approximately 14 x 10^6 Z°-decays accumulated until the end of 1994. Allowing for lepton conservability, a fit to the

hadronic cross sections and to the leptonic cross sections and asymmetries yields the following results :

M_Z	=	91.1849 ± 0.0034 GeV	
Γ_Z	=	2.4913 ± 0.0053 GeV	
σ_o^h	=	41.40 ± 0.10 nb	
$R_l = \Gamma_h/\Gamma_l$	=	20.708 ± 0.073	with l = e, μ or τ
A_{FB}^o (l)	=	0.0182 ± 0.0025	

From τ-polarisation measurements the asymmetry parameters $A_\tau = 0.148 \pm 0.022$ and $A_e = 0.136 \pm 0.027$ were determined ($A_l = 2\, g_{V_l}\, g_{A_l}/(g_{V_l}^2 + g_{A_l}^2)$)

B. A measurement of the τ-polarisation in Z° decays as a function of the production angle yielded an average $\langle P_\tau \rangle = -0.148 \pm 0.022$ and a Z°-polarisation $P_Z = -0.136 \pm 0.027$. The ratios of vector to axial vector coupling constants were found to be : $\bar{v}_\tau/\bar{a}_\tau = 0.074 \pm 0.011$ and $\bar{v}_e/\bar{a}_e = 0.068 \pm 0.014$, compatible with e - τ - universality.

C. A measurement of the τ-leptonic branching fractions in a sample of 25000 $Z^\circ \rightarrow \tau^+\tau^-$ events gave : $B(\tau \rightarrow e\, \nu\, \bar{\nu}) = (17.51 \pm 0.39)$ % and $B(\tau \rightarrow \mu\, \nu\, \bar{\nu}) = (17.02 \pm 0.31)$ % yielding a ratio of the muon to electron couplings to the weak charged-currents $g_\mu/g_e = 1.000 \pm 0.013$.

D. A study of radiative muon-pair events in the channel $e^+e^- \rightarrow \mu^+\mu^- (n\gamma)$ n = 1, 2 ... produced information on final state γ-radiation and allowed to extract the muon-pair cross section and asymmetry below the Z° peak from events with a relatively hard initial state photon. They were found to be in agreement with standard model predictions. No indication was found for the existence of a Z' with $M_{Z'} < 847$ GeV and $M_{Z'} < 988$ GeV for Y- and Y_L models respectively.

E. Multihadronic production in γγ-collisions with one of the scattered leptons tagged at very low virtual photon mass has been studied for the first time. The analysis requires a QCD-based component, indicating that the photon has a significant partonic content.

F. Using hadronic Z°-events, short range three-particle correlations were observed at small values of the four-momentum difference for both like sign (+++) and (---) an unlike-sign (++-) and (--+) pion combinations which are not a consequence of two-particle correlations. A possible explanation of the observed effect in like-sign combinations is the existence of higher-order Bose-Einstein interference effects.

G. Production characteristics of K°'s and light meson resonances were determined in a sample of almost 1 million Z°-events. Overall multiplicities have been determined for K°, $K^{*\pm}(892)$, ρ°(770), f°(975) and $f_2(1270)$. These average multiplicities and corresponding differential cross sections in the fractional momentum $x_p = p/p_{beam}$ have been compared to the default predictions of the JETSET-parton model. Significant discrepancies were found.

H. The differential cross-sections for the production of $K^\pm$ and (p)$\bar{p}$-particles were measured as a function of x_p using the RICH-information. The average $K^\pm$ and (p)$\bar{p}$ multiplicities per hadronic event were determined to be $N_K = 2.26 \pm 0.18$ and $N_p = 1.07 \pm 0.14$.

I. The average multiplicities of K_s^o, $K^\pm$, p($\bar{p}$) and Λ($\bar{\Lambda}$) and of charged particle in $b\bar{b}$ events have also been measured, distinguishing the component coming from fragmentation from that arising from the decay of b-hadrons.

J. A study of the production of strange octet and decuplet baryons in hadronic Z°-decays included the first measurement of the average $\Sigma^\pm$-multiplicity 0.170 ± 0.061 per hadronic event. The total and differential cross sections, the event topology and the baryon-antibaryon correlations have been compared with current hadronization models.

K. The forward-backward asymmetry in $e^+e^- \rightarrow Z^\circ \rightarrow b\bar{b}$ was determined using prompt leptons and a lifetime tag. The combined results at the Z°-pole give :

$$A_{FB}^{b\bar{b}} = 0.107 \pm 0.011 \text{ (stat. + syst)}$$

Within the semi-leptonic sample, the forward-backward asymmetry of the process $e^+e^- \rightarrow Z^\circ \rightarrow c\bar{c}$ was also measured to be :

$$A_{FB}^{c\bar{c}} = 0.083 \pm 0.22 \pm 0.016$$

The effective value of the Weinberg mixing angle derived from these measurements is :

$$\sin^2\theta_{eff}^{lep} = 0.2294 \pm 0.0021$$

L. The forward-backward asymmetries for the processes $e^+e^- \rightarrow c\bar{c}$ and $e^+e^- \rightarrow b\bar{b}$ at the Z°-resonance were also measured using a sample of 4757 identified $D^{\pm *}$ mesons. The results are :

$$A_{FB}^{c\bar{c}} = 0.077 \pm 0.29 \pm 0.012 \text{ and } A_{FB}^{b\bar{b}} = 0.059 \pm 0.062 \pm 0.024.$$

Constraining $A_{FB}^{b\bar{b}}$ to the value measured in the previous analysis, the charm asymmetry was determined to be : $0.068 \pm 0.027 \pm 0.011$ corresponding to $\sin^2\theta_{eff}^{lep} = 0.2307 \pm 0.0062 \pm 0.0026$

M. From a sample of 700000 hadronic Z-decays in which RICH tagged $K^\pm$- and Λ°-decays were selected, the strange quark forward-backward asymmetry at the Z°-peak was found to be :

$$A_{FB}^{s\bar{s}} = 0.131 \pm 0.035 \pm 0.013$$

N. Four different measurements of the partial decay width ratio $R_b = \Gamma_b/\Gamma_h$ have been performed. Combining all numbers, the following results are obtained :

$$R_b = 0.2210 \pm 0.0033 \pm 0.0003(\text{model}) \pm 0.0014(R_c)$$

$$BR(b \rightarrow l) = (11.06 \pm 0.039 \pm 0.19(\text{model}) \pm 0.12(R_c))\ \%$$

$$BR(b \rightarrow c \rightarrow l) = (7.70 \pm 0.97 \pm 0.33(\text{model}) \pm 0.32(R_c))\ \%$$

Note that the combined results of all four LEP-experiments on R_b tend to be in disagreement with the predictions of the standard model.

O. Using information depending mainly on the precision microvertex detector, R_b was measured to be :

$$R_b = 0.2209 \pm 0.0041 \pm 0.0042 \pm 0.0018\ (\Gamma_{c\bar{c}})$$

P. The mean lifetimes, $\tau^+$and τ°, of charged and neutral B hadrons tagged as jets with a secondary vertex were measured to be : $\tau^+ = (1.72 \pm 0.08)$ps and $\tau^\circ = (1.58 \pm 0.11)$ps.

For B-mesons one moreover estimated that :

$$\tau_{B^+} = (1.72 \pm 0.08 \pm 0.06)\text{ps and } \tau_{B^\circ} = (1.63 \pm 0.14 \pm 0.13)\text{ps}.$$

Q. A measurement of $B^\pm$ and B° lifetimes using $\bar{D}l^+$ events gave the results :

$$\tau_{B^+} = (1.61 \pm 0.16 \pm 0.12)\text{ps and } \tau_{B^\circ} = (1.61\ ^{+0.14}_{-0.13} \pm 0.08)\text{ps}.$$

R. Using a basic sample of 1.7 million Z°-decays, the average B-baryon lifetime was determined to be :

$$\tau = 1.21\ ^{+0.21}_{-0.18} \pm 0.04\ (\text{sys.exp})\ ^{+0.02}_{-0.07}\ (\text{sys.theor}).$$

S. A separate study was made of strange B-baryons decaying into $\Xi^{\mp} + l^{\mp}$ pairs. The measured production fraction corresponds to :

$$P(b \rightarrow \text{B-baryon}) \times Br(\text{B-baryon} \rightarrow \Xi^{\mp} l^{\mp} X) = (5.9 \pm 2.1 \pm 1.0) \times 10^{-4}$$

per lepton species. The major part of this signal was attributed to Ξ_b semileptonic decays.

T. A search for charmless B-mesons in a sample of 1.6 million hadronic decays yielded 3 candidates in 2-body modes with an estimated background of 0.29 ± 0.09 events.

U. A sample of B*-decays was identified from a peak in the M(B + γ) - M(B) mass difference with a light flavour averaged value of $(45.5 \pm 0.3 \pm 0.8)$MeV/c^2. The production ratio of B* to B-mesons in Z° decay was measured to be $0.72 \pm 0.03 \pm 0.06$. The average fractional B*-energy is : $\langle x_E \rangle = 0.695 \pm 0.009 \pm 0.013$.

From the decay angular distribution the relative contribution of longitudinally polarised B* was found to be $\sigma_L/(\sigma_L + \sigma_T) = 0.32 \pm 0.04 \pm 0.03$.

V. Strong experimental evidence for the existence of orbitally excited B-mesons B^{**}_{ud} has been obtained from the B*π-Q value distribution using an inclusive B-reconstruction method. The signal can be described as a single resonance of mass m(B**) = $(5732 \pm 5 \pm 20)$ MeV/c^2 and with $\Gamma = (145 \pm 28)$ MeV/c^2 but it can also be interpreted as stemming from several narrow and broad B^{**}_{ud} resonances. The rate of B^{**}_{ud} mesons per b-jet is $0.27 \pm 0.02 \pm 0.06$.

W. Using the precise microvertex detector measurements a search for pair production of neutral heavy Higgs bosons decaying into $b\bar{b}$ has been carried out in a study of hadronic decays of the Z-boson into four jet final states. No evidence for a signal was found, leading to limits on BR ($Z \rightarrow hA \rightarrow 4b$) from 3.5 to 5.5 x 10^{-4} at 95 % C.L.

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

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

Initial state radiation has been isolated in the radiative processes $e^+e^- \rightarrow \mu^+\mu^-\gamma$ with the aim of improving the cross-section and asymmetry measurements in $e^+e^- \rightarrow \mu^+\mu^-$ interactions below the Z°-peak ($20 \leq \sqrt{s} \leq 87$ GeV). The analysis of the data collected until 1994 was optimised and preliminary results were contributed to conferences.

Feed Forward Neural Networks were used in order to identify exclusive decay channels of the τ lepton. A first step consisted in determining the event topology in charged particles. An other network was then used in order to distinguish the corresponding charged leptons or hadrons as well as to establish the presence of neutral pions in the decay products. Migration matrices were computed to evaluate the mutual contaminations of various desintegration modes. The Neural Network method allowed to reach higher efficiencies than the classic analysis using linear selection criteria. Preliminary exclusive branching fractions were determined for five of those channels : $\tau \rightarrow e\ \nu\bar{\nu}$; $\tau \rightarrow \mu\ \nu\bar{\nu}$; $\tau \rightarrow \pi/K\nu$; $\tau \rightarrow \rho\ \nu$; $\tau \rightarrow a_1\ \nu \rightarrow \pi\pi^\circ\pi^\circ\nu$. The result obtained for the last one (9.7 % ± 0.3 %) is particularly promising since it was the first time it could be derived using the DELPHI detector at LEP. The statistical error is lower than the total error of the corresponding world average.

The study of particle correlations has been pursued : the invariant mass-dependence of particle correlations in hadronic final states has been studied and strong short range three-particle correlations have been observed which are at least partly explainable as Bose-Einstein correlations.

