INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES
ULB-VUB, Brussels

ANNUAL REPORT 1993

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J. LEMONNE and J. SACTON
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I. INTRODUCTION

The activities of the IIHE during 1992 were only partially reviewed in the 1972-1992 scientific activity report. For this reason, publications, contributions to conferences, workshops, seminars and schools which took place in 1992 will also be mentioned in the present report.

The physicists, engineers and computer scientists whose names are listed below have contributed to the different activities of the Institute during the year 1993.

U.L.B.

M. Barth (maître de recherche FNRS)
D. Bertrand (maître de recherche FNRS)
G. Bertrand-Coremans (chef de travaux)
C. Bricman (maître de recherche FNRS)
L. Favart (boursier IRSIA)
M. Gruwé (boursier IRSIA)
P. Huet (on leave for military service)
V. Lefébure (boursier IRSIA)
P. Marage (chef de travaux)
A. Panitch (boursier ULB)
J. Sacton (professeur ordinaire)
F. Stichelbaut (on leave for military service)
M. Vanderdonckt (boursier IRSIA)
C. Vander Velde (chargé de cours associé)
P. Van Laer (boursier IRSIA)
P. Vilain (chercheur qualifié FNRS)
J. Wickens (chercheur IISN)
G. Wilquet (chercheur qualifié FNRS)
V. Zhukov (visiting scientist from Moscow State University - 3 months)

V.U.B.

P. Bruyndonckx (vorser IWONL)
Cao Fang (VUBAROS fellow)
C. De Clercq (logistiek medewerker IIKW)
E. Evrard (vorser IIKW)
M. Goldberg (NFWO Sabatical from SOREQ-Israël)
T. Heiremans (vorser IIKW)
D. Johnson (hoogleraar VESALIUS College)
J. Lemonne (gewoon hoogleraar)
C. Mommaert (vorser IIKW)
J. Moreels (aangesteld navorser NFWO t.e.m. 30/06/1993)
R. Roosen (onderzoeksleider NFWO)
S. Tavernier (onderzoeksdirecteur NFWO)
R. Vandenbroucke-Tassin (logistiek medewerker IIKW)
W. Van Doninck (onderzoeksleider NFWO)
P. Van Esch (vorser IIKW)
Zhang Shuping (Rectorale beurs)

F. Verbeure, H. De Boeck, R. Chen, S. De Brabandere, E. De Wolf, 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 data and telecommunications has been conducted by P. Van Binst, F. Alexandre, A. Cohen, O. Paridaens, P. Paridans, J.M. Verbergt, E. Tsigros, R. Mzabet, E. Mannu, R. Najmabadi, B. Sales, A. Maimo, M. Colin, T. Nguyen, A. Guillen, S. Sattari from the ULB and by R. Vandenbroucke, N. Meulemans and S. Cekro from the VUB. These activities are reported in a separate document.

II. RESEARCH ACTIVITIES

II.1. NEUTRINO PHYSICS

II.1. 1. NEUTRINO AND ANTI-NEUTRINO INTERACTIONS IN THE BEBC BUBBLE CHAMBER

(P. Marage, J. Sacton)

1. WA59 Collaboration

(Athens, Bari, Birmingham, Brussels, CERN, Cracow, Ecole Polytechnique-Palaiseau, I.C. London, U.C. London, Munich, Oxford, Rutherford, Saclay, Stockholm)

New results were published by the WA59 collaboration using BEBC filled with a heavy H_2/Ne mixture. They report on the production rates and exclusive particle production properties of neutral strange particles (K^0_S, Λ^o, $\bar{\Lambda}^\circ$, Σ^0) using the largest available statistics in $\bar{\nu}$ interactions (1191 observed decays). The Λ hyperons were found to be polarised in the production plane, while the polarisation perpendicular to this plane is consistent with zero.

2. Big Bubble Chamber Neutrino Collaboration

Three BEBC Collaborations : WA21 (hydrogen), WA25 (deuterium) and WA59 (heavy neon-hydrogen mixture) combined their data, in collaboration with Russian groups from ITEP (Moscow) and IHEP (Serpukhov). The combined analysis led to the following results :

a. The diffractive production of charmed strange D^0_S and possibly D_S mesons was observed; the slope of the t distribution being (3.3 ± 0.8) GeV^{-2}. The production rate for charged

current neutrino interactions with an isoscalar target times the $D_S^+ \rightarrow \phi\pi^+$ branching fraction was found to be $(1.03 \pm 0.27)10^{-4}$.

b. The above mentioned data were also combined to those collected by the E180 Collaboration at FNAL (ν and $\bar{\nu}$ interaction on H_2-Ne in the 15-Foot Bubble Chamber) to study the Bose-Einstein correlations between like-sign charged pions. No substantial differences were found between the data sets obtained with neon, deuterium and hydrogen targets. In the Goldhaber parameterization, the radius of the pion emission region is ($0.80 \pm 0.04 \pm 0.16$) fm. and the chaocity parameter is ($0.61 \pm 0.04 \pm 0.15$). The data are compatible with a spherical shape of the emission region. No dependence of the effect is found on the target nucleon, on the multiplicity, on the forward/backward region and on the event kinematical variables.

3. Review of low Q^2, high ν neutrino physics

P. Marage and B.Z. Kopeliovich, a theoretical physicist at Dubna, wrote a review article on the main theoretical bases (CVC, PCAC, hadron dominance) and the experimental results of neutrino physics at low Q^2 ($\lesssim 1$ GeV^2) and high ν ($\gtrsim$ a few GeV). The experimental review mainly concerns the total ν-nucleon cross section and the production of π, ρ and $a_1/\rho\pi$ systems in atomic nuclei. Several of these results were obtained in the framework of the WA59 collaboration (shadowing, coherent interactions).

II. 1.2. NEUTRINO AND ANTINEUTRINO INTERACTIONS IN THE 15' BUBBLE CHAMBER FILLED WITH A HEAVY H2/NE MIXTURE AND EXPOSED TO THE TEVATRON HIGH ENERGY NEUTRINO BEAM

(M. Barth, E. De Wolf, P. Marage, J. Moreels, J. Sacton, L. Verluyten; E632 Collaboration : Berkeley, Birmingham, Brussels, CERN, Chandigarh, Fermilab, Hawaii, Illinois Institute of Technology, I.C. London, Jammu, Munich, Oxford, Rutgers, Stevens Institute of Technology, Tufts).

The coherent production of π and ρ mesons in ν_μ ($\bar{\nu}_\mu$)-neon charged-current interactions has been studied using the Fermilab 15-foot bubble chamber filled with a heavy Ne-H_2 mix and exposed to the Tevatron quadrupole triplet (anti) neutrino beam. The ν_μ ($\bar{\nu}_\mu$) beam had an average energy of 80 GeV (70 GeV). From a sample corresponding to approximately 28 000 charged-current interactions, net signals of (53 ± 9) $\mu^\pm \pi^\mp$ coherent events and (19 ± 7) $\mu^\pm \pi^\mp \pi^\circ$ coherent events have been extracted. For $E > 10$ GeV, the coherent pion production cross section was determined to be $(3.2 \pm 0.7) \times 10^{-38}$ cm^2 per neon

nucleus whereas the coherent ρ production cross section is $(2.1 \pm 0.8) \times 10^{-38} cm^2$ per neon nucleus. These cross sections and the kinematical characteristics of the coherent events at $|t| < 0.1$ GeV^2 are found to be in general agreement with the predictions of a model based on the hadron dominance and, in the pion case, on the partially conserved axial-vector current hypothesis.

II. 1.3. NEUTRINO AND ANTINEUTRINO SCATTERING ON ELECTRONS : THE CHARM-II EXPERIMENT (WA79)

(M. Gruwé, C. Mommaert, P. Vilain, G. Wilquet; CHARM-II or WA79 Collaboration : Brussels, CERN, Hamburg, Louvain-la-Neuve, ITEP-Moscow, Munich, Naples, Rome)

The analysis of the data accumulated between 1987 to 1991 is almost completed. The main aim of the experiment was a study of neutrino and antineutrino scattering on electrons. From the ratio of the differential cross sections of these reactions, the value of the electroweak mixing parameter, $\sin^2\theta_W$ was found to be

$$\sin^2\theta_W = 0.2324 \pm 0.0085$$

This study was complemented by a measurement of the shape of the differential cross sections, demonstrating in a direct way the coupling of Z° to right handed electrons.

The excellent granularity of the Charm-II detector has also allowed the selection of specific hadronic channels, leading to the following results :

- The cross sections of coherent single charged pion production have been measured. The observed signals of 748 ($\mu^- \pi$) and 631 ($\mu^+\pi$) events correspond to about 4 times the samples available until now. The results are in agreement with the predictions of models based on PCAC hypothesis.

- A search for quasi-elastic ν_τ interactions followed by the decay $\tau \rightarrow \pi \nu_\tau$ has been performed. The absence of signal allows to exclude values of $\sin^2 2\phi$ greater than 6.410^{-3} at 90% C.L., where ϕ is the ν_μ-ν_τ mixing angle.

II.I.4. SEARCH FOR ν_μ - ν_τ OSCILLATIONS : THE CHORUS EXPERIMENT

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

Approved in September 1991 by the CERN Research Board, this experiment is scheduled to take data during 1994 and 1995 in the wide band neutrino beam facility of the CERN-SPS. It aims at improving by more than one order of magnitude the existing upper limits on the parameters Δm^2, the difference between the ν_μ and ν_τ mass squared, and $\phi_{\mu\tau}$, the mixing angle between the 2 neutrino species, by detecting a few examples of the reaction ν_τ + nucleon $\rightarrow \tau^-$ + hadrons in a nuclear emulsion target. The localisation of the neutrino interactions in the target is performed by the accurate measurement of the trajectories of the outgoing charged products in several arrays of scintillating fibers.

Several years of R and D were necessary to improve both the fiber quality and the performances of the opto-electronic chain which amplifies the photonic signal and transform it into recordable electronic pulses. This year was mainly devoted to the construction and the installation of the various detector components. The IIHE, together with Louvain-la-Neuve, was in charge of the construction of 18 fibers arrays, each of about 2 m^2, and was involved in the assembly and the control of the 232 image intensifier tubes which form the CHORUS optoelectronic system. Furthermore, a CCD camera system was designed and the data acquisition program reading out these devices was written. Important contributions were also brought in the design and realisation of fast electronic modules used in the trigger logic.

In spite of a very tight time schedule, mainly due to delays in the delivery of the scintillating fibers, the full CHORUS detector could be completed at the end of October. During November, the detector has been exposed to various calibration beams and, for one week, to a neutrino beam. The accumulated data are being analysed to establish the detector performances.

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

(D. Bertrand, C. Bricman, F. Cao, H. De Boeck, S. De Brabandere, C. De Clercq, V. Lefébure, J. Lemonne, F. Stichelbaut, C. Vander Velde, W. Van Doninck, 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-Moscom, 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 DELPHI runs were very successful in 1993 with integrated luminosities of 15.8 pb^{-1} at the Z°-peak and 8.6 pb^{-1} at peak-2 GeV and 9.3 pb^{-1} at peak + 2 GeV, respectively. An additional statistics of approximately 106 000 leptonic and 754 000 hadronic Z°-events was accumulated.

