INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES

ULB -VUB BRUSSELS

ANNUAL REPORT 2005

iihe
BRUXELLES BRUSSEL

ULB

Vrije Universiteit Brussel

INTER-UNIVERSITY INSTITUTE FOR HIGH ENERGIES

ULB -VUB BRUSSELS

ANNUAL REPORT 2005

http://w3.iihe.ac.be

C. De Clercq - D. Bertrand

I. INTRODUCTION

The work presented in this report is supported by the Université Libre de Bruxelles (ULB), the Vrije Universiteit Brussel (VUB), the Fonds National de la Recherche Scientifique (FNRS), the Fonds voor Wetenschappelijk Onderzoek-Vlaanderen (FWO), the Fonds pour la Formation à la Recherche dans l'Industrie et dans l'Agriculture (FRIA), the Instituut voor de aanmoediging van Innovatie door Wetenschap en Technologie in Vlaanderen (IWT), the Belgian Federal Science Policy Office and the European Union.

The scientists whose names are listed below have contributed to the various activities of the Institute in 2005.

U.L.B.

D. Bertrand (directeur de recherche FNRS; chargé de cours temps partiel)
P. Berghaus (chercheur PAI)
O. Bouhali (informaticien)
B. Clerbaux (chercheur qualifié FNRS)
G. De Lentdecker (chercheur BELSPO : from March 2005)
L. Favart (chercheur qualifié FNRS)
T. Hreus (boursier FRIA : from October 2005)
X. Janssen (chercheur FNRS : from November 2005)
T. Mahmoud (chercheur PAI)
P. Marage (professeur ordinaire)
L. Neukermans (chercheur PAI : till September 2005)
Y. Piersaux (collaborateur scientifique)
B. Roland (boursier FRIA)
S. Rugovac (support logistique en informatique since October 2005)
J. Sacton (professeur émérite)
R. Toncelli (collaborateur scientifique)
C. Vander Velde (professeur)
P. Vanlaer (1er assistant)
P. Vilain (chercheur qualifié FNRS; chargé de cours temps partiel)
J. Wickens (chercheur IISN)
G. Wilquet (chercheur qualifié FNRS; chargé de cours temps partiel)

V.U.B.

A. Astvatsatourov (FWO postdoct. onderzoeker till June 2005, IUAP postdoct. onderzoeker since July 2005)
B. Baret (wetensch. medewerker FWO till February 2005, IUAP postdoct. onderzoeker since March 2005)
P. Bruyndonckx (wetenschappelijk medewerker GOA)
C. De Clercq (hoofddocent)
O. Devroede (wetenschappelijk medewerker)
S. De Weirdt (wetenschappelijk medewerker FWO)
J. D'Hondt (FWO postdoctoraal onderzoeker)
J. Heyninck (IWT specialisatiebeurs)
D. Hubert (IWT specialisatiebeurs)
D. Johnson (assistent VUB)
M. Krieguer (wetenschappelijk medewerker FWO)
C. Lemaître (IWT specialisatiebeurs)

J. Lemonne (gewoon hoogleraar, professor-emeritus)
S. Lowette (wetenschappelijk medewerker FWO)
P. Olbrechts (postdoctoraal onderzoeker OZR-VUB till March 2005, wetensch. medewerker from April 2005)
A. Rizzo (wetenschappelijk medewerker FWO)
R. Roosen (onderzoeksdirecteur FWO)
S. Rugovac (wetenschappelijk medewerker OZR-VUB till October 2005)
S. Tavernier (gewoon hoogleraar)
F. Udo (wetenschappelijk medewerker)
R. Vandenbroucke (logistiek medewerker VUB)
W. Van Doninck (onderzoeksdirecteur FWO, on leave of absence at CERN)
D. Wisnieuwski (wetenschappelijk medewerker Bilateraal akkoord Vlaanderen-Polen till September 2005)
M. Wisnieuwska (wetenschappelijk medewerker Bilateraal akkoord Vlaanderen-Polen till November 2005)

T. Anthonis, W. Beaumont, M. Cardaci, A. De Roeck,L. Rurua, D. Sunar, T. Sykor, I. Tsurin, P. Van Mechelen, S. Zhokin and E. De Wolf from the Universiteit Antwerpen (UA) have been working in close collaboration with the Institute.

Research in the field of telecommunications and data communication is conducted at IIHE/VUB by O. Bouhali and R. Vandenbroucke in collaboration with the members of the "Service Télématique et Communication" led by P. Van Binst at the ULB.

II. RESEARCH ACTIVITIES IN PARTICLE PHYSICS

I.1. NEUTRINO PHYSICS

A. CHORUS EXPERIMENT (CERN WA95)

(P. Vilain, G. Wilquet)

Built in 1993, the CHORUS detector has been exposed between 1994 and 1997 to the CERN-SPS neutrino beam. About one million interactions were recorded in the 770 kg nuclear emulsion target and more than 10 millions were produced in the calorimeter and spectrometer material. Events of this latter type were also recorded in 1998, when the beam was mainly operated for the NOMAD experiment.

The main purpose of the experiment was the search for ν_μ-ν_τ oscillation through the observation for the reaction $\nu_\tau + N \rightarrow \tau^- +$ hadrons. The very high spatial resolution power of nuclear emulsion enables the direct detection of the τ^- trajectory.