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

With the installation of 16 additional RF-superconducting cavities in the autumn of 1995, the LEP energy has been increased in successive steps to $\sqrt{s}$ = 130, 136 and 140 GeV. Preliminary results of the DELPHI experiment showed no anomalies w.r.t. the standard model expectations.

II.3. STUDY OF $e^{\pm}p$ COLLISIONS AT HERA.

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

A. Performances of HERA, H1 and COP.

The HERA accelerator operated from May to November 1995, delivering $\approx$ 10 pb^{-1}. The data recorded by the H1 experiment correspond to $\approx$ 5 pb^{-1}. This low efficiency results from the rather poor beam conditions which did not allow to run all of the H1 detector components in nominal conditions.

During the shutdown 94/95 important upgrades took place. A new driftchamber (BDC), a new backward calorimeter (SPACAL) and part of the forward proton spectrometer (FPS) were installed and brought in full operation. Also two new silicon detectors (CST and BST) were added. The data from the latter detectors are not yet used in the analysis.

The increased luminosity resulted in high event rates which caused problems to the trigger and data acquisition systems. Improvements in this area to cope with the expected future luminosity increases will be essential.

The central outer proportional chamber (COP) built and maintained by the IIHE group has been operated without problems. As the collaboration decided not to do any repairs to the central tracking detectors, COP has still one broken wire resulting in chamber inefficiencies. These inefficiencies, however, do not impair the first level trigger of which the COP detector is an essential part.

B. The proton structure function.

The tenfold increase in statistics during the 1994 running period has permitted to measure the proton structure function F_2 much more accurately (systematic error $\leq$ 10 %) in an enlarged (x, Q^2) range, which for the first time is approaching the fixed target region. These data, which exhibit scaling violations becoming stronger at small x, have been subjected to a QCD analysis to leading and next to leading order. The question to be answered is whether the DGLAP evolution equations at these low values of x are still valid or whether the BFKL equations should be used. At present the data do not allow to distinguish between the two evolution equations. A DGLAP and a mixed DGLAP+BFKL evolution describe the data equally well. The gluon distribution obtained from the QCD fit is found to be steeply rising with decreasing x, in agreement with an earlier and more approximate analysis.

C. Deep inelastic structure of proton diffraction.

The contribution of the "Rapidity Gap" events (deep inelastic scattering events with no forward energy flow) to the proton structure function F_2 has been evaluated. It is found that the diffractive events can be interpreted as the interaction of the electron with a colourless object (Pomeron) in the proton. The dependence of the structure function on the momentum fraction of the pomeron can be factorised i.e. the electron-proton interactions can be seen as an electron-pomeron interaction multiplied by a term giving the flux of pomerons in the proton. The precision of the electron-pomeron structure function does not allow to exclude a BFKL motivated pomeron trajectory.

D. Jets energy flow and fragmentation in DIS.

Measurement of the (2+1) jets rate permits to determine the variation of the strong coupling constant as a function of Q^2 and has led to the following value for α_s :

$$\alpha_s(M_{zo}^2) = 0.123 \pm 0.018$$

On the other hand, knowledge of the strong coupling constant and of the quark densities permits to determine the gluon structure function. From the (2+1) jet cross section the gluon density function in the proton has been determined in the range

$$1.9 \times 10^{-3} \leq x_g/p \leq 0.18$$

at an average $Q^2 = 30$ GeV^2. This measurement is in agreement with the gluon density obtained from the proton structure function F_2 and extends even to higher x values.

In an attempt to differentiate between the DGLAP and BFKL evolutions, a study of the forward jets was performed, the basic idea being that the BFKL evolution is not subjected to a strong transverse momentum ordering as the DGLAP evolution. Therefore the BFKL mechanism is expected to produce more transverse energy flow in the region between the struck quark and the remnant for low x events. The observed magnitude and x dependence of the average E_t is in agreement with the BFKL mechanism. However it is possible that the current hadronisation schemes are not adequate and that improved DGLAP models may equally well describe the data.

Examination of the fragmentation functions of charged particles in the Breit frame as a function of Q^2 indicates that they are very similar to those in e^+e^- interactions; no evolution in x is observed.

E. Photoproduction.

"Rapidity Gap" events were also observed in γp interactions. Analysis of the charged particle distributions as a function of p_t as well as a thrust analysis of the complete event shows that a model of p_t limited phase space, characteristic for soft diffractive processes, can not explain the data. The presence of an underlying hard process is needed to explain the features of the distributions.

Photoproduction of high energy jets has allowed to determine the momentum fraction (x_γ) of partons in the photon. It is found that at high x_γ the data are consistent with a direct and resolved component initiated by the quarks in the photon. At low parton momentum the data can only be explained by a gluonic component in the photon. A leading order gluon distribution is derived in a fractional momentum range $0.84 \leq x_\gamma < 1$.

F. Charged current cross section.

The availability of both e^+ and e^- beams in 1994 permitted to measure the charged-current cross sections :

$$\sigma(e^-p \mid p_t \geq 25 \text{ GeV}) = 46.6 \pm 13.5 \pm 35 \text{ pb}$$

$$\sigma(e^+p \mid p_t \geq 25 \text{ GeV}) = 21.9 \pm 3.4 \pm 2.0 \text{ pb}$$

G. Search for new particles.

A search for new particles (e-q compositness) has been conducted on e^+ and e^- data on a nine fold increased statistics in a Q^2 range = (160,200000) GeV^2. No significant deviations from the Standard Model have been observed.

In 1995, all IIHE and UIA members of the H1 collaboration have contributed to the general detector operation in Hamburg (R. Roosen and P. Marage acted as shift leaders). The COP chamber operation was controlled in Hamburg during the run by local residents (F. Botterweck in May-June and September, B. Clerbaux in July-August and October-November). The COP efficiencies were studied in Brussels by M. Barth and R. Roosen using a new analysis program.

The various H1 softwares were maintained in Brussels by G. Coremans. Early in 1995, R. Roosen installed a new control program for the multiwire proportional chambers (MWPC) data acquisition system. R. Chen and R. Roosen continued the development of a new on-line monitoring system, to be installed in 1996, whilst the UIA group contributed large samples of simulated events for general purpose. For the new Forward Proton Spectrometer ("Roman pots") recently installed in H1, D. Johnson and Z. Garutchava developed reconstruction and visualisation program and P. Van Esch contributed a full simulation of the Roman pots response, using the CERN GEANT package. A proposal for an "Upgrade of the FPS" has been submitted to the DESY PRC (H1-12/95 - 467).

The Belgian contributions to the physics analysis mainly concern three topics : structure function measurements, studies of diffractive interactions and studies of hadronic final state.

a. F_2 Structure function.

E. Evrard contributed to the analysis of moderate Q^2 (8-200 GeV^2) data taken in 1994 at the nominal interaction point. A. Panitch was in charge of the F_2 measurement at low x from the satellite bunch and of a cross check of the data taken with a shifted vertex. L. Favart used the 1993 radiative events for a determination of F_2 at low Q^2. A similar analysis will be applied on the 1994 data.

Based on the "thèse annexe of M. Gruwé", a new method was proposed to measure the F_L structure function using radiative events with a high energy photon detected along the e-beam.

b. Diffractive interactions at large Q^2.

B. Clerbaux and P. Marage have measured the elastic production of ρ mesons at large Q^2 and studied differential cross sections. P. Van Esch and R. Roosen have started an analysis of jet production in diffractive interactions.

c. Hadronic final state.

A study of multiplicity distributions by F. Botterweck, E. Dewolf and P. Van Mechelen has implied numerous Monte Carlo studies and Monte Carlo-data comparison.

Preparatory studies for transverse energy spectrum, rapidity spectrum and "seagull" effect have been performed.

Most of these contributions were presented at the summer conferences and workshops and/or circulated as internal H1 notes.

II.4. STUDY OF pp COLLISIONS AT LHC.

(T. Beckers, O. Bouhali, S. Claes, J. Nelissen, J. Stefanescu, S. Tavernier, W. Van Doninck, C. Vander Velde, P. Vanlaer, L. Van Lancker, F. Verbeure and J. Wulleman; CMS Collaboration : Athens, Baku, Belgium, Bhubaneshbar, *Bombay, Bristol, Brunel, Budapest, CERN, CIEMAT Madrid, Ecole Polytechnique Palaiseau, ETH Zurich, Helsinki, HEPHY Vienna, IC London, IHEP Protvino, INFN Bari, INFN Bologna, INFN Cappito, INFN Firenze, INFN Genova, INFN Padova, INFN Pisa, INFN Roma, INR Moscow, Ioannina, ITEP Moscow, JINR Dubna, Iyvaskyla, Kharkov, Kiel, LAPP Annecy, Lebedev Inst. Moscow, LIP Lisbon, Ljubljana, Lyon, Mannheim, Minsk, MSU Moscow, Oulu, PSI Villigen, Riga, Rutherford Appleton Laboratory, RWTH Aachen, Saclay, Salaspils, SEFT Helsinki, Sofia, Split, Strasbourg, Tallinn, Tashkent, Tbilisi, UC Davis, UC Los Angeles, UC Riverside, UT Dallas, Vilnius, Warszava)*

The construction of the "**L**arge **H**adron **C**ollider" (LHC) has been decided by the CERN Council in December 1994. This superconducting accelerator will be installed in the LEP tunnel and is expected to come into operation in the year 2004. Recently the CERN Research Board has recommended the construction of two

multipurpose detectors, ATLAS and CMS, to study proton-proton interactions at a centre-of-mass energy of 14 TeV at the LHC.

Five Belgian research groups from the IIHE(ULB-VUB), UIA, UCL and UMH are participating in the design and construction of the "**C**ompact **M**uon **S**olenoïd" (CMS) detector. They concentrate their efforts on the forward part of the central tracker which consists of an assembly of some 10000 "**M**icro **S**trip **G**as **C**ounters", MSGC's.

The progress achieved at the IIHE during the present year can be summarised as follows :

For the mechanical support structure, which is required to be stiff and light, a carbon fiber-honeycomb composit was developed and tested in collaboration with the laboratorium for Structural Analysis of Materials of the VUB (Professor P. Dewilde). The results w.r.t. stiffness, deformations, stress, rupture limit and vibrational modes were found to agree well with the finite element analyses (ANSYS) performed at the IIHE.

Concerning the detector cell, the MSGC, a series of prototypes have been built and tested. Using the cosmic hodoscope set-up at the IIHE, the original concept of a "wall-less φ crack" assembly of MSGC's has been successfully tested. No loss of efficiency was observed at the boundary between the micro strip substrates. It was also shown that the use of a Ne-DME gas mixture yields higher gas gains than the conventional mixtures (Ar-DME and CO_2-DME) while maintaining full detection efficiency for a gas layer of only 3 mm thickness. The results agree very well with the Monte Carlo simulations.
In September 1995 a sector prototype with the first wedge-shaped MSGC's was tested in a particle beam at CERN. For this prototype two substrates were mounted in a carbon fibre-honeycomb gas box using a "wall-less φ crack" assembly. More than 1000 channels were read out. This sector prototype constitutes the first step in the iteration towards the full design of the forward tracker of CMS.

In collaboration with IMEC (Leuven), substrates of a slightly different concept are being developed : The "**M**icro **G**ap **C**ounter" MGC. Here the anode strips are separated from the fully metalised cathode plane by polymer strips. Patterning of the cathode plane would yield a detector capable of measuring two coördinates with a single substrate.

Members of the IIHE also contributed to the development of the simulation software of the CMS experiment and to the design of fast read-out electronics for MSGC detectors (fast plex).