The main results presented at conferences or published during 1993 can be summarised as follows :

[A] Measurement of the Z° resonance parameters and electroweak coupling based on the analysis of a sample of approximately 1 170 000 Z°-decays accumulated until the end of 1992 were reported at the EPS-HEP Conference in Marseille. Allowing for independent couplings for the different lepton species, a 9 parameter fit to the hadronic cross sections and to the leptonic cross sections and asymmetries yields the following parameters :

$$M_Z = 91.188 \pm 0.009 \text{ GeV}$$

$$\Gamma_Z = 2.482 \pm 0.012 \text{ GeV}$$

$$\sigma_o^h = 41.02 \pm 0.27 \text{ nb}$$

$$R_e = \frac{\Gamma_h}{\Gamma_e} = 20.70 \pm 0.18$$

$$R_\mu = \frac{\Gamma_h}{\Gamma_\mu} = 20.48 \pm 0.15$$

$$R_\tau = \frac{\Gamma_h}{\Gamma_\tau} = 20.88 \pm 0.20$$

$$A_{FB}^{o\,e} = 0.0237 \pm 0.0092$$

$$A_{FB}^{o\,\mu} = 0.0143 \pm 0.0050$$

$$A_{FB}^{o\,\tau} = 0.0213 \pm 0.0068$$

B The longitudinal polarisation P_τ of τ-pairs has been measured in 5 different τ-decay channels leading to the results

Decay mode	P_τ
$\tau \rightarrow e\,\nu\,\bar{\nu}$	-0.092 ± 0.140
$\rightarrow \mu\,\nu\,\bar{\nu}$	-0.062 ± 0.088
$\rightarrow \pi\,\nu$	-0.212 ± 0.055
$\rightarrow \rho\,\nu$	-0.128 ± 0.042
$\rightarrow a_1\,\nu$	-0.181 ± 0.089
Combined data	-0.151 ± 0.029

The τ-lifetime was measured by four different methods leading to the overall result $\tau_\tau = 298 \pm 7$ fs. The ratio of the Fermi coupling constant from τ-decay relative to that from muon decay was found to be 0.985 ± 0.013, compatible with lepton universality.

Improved measurements of τ branching fractions into kaons and into other exclusive and inclusive channels have been performed.

C The following topics were studied in hadronic Z°-decay :

i) Determination of α_s :

- from the scaling violation in the hadronic fragmentation functions ($\alpha_s(M_z^2) = .118 \pm .005$);
- from the study of the distributions in thrust, heavy jet mass, energy-energy correlations ..... ($\alpha_s(M_z^2) = .123 \pm .006$);

- for b-quarks ($\alpha_s^b/\alpha_s^{udsc} = 1.00 \pm .04 \pm .03$ in agreement with flavour independence as predicted by QCD)

ii) A sample of 4-jet events was used to study the contribution of the triple gluon vertex. The results were found to be in agreement with the expectations from QCD

iii) The inclusive production of the meson resonances ρ°, $K^{*\circ}(892)$, $f_0(975)$ and $f_2(1270)$ was measured and compared to the predictions of the Monte Carlo generators JETSET 7.3PS and HERWIG 5.4.

iv) A study of the fragmentation properties of charm and bottom quarks into D-mesons was performed

✓ v) A study of B-meson decays into D ℓ^- x final states produced results such as :
- the mean value of the B meson energy fraction in b-quark fragmentation
  $\langle x_E(B) \rangle = .695 \pm .015 \pm .029$
- the average B-meson lifetime $\tau_B = (1.23^{+.14}_{-.13} \pm .15)$ ps

✓ vi) A sample of 253 B-meson decays reconstructed using the charged particles recorded in the silicon microstrip detector allowed the following lifetime estimates

$$\tau_{B^+} = (1.56 \pm .19 \pm .13) \text{ ps}, \quad \tau_{B^\circ} = (1.55 \pm .25 \pm .18) \text{ ps}$$

$$\tau_{B^+} / \tau_{B^\circ} = 1.01^{+.29}_{-.29} \pm .12$$

✓ vii) Evidence was found for the production of Λ_b decays in a sample of Λ-ℓ events. From a sub- sample of 18 decay vertices reconstructed in the muon data sample the Λ_b - lifetime was measured to be $\tau(\Lambda_b) = (1.04^{+.48}_{-.38} \pm .10)$ ps

✓ viii) A study of semi-leptonic decays of B-hadrons led to the results :

- BR ($b \rightarrow \ell$) = $(10.0 \pm .7 \pm .7)$ %
- The B-$\bar{B}$ mixing parameter $\chi = .121^{+.044}_{-.040} \pm .017$

✓ D Negative searches were made for scalar leptoquarks and lepton flavour violation in Z° decays (95% C.L. upper limits 3.2×10^{-5} for $Z^\circ \rightarrow e\,\mu$, 10.8×10^{-5} for $Z^\circ \rightarrow e\,\tau$ and 13.5×10^{-5} for $Z^\circ \rightarrow \mu\tau$).

During 1993 the interest of the Belgian Delphi groups active in the framework of the IIHE was mainly oriented towards the study of $Z^\circ \rightarrow \mu^+\mu^-$ and $Z^\circ \rightarrow \tau^+\tau^-$ line shapes and asymmetries, τ-polarisation and decay properties, measurements of the $Z^\circ \rightarrow b\bar{b}$ partial width and asymmetry and of two particle correlations in hadronic interactions.

II.3. STUDY OF e^-p COLLISIONS AT HERA.

(M. Barth, G. Bertrand-Coremans, E. De Wolf, E. Evrard, D. Johnson, P. Huet, L. Favart, P. Favart, P. Marage, J. Moreels, A. Panitch, R. Roosen, J. Sacton, P. Van Esch, P. Van Mechelen : H1 Collaboration : RWTH-Aachen, Birmingham, IIHE (ULB-VUB), Rutherford Appleton Laboratory, Cracow, University of Californai-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)

In 1992, the first year of data taking at the e-p collider HERA (at DESY, Hamburg), the H1 collaboration has accumulated good quality data in two runs corresponding, respectively, to integrated luminosities of 1.5 and 25 nb^{-1}. In 1993, good quality data corresponding to 300 nb^{-1} were taken. The two-layer cylindrical Central Outer Proportional Chamber (COP), built by the IIHE and incorporated in the first level trigger, worked correctly during these periods except for one broken wire, leading to the loss of 3/16 of the outer layer. The data acquisition electronics of the multiwire proportional chambers conceived and built in Brussels, as well as the DAQ software worked properly at a high acquisition rate.

Most of the results presented below are based on the 1992 data.

The IIHE group has participated mainly to the analysis of the proton structure function using deep inelastic events.

A *PHOTOPRODUCTION*

The e-p cross section at HERA is dominated by low Q^2 photon exchange. Already with the 1.5 nb^{-1} statistics of the first 1992 run, the H1 collaboration could measure the total quasi-real γ-p cross section, found to be $(159 \pm 7 \pm 20)\mu b$. This moderate value does

not support mini-jet models predicting a strong rise of the γ-p cross section with energy; it is in agreement with Regge motivated parameterisation.

Based on the same statistics, the collaboration reported the existence of a hard component in the photon ("resolved photon" interactions) observed in single particle pseudorapidity and transverse momentum distributions, and in jet formation (multijet correlations, jet transverse momentum and jet energy flow distributions).

With the full 1992 statistics, the inclusive jet cross section was measured, allowing to test the gluon content in the proton. The shape of the jet energy distribution is well described by leading order QCD calculations, whereas models assuming a very high gluon density at large x_γ are ruled out. However, none of the tested models describe well the measured jet pseudorapidity distribution.

B *DEEP INELASTIC SCATTERING*

One of the major goals of the HERA experiment is to measure the proton structure functions up to very high Q^2-values, and down to very low x-values.

Almost hundred deep inelastic events with $Q^2 > 5$ GeV^2 were collected in the first H1 run, with little background and small smearing effects in x and Q^2, reaching x-values as low as 10^{-4}. With the full 1992 statistics, the proton structure function F_2 (x, Q^2) could be measured for the first time in the low-x region (about 1000 neutral current events with Q^2 between 5 and 100 GeV^2 and x between 10^{-2} and 10^{-4}). These data allowed to narrow significantly the possible range of proton densities at small x ($x < 10^{-2}$) : parameterization with steeply rising F_2 structure functions at low x are clearly favoured.

The measurement of scaling violations of F_2 at small x-values showed no deviation from the logarithmic Q^2-dependence expected from QCD calculation. This dependence was used to derive the first measurement of the gluon distribution at very low x, which is observed to rise with decreasing x.

The hadronic final state in deep inelastic scattering can be used for several QCD tests. In particular, studies of energy flow, transverse momentum and pseudorapidity distributions, based on nearly 100 events from the first run, showed that hadronisation models based on first order matrix element calculations with additional proton shower evolution and in colour dipole radiation are both able to describe the data without adjustment of parameters. In contrast, the leading log parton shower approach fails if either a Q^2 or a W^2 scale is chosen for gluon radiation, - an intermediate scale being acceptable.

C *SEARCH FOR EXOTIC PARTICLES*

Based on the full 1992 statistics, a search was performed for leptoquarks, leptogluons and excited leptons. No evidence was found for the production of such particles, as investigated in several decay channels.

III. TEACHING ACTIVITIES AND SEMINARS

III.1. TEACHING ACTIVITIES

- **M. Barth, G. Coremans-Bertrand, M. Gruwé, P. Huet, P. Marage, F. Stichelbaut, C. Vander Velde, 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" (30h - 1st year University Studies in Sciences - ULB)
- "Prise, analyse et simulation de données expérimentales (10h - Licence Spéciale en Physique Théorique et Mathématique - 2ème Licence en Physique - ULB)

- **G. Bertrand-Coremans**

- "Questions Approfondies de Physique des Particules" (10h + 15h of practical work (part-time) - 2ème licence en sciences physiques - ULB)
- Participation to the practical work of the "1ère candidature polyvalente en médecine et pharmacie" - 120h

- **P. Bruyndonckx** contributed to laboratories attached to the physics courses ensured by D. Johnson for the VESALIUS College.