In the phase I of the analysis, today completed, the microscope scanning speed was not sufficient to treat all events and selection criteria optimised for the ν_τ interactions were applied. About 180000 vertices were located in the emulsion volume and 13500 further selected for visual inspection. After kinematical analysis, none of these events is retained as a ν_τ signal, while the expected background from other processes is estimated at 1.1 events.

In an effective two-flavours scheme, the ν_μ-ν_τ transition probability is given by:

$$P_{\mu\tau} = \sin^2 2\theta_{\mu\tau} \times \sin^2 \frac{1.27\,\Delta m^2 . L}{E}$$

where E(GeV) and L(km) are the neutrino energy and flight length, Δm^2(eV²) is the squared mass difference of the mass eigenstates and $\theta_{\mu\tau}$ the mixing angle.

In the absence of a significant signal, an upper limit on $P_{\mu\tau}$ was established, after integration on E and L. At large Δm^2, this limit corresponds, at 90 % C.L., to the limit:

$$\sin^2 2\theta_{\mu\tau} < 6.8\ 10^{-4}$$

The phase II of the data analysis started in 1999 and should lead this year to an improvement by a factor 2 to 3 of this limit thanks to :

- A refined track reconstruction code and more accurate alignment of the fibre trackers;
- The location of all events, without kinematical selection;
- The search around each located vertex of all the produced tracks and secondary activities (so called "net scan").

The two last items were made possible by the enormous progress achieved at the University of Nagoya in automated microscopes, allowing a gain in speed by two orders of magnitude. The final oscillation limit based on this new analysis will be published in 2006.

The net scan method has opened, in addition, the possibility to accumulate a large and unbiased sample of charmed particle production and decay events. Several new results have been published or accepted for publication in 2005 in addition to the about ten papers already published earlier on this topic:

- Measurements of D-zero production and branching fractions in neutrino nucleon scattering,
- Measurement of D-star production in neutrino interactions.
- Search for super - fragments and measurement of the production of hyper - fragments in neutrino-nucleus interactions
- Measurement of topological muonic branching ratios of charmed hadrons produced in neutrino-induced charged-current interactions
- Measurement of nucleon structure function in neutrino scattering

Several additional analyses are in progress and will be published during 2006.

B. OPERA EXPERIMENT (CERN CNGS1).

(G. Van Beek, P. Vilain, G. Wilquet)

In 2000, the CERN Council approved the construction of the SPS CNGS neutrino beam, pointing towards Gran Sasso LNGS underground laboratory. The long baseline neutrino oscillation OPERA project, based on this beam, was approved in February 2001.

The motivation for this experiment resides in the now clear evidence, mainly from the Super Kamiokande experiment, of an energy and zenithal dependent deficit in the flux of atmospheric ν_μ's. The data are well fitted in terms of ν_μ-ν_τ oscillation for Δm^2 about 2.5 10^{-3} eV^2 and $\sin^2 2\theta > 0.9$ and compatible with full mixing. OPERA aims at covering this domain of the parameters space and demonstrate the ν_μ-ν_τ oscillation hypothesis through the direct observation of ν_τ interactions.

The detector design was based on two conflicting requirements: the τ detection calls for the spatial resolution of nuclear emulsion but the required target mass of at least 1000 tons prohibits the use of a pure emulsion target as was done in the CHORUS experiment. The solution consists in stacking 1 mm thick lead foils interleaved with 200 μm plastic sheets covered on both sides by 50 μm emulsion layers. Detailed simulations of this configuration have shown that high τ detection efficiency can be preserved while keeping the background at a tolerable level.

The modular detector structure is as follows :

- 56 foils of lead interleaved with emulsion sheets of about 120 cm^2 area stacked to form a 8.5 kg brick;
- 3264 bricks are assembled in a wall. Each wall, of about 40 m^2 area, is followed by a pair of orthogonal planes of plastic scintillator strips trackers;
- A super-module is made from 31 walls followed by a muon spectrometer;
- Two identical super-modules compose the detector that reaches an effective target mass of 2000 tons.

Our group is more specifically involved in the conception, construction and installation of the Target Trackers (TT) together with three groups of IN2P3 (IReS, Strasbourg, IPNL, Lyon and LAPP, Orsay), the universities of Bern and Neuchâtel, and JINR, Dubna. A tracker plane consists of 4 modules, each composed of 7-m long 64 scintillator strips equipped with wavelength shifting fibres. A tracker is made of two planes with orthogonal readings. The optical signals transmitted by the fibres are readout at both ends by 64-channel photomultipliers.

The construction of the target section the first super–module was completed in November 2005, except for the filling of the target with bricks that is planned to begin in June 2006. The installation of the first planes of the second super-module has started in December; it is scheduled to be completed in early May 2006.

The aim is to start the target filling of the first super–module in early June 2006, start the data taking with a low intensity neutrino beam and a partially filled super-module mid-July when the CNGS beam is due to become operational and run for the last part of the 2006 SPS activity with one fully filled super-module and the nominal beam intensity. The scenario has been recommended by the SPSC in February 2006. The second super-module is aimed at being ready in 2007 with the resuming of the SPS period of activity.

NEUTRINO ASTRONOMY WITH AMANDA AND ICECUBE

(*B. Baret,P. Berghaus, D. Bertrand, C. De Clercq, D. Hubert, Ph. Olbrechts and A. Rizzo)*

This research project is pursued in collaboration with J.-M. Frère (“Professeur Ordinaire” in theoretical physics at the ULB), co-promotor at the FNRS level.