III. TEACHING ACTIVITIES AND SEMINARS

III.1. TEACHING ACTIVITIES

- **M. Barth, B. Clerbaux, G. Coremans-Bertrand, L. Favart, V. Lefébure, P. Marage, A. Panitch, J. Stefanescu, M. Vander Donckt, P. Vanlaer, P. Vilain, J. Wickens and G. Wilquet** have contributed to the practical work for students attending the lectures of J. Sacton on "Physique des Particules Elémentaires" and organized specific practical work for students of the 3rd year in physics at the ULB.

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

- **G. Bertrand-Coremans**
  - "Physique Expérimentale" (120 h of practical work - 1ère candidature en sciences pharmaceutiques - ULB).

- **C. De Clercq, R. Roosen, W. Van Doninck and P. Van Esch** have contributed to the practical work for students attending the lectures of J. Lemonne on "Elementaire Deeltjes" - Lic. Natuurkunde VUB.

- **E. De Wolf**
  - "Waarschijnlijkheidsrekening en statistiek (30 u - 2de kandidatuur Natuurkunde RUCA)
  - "Fundamentele wisselwerkingen tussen elementaire deeltjes" (30 u - 2de licentie Natuurkunde UIA).

- **E. Evrard and P. Van Esch**
  - "Algemene Natuurkunde" (30 h excercices - 2de kandidatuur Natuurkunde, Scheikunde - 1ste Lic. Geologie - Prof. J. Lemonne - VUB).

- **D. Johnson**
  - "Introduction to Physics II - Physics 103" (45 h - Vesalius College - VUB)
  - "Introduction to Physics I - Physics 101" (45 h - Vesalius College - VUB)

  All these lectures are accompanied by student consultation and regular interval student exercises.
  D. Johnson also assisted in the teaching and laboratory planning for the course "Physics Laboratory I - Physics 102" (Vesalius College - VUB).

- **J. Lemonne**
  - "Elementaire Deeltjes" (60 h + 60 h of practical work - 1ste and 2de licentie natuurkunde - VUB)
  - "Algemene Natuurkunde" (60 h + 60 h of practical work - 2de kandidatuur Natuurkunde en Scheikunde VUB and 30 h + 30 h of practical work - 1st licence Geologie VUB)
  - "Statistische Analyse van Experimentele Gegevens" (15 h + 15 h excercises - licentie Natuurkunde - VUB).

- **P. Marage**
  - "Histoire des sciences" (15 h - 2ème licence en Sciences Physiques et Sciences Mathématiques - ULB)
  - "Physique" (60 h of practical work - 1ère candidature Ecole de Commerce Solvay - ULB)
  - Animator of the "Atelier - Histoire des Sciences et pédagogie de la physique", formation continuée pour professeurs de physique de l'enseignement secondaire.

- **J. Sacton**
  - "Physique des Particules Elémentaires" (30h - 1ère licence en sciences physique - ULB)
  - Local coordinator of an ERASMUS student exchange programme at the level of the 3rd and 4th years in Physics.

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

- **C. Vander Velde**
  - "Mechanics 2" (26 h + 13 h of exercises - 1st year University Studies in Sciences - ULB)
  - "Laboratory" (20 h - 1st year in University Studies in Sciences ULB)
  - "Physique Générale" (60 h of practical work- 1ère Cand. Polytechnique ULB).

- **W. Van Doninck**
  - "Applied Physics" (45 h - Vesalius College VUB).

- **F. Verbeure**
  - "Introduction to elementary particle and nuclear physics"
  - "Elementary particle physics"
  - "Numerical analysis"
  - "Radioactivity"
  - "Simulations in physics".

- **P. Vilain**
  - "Questions Approfondies de Physique des Particules" (part time 10 h + 15 h of practical work - 2ème licence en sciences physique - ULB).

- **G. Wilquet**
  - "Prise, analyse et simulation de données expérimentales" (20 h - Licence Spéciale en Physique Théorique - 2ème Licence en Physique - ULB).

The yearly visit to CERN of the ULB students of the 3rd year in physics has been organized by P. Vilain and G. Wilquet.

The following Ph.D. theses and "licentieverhandelingen" were completed during 1995.

Ph D Theses.

- **Peter Bruyndonckx** (VUB) "Design and construction of a small animal PET scanner using Ba F_2 scintillation crystals". Promotor : S. Tavernier.

- **Laurent Favart** (ULB) "Mesure de la fonction de structure F_2 du proton à HERA, utilisant les interactions profondément inélastiques radiatives (ordre α^3)". Promoteur : P. Marage.

- **Magali Gruwé** (ULB) "Design and tests of the optoelectronic chains for the CHORUS neutrino oscillation experiment". Promoteurs : P. Vilain and G. Wilquet.

- **Chantal Mommaert** (VUB) "The scintillating fiber tracker for the CHORUS neutrino oscillation experiment : read-out, calibration and performance". Promotor : J. Lemonne; supervisor : P. Vilain.

Licentiaatsverhandelingen.

- **Min Dezillie** (VUB) "Bijdrage tot de studie van micro strip gas tellers met behulp van een cosmische hodoscoop". Promotor : J. Lemonne; supervisor : W. Van Doninck.

- **Brenda Jacobs** (VUB) "Bijdrage tot de studie van scintillatie kristallen voor gebruik in de electromagnetisch calorimeter van de CMS detector". Promotor : S. Tavernier.

- **Ann Van Lysebetten** (VUB) "Bepaling van de werkzame doorsnede voor de reactie $e^+ + e^- \rightarrow \mu^+ + \mu^-$ bij energieën beneden de Z° piek aan de hand van een studie van radiatieve processen bij LEP". Promotor : J. Lemonne; supervisor : C. De Clercq.

III.2. SEMINARS.

The following seminars were given by members of the IIHE :

- **P. Bruyndonckx**
  "Characteristics of a small animal PET scanner based on Ba F_2 and TMAE"
  University hospital of Geneva.

- **C. De Clercq**
  Introductory talk at "Open Campus day"
  VUB.

- **E. De Wolf**
  "Van quarks en de grote oerknal" (3 invited lectures)
  Centrum van beroepsvervolmaking leerkrachten (UIA).

- **J. Lemonne**
  "Deeltjesfysica in België, la physique des particules élémentaires" - Academic Session Museum of Natural Sciences - Brussels "Chiraliteit in de wereld van de Elementaire Deeltjes" - Colloquium VUB.

- **P. Marage**
  Organisation of a four days seminar : "Introduction à la civilisation et aux sciences du Moyen Age islamique" for teachers of secondary schools
  Ministère de l'éducation de la communauté française.

- **S. Tavernier**
  "New developments in detectors for positron emission tomography""
  P.S.I. Villingen (Switzerland).

- **A. Tomaradze**
  "First measurement of f_2 (1525) production in Z° hadronic decays"
  IIHE (ULB-VUB).

- **R. Vandenbroucke**
  "Local Area Networks : topology, cabling and equipment"
  Centre informatique de la région bruxelloise.

- **W. Van Doninck**
  - "The Belgian contribution to LHC experiments"
    Interfaculty Doctoral Seminar KU Leuven
  - "High Energy Physics"
    Exhibition "Naar de kern van de materie"
    Brussels (Belgium)
  - "The LHC project at CERN"
    Special day for industrials of the International Europhysics Conference on High Energy Physics
    Brussels (Belgium).

- **P. Vilain**
  "L'expérience CHORUS"
  Grenoble (France).

The organisation of the International Europhysics on High Energy Physics has prevented us to hold our yearly cycle of seminars.

IV. COMPUTER MATTERS.

IV.1. COMPUTING AND NETWORKING.

Management : R. Vandenbroucke
Scientific staff : Z. Cekro, N. Meulemans
Logistic and technical staff : G. Depiesse, D. Pirnay (part-time), G. Rousseau, L. Van Helleputte (till March 31).

A. Systems.

During 1995 three Alphastations 250 4/266 were acquired. More disk was bought in response to the increasing amount of data. A fast 20 Gbyte tape unit was bought to back up the disks in an acceptable amount of time. A DECstation 5200 which came back from CERN was set up as a diskserver, a "Prestoserve" disk accelerator was added to speed up disk operations. A PC was made available to the electronic engineers for design work.

B. Networking.

At the beginning of 1995 new ethernet cabling replaced the existing poor cabling, resulting in a more stable local network. However the now available local ethernet is becoming overloaded due to the high performance capabilities of the Alpha machines and the load of very large datafiles. Investigation work has started to upgrade the

10 Mbps ethernet backbone to a 100 Mbps FDDI backbone while keeping the past investments in the local network infrastructure.

Wide area networking was satisfactory in the beginning of 1995. However the change of service provider of Europanet created a bad networking environment : there were several routing problems which resulted in a loss of connectivity; the connection to Germany (and especially for the IIHE to DESY) became very bad. Contacts are established with Belnet to follow up and try to remediate those problems.

C. Scientific activities.

Nils Meulemans worked essentially at the LIRN project. LIRN aims at realising a library information and referral service of networks by means of X.500. He developed the X.500 structure based on a thesaurus for storing the information. He developed a WWW interface for access to the LIRN information.

Zlatica Cekro worked on ATM, the merging technology for high speed networks. She especially focused on performance measurements for IP over ATM.

IV.2. INTERACTIVE GRAPHICS DEVELOPMENTS IN THE DELPHI EXPERIMENT.

(D. Bertrand).

The interactive graphics system designed in 1987 in order to allow a 3D viewing of events recorded by the DELPHI detector has been completely updated in order to cope with $e^+ e^-$ interactions at higher energies (LEP 130; LEP 200). The program was ported on UNIX platforms working in an X window environment. The communication scheme is now using an efficient system of shared memories coupled to semaphores. The functionality was considerably increased by including the possibilities of online reconstruction of tracks and vertices as well as kinematic fits of Vzeros and jet structures.

In autumn 1995, the system was used at CERN on a 24H/day basis in parallel with the data acquisition in order to get an immediate hint for new phenomena which could arise in $e^+ e^-$ interactions at 130 GeV.

V. TECHNOLOGICAL R & D.

V.I. TECHNOLOGICAL TRANSFER FROM BASIC RESEARCH TO APPLICATIONS.

(Liu Xuan, S. Rajeswaran, S. Tavernier and S. Zhang; Collaboration : Hammersmith hospital (London), Royal Marsden hospital (London), Deutsche Krebsforschungszentrum (Heidelberg), Ospedale San Raffaele (Milano), Ringshospitalet (Copenhagen).

The aim of the present project is to use the photosensitive wire chamber technology to build a Positron Emission Tomograph camera with improved performances compared to present commercial systems.

Positron **E**mission **T**omography (PET) is a non-invasive, atraumatic method which allows the in vivo determination of the three-dimensional density distribution of a radioactively labelled substance. In a PET study the patient is administered a drug which is labelled with a positron emitting isotope. The positron annihilates with an electron into two back-to-back gamma rays of 511 keV which can be detected. From the observation of a sufficiently large sample of such annihilations it is possible to reconstruct the three-dimensional density distribution of a radioactively labelled substance in the patient.

A small diameter Positron Emission Tomograph (PET) dedicated to animal imaging, using Ba F_2 crystals and photosensitive wire chambers with tetrakis-dimethylamine-ethylene (TMAE), has been designed and built. It consists of 17 cylindrical rings with 200 mm inner diameter without inter-ring septa, thus allowing for 3D data

acquisition and reconstruction. The instrument contains 2958 Ba F_2 crystals measuring 3 x 3 x 20 mm^3 each. It is fully completed and operational.

First physics measurements show that the tomograph meets the design specifications : 1) the detection efficiency for one 511 keV photon is 34 %, 2) the sensitivity as measured with a ^{68}Ge point source at the centre is 25'000 cps per Mbq, 3) the tangential resolution (FWHM) varies from 3 mm at the centre to 4.5 mm at a position 50 mm radially off centre, 4) the radial resolution (FWHM) varies from 3 mm at the centre to 6 mm at 50 mm radially off centre, and the axial resolution is 3.5 mm, 5) the coincidence time resolution (FWHM) is 29 ns, which allows the use of a time window of 50 ns. Projection data and the corresponding reconstructed image for a uniform ^{68}Ge cylinder 54 mm in diameter are also presented. These show that good uniformity can be achieved within the field of view.