- **P. Bruyndonckx, C. De Clercq, E. Evrard, S. Tavernier, 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**

- "Aanvullingen der wiskunde : waarschijnlijkheidsrekening en statistiek - 1ste licentie Natuurkunde UIA (30u)
- "Fundamentele wisselwerkingen tussen elementaire deeltjes" - 2de licentie Natuurkunde UIA (30u)
- "Experimentele studie van wisselwerkingen tussen elementaire deeltjes - 2de licentie Natuurkunde UIA (15u)

• **D. Johnson**

- "Introduction to Physics II - Physics 103" (45h - Vesalius College - VUB)
- "Introduction to Physics I - Physics 101" (45h - Vesalius College - VUB)
- "Solid State Physics - Physics 202" (45h - 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" (60h + 60h of practical work - 1ste and 2de licentie natuurkunde - VUB)
- "Algemene Natuurkunde" 2de kandidatuur Natuurkunde en Scheikunde VUB (60h + 60h of practical work and Geologie (30h + 30h of practical work at the VUB)
- "Statistische Analyse van Experimentele Gegevens" (15h + 15h excercises - licentie Natuurkunde - VUB)

• **P. Marage**

- Participation to the practical work (general physics) of the 1ère candidature Ecole de Commerce Solvay (60h) - ULB
- "Histoire des sciences" (15h) - 2ème licence en Sciences Physiques et 2ème Licence en Sciences Mathématiques - ULB

• **E. Evrard and P. Van Esch**

- "Algemene Natuurkunde" (30h excercices) - 2de kandidatuur Natuurkunde, Scheikunde - 1ste Lic. Geologie - Prof. J. Lemonne - VUB)

• **J. Sacton**

- "Physique des Particules Elémentaires" (30h - 1ère licence en sciences physique - ULB)

• **S. Tavernier**

- "Detectie van Ioniserende Stralingen" (15h + 15h of practical work - 2de licentie Natuurkunde and Bijzondere Licentie Medische Fysica - VUB)

• **C. De Clercq, T. Heiremans and S. Tavernier**

- Practical work 2de Kandidatuur Natuurkunde, VUB

• **C. Vander Velde**

- "Mechanics 2" (26h + 13h of exercises) and "Introduction to Experimental Physics (8h + 16h lab) - 1st year University Studies in Sciences - ULB
- "Prise, analyse et simulation de données expérimentales" (part-time 10h - licence spéciale en Physique Théorique - ULB)
- "Laboratory" - 1st year in University Studies in Sciences - ULB
- "Participation to the practical work (general physics) 1ère cand. Chimie et Math. (60h)
- "Tracking in HEP Collider Experiments"
  Series of 4 lectures given at the 1993 Joint Belgian-Dutch-German (Aachen) School of Particle Physics

• **W. Van Doninck**

- "Industrial Physics" (45h - 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 10h + 15h of practical work - 2ème licence en sciences physique - ULB)
- "Participation to the practical work (general physics) 1ère cand. Ecole de Commerce Solvay (60h)

• **G. Wilquet**

- "Prise, analyse et simulation de données expérimentales (10h - Licence Spéciale en Physique Théorique et Mathématique - 2ème Licence en Physique - ULB)

The following thesis works, "mémoire de licence", "licentieverhandelingen" and final year research works in applied siences were completed during 1993.

THÈSES D'AGRÉGATION (1992)

- **D. Bertrand** : Le Modèle Standard à l'épreuve du LEP
- **P. Marage** : La physique du neutrino à petit transfert de quadri impulsion et à grand transfer d'énergie

PH.D. THESIS (1993)

- **P. Huet** : A VME bus-based data acquisition system for the multiwire proportional chambers of the H1 detector at the HERA collider
- **F. Stichelbaut** : La détection des muons dans l'expérience DELPHI et son rôle dans l'étude de l'interaction $e^+e^- \rightarrow \mu^+\mu^-$

MÉMOIRES 1992

- **J. Stefanescu** : Discrimination entre paramétrisations des fonctions de structure du nucléon au collisionneur HERA
- **R. Van Praag** : Contribution à l'identification de l'électron dans le calorimètre arrière du détecteur H1 à HERA
- **I. Ben Rabah** : Détermination du rendement lumineux d'une fibre scintillante entrant dans la composition d'un détecteur

MÉMOIRES 1993

- **I. Chatzantonakis** : Contribution à l'évaluation d'une chaîne optoélectronique pour la lecture de détecteurs en fibres scintillantes.
- **B. Dutrieue** : Contribution à l'étude de la réponse des compteurs à gaz à microstrip en fonction de l'angle d'incidence des particules
- **V. Lefebure** : Etude de l'universalité leptonique par l'analyse comparée des interactions $e^+e^- \rightarrow \mu^+\mu^-$ et $e^+e^- \rightarrow \tau^+\tau^-$ produites au LEP
- **A. Panitch** : Reconstruction du vertex d'interaction dans l'expérience H1 à HERA
- **L. Simon** : Etude de la rapidité des hadrons dans les interactions profondément irélastique electron-proton à HERA

TRAVAIL DE FIN D'ÉTUDES (SCIENCES APPLIQUÉES)

- **P. Van Laer** : Simulation du développement des avalanches dans une chambre multiple

MÉMOIRES ERASMUS 1993

- **L. Donadille et S. Grimault** : Etude de la production quasi élastique de mésons ρ° dans l'expérience H1 à HERA

VERHANDELINGEN 1992

- **I. Puttaert** : Studie van de overgang van het proportioneel- naar het stromerregime als funktie van de initiële ionisatie opgewekt in een driftkamer
- **K. Van Ouytsel** : Bijdrage tot de proefondervindelijke studie van de voorwaarts-achterwaartse asymmetrie in $Z^\circ \rightarrow \tau^+ \tau^-$ processen waargenomen in het DELPHI-LEP experiment
- **R. Voets** : Bijdrage tot de proefondervindelijke studie van τ polarisatie in $Z^\circ \rightarrow \tau^+ \tau^-$ vervallen in het DELPHI-LEP experiment

VERHANDELINGEN 1993

- **P. Van Esch** : Fotoproduktie contaminatie in diep-inelastische ep verstrooiing waargenomen in het H1-HERA expeirment
- **B. De Rooms** : Bijdrage tot de bepaling van de voorwaarts-achterwaartse asymmetrie in de reactie $e^+e^- \rightarrow \mu^+\mu^-$ bij LEP

AFSTUDEERWERKEN 1992

- **K. Verhoeven** : Optimalisatie van het foton rendement van BaF_2 scintillatiekristallen voor het gebruik van een PET-camera
- **F. Camermans** : Optimalisatie via computersimulatie van een neutrinodetector

AFSTUDEERWERKEN 1993

- **W. Couwenbergh** (Fac. Toegepaste Wetenschappen) : Bijdrage tot de simulatie van de microstrip gasteller in de CMS detector voor de Large Hadron collider te CERN.

III.2. SEMINARS

The following seminars were given by members of the IIHE

- **M. Goldberg**
  Element-specific Radiographic Imaging via Gamma-Ray Nuclear Resonance Absorption (IIHE, Brussels)

- **P. Marage**
  - Low Q^2, high ν neutrino physics (CVC, PCAC, Hadron dominance, Harvard University-USA, 1992)
  - Physics at HERA with the H1-detector (Tufts University-USA, 1992)

- **W. Van Doninck**
  - Leptonic decays of the Z° from an experimental point of view (Aken-Duitsland, 1992)
  - Een reis in het oneindig kleine (Fysica demo-Wetenschapsweek, VUB, 1992)

- **E. De Wolf**
  Intermittency to Hot Spots ?
  Invited talk at Dept. of Theoretical Physics (Lund University, Sweden,1992)

- **C. De Clercq**
  Belgische bijdrage tot het DELPHI experiment bij de LEP versneller van het CERN (Bijscholing Natuurkunde voor leraars S.O. , VUB, 1992)

- **J. Sacton and C. Vander Velde**
  Le CERN et l'exploration de l'infiniment petit (Centre universitaire, un film scientifique, ULB, 1992)

- **Zhang Shuping**
  A small animal PET scanner based on TMAE +MSAC (Coimbra-Portugal, 1993)

- **C. De Clercq**
  Recent results on Electro-Weak precision tests at LEP (IIHE, Brussels - 1993)

- **C. Mommaert**
  Opto-electronical readout of the scintillating fiber tracker in the CHORUS experiment (ICFA School on Instrumentation in High Energy Physics, Bombay-India, 1993)

- **S. Tavernier**
  - Technologie uit de hoge energie fysica toegepast op Postitron Emissie Tomografie (UIA-Antwerpen, 1993)
  - New developments in PET instrumentation (Goethe Universität-Frankfurt, 1993)
  - Fast readout electronics for positron emission tomography (Warsaw-Poland, 1993)

- **J. Sacton**
  The High Energy Physics Computing Coordinating Committee (Plenary ECFA meeting CERN - 1992)

IV. COMPUTER MATTERS

IV. 1. COMPUTING AND NETWORKING

During 1993 the VAX8200 has been replaced by two VAXstations (a VAXstation 4000/90 and a VAXstation 4000/90) thereby realizing an upgrade on the available processing power and processing speed on the VAX platform. Two DECstations were acquired : the first one is mostly dedicated to the physics work analysis of the H1 experiment; the second one is mainly used for mechanical design. There were also Macintoshes installed for data acquisition purposes and one PC for electronical designs.
To enable the use of graphical software, which is now essential in the day-to-day physics work, X-window terminals were installed.

New software was acquired for mechanical design on the DECstations and software for electronical design on the PC. With DIGITAL a "DECcampus" contract was

signed providing us with a whole range of software for all DIGITAL platforms at a reasonable price.

During 1993 the local network of the IIHE was partly renewed : new cabling and more repeaters were installed to cope with the increasing use of the local ethernet. Concerning wide area networking, the laboratory could start using a 1 Mbps connection to EUROPAnet thereby getting a much better connection to CERN and DESY.

IV. 2. GRAPHICS DEVELOPMENT

(D. Bertrand, T. Heiremans)

The general interactive graphics analysis program has been adapted to the UNIX platforms environment. Two types of machines were used with success :

- A DecStation working under the ULTRIX v 4.2 operating system
- A DecAlpha 3000/500 station using the OSF/1 v 1.3 operating system

The X11 based user interface is working on these stations within the Motif windowing system. The communication between the asynchronous processes of the graphics package is performed in real time using a shared memory area with semaphores.

The development of an interactive graphical interface in the context of multidimensional analysis was pursued. It resulted in the production of a prototype which will be included in the software PAW (Physics Analysis Workstation) developed at CERN and used by most of the community of high energy physicists.

V. TECHNOLOGICAL R&D

V.1. TECHNOLOGY TRANSFER FROM BASCIC RESEARCH TO APPLICATIONS

(P. Bruyndonckx, M. Goldberg, S. Tavernier and S. Zhang; Collaboration : Brunel University, Brussels, CERN, Ecole Polytechnique-Palaiseau and LAL/Orsay).

The photosensitive wire chamber technology was developed over the last decade in a number of High Energy Physics research institutes. It allows to detect and localise very weak light signals over large areas. It is now used in a number of instruments like the

DELPHI Ring Image Cherenkov detector. The aim of the present project is to use this technology to build a Positron Emission Tomograph camera with improved performances compared to present commercial systems.

Positron Emission Tomography (PET) is a non-invasive, a traumatic method which allows the in vivo determination of the three-dimensional density distribution of a radioactively labelled substance. It is an important medical research tool.

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 511keV 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.

We are now building a small, high resolution PET-scanner to be used for laboratory animals, based on the photosensitive wire chamber technology. This instrument contains 3060 BaF_2 crystals measuring 3 x 3 x 20 mm^3. It will allow a resolution in the image of better than 3 mm in all 3 space directions. This project is partially funded by the EC Human Capital and Mobility program in a network involving the IIHE (Brussels), Hammersmith Hospital (London), Deutsches Krebsforschungzentrum (Heidelberg), Ospedale San Raffaele (Milano) en Rigshospitalet (Copenhagen). The instrument will be build in Brussels and evaluated in these different hospitals for biomedical research applications.

V.2. R&D ON THE SCINTILLATING FIBERS TECHNOLOGY

(M. Gruwé, C. Mommaert, P. Vilain, G. Wilquet; Collaboration : IIHE(Brussels), Universities of Rome and Louvain, CERN, IHEP Protvino and JINR Dubna)

On top of the construction of large scintillating fibre trackers for the Chorus experiment (see II.1.4) the special R&D program on the development of large scale high resolution targets has been persued, using the technology of bundles of thin (20 μm diameter) coherent glass capillaries filled with a liquid scintillator.