The AMANDA neutrino telescope is designed for the observation of high energy neutrinos from astrophysical sources in the northern hemisphere. The detector is located at the geographical South Pole and consists

of 677 photo multiplier tubes (PMT) of a diameter of 8 inches deployed on a cylindrical array of a diameter of 200m and a height of 500m in the Antarctic ice at a depth of 1500m. A telescope of a second generation, IceCube, is presently under construction. A volume of 1 km^3 will be equipped with a total of 4800 PMT's of a diameter of 10 inches at depths between 1500 and 2300m completed by 160 surface stations made of 2m^3 ice tanks containing 2 PMT's each. The PMT's measure the Cherenkov light emitted in the ice by charged relativistic particles, like the muons produced in charged current muon-neutrino interactions below the detector or the light resulting from cascades produced by electron or tau-neutrinos in the detector. At the present time, 540 IceCube PMT's are deployed into the ice and 30 tanks are installed on the surface. The Icecube telescope will be completed in 2011. Calibrations are performed on the modules presently deployed, and the physics analysis will start in 2007 on a combination of data sampled from the AMANDA and the partial IceCube telescope.
The main results published in 2005 by the AMANDA collaboration are :

- Flux limits on ultra high energy neutrinos with AMANDA-B10

This result is based on the data sampled by the partial AMANDA-B10 detector (302 optical modules) in 1997. A search was performed for a diffuse flux of neutrinos of all flavours with energies above 10^{16} eV. At these energies the Earth is opaque to neutrinos, and thus neutrino induced events are concentrated at the horizon. The background originates from large muon bundles from down-going atmospheric air shower events. No excess events above the background expectation are observed. An upper limit of the neutrino flux following E^{-2}, with equal mix of all flavours was computed :$E^2\Phi(10^{15}eV<E<3x10^{18}eV) < 0.99x10^{-6}$GeV $cm^{-2}s^{-1}sr^{-1}$ at 90% confidence level.
This is the most restrictive experimental bound placed by any neutrino detector at these energies. Bounds to specific extra-terrestrial neutrino flux predictions were also computed.

- Search for extra-terrestrial point sources of high energy neutrinos with AMANDA-II using data collected in 2000-2002

This search was performed with the totality of the AMANDA detector (677 optical modules). A sample of high energy neutrinos originating from the northern hemisphere collected in the years 2000, 2001 and 2002 was analysed. In particular, a comparison with the single-year result previously published showed that the sensitivity was improved by a factor 2.2. The muon neutrino flux upper limits on selected candidate sources, corresponding to an E^{-2} neutrino energy spectrum, were included. Sky grids were used to search for possible excess above the background of cosmic ray induced atmospheric neutrinos. This analysis revealed no statistically significant excess in the sample.

Activities of the IIHE group

The IIHE group took a large responsibility in the analysis of the data taken with AMANDA-B10 in 1997-99. This is a difficult task as the reconstruction and simulation programs had to be adapted to the varying detector configuration (10 strings in 98, 13 strings in 99 and 19 strings from 2000 onwards). Two analyses were pursued with these data in 2005 :

- study of WIMP (neutralino) annihilations in the centre of the earth
- search for high energy point like neutrino sources inside and outside our galaxy.

The results of the WIMP search in the 99 data were shown at several conferences, and are published as the thesis of Ph. Olbrechts. A publication is presently in its final stage and will be soon submitted to an international review.
For the combined 97-99 point source search the main effort was the filtering and reconstruction of the data, and the production of samples of simulated data. Many difficulties were encountered linked to bugs in the new SIEGLINDE reconstruction software to which this sample of events was used as test bench. Presently the analysis is in its final stage of the selection procedure and an unblinding request will soon be made. The final goal is a global analysis for data taken from 1997 to 2004.
The data taken with AMANDA II in 2000-03 are being analysed with the aim of searching for WIMP annihilations in the sun. In 2005 the main effort was put on the selection procedure and on the simulations. The trigger conditions

to accept data were also extended to include string triggered events with a large gain in statistics for the low energy events.

In the context of the preparation of the IceCube detector, the OM tests which were started in 2001 were pursued. Two IceCube DOMs were used to perform various sensitivity tests to led light. The TestDAQ software was run on a DomHub in order to develop a slow control monitoring program. A first version of this software is presently running and will be soon tested on the large test station of the PSL laboratory in Madison (Wisconsin).

II.2. STUDY OF $e^+ e^-$ ANNIHILATION AT LEP – THE DELPHI EXPERIMENT

(D. Bertrand, C. De Clercq, J. D'Hondt, J. Lemonne and J. Wickens)

During 12 years, between 1989 and 2000, the DELPHI experiment has taken about 4 million events at the Z^0 resonance (LEP I experiment), and about 10,000 W-pair events at energies between 161 and 209 GeV (LEP II experiment).
The analysis of the data taken at the Z^0 peak is finished. Final results at the Z-pole from ALEPH, DELPHI, L3, OPAL, and SLD have been combined by the LEP Electroweak Working Group and the SLD Electroweak and Heavy Flavour Groups (CERN-PH-EP/2005-041 and hep-ex/0509008, accepted for publication in Physics Reports.) The measurements include cross-sections, forward-backward asymmetries and polarized asymmetries.
The mass and width of the Z boson are precisely measured to be :

$M_Z = 91.1875 \quad 0.0021$ GeV
$\Gamma_Z = 2.4952 \quad 0.0023$ GeV

and the electroweak mixing parameter $\sin^2 \theta_{eff}^{lept} = 0.23153 \pm 0.00016$.
The number of light neutrino species is determined to be 2.9840 0.0082, in agreement with the three observed generations of fundamental fermions.