These performances compare favourably with other small animal scanners which have been built elsewhere.

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

(P. Annis, C. Mommaert, P. Vilain, G. Wilquet; Collaboration RD46 : Naples, CERN, Rome "La Sapienza", IHEP Protvino, Louvain-la-Neuve, Humbolt Berlin, NIKHEF Amsterdam, JINR Dubna).

In summer 1994, an active target (length : 180 cm; section : 2 x 2 cm^2) made of 5 x 10^5 capillaries of 20 μm diameter has been exposed in the CERN SPS neutrino beam in front of the CHORUS set-up. The capillaries were filled with liquid purified methylnaphtalene doped with 3M 15. After amplification through a series of 5 image intensifiers, the signals are recorded on a 10^6 pixels CCD. From the reconstruction of several thousands of muon tracks and about fifty neutrino interactions the spatial resolution has been estimated to be 28 μm and the attenuation length was found to be 384 cm.

A second target equipped with a new type of image intensifier (Electron Bombarded CCD - EBCCD) has been installed in the neutrino beam in summer 1995. This new device is expected to both improve the spatial resolution of the active target and to simplify the optoelectronics read-out chain. This R & D program has been recently approved by the CERN Research Board under the code number RD 46.

V.3. R & D ON HEAVY SCINTILLATORS.

(F. Tallouf, S. Tavernier; Crystal Clear Collaboration (CERN, RD-18) and EU Human Capital and Mobility Network "Search for new and better scintillators for radiation detection").

The R & D work on new heavy scintillating materials took place in the framework of the CERN R & D project CRYSTAL CLEAR (RD-18). S. Tavernier was elected spokesman of this collaboration in 94.

The aim of the CRYSTAL CLEAR was to find the best possible scintillating material for an electromagnetic calorimeter at LHC and to make a preliminary design of it. A multidisciplinary team was formed which involves solid state physicists, high energy physicists and engineers. Eventually the CMS experiment chose for an electromagnetic calorimeter based on our design and using PbW04 scintillator. The responsibility for the design and construction of this calorimeter now belongs to the CMS collaboration but CRYSTAL CLEAR continues to play an essential role in providing its expertise. Indeed, at present, the quality of the PbW04 samples varies considerably from sample to sample. Although some samples with good characteristics have been produced (no slow component in the scintillation light, radiation hard), most of the samples obtained so far were not acceptable. CRYSTAL CLEAR has also considered, and studied, a large number of other materials. One of these, CeF3, has been particularly well studied. It was not taken by CMS because of its higher cost compared to PbW04. At the beginning of the CRYSTAL CLEAR project, Ce F_3 was a little known scintillating material. It is now a well established scintillator with high speed (30 ns decay time), no afterglow and good radiation hardness. Moreover, in collaboration with industry, the technology to produce large size crystals in large quantities has been developed. An extensive review of the properties of CeF3 was prepared and will be published shortly.

Another class of materials which was extensively studied are the cerium doped heavy fluoride glasses. These materials have a much lower light yield and are less radiation hard than CeF3, but their lower cost makes them an interesting alternative.

The CRYSTAL CLEAR collaboration has made a thorough study of Ce3+ as a scintillating centre. Largely thanks to their work, the scintillation mechanism of CeF3 is now well understood, and it is possible to predict which materials are likely to be fast, dense and luminous cerium based scintillators. Particularly promising are Lu2Si05:Ce (LSO), LuAl03:Ce (LuAP), YAl03:Ce (YAP) and Gd2Si05:Ce (GSO). All these materials exhibit the characteristic luminescence of the 5d - 4f transition from the Ce 3+ ion. This ion emits around 330-400 nm with a decay time of the order of 30 ns. The light yield depends on the position of the 4f level of Ce3+ relative to the top of the valence band of the host material. In the oxides listed above, this 4f level is situated just above this valence band, leading to efficient hole trapping and hence a luminous scintillator. Light yields in these materials vary from 10'000 to 30'000 photons/MeV. One or more of these scintillators will very probably replace some of the more traditional materials in several applications outside the field of high energy physics.

VI. TECHNICAL AND ADMINISTRATIVE WORK.

The members of the workshop staff were : J. De Bruyne, H. De Nil, M. Devos (till October 95), J.P. Dewulf, L. Etienne, R. Gindroz, R. Goorens, E. Lievens, E. Raspoet, R. Ruidant (till May 95), G. Van Beek, J. Vanbegin, R. Vanderhaeghen (from October 95), L. Van Lancker, C. Wastiels with the help of M. Pins and R. Pins.

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

For the CHORUS experiment two new emulsion trackers were constructed under the responsibility of Guy Van Beek and with the technical assistance of Eddy Raspoet and Robert Gindroz. Three similar trackers, of 3 m diameter, aiming to improve the momentum resolution have been designed and the preparations for their construction in the workshop have started. Guy Van Beek has also taken an important share in the maintenance of the CHORUS opto-electronics read out system. For the RD46 project, launched by the CHORUS collaboration, a support structure for the large capillary targets has been designed and constructed by Guy Van Beek and Eddy Raspoet.

In the framework of the H1 experiment at DESY, Christian Wastiels with the assistance of Hans De Nil have been responsible for the maintenance and upgrade of the **C**entral **O**uter **P**roportional Chamber (COP) designed and built in the IIHE. A complete recabling of this detector has been accomplished at DESY after the winter shut down.

For the DELPHI experiment at LEP the maintenance and upgrades of the MUF detector are under the responsability of Robert Goorens. All the connections between the **L**ep **T**ime **D**igitizers (LTD) and discriminator boards have been improved. Jean-Paul Dewulf and Robert Goorens have also taken the responsability for the design, construction and testing of the new muon subtrigger card and of part of the central trigger control of DELPHI.

J.P. Dewulf was responsible for the installation and maintenance of the PCAD software package for electronic design.

The IIHE has been largely responsible for the design of the forward MSGC tracker of the CMS project at LHC. Luc Van Lancker has designed (pro engineering) the mechanical support structure based on carbon fiber - honeycomb composite material. The mechanical stability has been evaluated with a finite element analysis (ANSYS) and tested with the help of the laboratorium of Structural Analysis of Materials of the VUB (Professor P. Dewilde). Etienne Lievens, with the assistance of Robert Gindroz, Eddy Raspoet and Robert Ruidant have constructed the sector prototype and several mock-up modules to evaluate the validity of the design. Marc Devos and René Vanderhaeghen have built 5 electrometers and ensured the maintenance of the data acquisition system of the cosmic hodoscope. Myriam Pins has contributed to the ultrasonic wire bonding of several MSGC prototypes.

For the **P**ositron **E**mission **T**omograph (PET), Léon Etienne was responsible for the read-out electronics with assistance from Christian Wastiels and Hans De Nil. Jean Debruyne was responsible for the technical support of this project while Rolande Pins has constructed the wire chamber for the detection of the scintillation photons.

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

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

VII. REPRESENTATION IN COUNCILS AND COMMITTEES.

C. De Clercq was the Belgian representative at the HEPCCC Technical Advisory Subcommittee (HTASC).

D. Johnson was member of the Academic Standards Committee for Upperclassmen at the Vesalius College, VUB.

J. Lemonne has been the Belgian scientific representative in the CERN Council; he was a member of the EPS-HEP board. He was president of the Department of Physics of the VUB and represented (from September to December 1995) the Faculty of Science in both the plenary (Raad van Bestuur) and restricted (Bestuurscollege) Councils of the VUB. He was the representative of the Faculty of Science in the "Senate" of the VUB and chairman of the "Commissie Middelen en Personeel" of this Faculty. He was also a member of the "Commissie Begroting en Financiën" of the Vlaamse Raad voor Wetenschapsbeleid and of the "Overlegsgroepen : Wetenschappen en Natuurkunde" of the Vlaamse Interuniversitaire Raad (VLIR).

J. Lemonne, J. Sacton and F. Verbeure were members of the Scientific Commissions "Hautes et Basses Energies" of the IISN and "Hoge Energie" of the IIKW and of the Belgian Selection Committee of CERN fellows.

P. Marage was member of the "Commission d'évaluation scientifique pour les nominations au titre de premier assistant", of the "Commission des Finances" and of the "Commission du Patrimoine" of the ULB, associate member of the "Comité National de Logique, de Philosophie et d'Histoire des Sciences", member of the "Comité scientifique attaché au Musée des Sciences" and of the Council of "Objectif Recherche" (Belgian association for promotion of Science) and of Altaïr, an ASBL devoted to the history of science (ULB).

J. Sacton was Dean of the Faculty of Sciences of the ULB until 1st October 1995; since then he acted as Vice Dean. He also acted as chairman of the C11 Commission (Particles and Fields) of the **I**nternational **U**nion for **P**ure and **A**pplied **P**hysics (IUPAP) and as a member of the **I**nternational **C**ommittee for **F**uture **A**ccelerators (ICFA). He was vice-chairman of the "Comité Scientifique attaché au Musée des Sciences et Technologies" of the ULB at Parentville. He was also a member of the "Commission de Physique" at the FNRS and of the "Commissie voor Fysica" at the NFWO.

S. Tavernier was member of the "Onderzoeksraad" of the VUB and chairman of the "Facultaire onderzoekscommissie Wetenschappen" van de Onderzoeksraad. He is spokesman of the "Crystal Clear Collaboration (CERN,, R & D18) and coordinator of the Human Capital and Mobility Network : "Search for new and better scintillating materials for basic research".

R. Vandenbroucke acted as chairperson of the DECUS BELUX Network SIG, as member of the DECUS Europe Network and Integration SIG, as representative of DECUS BELUX in the DECUS Europe Council and in EWOS, as belgian representative in the HEPnet Technical Committee and in the Public Procurement Group of the European Commissions. She was also the alternate representative (of Professor J. Tiberghien) in the BELNET Policy Board.

W. Van Doninck acted as a belgian representative in plenary ECFA and as a member of the Board of directors of the Belgian Physical Society.

F. Verbeure acted as Vice Rector of the Universitaire Instelling Antwerpen since 1st October 1995.

P. Vilain was the Belgian representative at the Restricted European Committee for Future Accelerators (RECFA).

G. Wilquet was nominated as a member of the SPS and LEAR Committee at CERN.

The following responsibilities were taken in the organisation

1) of the *DELPHI experiment* :
- **D. Bertrand** : member of the editor committee
- **C. De Clercq** : Muon project leader
- **J. Lemonne** : Vice-chairman of the Collaboration Board and representative of "Belgium", representative of the IIKW-IISN in the Finance Committee
- **C. Vander Velde** : contact person of the DELPHI Collaboration for the sub-group "New particles - generators" of the LEP 200 Workshop
- **J. Wickens** : member of the DELPHI Analysis Panel and of the on-line/off-line coordinator panel, project leader of DELPHI off-line software

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

3) of the *CMS experiment* :
- **W. Van Doninck** : member of the management board and of the collaboration board; deputy MSGC coordinator
- **J. Lemonne** and **J. Sacton** : representatives of the IIKW and IISN, respectively, in the Finance Committee
- **S. Tavernier** : member of the ECAL institution board

4) of the *CHORUS experiment* :
- **P. Vilain** : representative of the IIHE at the Collaboration Board.

VIII. ATTENDANCE TO CONFERENCES, WORKSHOPS AND SCHOOLS.

VIII.1. CONFERENCES AND WORKSHOPS.