The goal is to design and construct a prototype target of 2 x 2 x 150 cm to be integrated in the Chorus detector in the CERN neutrino beam, for the 1994 and 1995 runs. Such targets have been developed in collaboration with Schot Fibre Optics, USA who managed to provide us with a satisfactory prototype in late 1993, the main difficulty residing in the coherency of the bundle along its length. Tests of former prototypes with a new liquid

scintillator developed by Geosphera, Russia, showed a record attenuation length of over 3m and a hit density of around 4 mm^{-1} at the far target end. A 4-image intensifiers chain has been designed, with two tubes from Geosphera, Russia, and two from Varo, USA, specially adapted to our needs in order to couple to a Megapixel CCD from Thomson with the required compacity, gain, and space and time resolutions. The data acquisition and the trigger systems to be integrated into the Chorus experiment have also been finalised. Orders for all items have been sent and their delivery is in progress, in time with the foreseen schedule.

V.3. CONTRIBUTION TO THE DESIGN OF PART OF THE CMS-DETECTOR FOR LHC

(E. De Wolf, J. Lemonne, J. Sacton, S. Tavernier, C. Vander Velde, W. Van Doninck, P. Van Laer, F. Verbeure, P. Vilain, G. Wilquet and J. Wulleman, ; 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)

Five Belgian research groups from the IIHE (VUB/ULB), UIA, UMH and UCL joined their efforts in view of their participation to the LHC experimental program. They are members of an international collaboration that proposed the Compact Muon Solenoïd (CMS) detector. This project is one out of the three proposed multi purpose detectors (ATLAS, CMS, L3P) for pp physics at an interaction point of the Large Hadron Collider (LHC) planned in the LEP tunnel at CERN. After scrutiny by the LHCC scientific committee, two detector proposals were selected and approved by the CERN Research Board; i.e. ATLAS and CMS.

The Belgian effort concentrates on the central tracking system of the CMS detector (see figure 2) which mainly consists of an assembly of some 20 000 Micro Strip Gas Counters (MSGC's). In this respect, the Belgian groups contribute to both :

- the international generic R&D program concerning this novel technique (RD28)
- the specific CMS related R&D for the design of the central tracking system

So far the Belgian, and in particular the IIHE research efforts, have concentrated on generic R&D on substrate development, design of layout and mechanical

support structures, MSGC prototype manufacturing, experimental test benches for MSGC prototypes, prototype tests, MSGC simulation studies and design of read-out electronics.
A short progress review is given below.

One of the known drawbacks of glass substrates commonly used for MSGC fabrication, is the polarisation and charging up of the glass in the presence of strong electric fields, resulting in a gain drop of the avalanche charge. An international research effort is devoted to ways of curing this drawback through the development of slightly conductive glasses, ion implantation and conductive coatings. In close collaboration with IMEC (Leuven), NIKHEF (Amsterdam) and the university of Pisa, different substrate production techniques are investigated (photo-lithography; lift-off; ion implantation and surface coatings). The first samples of substrates produced in Belgium (IMEC) will be available soon.

The Belgian groups being responsible for part of the forward tracking system of CMS have produced a first design of a forward "wheel". A back to back assembly of two discs made from a carbon fiber-honeycomb composite structure is envisaged to support 484 MSGC's in 10 concentric rings. First finite element analysis calculations indicate acceptable deformations due to gravity ($\lesssim 5$ μm). In collaboration with the engineering department of the VUB (Prof. P. De Wilde) a 1:5 scale model and a full size sector of such a structure will be built and tested.

Benefiting from the tooling developed in NIKHEF, several MSGC counters have been built there by a IIHE technician. They are now operational at the IIHE. An infrastructure similar to the NIKHEF one is being set up at the IIHE including clean room, ultrasonic wire bounder, substrate inspection microscopes, projection table, etc.
A batch of 20 substrates has been purchased from SRON to allow the construction of several 64 channel MSGC counters.

Several set-ups have been developed and built to allow the study of prototype MSGC counters. One is based on the modification of an existing cosmic tracking hodoscope equipped with drift chambers. It will allow a detailed investigation of the MSGC efficiency for minimum ionising particles (cosmic muons) w.r.t. the angle of incidence.
The second set-up is based on a pulsed N_2 laser. A precision x-y-z stage (1 μm) allows the scanning of the entire MSGC surface to evaluate uniformity of response, dead space between adjacent substrates, etc.

Awaiting the completion of the test set-ups, 2 MSGC 64 channel prototypes have been made operational at the IIHE. Using an Ar/C4H10 40/60 gas mixture, the collected charge spectrum has been measured in an exposure to a Fe^{55} radioactive source, yielding the

characteristic shape. Pulses from the N_2 laser have also been detected. A data acquisition system based on NIM and CAMAC read by a MacII computer has been developed for the prototype tests.

In collaboration with NIKHEF, first measurements have been performed of MSGC efficiencies w.r.t. the angle of incidence in the plane perpendicular to the strip orientation. For this experiment, a stack of 4 MSGC's was exposed to cosmic radiation.

A Monte Carlo simulation study has been performed at the IIHE to investigate the response, and in particular the efficiency, of MSGC's to incident minimum ionising particles at various angles of incidence w.r.t. the substrate plane. The dependence upon the gas mixture and width of the gasgap have also been studied. A substantial drop of efficiency for large angles w.r.t. normal incidence, especially in the plane perpendicular to the strip orientation, is predicted and clearly observed in the first measurements.

A joint international R&D effort has been launched for the design and development of radiation hard read out chips for MSGC . Highly integrated 128 channel chips of preamplifier-shaper-pipeline buffer are envisaged to read out the numerous ($\sim 10^7$) channels of the CMS central tracker. In collaboration with IMEC, CERN, NIKHEF and Lyon, an adapted version of the Fastplex chip is under study.

The IIHE contributed via the theoretical evaluation of a low noise preamplifier in the Thomson BiCMOS and Mietec 1,5 μm CMOS processes. A 1,5 μm CMOS Mietec 5 channel prototype will be available soon for testing.

VI. TECHNICAL AND ADMINISTRATIVE WORK

The members of the workshop staff were : J. De Bruyne, H. De Nil, M. Devos, J.P. Dewulf, L. Etienne, S. Franchomme, R. Gindroz, R. Goorens, P. Lamonte, E. Lievens, E. Raspoet, R. Ruidant, G. Van Beek, J. Vanbegin, L. Van Lancker, J. Vanvaerenbergh, G. Vincent and C. Wastiels with the help of A. De Coster, D. Luypaert-Peymans, R. Pins, and M. Pins.

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

G. Van Beek has contributed to the design of the mechanics for the opto-electronic chains and to the construction procedure of the scintillating fibre trackers for CHORUS. He and P. Lamonte have taken responsability for their construction and evaluation, the team consisting of G. Vincent, R. Ruidant, A. De Coster, E. Raspoet, M. Pins, D. Luypaert and R. Gindroz. At CERN, they have lead the assembly of the trackers and their installation on the CHORUS detector, with the help of E. Raspoet and R. Gindroz. G. Van Beek has contributed to the assembly of the opto-electronic chains in the lab and their installation on Chorus with the help of R. Gindroz. A series of test-up's for the measurement of image intensifiers has been constructed by G. Van Beek and P. Lamonte with the help of the mechanicians and for the electronics by R. Goorens. J.P. Dewulf has taken full responsability for the design, prototype constructions, test and production of two VME cards for the fast decision logics of the CHORUS trigger.

H. De Nil and C. Wastiels have taken care, in Hamburg-DESY, of the maintenance of the cabling of the Central Outer Proportional Chambers of the H1 detector.

L. Van Lancker has acted as consultant for the design of a Positron Emission Tomology camera prototype which has been constructed by J. De Bruyne, E. Lievens, G. Vincent, M. Pins and R. Pins. L. Etienne has designed and constructed the trigger card for the camera.

For the Delphi experiment, the main task has consisted in the maintenance of the detector at CERN. This has been the responsability of R. Goorens who also has developed two cards for the forward muon chambers trigger systems.

The starting of the R&D program on Micro-strip gas chambers to be used in the central tracking of the CMS detector has involved various activities : the gas system has been installed by E. Lievens and a cosmic muon hodoscope by R. Gindroz and R. Ruidant, while M. Pins has contributed to the prototype assembly, mainly in NIKHEF-Amsterdam. L. Van Lancker has taken responsabilities in the design of the mechanical structure for the MSGC forward tracking system on the CMS detector; he has acquired the necessary expertise in the domain of the composite materials.

R. Gindroz, R. Ruidant, C. Wastiels and R. Goorens have in charge the maintenance of the bubble chamber film measuring devices. R. Goorens takes also care of the pool of NIM/CAMAC material. New communication and electricity networks have been installed by H. De Nil, in the computer room and throughout the complete institute.

D. Pirnay has performed computer related operational tasks and 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

J. Lemonne has been the Belgian scientific representative in the CERN Council. He is also the president of the Department of Physics of the VUB.

J. Lemonne, J. Sacton and **F. Verbeure** contributed to the organization of the Joint Belgian, Dutch and German (Aachen) Summer School on Elementary Particle Physics at Retie, Belgium (1992) and Dalphsen-Netherland (1993)

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.

J. Sacton was also a member of the "Commission de Physique" at the FNRS

J. Sacton was "Doyen de la Faculté des Sciences de l'ULB". He also acted as a member of the C11 Commission (Particles and Fields) of the International Union for Pure and Applied Physics (IUPAP) and as Chairman of the High Energy Physics Computer Coordinating Committee (HEPCCC).

F. Verbeure was the Dean of the Faculty of Science and a member of the Council of the UIA (until 30/9/1993).

P. Vilain was the Belgian representative at Plenary ECFA and since 1993 at the RECFA (Restricted European Committee for Future Accelerators.

P. Marage was a member of the Council of the ULB of the "Commission des Finances", the "Commission du Patrimoine" and the "Commission d'évaluation Scientifique pour les nominations au titre de premier assistant" à l'ULB. He was also a member of the board of the Conseil Interuniversitaire Francophone-CIUF.

S. Tavernier was member of the "Bureau van de Onderzoeksraad" of the VUB and Chairman of the "Commissie voor Basis en Toegepaste Wetenschappen" van de Onderzoeksraad. He is member of the board of the "Crystal Clear Collaboration (CERN, R&D18), Coordinator of the "Human Capital and Mobility Network, Search for new and better scintillating materials for basic research"

W. Van Doninck acted as a Belgian representative in plenary ECFA and coordinator for the Belgian representation at the CERN-day of Honour (Sevilla, 1992)

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

- **D. Bertrand** : member of the Software Coordination Panel (SCOOP)
- **J. Lemonne** : Vice-chairman of the Collaboration Board and representative of "Belgium". representative of the IIKW-IISN in the DELPHI Finance Committee
- **C. Vander Velde** : responsible for the muon subtrigger
- **J. Wickens** : member of Coordination Panel, Physics Analysis Panel, of the Software Coordination Panel, of the off-line task force and the Computer Hardware Panel

The following responsibilities were taken in the organisation of the H1 experiment :

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

The following responsabilities were taken in the organisation of the CMS experiment

- **W. Van Doninck** : member of the management board and of the collaboration board.

R. Vandenbroucke-Tassin represented Belgium in the IXI-telecommunication project and in the Public Procurement Group. She represented the Belgian HEP-community in the Hepnet Requirement Committee HRC. She was the chairperson of the DECUS BELUX Networks SIG and acted as Communication Coordinator. She is a delegate to the European Decus Council. She was a member of the DECUS Europe Networks SIGCC and European Communications Coordinator. She also represented DECUS Europe in EWOS (European Workshop on Open Systems).