The analysis of the high energy LEP II data is still in progress. In the following sections the main results published in 2005 are discussed with special emphasis on the contributions from the physicists of the Brussels-Antwerp group.

1) General DELPHI results :

New measurements of the forward-backward asymmetries in the processes $e^+e^- \rightarrow b\bar{b}$ using an enhanced impact parameter tag led to the b-quark pole asymmetry :

$A^{0,b}$=0.0972± .0030 (stat)± .0014(syst)

The multiplicity of hadronic three-jet events has been measured as a function of variables depending on the event topology yielding the most precise measurement of the colour factor ratio performed so far:

C_A/C_F=2.261 $0.014_{stat.}$ 0.036 $0.066_{theo.}$

where C_F and C_A can be interpreted as the effective colour charges of the triplet quarks and the octet gluons. The result is in agreement with the SU(3) expectation of 9/4 of QCD.

Combining LEP I and LEP II results within the energy range from 89 GeV to 209 GeV , the four-jet rate has been used to measure α_s in the next to leading order approximation yielding:

$$\alpha_s(M_Z^2) = 0.1175 \quad 0.0030$$

and the logarithmic energy slope was measured to be:

$$d\alpha_s^{-1}/d\log E_{CM} = 1.14 \quad 0.36$$

In a paper on Bose-Einstein correlations (BEC) in W^+W^- events at LEP II ,dedicated to the late Frans Verbeure (UA) , an indication for inter-W BEC between like sign particles at the level of 2.4 standard deviations of the combined statistical and systematic uncertainties , was published.

Further searches at LEP II for Higgs bosons in the processes $e^+e^- \rightarrow hZ$ and $e^+e^- \rightarrow hA$ (Higgs boson pair production) remained unsuccessful. Limits on new non-standard model interactions between neutrinos and electrons were also determined from a study of the reaction $e^+e^- \rightarrow \gamma(\gamma)$ +invisible particles in which searches for new processes predicted by supersymmetric and extra-dimensional models were also made.
No significant deviations from the standard model have been found.

2) Activities of the Brussels group

At the IIHE the efforts were concentrated on the following DELPHI- LEP II studies :

- *Measurement of the W boson mass and width :*

From the information of reconstructed $e^+e^- \rightarrow WW$ events estimators were developed to extract the mass and the width of the W boson. This was done by using kinematic fits on the final state topology and techniques which convolute the experimental resolution function with the expected theoretical templates.
The complete LEP II data set has been used to infer a value for these estimators and dedicated studies are performed to estimate the magnitude of several systematic uncertainties.
The main focus during 2005 was on finalizing the systematic uncertainties due to our understanding of the fragmentation process. During 2005 the latest values for the beam energy became available and the W boson mass values were adapted accordingly.

- *An investigation of Colour Reconnection in WW Events :*

In the reaction $e^+e^- \rightarrow WW \rightarrow (q_1\bar{q}_2)(q_3\bar{q}_4)$ the final state partons may coexist in space and time and cross-talk between the two evolving $(q_1\bar{q}_2)$ and $(q_3\bar{q}_4)$ hadronic systems, known as colour reconnection, may be possible during fragmentation through soft gluon exchange. Two complementary and essentially independent analyses of fully hadronic decays of W-pairs , studying the particle flow between jets and W-mass estimators, were performed and compared to models. In the framework of the SK-I model , the value of the colour reconnection parameter $\kappa = 2.2^{+2.5}_{-1.3}$, corresponding to the probability of reconnection in the range [0.31-0.68] at 68% confidence level with a best value of 0.52 .

- *Measurement of the W-boson polarisation and determination of anomalous Triple Gauge Boson couplings (TGC)*

The Spin Density Matrix elements were measured for semi-inclusive W production in the energy domain ranging from 189 GeV up to 209 GeV. The semi-leptonic muon and electron events were used. Results on the W polarisation as a function of the W production angle and on anomalous CP-conserving and CP-violating TGC's have been derived from these data.

The latest results are:

i) for the average fraction of longitudinally polarized W's :

$$\sigma_L / \sigma_{tot} = 24.9 \pm 4.5_{stat.} \pm 2.2_{syst.} \%$$

ii) for one parameter fits of the SDM elements to the full data sample with combined statistical and systematic errors:

$$\Delta g_1^z = .08 \pm^{.08}_{.11} \qquad \lambda_\gamma = .19 \pm^{.12}_{.13} \qquad \text{and} \quad \Delta_{\kappa_\gamma} = -.35 \pm^{.16}_{.15} \text{ for the CP-conserving TGC's}$$

and

$$g_4^z = .40 \pm .19 \qquad \tilde{\kappa}_z = -.09 \pm^{.08}_{.05} \text{ and } \tilde{\lambda}_z = -.09 \pm .07 \text{ for the CP-violating TGC's.}$$

All those results, including those from 2- and 3-parameter fits, are in good agreement with the predictions of the Standard Model.