- 17th International Symposium on Lepton-Photon Interactions; Beijing - China : *D. Bertrand, G. Bertrand-Coremans, Cao Fang, D. Johnson, J. Lemonne, J. Sacton, P. Vilain*
- International Symposium on Multiparticle Dynamics; Stara Lesna - Slovakia : *F. Verbeure*
- Four Seas Conference; Trieste - Italy : *S. Tavernier*
- XXXth Rencontre de Moriond : Electroweak Interactions and Unified Theories; les Arcs - France : *Cao Fang and M. Vander Donckt*
- XXXth Rencontre de Moriond : QCD and High Energy Hadronic Interactions; Meribel - France : *B. Clerbaux and E. de Wolf*
- IInd Rencontre du Vietnam; Ho Chi Minh Ville - Vietnam : *C. De Clercq and W. Van Doninck*
- VIth Blois Workshop on Elastic and Diffractive Scattering; Blois - France : *A. Panitch*
- Workshop on deep inelastic scattering; Cambridge - U.K. : *B. Clerbaux, P. Marage, R. Roosen*
- Workshop on deep inelastic scattering and QCD; Paris - France : *L. Favart*

- Preparatory meeting of the $e^+ e^-$ Linear Collider Workshop; Annecy - France : *C. Vander Velde*
- Applications and Sciences of Artificial Neural Networks; Orlando - U.S.A. : *V. Lefébure*
- International Workshop on Micro Strip Gas Chambers; Lyon - France : *T. Beckers, O. Bouhali, J. Nelissen and C. Vander Velde*
- Second International Conference on composites engineering (ICCE/2); New Orleans - U.S.A. : *L. Van Lancker*
- Vierde seminarie "PRO-Engineer"; Genappe - Belgium : *S. Claes and L. Van Lancker*
- ANSYS Workshop; Paris - France : *L. Van Lancker*
- First Workshop on Electronics for LHC experiments; Lisbon - Portugal : *J.P. Dewulf*
- Image Detector Workshop; UCLA Santa Monica - U.S.A. : *S. Zhang*
- Workshop on Positron Emission Tomography (Drug Information Association); Brugge - Belgium : *S. Zhang*
- IEEE Nuclear Science Symposium and Medical Imaging Conference; San Franciso - U.S.A. : *X. Liu, S. Rajeswaran and S. Tavernier*
- International Conference on Inorganic Scintillators and their Applications; Delft - The Netherlands : *S. Tavernier*
- PET Instrumentation for Animal Imaging Workshop; San Francisco - U.S.A. : *X. Liu, S. Rajeswaran and S. Tavernier*
- Beijing Calorimetry Symposium; Beijing - China : *T. Beckers*
- 6^{th} International Conference on Human - Computer Interactions; Tokyo - Japan : *R. Vandenbroucke*
- Conférence sur la Gestion de Réseaux; Paris - France : *R. Vandenbroucke*
- DECUS Europe Symposium; Dublin - Ireland : *R. Vandenbroucke*
- TELECOM'95; Geneva - Switzerland : *R. Vandenbroucke*
- 2^{nd} National Host and Acts Information Days; Vienna - Austria : *R. Vandenbroucke*
- CEN/CENELEC/ETSI : Standardization in the European Information Society; Cannes - France : *R. Vandenbroucke*
- DECUS BELUX Symposium; Blankenberge - Belgium : *R. Vandenbroucke*
- Colloque sur le Multimedia : mythe, fiction, opportunité; Nivelles - Belgium : *R. Vandenbroucke*

VIII.2. SCHOOLS.

- European School of High Energy Physics; Dubna - Russia : *V. Lefébure*
- ICFA 95 Instrumentation Summer School; Ljubljana - Slovenia : *P. Annis, M. Vander Donckt*
- Summer School organized by the Collaboration of Theorists and Experimentalists on QCD (CTEQ); Bad Lauterberg - Germany : *P. Van Esch*

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

(R. Alluyn, M. Barth, T. Beckers, D. Bertrand, G. Coremans, O. Bouhali, C. Carlier, J. Castera, S. Claes, B. Clerbaux, S. De Brabandre, J. Debruyne, C. De Clercq, A. De Coster, M. Delasorte, H. De Nil, G. Depiesse, M. De Schutter, M. Devos, E. Dewolf, J.P. Dewulf, L. Etienne, C. Fang, D. Favart, M. Garnier, R. Gastmans, R. Gindroz, M. Goeman, B. Goorens, M. Gruwé, D. Johnson, V. Lefébure, J. Lemonne, J. Liesen, E. Lievens, D. Luypaert, P. Marage, J. Nelissen, A. Panitch, M. Pins, R. Pins, D. Pirnay, E. Raspoet, R. Roosen, G. Rousseau, J. Sacton, J. Stefanescu, G. Van Beek, J. Van Begin, R. Vandenbroucke, M. Vander Donckt, C. Vander Velde, W. Van Doninck, P. Van Esch, L. Van Lancker, P. Vanlaer, P. Van Mechelen, F. Verbeure, P. Vilain, G. Wallenborn, C. Wastiels, J. Wickens, G. Wallenborn, G. Wilquet).

The 1995 International Europhysics Conference on High Energy Physics was held in Brussels on the ULB-VUB campus "de la plaine" from the 27th of July until the 2nd of August 1995. During the first three days, 236 talks were given in twenty parallel sessions covering almost all topics of experimental and theoretical particle physics as well as related subjects. These matters were subsequently reviewed in the plenary sessions which took place during the last three days. The conference attracted almost seven hundred participants from 38 countries.

The Board of the High Energy and Particle Physics division (HEPP) of the EPS was the International Organising Committee. The local Organising Committee was composed of members of the IIHE (ULB-VUB) and UIA and of representatives of the KUL and UCL. All Belgian Universities involved in particle physics proposed scientific secretaries. At the administrative and logistical level, the conference was mainly organised by the scientific, administrative and technical staffs of the IIHE.

A large amount of new experimental results were presented, confirming (apart from a few yet puzzling exceptions, such as the measured decay rates of the Z^0 boson into pairs of charm and beauty quarks) the impressive success of the Standard Model of Electro-Weak and Strong interactions. Much attention was also paid to new theoretical ideas and their possible verification in future collider experiments at energies extending up to the TeV range.

During the opening session of the conference the 1995 EPS High Energy and Particle Physics Prize was awarded to Paul Söding (DESY), Bjorn Wiik (DESY), Gunther Wolf (DESY) and Sau Lan Wu (Wisconsin) for the first observation of three jet events in e^+e^- collisions at PETRA. This discovery represented the first direct indication of the existence of the gluon. The confirmation of the existence of this important fundamental particle emerged gradually from four PETRA experiments performed at DESY : JADE, MARK-J, PLUTO and TASSO to which a special complementary prize of the Executive Committee of the EPS was also awarded.

The organisational responsibilities of the IIHE members of the Local Organising Committee were shared as follows :

- J. Lemonne and J. Sacton : Chairmen of the Local Organising Committee directly in charge of the budget control and the contacts with sponsors.
- D. Johnson : financial support to physicists from Eastern European (EC; International Science Foundation) and developping countries
- G. Coremans-Bertrand (assisted by M. Goeman) : administrative secretariat (documents, registration, accommodation on campus, hotels (coordination), meals on campus, transport, special ticket fares, ...)
- D. Bertrand : equipment of auditoria and rooms and administrative computing network
- P. Vilain : photocopy services
- R. Vandenbroucke : users computing network
- E. De Wolf : abstracts and contributed papers, library and display
- F. Verbeure : scientific secretariat and practical organisation of parallel sessions
- C. Vandervelde : proceedings
- C. De Clercq and P. Marage : publicity, press and external communication
- Exhibitions :
  - R. Roosen : scientific books
  - W. Van Doninck and G. Wilquet : instrumentation (including the organisation of a special session for industrials on LHC)
  - P. Marage : the Solvay Congresses
- W. Van Doninck : social events

The conference generated several related activities; notable were a series of exhibitions which took place before and during the meeting. The first presentation of this conference to representatives of the Belgian scientific, administrative, industrial and political worlds as well as to the press took place at the end of April 1995 in the Royal Institute for Natural Sciences at the occasion of the opening of three simultaneous exhibitions concerning "CERN", "Particle Physics in Belgium" and "The Solvay Physics Congresses and the Birth of Modern Physics". During the academic opening session talks were presented concerning : Particle Physics in Europe (C. Llewellyn-Smith, Director General of CERN), the activities of the European Physical Society (G. Jarlskog, president of the EPS-HEP division) and "Particle Physics in Belgium (J. Lemonne).

The global coordination of these activities, to which members of the entire Belgian HEP community contributed, was ensured by C. De Clercq and by P. Marage. These pre-conference manifestations, which lasted four weeks, were very successful and attracted over 4000 visitors.

A series of introductory talks concerning the topics illustrated by the exhibitions were also given to secondary school teachers (155 in total) by C. Vandervelde and W. Van Doninck. During May, 193 groups of about 20 students each (97 French speaking and 96 Flemish) visited the exhibitions. The exhibitions were also honoured by a visit of His Majesty, King Albert of Belgium.

During the conference two additional exhibitions ("Industrial" and "Scientific Books") have also been organised.

The Solvay exhibition was also repeated at this as well as on several other occasions before and after the conference (VUB, Mons, Hotel Metropole-Brussels, Barcelona). A related talk was given during the Conference by G. Wallenborn (ULB) who made a major contribution to this topic of considerable interest to the history of Science.

A one day Colloquium on "Les Conseils Solvay et les débuts de la physique moderne" was organised by P. Marage and G. Wallenborn at the ULB. P. Marage and G. Wallenborn have also edited a book with the same title as the colloquium which was widely distributed with some 2300 copies at present.

All these activities, in particular the conference itself, focused the attention on the remarkable progress of particle physics, not only of the Belgian scientific and political authorities, but also of the public at large.

X. LIST OF PUBLICATIONS, REPORTS AND CONTRIBUTIONS TO CONFERENCES.

X.1. PUBLICATIONS.

Neutrino Physics

- Spin alignment and parity violation effects in ρ° production in neutrino and antineutrino charged current interactions
  V.G. Zaetz et al.
  Z. Phys. C66 (1995) 583-590

- Study of D^{*+} and search for D^{**0} production by neutrinos in BEBC
  A.E. Asratyan et al.
  Z. Phys. C68 (1995) 43-46

- Search for heavy isosinglet neutrinos"
  P. Vilain et al.
  Phys. Lett. B351 (1995) 387-392

- Experimental study of electromagnetic properties of the muon neutrino in neutrino-electron scattering

P. Vilain et al.
Phys. Lett. B345 (1195) 115-118

- A precise measurement of the cross section of the inverse muon decay $\nu_\mu + e^- \rightarrow \mu^- + \nu_e$
P. Vilain et al.
Phys. Lett. B364 (1995) 121-126

e^+e^- physics

- First evidence of hard scattering processes in single tagged $\gamma\gamma$ collisions
P. Abreu et al.
Phys. Lett. B342 (1995) 402-416

- Production characteristics of K° and light meson resonances in hadronic decays of the Z°
P. Abreu et al.
Z. Phys. C65 (1995) 587-602

- Measurement of the forward-backward asymmetry of $e^+e^- \rightarrow Z \rightarrow b\bar{b}$ using prompt leptons and a lifetime tag
P. Abreu et al.
Z. Phys. C65 (1995) 569-585

- Observation of orbitally excited *B* mesons
P. Abreu et al.
Phys. Lett. B345 (1995) 598-608

- Production of charged particles, K^0_S, $K^{\pm}$, p and Λ in $Z \rightarrow b\bar{b}$ events and in the decay of b hadrons
P. Abreu et al.
Phys. Lett. B347 (1995) 447-466

- Measurement of the forward-backward asymmetry of charm and bottom quarks at the Z pole using $D^{*\pm}$ mesons
P. Abreu et al.
Z. Phys. C66 (1995) 341-354