VIII. ATTENDANCE TO CONFERENCES, WORKSHOPS AND SCHOOLS

VIII. 1. CONFERENCES AND WORKSHOPS

- GIF 92 : Le neutrino et ses mystères (Montpellier, France - 1992)
  M. Gruwé, C. Mommaert

- General meeting of the Belgian Physical Society (Liège - 1992)
  Cao Fang, E. Evrard, J. Lemonne, C. Vander Velde

- International Workshop on Heavy Scintillators for Scientific and Industrial Applications (Chamonix, France - 1992)
  Zhang Shuping

- Neutrino 92 (Granada, Spain - 1992)
  P. Vilain, G. Wilquet

- 3rd Joint European Networking Conference (Inssbrück, Austria -1992)
  R. Vandenbroucke

- 4th IFIP Conference on High Performance Networking (Liège - 1992)
  R. Vandenbroucke

- General meeting on LHC Physics and Detectors (Evian, France - 1992)
  J. Lemonne, W. Van Doninck

- XXVIII Rencontres de Moriond - Electroweak Interactions and Unified Theories (Les Arcs, France - 1992)
  S. De Brabandere and C. De Clercq

- XXVIth International Conference on High Energy Physics (Dallas, USA - 1992)
  E. De Wolf, D. Johnson, J. Lemonne, J. Sacton

- XXth International Symposium on Multiparticle Dynamics (Santiago de Compostella, Spain - 1992)
  E. De Wolf

- Conference on Computing in High Energy Physics (Annecy, France - 1992)
  C. De Clercq, J. Sacton

- IEEE Visualisation 92 (Boston, USA - 1992)
  T. Heiremans

- XXIII International Symposium on Multiparticle Dynamics (Aspen, USA - 1993)
  E. De Wolf and F. Verbeure

- International Symposium on 30 years of Neutral Currents : from Weak Neutral Currents to the W/Z and beyond (Los Angeles, USA - 1993)
  J. Sacton

- XIIth Rencontres de Moriond (Les Arcs, France - 1993)
  M. Gruwé

- ICFA seminar on Future Perspectives in High Energy Physics (DESY/Hamburg, Germany - 1993)
  J. Sacton

- Perkins Conference (Oxford, UK - 1993)
  J. Sacton, W. Van Doninck

- Conference on the Bubble Chamber and its Contribution to Particle Physics (CERN/Geneva, Switzerland - 1993)
  J. Sacton

- Neutral currents : twenty years later (Paris, France - 1993)
  D. Bertrand, G. Bertrand-Coremans, J. Sacton, W. Van Doninck, P. Vilain, G. Wilquet

- Cracow Workshop on Multiparticle Production (Cracow, Poland - 1993)
  E. De Wolf

- XXVIIIth Rencontres de Moriond, QCD and High Energy Hadronic Interactions (Les Arcs, France - 1993)
  E. De Wolf

- XVI International Symposium on Lepton-Photon Interactions (Cornell, USA - 1993)
  C. De Clercq, J. Sacton

- 54th Meeting of Plenary ECFA (CERN/Geneva, Switzerland - 1993)
  J. Sacton

- The 3th London Conference on Positron Sensitive Detectors (Brunel/London, UK - 1993)
  M. Goldberg, S. Tavernier, S. Zhang

- 32nd Internationale Universitätswochen für Kern- und Teilchenphysik (Schladmich, Austria - 1993)
  E. Evrard

- Conference on Network Management (Krakow, Poland - 1993)
  R. Vandenbroucke

- Interop Europe 1993 (Paris, France - 1993)
  R. Vandenbroucke

- First workshop on RICH detectors (Bari, Italy - 1993)
  P. Bruyndonckx

- IEEE Nuclear Science Symposium and Medical Imaging Conference (San Fransisco, USA - 1993)
  P. Bruyndonckx

- Workshop on Progress in Gaseous Microstrip Proportional Chambers (Grenoble, France - 1993)
  C. Vander Velde

- International Europhysics Conference on High Energy Physics (Marseille, France - 1993)
  D. Bertrand, E. De Wolf, J. Lemonne, A. Tomaradze

- Sixteenth Kasimierz meeting on Elementary Particle Physics (Warschau, Poland - 1993)
  R. Roosen

- ν 93 Conference (Sevilla, Spain - 1993)
  P. Vilain, G. Wilquet

- XXI International Meeting on Fundamental Physics - Physics at HERA (Madrid, Spain - 1993)
  P. Van Mechelen

- Advanced Study Conference on Heavy Flavours (Pavia, Italy - 1993)
  H. De Boeck

- Symposium on Applications and Developments of Gaseous Chamber Techniques for use in Physics, Biology and Medicine (Lund, Sweden - 1993)
  S. Tavernier

- 2nd International Workshop on Physics and Experiments at Linear e^+e^- Colliders (Hawaii, USA - 1993)
  C. Vander Velde

- Workshop "e^+e^- Collisions at 500 GeV" (DESY/Hamburg, Germany - 1993)
  C. Vander Velde

- ICFA meeting (CERN 1993°
  J. Sacton

- IUPAP CII Commission meetings at Dallas 1992 and Cornell 1993
  J. Sacton

VIII.2. SCHOOLS

- 1992 Joint Belgian-Dutch-German (Aachen) Summer School on Elementary Particle Physics (Retie, Belgium - 1992)
  L. Favart, M. Gruwé, C. Mommaert, P. Van Esch

- College on Medical Physics on Imaging and Radiation Protections (I.C.T.P./Trieste, Italy - 1992)
  S. Zhang

- XVth Automn School "Particles in the Nineties (Lissabon, Portugal - 1993)
  Cao Fang

- SUSSP93 (St. Andrews, Schotland - 1993)
  P. Van Esch

- The 1993 European School of High Energy Physics (Zakopane, Poland - 1993)
  L. Favart

- 1993 Joint Belgian-Dutch-German (Aachen) Summer School on Elementary Particle Physics (Dalfsen, Netherlands - 1993)
  R. Chen, S. De Brabandere, P. Van Esch, P. Van Mechelen

- ICFA School on Instrumentation in High Energy Physics (Bombay, India - 1993)
  C. Mommaert

IX. LIST OF PUBLICATIONS, REPORTS AND CONTRIBUTIONS TO CONFERENCES

IX.1. PUBLICATIONS

NEUTRINO PHYSICS

- Study of high-energy neutrino neutral-current interactions
  M. Aderholz, ..., P. Marage, ..., J. Sacton, ... et al.
  Phys. Rev. D45 (1992) 2232

- Neutral strange particle production in antineutrino-neon charged current interactions
  S. Willocq, ..., P. Marage, ..., J. Sacton, ... et al.
  Z. Phys. C - Particles and Fields 53 (1992) 207

- Diffractive production of charmed strange mesons by neutrinos and antineutrinos
  A.E. Asratyan, P. Marage, ..., J. Sacton, ... et al
  Z. Phys. C - Particles and Fields 58 (1993) 55

- Coherent production of single pion and ρ mesons in charged-current interactions of neutrinos and antineutrinos on neon nuclei at the Fermilab Tevatron
  S. Willocq, ..., M. Barth, E. De Wolf, P. Marage, J. Sacton, ... et al.
  Phys. Rev. D47 (1993) 2661

- Search for ν_μ - ν_τ oscillation
  M. Gruwé, C. Mommaert, P. Vilain, G. Wilquet, ... et al.
  Phys. Lett. B309 (1993) 463

- Neutral current coupling constants from neutrino- and antineutrino-electron scattering
  P. Vilain, G. Wilquet, ... et al.
  Phys. Lett. B281 (1992) 159

- Measurement of differential cross sections for muon-neutrino electron scattering
  P. Vilain, G. Wilquet, ... et al.
  Phys. Lett. B309 (1993) 267

- Low Q2, High ν Neutrino Physics (CVC, PCAC, Hadron Dominance)
  B.Z. Kopeliovich, P. Marage
  Int. J. of Mod. Phys. A8 (1993) 1513 and Bulletin IIHE 92.02 (1992)

- Bose-Einstein correlation in neutrino and antineutrino interactions with nucleons
  V.A. Korotkov, ..., P. Marage, ... et al.
  Z. Phys. C60 (1993) 37

- Neutral secondary vertices associated to high energy neutrino interactions
  M.D. Jones, ..., M. Barth, P. Marage, ... et al.
  Nucl. Phys. B31 (1993) 284
  Phys. Rev D50 ② (1994) 6641

Coherent single charged pion production by neutrino
P. Vilain et al
Phys Lett B313 (93) 267-275

ep PHYSICS

- Hard scattering in γp interactions
  G. Bertrand-Coremans, E. Evrard, L. Favart, P. Huet, D. Johnson, P. Marage, J. Moreels, R. Roosen, J. Sacton, P. Van Esch, ... et al.
  Phys. Lett. B297 (1992) 205

- Measurement of the hadronic final state in deep inelastic scattering at HERA
  G. Coremans, E. Evrard, L. Favart, P. Huet, D. Johnson, P. Marage, J. Moreels, R. Roosen, J. Sacton, P. Van Esch, ... et al.
  Phys. Lett. B298 (1993) 469

- Total photoproduction cross section measurement at HERA energies
  G. Coremans, E. Evrard, L. Favart, P. Huet, D. Johnson, P. Marage, J. Moreels, R. Roosen, J. Sacton, P. Van Esch, ... et al.
  Phys. Lett. B299 (1993) 374

- Observation of deep inelastic scattering at low x
  G. Coremans, E. Evrard, L. Favart, P. Huet, D. Johnson, P. Marage, J. Moreels, R. Roosen, J. Sacton, P. Van Esch, ... et al.
  Phys. Lett. B299 (1993) 385

- A search for leptoquarks, leptogluons and excited leptons in H1 at HERA
  G. Coremans, E. Evrard, L. Favart, P. Huet, D. Johnson, P. Marage, J. Moreels, R. Roosen, P. Van Esch, ... et al.
  Nucl. Phys. B396 (1993) 3

- Measurement of inclusive jet cross sections in photoproduction at HERA
  G. Coremans, E. Evrard, L. Favart, P. Huet, D. Johnson, P. Marage, J. Moreels, R. Roosen, P. Van Esch, ... et al.
  Phys. Lett. B314 (1993) 436

- Measurement of the proton structure function $F_2(x.Q^2)$ in the low x region at HERA
  G. Coremans, E. Evrard, P. Huet, D. Johnson, P. Marage, J. Moreels, R. Roosen, P. Van Esch, ... et al.
  Nucl. Phys. B407 (1993) 515

e^+e^- PHYSICS

- Electroweak parameters of the Z° resonance and the standard model
  The LEP collaborations : ALEPH, DELPHI, L3 and OPAL
  Phys. Lett. B276 (1992) 247

- Search for excited charged leptons in Z° decays
  P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
  Zeitschrift für Physik C53 (1992) 41

- Study of orientation of three-jet events in Z° hadronic decays using the DELPHI detector
  P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
  Phys. Lett. B274 (1992) 498

- Search for scalar leptoquarks from Z° decays
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B275 (1992) 222

- Production of strange particles in the hadronic decays of the Z°
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B275 (1992) 231

- Multiplicity dependence of mean transverse momentum in e^+e^- annihilations at LEP energies
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B276 (1992) 254

- A measurement of the $b\bar{b}$ forward-backward asymmetry using the semileptonic decay into muons
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B276 (1992) 536

- A measurement of $\sin^2\theta_W$ from the charge asymmetry of hadronic events at the Z° peak
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B277 (1992) 371

- A search for neutral Higgs particles in Z° decays
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Nucl. Phys. B373 (1992) 3