II.3. STUDY OF EP COLLISIONS AT HERA – THE H1 EXPERIMENT

(A. Astvatsatourov, T. Anthonis, E. De Wolf, L. Favart, T. Hreus, D. Johnson, P. Marage, B. Roland, R. Roosen, D. Sunnar, T. Sykora and P. Van Mechelen)

During the period 2004-2005 HERA entered the high luminosity phase (phase II).

After some difficulty in running the machine in this mode, HERA finally delivered high luminosity allowing H1 to collect 100 pb^{-1} during the year 2005 alone. The new VFPS (Very Forward Proton Spectrometer) detectors, installed in 2003 under the responsibility of the IIHE group, have been accumulating data of which about 20 pb-1 are usable for physics analysis.

The main activities of the group are related to the VFPS project. The detector registered first data in 2004, but due to radiation damage on the optical fibre readout connections, the data acquisition system degraded after a short period. Such a radiation problem had never occurred to a similar detector, the FPS, located 100m in front of the VFPS. The damaged fibres have now be replaced and protected by concrete blocks. During 2005 the first good VFPS data have been collected. First analysis indicates that the VFPS triggered data are indeed in the expected

kinematic range. More detailed physics analyses require a calibration of the VFPS detector position w.r.t the beam. This procedure is rather complex as it is based on knowledge of the HERA beam optics. The parametrised beam optics is used in a neural network such that for a given class of events, parameters measured in the H1 detector can be correlated with measurements in the VPFS. At present the position calibration has been tuned on MonteCarlo events and will now be applied to real data samples. Once this calibration is done, the physics analysis can start on the total of 20 pb^{-1} which have been recorded in 2005.

During the year 2004-2005, H1 published a total of 21 articles in international journals. The various topics studied can be grouped under the following headings :

- QCD and hadronic structure:

A large fraction of the H1 studies refer to QCD analysis either in deep inelastic scattering - measurement of the proton structure functions, study of the production jets and heavy quarks in the hadronic final state - or in diffractive processes - studying diffractive structure function, exclusive final states ρ, J/ψ. These studies not only lead to a more precise knowledge of the strong interactions but also provide a better understanding into the nature of diffractive processes.

- New phenomena:

The search for new phenomena has lead to the observation of a narrow anti-charmed baryonic state interpreted as a penta-quark i.e matter constituted by 5 quarks. Tighter upper limits on the observation of supersymmetric particles (squarks,stops...) have been established.
A generic study investigating the agreement between specific final state configurations combining jets and isolated particles and the standard model has been conducted.
Finally a monopole search has been performed on part of a beamtube from the H1 experiment after a long exposure. No evidence for a monopole has been found.

Activities of the IIHE group

The physicists of the IIHE have been working in the field of diffraction :

- Analysis of diffractive events using the VFPS (2 PhD)
- Deeply Virtual Compton Scattering (1 PhD) ,
- Vector Meson production rho and phi (1 analysis in press)
- Hadronic Final State (1 PhD).

II. 4. STUDY OF pp COLLISIONS AT LHC – THE CMS EXPERIMENT

(W. Beaumont, O. Bouhali, B. Clerbaux, E. De Wolf, A. De Roeck, G. De Lentdecker, S. De Weirdt, J.P. Dewulf, J. D'Hondt, R. Goorens, J. Heyninck, S. Lowette, T. Mahmoud, P. Marage, L. Neukermans, L. Rurua, S. Tavernier, F. Udo, C. Vander Velde, W. Van Doninck, P. Vanlaer, L. Van Lancker, J. Wickens).

In December 1994, the CERN council decided the construction in the LEP tunnel of a "Large Hadron Collider" (LHC) which is expected to start in June 2007. This machine will allow to study proton-proton interactions

at a centre-of-mass energy of 14 TeV with luminosities around 10^{34} cm^{-2} s^{-1}. Two multipurpose detectors, ATLAS and CMS, are presently being constructed and installed at the LHC.

A large research program will be performed at this collider. The machine and detectors have been optimised for the search of new physics at high energy, with particular focus on the discovery of the Higgs boson(s) over a very large mass range. It will discriminate between different theories to extend the Standard Model, with, for example, the observation of supersymmetric particles or with manifestation of extra spatial dimensions. Studies of the top quark properties will become possible due to the large top pair production rate.

The Compact Muon Solenoid (CMS) collaboration consists of more than 2000 physicists and engineers from 176 institutes all over the world among which five Belgian research groups from the IIHE (ULB-VUB), UA, UCL and UMH. The Belgian teams have chosen to participate to the design and construction of the Silicium tracker detector of CMS. The IIHE took the following responsibilities: coordination of the design and production of 17000 frame components to support the Silicium detector modules and 17000 pitch adapters, assembly of 6500 frames, assembly of around 1700 modules for the forward wheels of the tracker using a high precision positioning machine (gantry), mounting of modules on about 30 to 40 support structures in the shape of a sector of a wheel (so called petals), and detailed long term tests of the modules and the petals.

The procurement of the pitch adapters was successfully terminated and all the module frame components were delivered to the assembly centres in Italy, in Pakistan and at the IIHE. The frame assembly of the 10 different geometries of the forward tracker was almost terminated end of the year 2005, with a amount of 1000 frames assembled in 2005.

Brussels is one of the eight centres having a gantry positioning machine in order to assemble modules, with a precision of a few microns. Detailed calibration and tests were performed and around 1000 modules from four different geometries were assembled during the year 2005.