- Measurement of $\Gamma_{b\bar{b}}/\Gamma_{had}$ using impact parameter measurements and lepton identification
P. Abreu et al.
Z. Phys. C66 (1995) 323-339

- A study of radiative muon-pair events at Z° energies and limits on an additional Z' gauge boson
P. Abreu et al.
Z. Phys. C65 (1995) 603-618

- Measurement of the $\Gamma_{b\bar{b}}/\Gamma_{had}$ branching ratio of the Z by double hemisphere tagging
P. Abreu et al.
Z. Phys. C65 (1995) 555-568

- Inclusive measurements of the $K^{\pm}$ and $p/\bar{p}$ production in hadronic Z° decays
P. Abreu et al.
Nucl. Phys. B444 (1995) 3-26

- First measurement of the strange quark asymmetry at the Z° peak
P. Abreu et al.
Z. Phys. C67 (1995) 1-13

- Search for heavy neutral Higgs bosons in two-doublet models
P. Abreu et al.
Z. Phys. C67 (1995) 69-79

- Measurements of the τ polarisation in Z° decays
  P. Abreu et al.
  Z. Phys. C67 (1995) 183-201

- Observation of short range three-particle correlations in e+e- annihilations at LEP energies
  P. Abreu et al.
  Phys. Lett. B355 (1995) 415-424

- Strange baryon production in Z hadronic decays
  P. Abreu et al.
  Z. Phys. C67 (1995) 543-553

- A measurement of B^+ and B° lifetimes using $\bar{D}\ell^+$ events
  P. Abreu et al.
  Z. Phys. C68 (1995) 13-23

- Search for exclusive charmless *B* meson decays with the DELPHI detector at LEP
  P. Abreu et al.
  Phys. Lett. B357 (1995) 255-266

- B^* production in Z decays
  P. Abreu et al.
  Z. Phys. C68 (1995) 353-362

- Lifetime of charged and neutral B hadrons using event topology
  W. Adam et al.
  Z. Phys. C68 (1995) 363-374

- Lifetime and production rate of beauty baryons from Z decays
  P. Abreu et al.
  Z. Phys. C68 (1995) 375-390

- A measurement of the τ leptonic branching fractions
  P. Abreu et al.
  Phys. Lett. B357 (1995) 715-724

- Production of strange B-baryons decaying into $\Xi^{\mp} - \ell^{\mp}$ at LEP
  P. Abreu et al.
  Z. Phys. C68 (1995) 541-553

- Upper limits on the branching ratios $\tau \rightarrow \mu\gamma$ and $\tau \rightarrow e\gamma$
  P. Abreu et al.
  Phys. Lett. B359 (1995) 411-421

- Measurement of $\Delta^{++}(1232)$ production in hadronic Z decays
  P. Abreu et al.
  Phys. Lett. B361 (1995) 207-220

- Study of prompt photon production in hadronic Z° decays
  P. Abreu et al.
  Z. Phys. C69 (1995) 1-14

ep physics

- Determination of the strong coupling constant from jet rates in deep inelatisc scattering
  T. Ahmed et al.
  Phys. Lett. B346 (1995) 415-425

- First measurement of the deep-inelastic structure of proton diffraction
  T. Ahmed et al.
  Phys. Lett. B348 (1995) 681-696

- Observation of hard processes in rapidity gap events in γp interactions at HERA"
  T. Ahmed et al.
  Nucl. Phys. B435 (1995) 3-20

- A measurement of the proton structure function $F_2(x, Q^2)$
  T. Ahmed et al.
  Nucl. Phys. B439 (1995) 471-502

- Inclusive parton cross sections in photoproduction and photon structure
  T. Ahmed et al.
  Nucl. Phys. B445 (1995) 195-215

- The gluon density of the proton at low x from a QCD analysis of F_2
  S. Aid et al.
  Phys. Lett. B354 (1995) 494-505

- Transverse energy and forward jet production in the low x regime at HERA
  S. Aid et al.
  Phys. Lett. B356 (1995) 118-128

- Comparison of deep inelastic scattering with photoproduction interactions at HERA
  S. Aid et al.
  Phys. Lett. B358 (1995) 412-422

- A study of the fragmentation of quarks in e^-p collisions at HERA
  S. Aid et al.
  Nucl. Phys. ~~Phys. Lett.~~ B445 (1995) 3-21

- A direct determination of the gluon density in the proton at low x
  S. Aid et al.
  Nucl. Phys. B449 (1995) 13-21

- Experimental study of hard photon radiation processes at HERA
  T. Ahmed et al.
  Z. Phys. C66 (1995) 529-542

- Measurement of the e^+ and e^- induced charged current cross sections at HERA
  S. Aid et al.
  Z. Phys. C67 (1994) 565-575

- Leptoquarks and compositeness scales from a contact interaction analysis of deep inelastic $e^{\pm}p$ scattering at HERA
  S. Aid et al.
  Phys. Lett. B353 (1995) 578-588

- Measurement of the total photon-proton cross section and its decomposition at 200 GeV centre of mass energy
  S. Aid et al.
  Z. Phys. C69 (1995) 27-38

Hadron-hadron interactions

- Backward proton production in π^+ and K^+ collisions with Al and Au nuclei at 250 GeV/c
  N.M. Agababyan et al.
  Z. Phys. C66 (1995) 385-391

- Angular dependence of Bose-Einstein correlations in interactions of π^+ and K^+ mesons with protons and nuclei at 250 GeV/c
  N.M. Agababyan et al.
  Z. Phys. C66 (1995) 409-415

- Angular dependence of particle correlations in π^+/K^+p interactions at 250 GeV/c
  N.M. Agababyan et al.
  Phys. Lett. 353B (1995) 397-401

- Higher order Bose-Einstein correlations in π^+p and K^+p collisions at 250 GeV/c
  N.M. Agababyan et al.
  Z. Phys. C68 (1995) 229-237

- Study of Bose-Einstein correlations for pions produced in pp collisions at 400 GeV/c
  M. Aguilar-Benitez et al.
  Bull. of Tokyo Metropolitan College of Allied Medical Sciences 3 (1995) 187-206

Experimental techniques

- Development of large-volume, high-resolution tracking detectors based on capillaries filled with liquid scintillator
  S. Buontempo et al.
  Nucl. Instrs & Methods A360 (1995) 7-12

- Status report on CHORUS experiment at CERN"
  E. Arik et al.
  Nucl. Instrs & Methods A360 (1995) 254-257

- Performance of a prototype of the CMS central track detector
  O. Adriani et al.
  Nucl. Instrs & Methods A367 (1995) 189-192

- Experimental results from a large volume active target made of glass capillaries and liquid scintillator
  P. Annis et al.
  Nucl. Instrs & Methods A367 (1995) 377-383

- Performance and calibration of the CHORUS scintillating fiber tracker and optoelectronics readout system
  P. Annis et al.
  Nucl. Instrs & Methods A367 (1995) 367-371

- Prototype tests and substrate studies for the CMS ~~central~~ forward tracker
  X. Lauwerys et al.
  Proceedings of the International Workshop on MSGC's - Legnaro Edizioni Progetto Padova (1995)

- The design and physical characteristics of a small animal PET
  R.M. Bloomfield et al.
  Phys. Med. Biol. 40 (1995) 1105-1126

- Test beam results of a cerium fluoride crystal matrix
  E. Auffray et al.
  Nucl. Phys. B44 (1995) 57-62

- First results on large Ce F_3 crystals in a test beam
  E. Auffray et al.
  Published in "Scintillators and Phosphor materials" edited by M. Weber, MRS, 1994, p. 117-122

- Test beam results of a Ce F_3 crystal matrix
  T. Beckers et al.
  Proceedings of the 5th International Conference on Calorimetry in High Energy Physics, UPTO, NY, 25 September - 10 October 1994

Varia

- Naar de kern van de materie
  C. De Clercq
  VELEWE, Tijdschrift van de vereniging van leraars in de wetenschappen, jaargang 39-1995, nummer 2

- Comments on the book "The Quantum Generation. Highlights and tragedies of the golden age of physics" by M. Ryutova-Kemoklidze, Ed. Springer Verlag
  P. Marage
  Physicalia XXXI n° 11 (1994)

- La physique avant le premier Conseil (Solvay)
  P. Marage and G. Wallenborn
  Les Conseils Solvay et les débuts de la physique moderne (1995) p. 77 to 108

- La naissance d'une nouvelle physique
  P. Marage and G. Wallenborn
  Les Conseils Solvay et les débuts de la physique moderne (1995) p. 111 to 245

- The book "Les Conseils Solvay et les débuts de la physique moderne" was edited by P. Marage and G. Wallenborn at the occasion of the related Exhibition and Colloquium (see section IX)

X.2. REPORTS.

- A study of radiative muon-pairs at Z° energies with the DELPHI detector
  Cao Fang, C. De Clercq and J. Lemonne
  DELPHI 95-63 PHYS 498

- A study of like-sign charged kaon correlations in Z° decays
  N. Pukhaeva, A. Tomaradze, F. Verbeure and L. Vitale
  DELPHI 95-25 PHYS 477

- Multiplicities and correlations : review of recent results
  F. Verbeure
  DELPHI 95-149 PHYS 572

- First measurement of $F_2'(1525)$ in Z° hadronic decays
  F. Verbeure
  DELPHI 95-160 PHYS 578

- F_2 measurement at low Q^2 using intial state radiative events
  L. Favart
  H1 note 07/95 - 444

- More on $R = \sigma_L/\sigma_T$ measurement using radiative events
  M. Gruwé, L. Favart, P. Marage and Z. Zhang
  H1 note 02/95 - 425

- Run selection for the H1 1993 F_2 analysis
  U. Bassler, ..., E. Evrard, P. Marage, A. Panitch, R. Roosen
  H1 note 02/95 - 428

- A global DIS event selection for the 1993 structure function measurement
  U. Bassler, ..., E. Evrard, P. Marage, A. Panitch, R. Roosen
  H1 note 02/95 - 429

- Energy calibration and resolution in the BEMC
  A. Panitch
  H1 note 08/95 - 449

- Treatment of the proton satellite bunches in 1994 data
  S. Levonian and A. Panitch
  H1 note 09/95 - 454

- High resolution tracking devices based on capillaries filled with liquid scintillator
  R. van Dantzig, ..., P. Annis, M. Gruwé, C. Mommaert, P. Vilain, G. Wilquet
  CERN LHCC 95-7; P60/LDRB

- Upgrade of the H1 forward proton spectrometer
  H1 Collaboration
  H1 12/95 - 467; PRC 96/01

- Cooling study for the CMS forward tracker
  S. Claes, W. Van Doninck and L. Van Lancker
  CMS TN/45-086

- Material specification and evaluation of the mechanical support structure for the CMS forward tracker
  S. Claes, W. Van Doninck and L. Van Lancker
  CMS TN/45-087

X.3. CONTRIBUTIONS TO CONFERENCES.