- Study of final state photons in hadronic Z° decay and limits on new phenomena
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Z. Phys. C - Particles and Fields 53 (1992) 555

- Classification of the hadronic decays of the Z° into b and c quark pairs using a neural network
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B295 (1992) 383

- Measurement of the average lifetime of B hadrons
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Z. Phys. C - Particles and Fields 53 (1992) 567

- Searches for heavy neutrinos from Z° decays
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B274 (1992) 230 and CERN/PPE 91-175

- Determination of α_s in second order QCD in hadronic Z° decays
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Zeitschrift für Physik C54 (1992) 55 and CERN/PPE 91-181

- Electroweak parameters of the Z° resonance and the standard model
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B276 (1992) 247 and CERN/PPE 91-232

- Measurement of Z° branching fraction to be quark pairs using the boosted sphericity product
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B281 (1992) 383 and CERN/PPE 92-7

- A study of the decays of τ leptons produced on the Z° resonance at LEP
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Zeitschrift für Physik - Particles and Fields C55 1992) 555 and CERN/PPE 92-60

- Charged multiplicity distributions for fixed number of jets in Z° hadronic decays
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Zeitschrift für Physik - Particles and Fields C56 (1992) 63 and CERN/PPE 92-64

- Bose-Einstein correlations in the hadronic decays of the Z°
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B286 (1992) 201

- Measurement of the partial width of the Z° into $b\bar{b}$ final states using their semi-leptonic decays
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Zeitschrift für Physik - Particles and Fields C56 (1992) 47 and CERN/PPE 92-79

- Evidence for B_s^0 meson production in Z° decays
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B289 (1992) 199 and CERN/PPE 92-104

- Multiplicity fluctuations in hadronic final states from the decays of the Z°
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, S. Tavernier, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Nucl. Phys. B386 (1992) 471 and CERN/PPE 92-120

- Updated parameters of the Z° resonance from combined preliminary data of the LEP experiments
J. Wickens, ... et al.
CERN/PPE 93-157

- A measurement of B-meson production and lifetime using D ℓ-events in Z° decays
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Zeitschrift für Physik - Particles and Fields C57 (1993) 181 and CERN/PPE 92-174

- Measurements of inclusive production of light meson resonances in hadornic decays of the Z°
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B208 (1993) 236 and CERN/PPE 92-183

- A search for lepton flavour violation in Z° decays
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B298 (1993) 247 and CERN/PPE 92-190

- A study of B°-$\bar{B}$°mixing using semileptonic decays of hadrons produced from Z°
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B301 (1993) 145 and CERN/PPE 92-203

- A measurement of the tau lifetime
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B302 (1993) 356 and CERN/PPE 93-12

- Measurement of the triple gluon vertex from 4-jet events at LEP
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Zeitschrift für Physik - Particles and Fields C59 (1993) 357 and CERN/PPE 93-20

- Measurement of Λ_b production and lifetime in Z° hadronic decays
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B311 (1993) 379 and CERN/PPE 93-32

- Measurement of the mass of the Z° boson and the energy calibration of LEP
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B307 (1993) 187 and CERN/PPE 93-53

- Determination of α_s for b-quarks at the Z° resonance
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B307 (1993) 221 and CERN/PPE 93-59

- A measurement of D-meson production in Z° hadronic decays
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Zeitschrift für Physik - Particles and Fields C59 (1993) 533 and CERN/PPE 93-70

- Search for Z° decays to two leptons and a charged particle-antiparticle pair
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Nucl. Phys. B403 (1993) 3 and CERN/PPE 93-77

- Determination of α_s from the scaling violation in the fragmentation function e^+e^-
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B311 (1993) 408

- A measurement of the mean lifetimes of charged and neutral B-hadrons
P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
Phys. Lett. B312 (1993) 253

- Determination of α_s using the next-to-leading-log approximation of QCD
  P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
  Zeitschrift für Physik - Particles and Fields C59 (1993) 21

- Searching for weakly intearcting supersymmetric particles
  R. Becker and C. Vander Velde
  To be published in the Proceedings of the Workshop on Linear e^+e^- Collider at 500 GeV, Hawaii (1993)

- Limits on the production of scalar leptoquarks from Z° decays at LEP
  P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
  Phys. Lett. B318 (1993) 620 and CERN/PPE 93-161

- Measurement of the $B°$-$\overline{B°}$ mixing using the average electric charge of hadron-jets in Z° decays
  P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
  Phys. Lett. B322 (1994) 459

Production of Λ and $\Lambda\bar{\Lambda}$ correlations in the hadronic decays of the Z°
P Abreu Phys Lett B 303 - 249 - 1993

HADRON-HADRON INTERACTIONS

- Two-particle azimuthal and rapidity correlations in intervals of transverse momentum in π^+p interactions at 250 GeV/c
  I.V. Ajinenko, ..., E. De Wolf, F. Verbeure, ... et al.
  Z. Phys. C, Particles and Fields C58 (1993) 357

- Behavior of correlations and fluctuations in high-energy hadroproduction
  E.A. De Wolf, I.M. Dremin, W. Kittel
  Uspekhi Fysiki Nauk 163 (1993) 1

- Influence of multiplicity and kinematical cuts on Bos-Einstein correlation in π^+p intearctions at 250 GeV/c
  N.M. Agababyan, ..., E. De Wolf, F. Verbeure, ..., et al.
  Z. Phys. C, Particles and Fields C59 (1993) 195

- Factorial Moments, Cumulants, Correlators and Correlation Integrals in π^+p and K^+p interactions at 250 GeV/c
  N. Agababyan, ..., E. De Wolf, F. Verbeure, ..., et al.
  Z. Phys. C, Particles and Fields C59 (1993) 405

- Pomeron-pomeron cross sectcion from inclusive production of a central cluster in quasi-elastic π^+p and K^+p scattering at 250 GeV/c
  N. Agababyan, ..., E. De Wolf, F. Verbeure, ... et al.
  Z. Physic C, Particles and Fields C60 (1993) 229

EXPERIMENTAL TECHNIQUES

- Determination of the Scintillation light yield of $LaF_3:Nd^{3+}$
  M. Gruwé and S. Tavernier
  NIM A311 (1992) 301

- A high-resolution tracking detector based on capillaries filled with liquid scintillator
  M. Adinolfi, ..., M. Gruwé, ... et al.
  NIM A311 (1992) 91

- Progress on high-resolution tracking with scintillating fibres : a new detector based on capillaries filled with liquid scintillator
  M. Adinolfi, ..., M. Gruwé, ..., G. Wilquet, ... et al.
  NIM A315 (1992) 177

- Opto electronical readout for scintillating fiber trackers
  C. Mommaert
  Proceedings of the WCC 1992 : Wire Chamber and Position Sensitive Detectors
  Nuc l. Instr. and Meth.

- A fully 3D small PET scanner
  S. Tavernier, P. Bruyndonckx and Zhang Shuping
  Phys. Med. Biol. 37 , 3 (1992) 635

- Study of the spatial resolution in gamma dtectors using photosensitive wire chambers in view of their use as high resolution PET scanners
  P. Bruyndonckx, Z. Shuping and S. Tavernier
  Nucl. Instr. and Meth. A323 (1992) 54

- A set-up for precise measurements of scintillating fiber bundles using an optoelectronic readout chain and a silicon microstrip detector system
  J. Bähr, ..., M. Gruwé, ... et al.
  NIM A324 (1993) 145

- Calibration and performance of the CHARM-II detector
  D. Geiregat, P. Vilain, G. Wilquet, G. Van Beek, P. Vilain, G. Wilquet, ... et al.
  Nucl. Instr. and Meth. A325 (1993) 92

- Scintillating fiber trackers with optoelectronic readout for the CHORUS neutrino experiment
  S. Aoki, ..., M. Gruwé, C. Mommaert, ... et al.
  NIM A344 (1993) 143

IX.2. REPORTS

- Le CERN et l'essor de la physique des particules en Europe
  J. Sacton and C. Vander Velde
  CEPULB - Cahier 7 (1992)

- A set-up for precise measurements of scintillating fiber bundles using an opto electronic readout chain and a silicon micro strip detector system
  M. Gruwe, C. Mommaert, ... et al.
  DESY 92-088 (1992)

- Background of semi-leptonic charm decays in deep inelastic scattering
  E. Evrard and A. De Roeck
  H1 internal note H1-03/92-215 (1992)

- Dossier "Le Doctorat en Belgique"
  P. Marage
  Objectif Recherche 12 (1992)

- "La fusion froide"
  P. Marage
  Objectif Recherche 14 (1992)

- The emulsion technique and its continued use
  J. Sacton
  Bulletin IIHE 93.06 (1993)

- Au coeur de la matière : l'ULB et le CERN
  J. Sacton
  L'ULB et l'Europe : 30 ans d'histoire commune, p. 54 (1993)

- The H1 detector at HERA
  Abt, ..., G. Coremans, D. Johnson, P. Marage, ... et al.
  DESY 93 (1993) 103

- Vertex reconstruction using BPC and CIP in DIS events
  A. Panitch and P. Marage
  H1-Note 05/93 (1993) 297

- Comparison of momentum spectra of hadrons from neutrino interactions on neon with deuterium and with models of formation length
  V.A. Gapienko, ..., P. Marage, ... et al.
  Paper submitted to the International Conference on HEP, Marseille (1993)

- Weakening of the nuclear cascade observed in the charge distribution of neutirno-neon events
  V.A. Gapienko, ..., P. Marage, ... et al.
  Paper submitted to the International Conference on HEP, Marseille (1993)

- A new search for $\nu_\mu \rightarrow \nu_\tau$
  M. de Jong, ..., C. Mommaert, ... et al.
  CERN PPE 93-131 (1993)

- A measurement of multi-jet rates in deep inelastic scattering at HERA
  D. Johnson
  DESY preprint 93-137 (1993)

- Production rate and decay lifetime measurements of B_s° mesons at LEP using Ds and ϕ mesons
  P. Abreu, ..., D. Bertrand, H. De Boeck, C. De Clercq, Cao Fang, J. Lemonne, F. Stichelbaut, C. Vander Velde, F. Verbeure, W. Van Doninck, J. Wickens, ... et al.
  CERN/PPE 93-176

- Experimental study of inclined particle tracks in micro strip gas counter
  F.D. van den Berg et al.
  Bulletin IIHE 93.07 (1993)

IX.3. CONTRIBUTIONS TO CONFERENCES

a) Presented by members of the IIHE

- Studies of Muon Pair production in e^+e^- Annihilations at the LEP collider of CERN
  Cao Fang
  General Scientific Meeting of the Belgian Physical Society, May 1992, Liège

- Deep Inelastic Scattering Physics at HERA with the H1 detector
  E. Evrard
  General Sientific Meeting of the Belgian Physical Society, May 1992, Liège

- Opto-electronical readout for scintillating fiber trackers (Poster presentation)
  C. Mommaert
  6th Wire Chamber Conference (Vienna, Austria - 1992)

- Intermittency and Correlations; Experimental
  E. De Wolf
  Invited Review talk at XVIth International Conference on High Energy Physics (Dallas, USA - 1992)

- Understanding Intermittency
  E. De Wolf
  Invited talk at XXth International Symposium on Multiparticle Dynamics (Santiago de Compostela, Spain - 1992)

- Study of the spatial resolution in gamma detectors using photosensitive wire chambers in view of their use as high resolution PET scanners
  P. Bruyndonckx
  6th International Wirechamber Conference (Vienna, Austria - 1992)