Another important responsibility from the IIHE group is the assembly and the long term test of the petals. A total of twelve petals were assembled and tested successfully during the year 2005. The IIHE also participated in the development of the optoelectronic system used in these tests.

In parallel, the CMS physicists of the IIHE, both in Brussels and in Antwerp, continue to prepare the physics analyzes. They contribute to the simulation studies of several physics channels of high relevance at the LHC. They participate to the development of the simulation and reconstruction programs which are required in order to perform the analyzes.

The physics channels studied are the following :

- the search for a MSSM heavy charged Higgs boson through the decay into a top-antibottom quark pair ;
- the search for lepton flavour violation in the Higgs sector, in particular at low Higgs mass ;
- the search for Kaluza-Klein recurrences of the Z and photon and of a graviton through the decay into an electron-positron pair, in models with large extra dimensions ;
- the semi-leptonic decay of a top-antitop quark pair within the Standard Model, in order to measure the top mass with 1 GeV precision.

The related software developments are :

- precise reconstruction of the particle interaction and decay points (vertices) in the ambiguous and noisy events expected at the LHC; Brussels is coordinating these developments for the collaboration ;

- reconstruction and calibration of jets from light and heavy partons ;
- reconstruction of very energetic electrons and photons, in particular the treatment of saturated cells of the CMS electromagnetic calorimeter.

A large fraction of these studies have already been approved by the CMS collaboration and have been presented at international conferences, or accepted for publication in international scientific journals. In particular, the group provides an important contribution to the CMS Physics Technical Design Report (PTDR volume1) published end of the year 2005. The IIHE physicists are also actively interacting with theorists and phenomenologists, in the framework of the Belgian Inter-University Attraction Pole on Fundamental Interactions.

Grid development

The CMS team also contributes significantly to the deployment of the LHC Computing Grid (LCG). A cluster of 110 processors with 2 TB disk space has been installed, and has passed the certification tests of the European Grid Program EGEE in July 2005 (see the section on the Grid development at IIHE).

III. APPLIED R&D AND SPIN-OFF

DEVELOPMENT OF NEW SCINTILLATION MATERIALS AND OF RADIATION DETECTORS FOR BIOMEDICAL IMAGING APPLICATIONS – THE CRYSTAL CLEAR PROJECT.

(P. Bruyndonckx, O. Devroede, M. Krieguer, C. Lemaître, D. Wisniewski, M. Wisniewska, S. Tavernier, Y. Wu)

At the front line of organic research, molecular and cellular biologists engineer new molecular arrangements, including genes and proteins. Having produced these new strains, the next task is to investigate what happens when they are implanted in living tissue. The researchers want to know how the new genes "express" themselves. In a different area - pharmaceutical research - the effects of potential new drugs have to be established as quickly as possible. In the past, results have been established "in vitro", by either killing the samples or by taking biopsies. Until recently, there has been no other way of studying the effects of genetic manipulation or drug administration. Now researchers have found how imaging techniques used in medical diagnosis can be adapted for genetic or drug research, providing an immediate picture of how the modified tissue behaves "in vivo". One of these techniques is Positron Emission Tomography (PET).

Since a few years there has also been a steadily growing interest to use PET for mammography studies. Existing clinical PET systems are not optimized for this and the development of dedicated Positron Emission Mammography (PEM) scanners, which are specifically designed and optimized for the task at hand, is required.

From its inception, PET technology has continually benefited from new developments in radiation detection, first using sodium iodide crystals, then the improved performance from bismuth germinate (BGO), and more recently superior materials such as lutetium orthosilicate or aluminates, faster and more effective than BGO. The arrival of more advanced position sensitive PMTs (PS-PMTs) and Avalanche photo diodes (APDs) make it possible to read out matrices of small crystals individually without the introduction of excessive dead space.

In the framework of the Crystal Clear Collaboration (CCC), the IIHE, together with the UGent, CERN, the Université Claude Bernard, Lyon, the Ecole Polytechnique Fédérale de Lausanne, and the Forschunszentrum Juelich is developing a new generation of high-resolution small animal PET scanners. We have also negotiated license contracts of our technology with major commercial companies. The first design of these small animal PET scanners is based on the use of position sensitive PMTs (PSPMT) and a phoswhich of LSO/LuAP scintillators to provide the depth of interaction information. In addition, a project for a mammography PET camera (ClearPEM) has been set-up. This CCC project is in collaboration with the VUB university hospital and a Portuguese consortium of scientific institutes led by LIP (Lisbon), which is also a member of the Crystal Clear Collaboration.

The IIHE was responsible for the design and construction of the front-end detector modules for a number of small animal PET systems being developed within the collaboration. These detector modules consist of a double layered 8x8 crystal matrix mounted on a position sensitive PMT. The upper layer contains 64 LSO crystals measuring 2x2x8 mm while the bottom layer consists of 64 LuYAP crystals measuring 2x2x8 mm. To check several thousand LSO and LuYAP crystals, an automated crystal evaluation set-up was developed. This set-up measures the light yield and decay time of crystal batches. The results are stored in a database and used for crystal selection. Because LSO and LuYAP have significantly different light yields, their light output need to be equalized before they can be used in a phoswhich configuration. Extensive testing was performed to select the best procedure. To check the quality of a fully assembled detector module, energy spectra and sensitivity of each pixel in the detector are measured in a dedicated evaluation set-up.