- The CHORUS ν oscillation experiment at CERN
  G. Wilquet
  International Europhysics Conference on High Energy Physics - Brussels (Belgium)

- Status of the CHORUS experiment
  M. Vander Donckt
  General Scientific meeting of the Belgian Physical Society meeting - Antwerpen (Belgium)

- Tau decay analysis with neural networks
  D. Bertrand and V. Lefébure; presented by V. Lefébure
  Applications and Sciences of Artificial Neural Networks SPIE 2492 (1995) 1098 - Orlando (USA)

- Tau decay analysis using neural networks
  D. Bertrand and V. Lefébure (DELPHI Collaboration); presented by V. Lefébure
  General Scientific meeting of the Belgian Physical Society meeting - Antwerpen (Belgium)

- Multiplicities and correlations : review of recent results
  F. Verbeure
  Invited talk at the International Europhysics Conference on High Energy Physics - Brussels (Belgium)

- Bose-Einstein correlations at LEP
  F. Verbeure
  Review talk at the International Symposium on Multiparticle Dynamics - Stara Lesna (Slovakia)

- Determination of σ^{μ} and Δ^{μ}_{FB} below the Z° peak from a study of $e^+e^- \rightarrow \mu^+\mu^-$ ($n\gamma$) events at LEP
  C. De Clercq
  IInd Rencontres du Vietnam - Ho Chi Minh City (Vietnam)

- Exclusive production of vector mesons in H1 at HERA
  P. Marage
  International Europhysics Conference on High Energy Physics - Brussels (Belgium)

- A measurement of the proton structure function F_2 (x, Q^2)
  E. Evrard (H1 Collaboration)
  General Scientific meeting of the Belgian Physical Society meeting - Antwerpen (Belgium)

- Micro strip gas counters : recent developments and use at the LHC
  P. Vanlaer
  International Europhysics Conference on High Energy Physics - Brussels (Belgium)

- Operation of MSGC's in Ne/DME and study of edge effects with side to side MSGC's
  O. Bouhali, ..., C. Vander Velde, W. Van Doninck, P. Vanlaer, L. Van Lancker and V. Zhukov
  International Workshop on Micro Strip Gas Chambers - Lyon (France)

- Tests of micro strip gas counters for forward tracking at the LHC
  O. Bouhali, M. Dezillie, C. Vander Velde, W. Van Doninck, P. Vanlaer and V. Zhukov (CMS Collaboration); presented by P. Vanlaer
  General Scientific meeting of the Belgian Physical Society meeting - Antwerpen (Belgium)

- MGC development for forward wheels of the CMS tracker
  J. Nelissen (CMS Collaboration)
  General Scientific meeting of the Belgian Physical Society meeting - Antwerpen (Belgium)

- The CMS detector and some selected prototype results
  W. Van Doninck
  IInd Rencontres du Vietnam - Ho Chi Minh City (Vietnam)

- Spin-off from scintillator research at CERN
  S. Tavernier
  Invited talk at the Four Seas Conference - Trieste (Italy)

- Design and physical characteristics of a small animal PET using Ba F_3 crystals and a photosensitive wire chamber
  X. Liu, S. Rajeswaran, S. Tavernier, S. Zhang
  PET Instrumentation for Small Animal Imaging Workshop - San Francisco (USA)

- Studies of a cerium fluoride matrix in a test beam
  T. Beckers (RD-18/Crystal Clear Collaboration)
  General Scientific meeting of the Belgian Physical Society meeting - Antwerpen (Belgium)

- The myth of Internet
  R. Vandenbroucke
  DECUS-BELUX Symposium - Blanckenberg (Belgium)

- Contribution to the Cogne XIII SPSLC Workshop
  - Report on JETSET and PS 202 at LEAR; CERN/SPSLC 95-60 vol. 2 p. 797-821
  - Report on PS/85/2 at LEAR; CERN/SPSLC 95-60 vol. 2 p. 822
  - Report on P291 (experimental study of the phenomenology of spallation neutrons in a large lead block); CERN/SPSLC 95-60 vol. 3 p. 999-1019

  G. Wilquet

- The International Union for Pure and Applied Physics and its C11 Commission on Particles and Fields
  J. Sacton
  Invited talk at the 17th International Symposium on Lepton and Photon Interactions - Beijing (Chine)

FIGURES

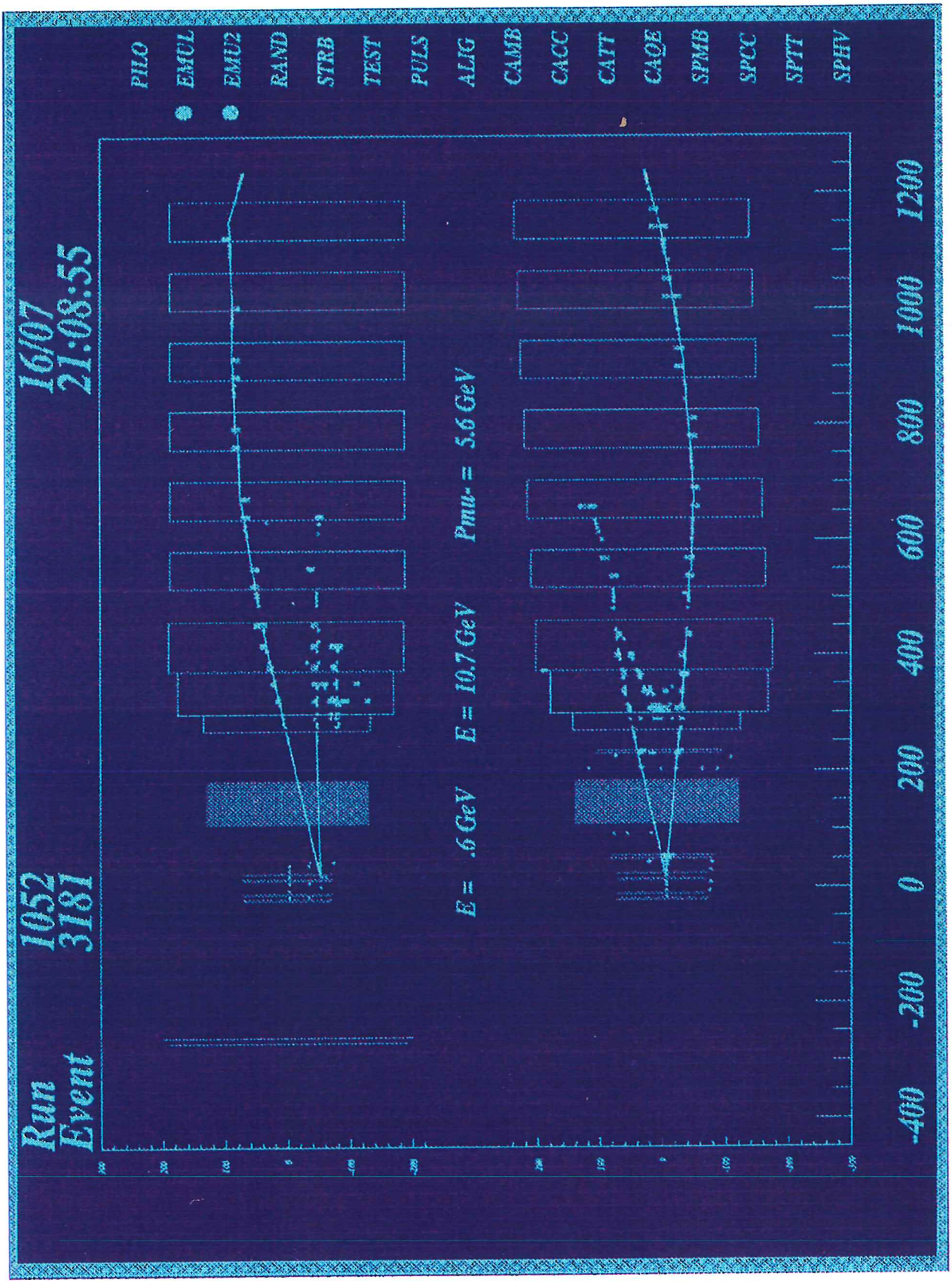


Fig. 1.: A di-muon neutrino interaction in the CHORUS detector.

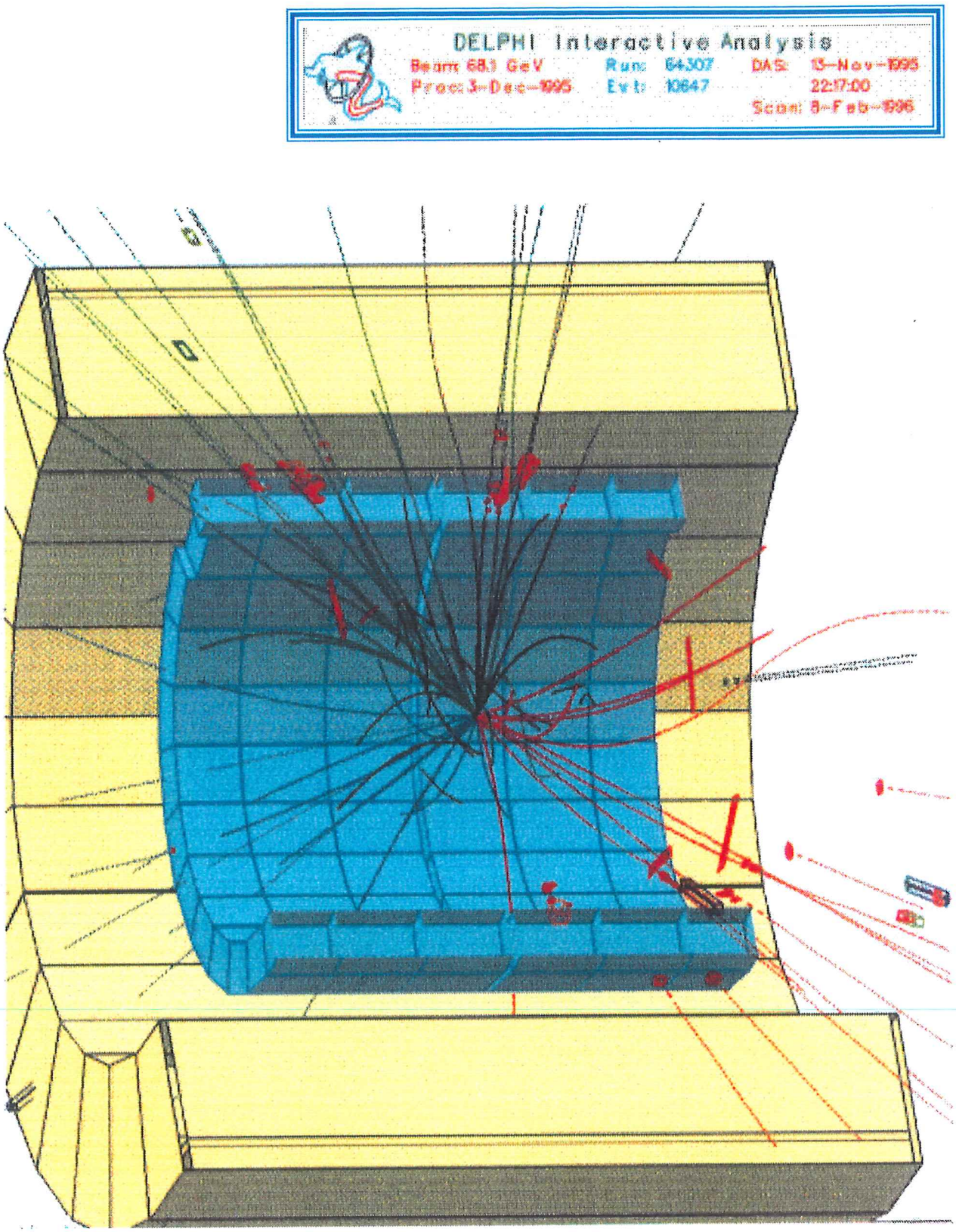


Fig. 2 : A four-jet event registred in the DELPHI detector at 135 GeV.