- A positron emission tomograph scanner using BaF_2 scintillators and wire chambers
  S. Tavernier
  International Workshop on heavy scintillators for scientific and industrial applications (Chamonix, France - 1992)

- Report of the working group on applications of scintillators
  S. Tavernier
  International Workshop on heavy scintillators for scientific and industrial applications (Chamonix, France - 1992)

- Z° Lineshape and leptonic forward backward asymmetries at LEP
  C. De Clercq
  XXVIII Rencontres de Moriond (Les Arcs, France - 1993)

- Study of a high resolution 3D-PET scanner
  Zhang Shuping
  The 3th London Conference on Positron Sensitive Detectors (Brunel/London, UK - 1993)

- Measurement of the τ-polarisation at the LEP experiments
  D. Bertrand
  International Europhysics Conference on High Energy Physics (Marseille, France - 1993)

- Results from the H1 experiment
  R. Roosen
  16th Kasimierz meeting on Elementary Particle Physics (Warschau, Poland - 1993)

- Intermittency Revisited
  E. De Wolf
  Invited talk at XXVIIIth Rencontres de Moriond, QCD and high energy hadronic interactions (Les Arcs, France - 1993)

- Correlations and Monte Carlo's
  E. De Wolf
  Invited talk at Soft Physics and Fluctuations, Cracow workshop on Multiparticle Production (Cracow, Poland - 1993)

- Graphical Techniques for Multi-dimensional Data Analysis - An overview
  T. Heiremans
  General Scientific Meeting of the Belgian Physical Society (KU Leuven - 1993)

- The Brussels High Resolution PET
  S. Tavernier
  Symposium on Applications and Developments of gaseous Chamber-Techniques for use in Physics, Biology and Medicine (Lund, Sweden - 1993)

- Security Inspection Systems
  M. Goldberg
  The 3rd London Conferenc on Positron Sensitive Detectors (London, UK - 1993)

- Searching for weakly interacting sypersymmetric particles
  C. Vander Velde
  2nd International Workshop on Physics and Experiments at Linear e^+e^- colliders (Hawaii, USA - 1993)

- Aspects of scalar lepton searches
  C. Vander Velde
  Workshop e^+e^- Collisions at 500 GeV (DESY/Hamburg, Germany - 1993)

- The emulsion technique and its continued use
  J. Sacton
  Invited talk at the Perkins Conference (Oxford, 1993)

b) Others

- Scintillator fibre arrays for particle tracking
  J. Bähr, ..., M. Gruwé, ... et al.
  Contribution to the XIth Moriond Workshop, Tests of Fundamental Laws in Physics
  Ed. Frontières, Gif s/Yvette (M68) (1991) 129

- Experimental study of the backgorund at low x QCD at HERA
  M. Besançon, ..., E. Evrard, ... et al.
  Proceedings of the 1992 HERA Workshop, Vol. I (1992)

- Neutral strange-particle production in neutrino-neon charged-current interactions at the Fermilab Tevatron
  M. Barth, ... et al.
  Particles and Fields, Batavia (1992)

- Strangeness production in neutrino interactions
  M. Barth, ... et al.
  International Conference on High Energy Physics, Dallas (1992)

- BaF_2 scintillators with MWPC-TMAE readout for positron emission tomography
  P. Bruyndonckx, M. Goldberg, S. Taverier and Z. Shuping
  Contribution to "International Workshop on Heavy Scintillators for Scientific and Industrial Applications"
  To be published in the proceedings, (1992)

- New NA22 results on correlations, in Proc. QCD and High Energy Interactions
  E.A. De Wolf
  Rencontres de Moriond 1993, Ed. J. Tran Thanh Van, Ed. Frontières 1993, p. 507

CONTRIBUTIONS OF THE DELPHI COLLABORATION TO THE DALLAS CONFERENCE (August 1992)

- A measurement of the charm quark asymmetry at the Z POLE
  DELPHI 92-51 PHYS 172REV.

- Classification of the hadronic decays of the Z° into b and c quark pairs using a neural network
  DELPHI 92-67 PHYS 179

- AStudy of radiative muon-pair events at Z° energies
  DELPHI 92-76 PHYS 187

- Measurement of inclusive production of light meson resonances in hadronic decays of the Z°
  DELPHI 92-71 PHYS 182

- A measurement of the tau lifetime
  DELPHI 92-93 PHYS 204

- A study of $B°$-$\bar{B}°$ oscillations using dileptons from semileptonic decay of b quarks produced from Z°
  DELPHI 92-73 PHYS 184

- High precision relative luminosity measurement with a very small angle tagger (VSAT) in DELPHI
  DELPHI 92-77 PHYS 188

- A measurement of D meson production in hadronic Z° decay
  DELPHI 92-74 PHYS 185

- Limits on the production of scalar lepto quarks from Z° decays
  DELPHI 92-102 PHYS 210

- A measurement of B meson production and lifetime using Dl^- events in Z° decays
  DELPHI 92-78 PHYS 189

- Search for new phenomena with photon channels Z° decays
  DELPHI 92-85 PHYS 196

- Neural Higgs bosons in a two doublet model
  DELPHI 92-80 PHYS 191

- A search for $Z^\circ \rightarrow l^+ l^- V$
  DELPHI 92-84 PHYS 195

- A search for lepton flavour violation in Z° decays
  DELPHI 92-69 PHYS 180

- Evidence for Λ_b production and lifetime in Z° hadornic decays
  DELPHI 92-81 PHYS 192

- Leptonic events with energetic isolated photons in Z° decays
  DELPHI 92-82 PHYS 193

- Search for heavy charged Higgs in Z° hadronic decays
  DELPHI 92-75 PHYS 186

- Refined measurement of the average lifetime of B hadrons using high pt muons
  DELPHI 92-83 PHYS 194

- Evidence for the triple-gluon vertex from 4-jets events at LEP
  DELPHI 92-70 PHYS 181

- Determination of α_s from the scaling violation in the fragmentation functions of the process $e^+e^- \rightarrow h + \chi$
  DELPHI 92-110 PHYS 216

- Ligh scalar top at LEP energies
  DELPHI 92-86 PHYS 197

- Interjet correlations in Z° decays
  DELPHI 92)87 PHYS 198

- Production of K_s° and Λ at small x in the hadronic decays of the Z°
  DELPHI 92-88 PHYS 199

- Multiplicity fluctuations in hadronic final states from the decay of the Z°
  DELPHI 92-79 PHYS 190

- Determination of α_s for b quarks at the Z° resonance
  DELPHI 92-91 PHYS 202

- Particle identification with the forward RICH detector of DELPHI
  DELPHI 92-89 PHYS 200

- A measurement of the mean lifetimes of charged and neutral B hadrons
  DELPHI 92-90 PHYS 201

- The DELPHI microvertex detector
  DELPHI 92-92 PHYS 203

- Search for Z° decays into sleptons and neutralinos using the Delphi detector
  DELPHI 92-95 PHYS 206

- A study of B $\rightarrow$ J/Ψ in clusive production in Z° hadronic decays with DELPHI
  DELPHI 92-72 PHYS 183

- Measurement of the forward backward asymmetry of $e^+e^- \rightarrow Z^\circ \rightarrow b\bar{b}$ using prompt leptons
  DELPHI 92-96 PHYS 207

- A measurement of the B-$\bar{B}$ mixing parameter using muons and the charge of the jet
  DELPHI 92-94 PHYS 205

- B_s° tagging at LEP energies using Ds and ϕ mesons
  DELPHI 92-97 PHYS 208

- An update on the search for neutral Higgs particles in Z° decays
  DELPHI 92-101 PHYS 209

- Γ_{bb} and $\langle X_E \rangle_B$ using the Z° semi leptonic decay into muons
  DELPHI 92-105 PHYS 211

- Measurement of the charged particle multiplicity in t decays
  DELPHI 92-106 PHYS212

- A status report on the analysis of prompt photons in hadronic events
  DELPHI 92-109 PHYS215

- Determination of α_s from the scaling violation in the fagmentation functions of the process
  $e^+e^- \rightarrow h + X$
  DELPHI 92-110 PHYS 216

- Search for an excited neutrino using the DELPHI detector
  DELPHI 92-111 PHYS217

- On the determination of the longitudinal component of the fragmentation function of the process
  $e^+e^- \rightarrow h + X$
  DELPHI 92-112 PHYS218

- Parameters of the Z° resonance from combined preliminary data of the LEP experiments
  DELPHI 92-113 PHYS219

- Preliminary DELPHI results on the Z° resonances parameters and its electroweak couplings
  DELPHI 92-114 PHYS220

<u>CONTRIBUTIONS OF THE DELPHI COLLABORATION TO THE MARSEILLE CONFERENCE (July 1993)</u>

- Measurements of the lineshape of the Z° and determination of electroweak parameters from its hadronic and leptonic decays
  DELPHI 93-62 PHYS 289

- DELPHI data on electroweak parameters for the Marseille and Cornell Conferences 1993
  DELPHI 93-101 PHYS 328

- Measurement of the 1992 tau-lepton cross section and charge asymmetry
  DELPHI 93-103 PHYS 330

- A study of radiative muon-pair events at Z° energies
  DELPHI 93-63 PHYS 290

- Study of $\tau\tau\gamma$ events using the DELPHI detector at LEP
  DELPHI 93-100 PHYS 327

- Update of the DELPHI τ lifetime measurements
  DELPHI 93-64 PHYS 291

- Measurements of the τ polarization in Z° decays
  DELPHI 93-65 PHYS 292

- Summary of τ branching ratios submitted to Summer conferences 1993
  DELPHI 93-104 PHYS 331

- Measurement of the branching ratio of the Cabibbo suppressed decay $\tau \rightarrow K\nu$
  DELPHI 93-66 PHYS 293

- Measurement of $\tau \rightarrow 3\ \pi\nu_\tau$ branching ratio and P_τ with the DELPHI detector
  DELPHI 93-68 PHYS 295

- A study of kaon production in Tau decays with the DELPHI detector at LEP
  DELPHI 93-69 PHYS 296

- Search for the standard model Higgs boson in Z° decays
  DELPHI 93-70 PHYS 297

- Search for the standard model Higgs boson in Z° decays
  DELPHI 93 70 PHYS 297

- A search for a high mass resonance in photonic final states
  DELPHI 93 71 PHYS 298

- An update of the study of Z° decays to two leptons and a charged particle-antiparticle pair
  DELPHI 93-72 PHYS 299

- Search for Z° decays to two leptons and a charged particle-antiparticle pair
  CERN PPE/93-77

- Four jet events with long-lived particles
  DELPHI 93-102 PHYS 329

- Limits on the production of scalar leptoquarks from Z° decays at LEP
  DELPHI 93-97 PHYS 324

- Influence on the Bose-Einstein effect by decaying long-lived states
  DELPHI 93-76 PHYS 303

- Invariant mass dependence of particle correlations in hadronic final states from the decay of the Z°
  DELPHI 93-76 PHYS 300

- Λ production and $\Lambda\bar{\Lambda}$ correlations in the hadronic decays of the Z°
  DELPHI 93-07 PHYS 259

- Production of $\Sigma(1385)\pm$ in the hadronic decays of the Z°
  DELPHI 93-35 PHYS 273

- Inclusive production of the $\phi(1020)$ in the hadronic decays of the Z°
  DELPHI 93-24 PHYS 270

- Study of hard scattering processes in multihadronic $\gamma\gamma$ collisions at LEP
  DELPHI 93-89 PHYS 316