In collaboration with other groups in the Crystal Clear Collaboration, the team at the VUB has also built a complete small animal PET system. The data acquisition software for this, and parts of the electronics and mechanics were developed at the VUB. The system was recently moved to U-Gent where it will be used in a number of biomedical research projects. In figure 5 one sees the image of a high resolution Derenzo phantom. This phantom consists of a cylinder in Plexiglas with number of holes of different diameter drilled in it. The holes can be filled with a solution of FDG in water. In our phantom there are holes of 1.0, 1.2, 1.4, 1.6, 1.8 and 2.0 mm. The images were reconstructed using the OSOM algorithm. The image show that dots down to 1.6 mm are clearly resolved.

In preparation for the design of the PEM prototype, studies using Avalanche Photo diodes (APD) are performed. APDs are more compact, are more easily subdivided in small pixels, and are potentially lower in cost. In these prototype detector modules, very small individual crystals are replaced by a solid scintillator block to eliminate dead zones in- between the crystals. In addition, these scintillator blocks are much cheaper to produce and easier to mount. The position and depth of interaction is determined from the light distribution measured over the pixels in the APD array. The information is extracted from the light profile using neural networks, support vector machines or statistically based methods. The performance of these detector configurations for tomographic imaging was evaluated on a hardware simulator. This device consists of two rotating platforms onto which two detector modules can be mounted. The two platforms can rotate over 360° and can also rotate relative to one another. This allows us to simulate a complete (or partial) detector ring of a PEM (or a next generation small animal PET) scanner and reconstruct tomographic images of an object. Coincidence events from a ^{22}Na point source were taken and processed using neural networks. These tomographic data were reconstructed using a filtered back-projection algorithm and the iterative OSEM algorithm. The resulting image showed the very encouraging FWHM resolution of resp 1.8 mm and 1.6 mm.

IV. COMPUTING AND NETWORKING

(D. Bertrand, O. Bouhali, S. De Weirdt, G. Rousseau, S. Rugovac, S. Tavernier, E. Torisaen, P. Vanlaer, R. Vandenbroucke, D. Vijverman)

The management of the IIHE computer team is under the responsibility of O. Bouhali. This covers the following tasks:

- coordinating the work of the technical staff ;
- follow-up of the maintenance and insurance contracts ;
- planning for hardware and software upgrade ;
- providing support for LINUX users ;
- co-representing the IIHE in the BEgrid and Belgrid projects ;
- organizing regular meetings with the users.

Over the last year the following projects have been followed up :

A. Storage system backup

The storage facility of the IIHE is composed of:

- a SAN of type MA8000 with a raw capacity of 3 TB (RAID 5);
- a SAN of type MSA1500 with a raw capacity of 7.2 TB (RAID 5);

The storage systems are controlled by means of a dual processor disk server with two Gbps network cards.

B. Clusters and servers

Figures 6 and 7 give a schematic view of part of the IIHE network. The local computing facility is composed of two clusters :

- the BEO cluster with 22 CPUs;
- the LXCLUS cluster: with 16 CPUs.

The following servers have been installed :

- Printserver: based on Linux, it provides a centralized printing solution.
- Linux server: it is a dual processor machine, 2 GB RAM, 2 Gbps network cards and almost 1 TB of disk space. It replaces the old Alpha server which was in operation for more than 8 years.

C. GRID computing

The major challenge we are facing is the enormous volume of data produced and the consecutive need in the processing power and the storage capability. A GRID-based solution is the most ultimate. Therefore we're participating to several national and international grid projects. More details can be found in the IIHE grid report (ref. "Grid computing activities at the IIHE", D. Bertrand, O. Bouhali, S. Rugovac, S. Tavernier, P. Vanlaer, S. De Weirdt – December 2005, http://w3.iihe.ac.be/Grid).

BEgrid and Belgrid

The BEgrid platform is composed of 330 CPUs and 3 TB of disk space, distributed over the participating institutes (see Figure 6). The IIHE is participating with 78 CPUs and 1.2 TB of disk space. Several applications are running on this platform. The IIHE site, together with other Belgian sites, has passed the EGEE certification test.

The IIHE resources form part of the ULB/VUB gridcluster that also includes CPUs and disk space contributed by the Flemish Government (34 CPU's and 0.9Tbyte storage) and by a project of the Brussels region (14 CPUs).

BEgrid is connected to the EGEE infrastructure and in this way Belgian resources, including those of the IIHE, can be brought into an international infrastructure.

At the Belgrid side, each partner has interconnected 7 dual CPU machines with the recent grid middleware.

CMS Tier-2

The Belgian Institutes participating to CMS have the project to build a federated Belgian Tier-2 center. This latter is expected to be physically located at two sites: ULB-VUB and UCL computing centers. The IIHE team is playing a key role in planning, testing and installing the necessary infrastructure for the foreseen Tier-2.

EGEE

ULB (IIHE and STC) is an official partner in the EGEE II project. VUB (ELEM) is in this project a "Joint Research Unit'.

The IIHE team has recently joint the group working on the test and integration of the EGEE middleware gLite. Our team is in charge of testing of the Logging and Bookkeeping (LB) service of the middleware (SA3).

ULB and VUB are also active at the level of other EGEE workpackages : NA2 (dissemination and Outreach), NA3 (Training) and NA4 (Applications).