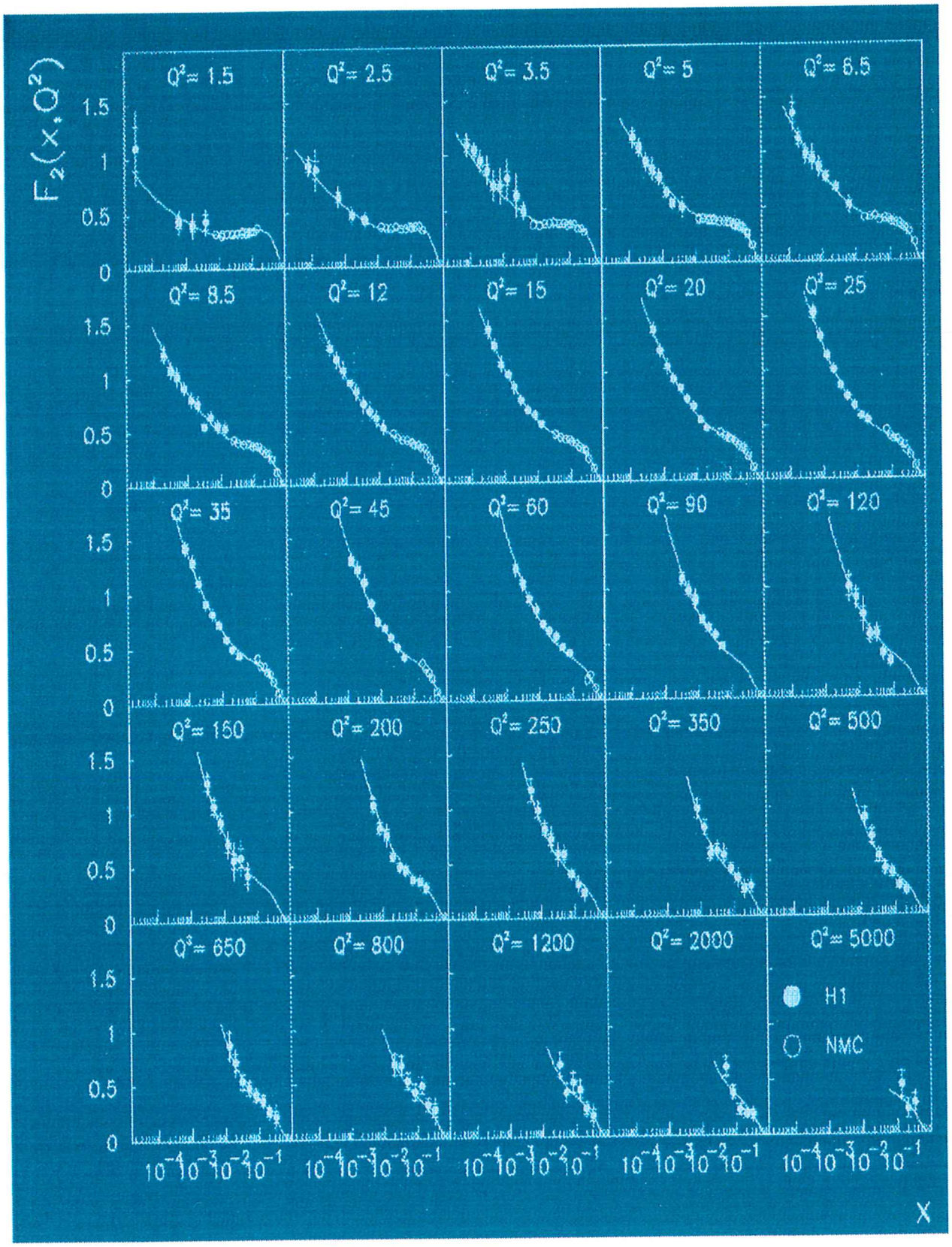
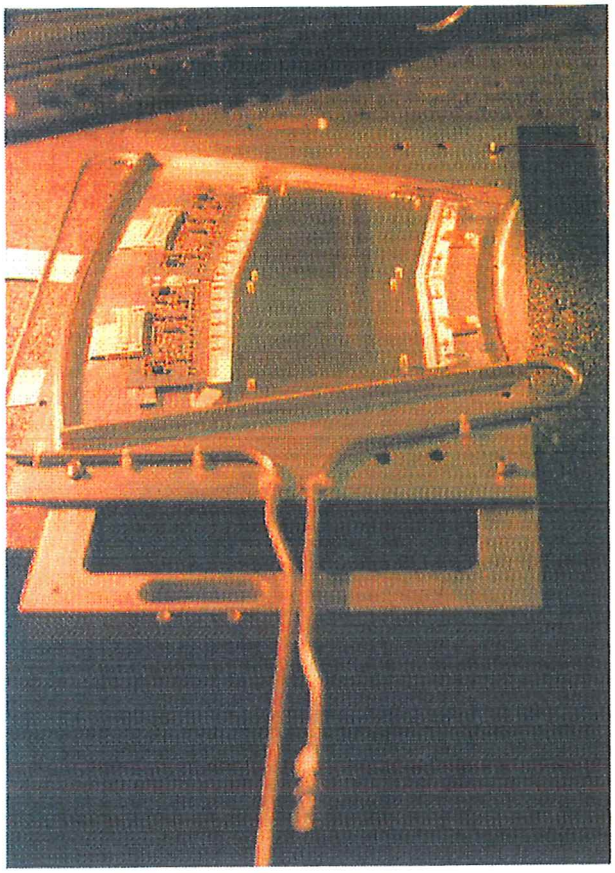


Fig. 3 : Measurement of the structure function $F_2(x, Q^2)$ as function of x for various Q^2-values expressed in GeV^2. The curves represent the NLO QCD fit.

Fig. 4 : CMS experiment - First sector prototype where two wedge shaped Micro Strip Gas Counters (MSGC's) are mounted side by side with a wall-less phi crack..



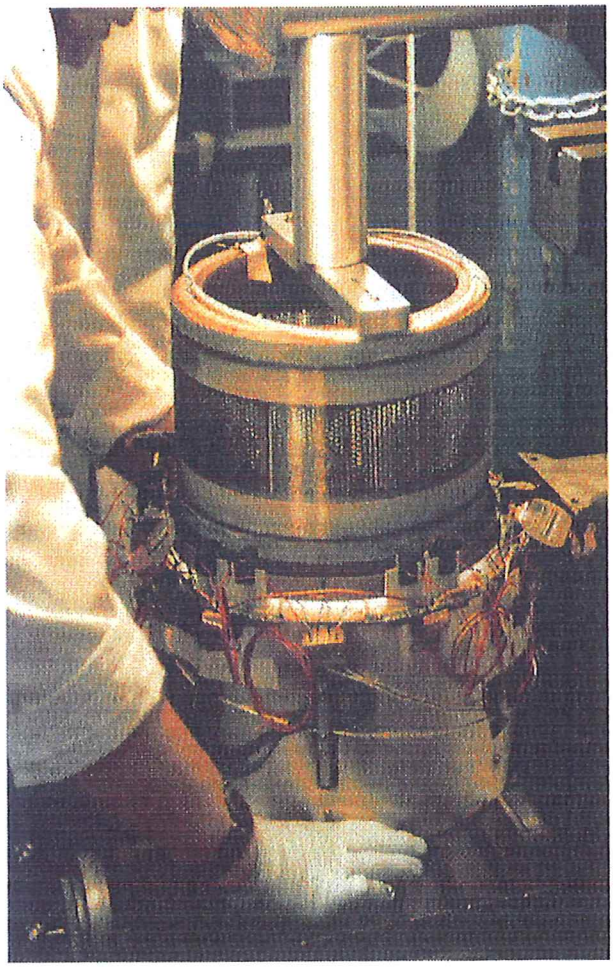


Fig. 5 : Detector part of the small animal PET scanner during assembly. The ring with 3000 BaF_2 crystals is being introduced in the wire chamber.

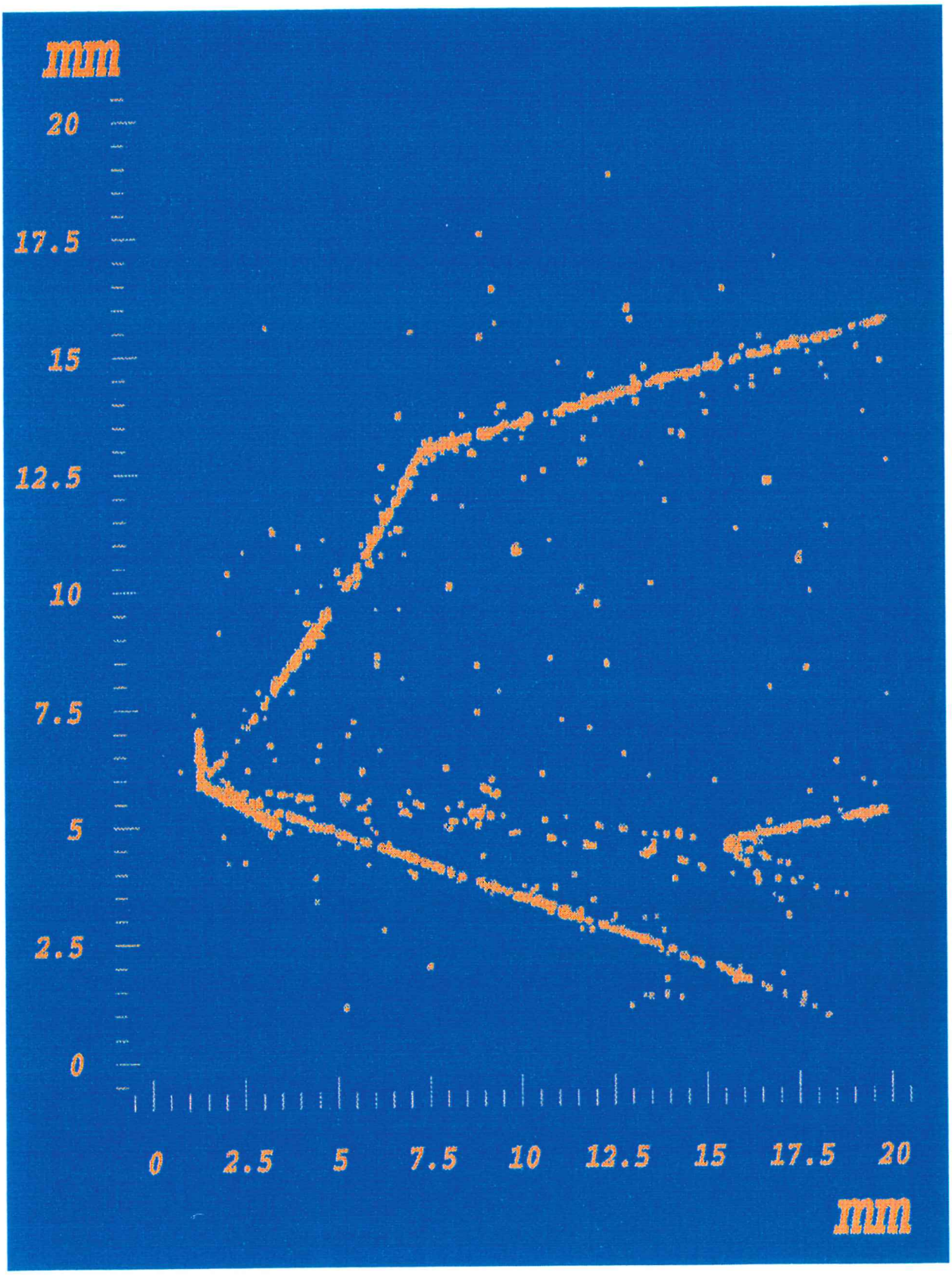


Fig. 6 : A neutrino interaction in the capillary target prototype tested in the Chorus set-up.

Fig. 7 : Part of the Solvay exhibition in the nice office of the conservator of the Royal Institute of Natural Sciences.

Fig. 8 : A general view of the Cern exhibition in the Royal Institute of Natural Sciences in Brussels.

Fig. 9 : Very attentive physicists during the sessions of the EPS-HEP95 Conference.

Fig. 10 : Young and dynamic contributors to the organisation of the Conference.

Fig. 11 : The participants of the EPS-HEP95 conference were received at the Brussels Town Hall.