- First evidence of hard scattering processes in very low Q^2 single tagged $\gamma\gamma$ collisions using the DELPHI VSAT detector
  DELPHI 93-90 PHYS 317

- Study of single tagged mulithadronic $\gamma\gamma^*$ events at a $\langle Q^2 \rangle \simeq 12$ GeV^2/c^4
  DELPHI 93-60 PHYS 288

- Determination of the semi-leptonic branching ratio of the b quark using single and di-lepton events
  DELPHI 93-96 PHYS 323

- Measurement of the B°-$\bar{\text{B}}$° oscillation strenght using the average electric charge of hadron-jets in lepton-tagged Z°-decays into bottom-quarks
  DELPHI 93-79 PHYS 306

- Update of the measurement of B°-$\bar{\text{B}}$° mixing parameters in DELPHI
  DELPHI 93-80 PHYS 307

- First measurement of B°-$\bar{\text{B}}$° mixing using Λ lepton correlations
  DELPHI 93-108 PHYS 335

- A measurement of the B_d^0 oscillation frequency using the time evolution
  DELPHI 93-81 PHYS 308

- Note on DELPHI measurements of the B-hadrons lifetime
  DELPH.93-82 PHYS 309

- An update to the measurement of the average lifetime of B hadrons from Z° decay
  DELPHI 93-83 PHYS 310

- A measurement of B-hadron lifetimes using secondary vertices in hadronic events at DELPHI
  DELPHI 93-84 PHYS 311

- An update to the measurement of the lifetimes of charged and neutral B-hadrons
  DELPHI 93-94 PHYS 321

- Inclusive J/Ψ production in Z° hadronic decays with DELPHI
  DELPHI 93-85 PHYS 312

- Production rate and decay lifetime measurements of B_s^0 mesons at LEP using D_s and ϕ mesons
  DELPHI 93-86 PHYS 313

- Measurement of B_s^0 meson lifetime
  DELPHI 93-87 PHYS 314

- A measurement of the B_s^0 meson mass
  DELPHI 93-107 PHYS 334

- Measurement of beauty baryons production and lifetime in Z° hadronic decays using 1990-92 data
  DELPHI 93-88 PHYS 315

- Search for strange-B baryon production at LEP
  DELPHI 93-95 PHYS 322

- A search of radiative rare B decays with the DELPHI detector at LEP
  DELPHI 93-98 PHYS 325

- Determination of $\Gamma_{b\bar{b}}$ and BR(b$\rightarrow \ell$) using semi-leptonic decays
  DELPHI 93-74 PHYS 301

- Measurement of the $Z^\circ \rightarrow b\bar{b}$ branching ratio by hemisphere double tagging
  DELPHI 93-75 PHYS 302

- Measurement of $\frac{\Gamma_{b\bar{b}}}{\Gamma_{had}}$ using micro vertex and lepton double tags
  DELPHI 93-93 PHYS 320

- Measurement of the forward-backward asymmetry of $e^+e^- \rightarrow Z^\circ \rightarrow b\bar{b}$ using prompt muons
  DELPHI 93-77 PHYS 304

- Inclusive measurement of the forward-backward asymmetry in $Z \rightarrow b\bar{b}$ events at LEP
  DELPHI 93-78 PHYS 305

- Recent results of the forward ring imaging Cherenkov detector of DELPHI
  DELPHI 93-106 PHYS 333

FIGURE CAPTIONS

Fig. 1 : Schematic view of the CHORUS detector showing, from right to left, the veto wall, the target comprising the emulsion stacks and the fiber trackers, the hexagonal air core magnet (surrounded by the "diamond" trackers built in Brussels and Louvain-la-Neuve), the calorimeter and the muon spectrometer

Fig. 2 : The CMS Central Tracing System

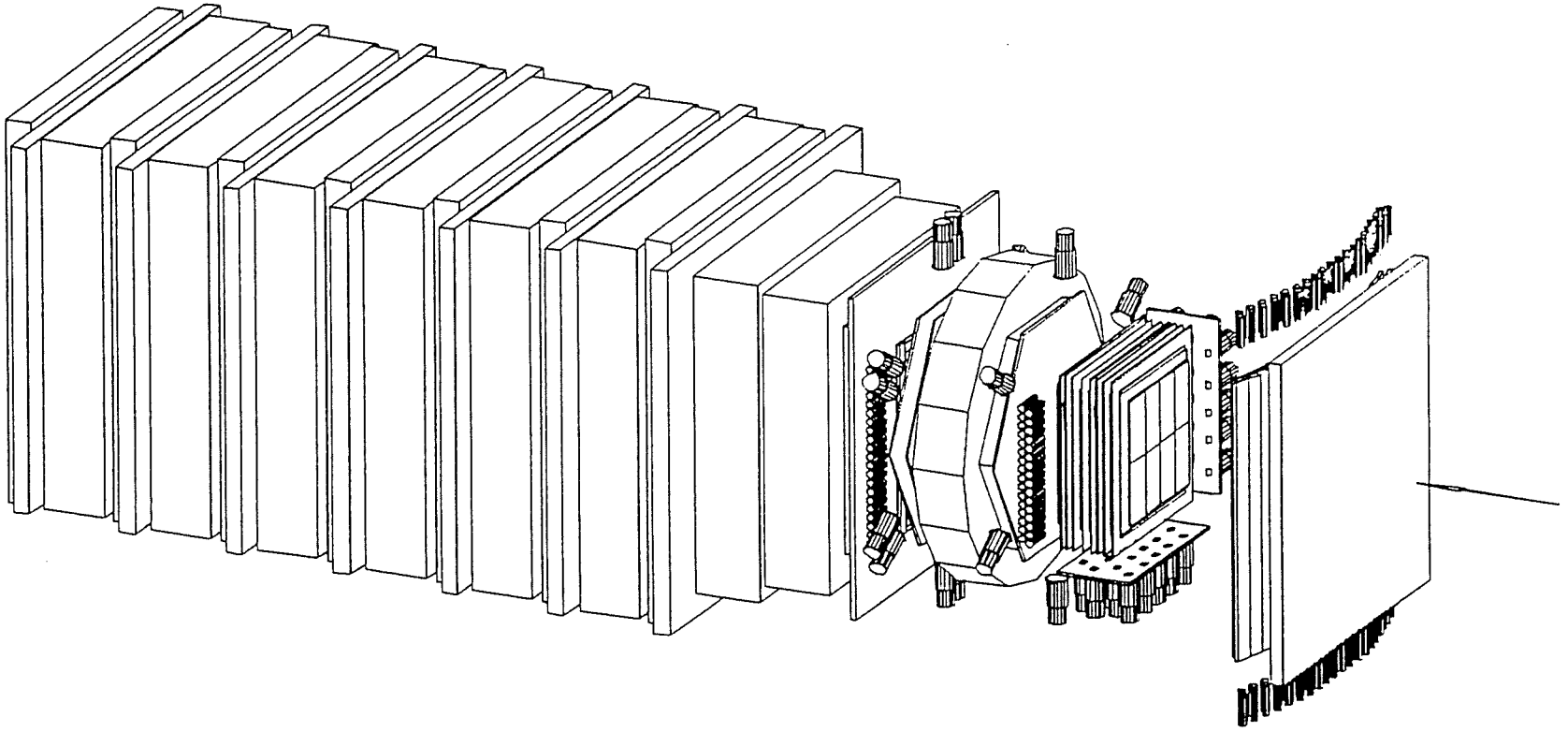

Fig. 1

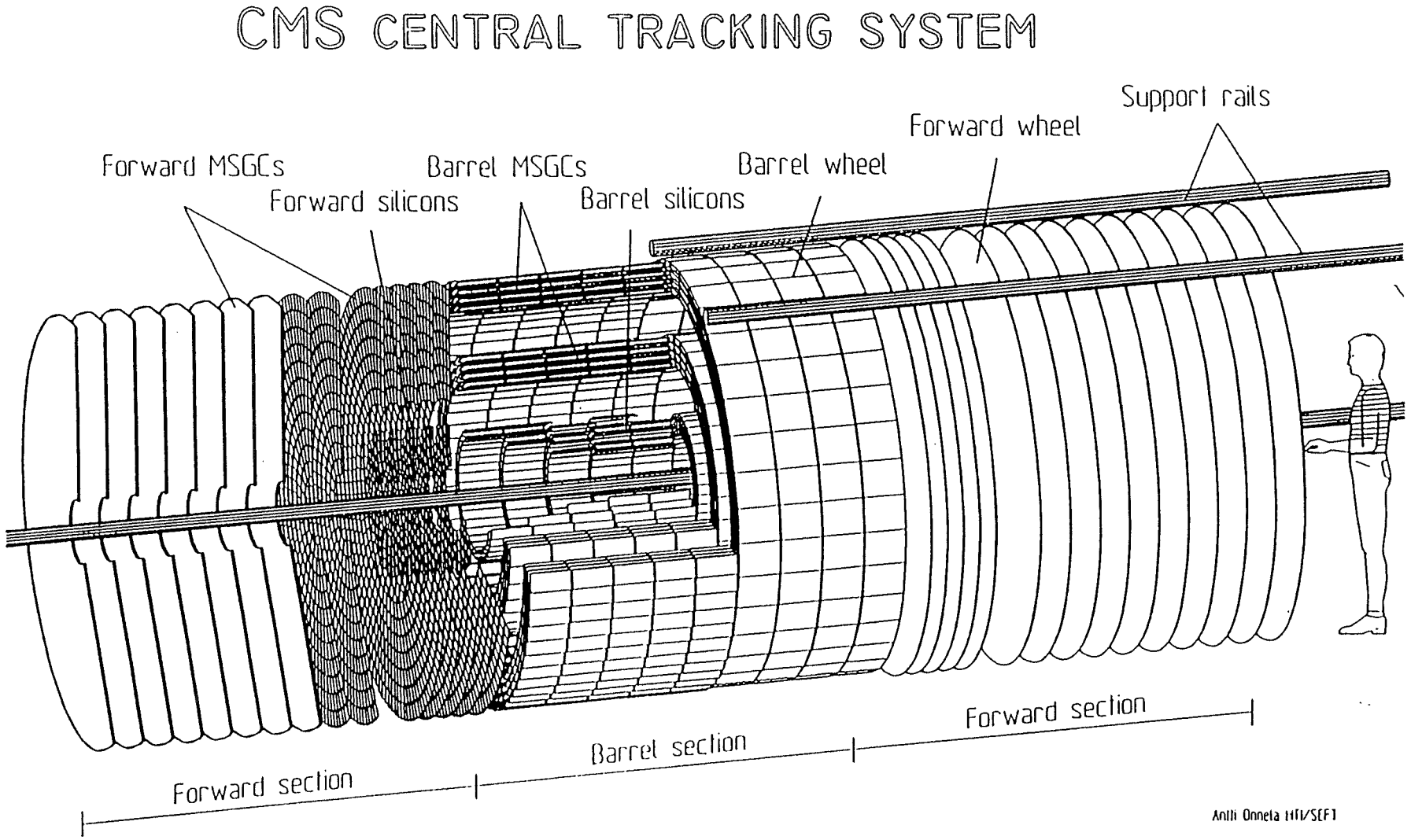
CMS CENTRAL TRACKING SYSTEM
Support rails
Forward wheel
Barrel wheel
Barrel MSGCs
Barrel silicons
Forward MSGCs
Forward silicons
Forward section
Barrel section
Forward section
Antti Onnela HFI/SEFT

Fig. 2