Others

The IIHE team is also involved in many grid-related activities :

- Theses: The IIHE and the Service of Distributed Systems of the Faculty of Sciences (ULB), together with the service of Computer Networking and Engineering of the Faculty of Applied Sciences at the ULB have launched three undergraduate theses which focus on the main ongoing grid activities within these services.
- The IIHE is participating to the dissemination of the grid concept at the national scale.
- In order to contribute to ease the digital divide between the less-resourced countries and the EU, the IIHE is collaborating with several Institutions in Morocco. The aim is to promote grid computing in this country.

D. Others services

The following services have been setup :

- a VRVS machine for videoconferencing purposes;
- an online manual of computing;
- a grid activity report.

V. THE INTER-UNIVERSITY ATTRACTION POLE (IAP) IN FUNDAMENTAL INTERACTIONS

The IIHE is part of the IAP 5/27 (www.f-i.be) in collaboration with the following groups : Theoretische Fysica (KUL), Elementaire Deeltjes Fysica (UA), Unité de Physique Théorique et de Physique Mathématique and Unité de Physique des Hautes Energies (UCL), Physique des Particules Elémentaires (UMH), Physique Mathématique des Interactions Fondamentales and Physique Théorique (ULB), Theoretische Natuurkunde (VUB).

The purpose of this IAP, extending over the years 2002 to 2006, is to improve our understanding of Fundamental Interactions through a closer collaboration between Belgian research teams engaged in theoretical or experimental investigations in the field.

Most of the physicists of the IIHE participated, in 2005, to the general meeting of the IAP which took place in May at the VUB, as well as to the thematic journal clubs (LHC phenomenology, Brussels sandwich workshops) organised in this framework (see http://www.f-i.be).

Some IIHE physicists participated to the on-site evaluation which took place at the ULB, on 5 December 2005.

VI. TECHNICAL AND ADMINISTRATIVE WORK

The members of the workshop staff in 2005 were: J. De Bruyne, P. de Harenne, J.-P. Dewulf, L. Etienne, R. Gindroz, R. Goorens, S. Hannaert, B. Meerschaut, G. Van Beek, R. Vanderhaeghen, L. Van Lancker and Ch. Wastiels, with the help of A. De Coster, M. Goeman, D. Pirnay and J. Liesen. D. Bertrand was in charge of the general coordination.

L. Van Lancker has the general responsibility of the design and of the assembly process of carbon fiber frames which will support the silicon detector of the forward CMS tracker. He is also responsible for the mechanics of the Gantry Robot used to glue silicon sensors and readout hybrids to the frames during module assembly. Mass production of the carbon fiber support frames for the silicon detector modules is ensured by A. De Coster with the help of J. Liesen, S. Hannaert and several job students. The Gantry electronics maintenance is the responsibility of Ch. Wastiels (who coordinated the production of the Gantry control electronics) and J.-P. Dewulf. Daily operation of the Gantry is performed by B. Meerschaut with the help of M. Goeman, M. Pins, D. Pirnay and G. Rousseau.

J.-P. Dewulf is responsible for the chain of readout electronics and safety controls used to test the Petals. He has been closely involved in the design of the readout chain used during these tests, and designed a test facility for the analog optical hybrids for CMS. R. Vanderhaeghen was involved in the installation of the readout system. Construction of the clean room used for Petal assembly was coordinated by L. Van Lancker. R. Gindroz and S. Hannaert participated to this construction. Petal assembly is performed by P. de Harenne, L. Etienne, R. Goorens and Ch. Wastiels .

The quality of the pitch adapters, which will interface the modules to the amplification electronics, was checked during all the production on special machine at CERN. R. Gindroz and B. Goorens participated to these tests in 2005.

The logistics involved in the shipping of modules and parts between the IIHE and other laboratories of the CMS collaboration is taken care of by M. Goeman and D. Pirnay. R. Gindroz and S. Hannaert have acted as courier for several shipments to nearby Institutes.

G. Van Beek is responsible for the mechanics of the scintillator strips target tracker modules for OPERA. His contributions include R/D on tracker design. He is co-responsible for the trackers installation on the OPERA detector and has contributed to the conception of the procedure used for their survey. He is following-up the production by industry of the tracker end-caps and of the mechanical parts used in the tracker planes assembly. He has participated to the construction of the trackers in the LNGS cavern and to their insertion and survey in the OPERA target. R. Gindroz and S. Hannaert have contributed to OPERA through the fabrication of mechanical parts. They, together with R. Vanderhaeghen, have taken routinely charge of the transportation of the end-caps and other components to CERN and to IReS, Strasbourg.

L. Etienne is responsible of the installation of the test station for the DOM modules (Digital Optical Modules) of the IceCube experiment. He also maintained the test stations of the AMANDA modules which were used for practical works of undergraduate students in physics.

J-P. Dewulf and L. Etienne were in charge of the design and the realisation of a new data acquisition system for a cosmic rays experiment to be implemented in secondary schools (OCRE). This system was considerably upgraded during 2005. L. Etienne was also in charge of the preparation of the scintillators used in the experiment.

In the framework of the spin-off activities related to detector developments for medical applications, J. De Bruyne and Ch. Wastiels were in charge of the technical support of the CRYSTAL CLEAR project.

The secretarial work and the general administrative support of the experiments were accomplished by R. Alluyn and D. Peymans. They were assisted by M. Goeman, J. Liesen and D. Pirnay. D. Peymans had in charge the organisation of the general meeting of the MICAS doctoral school (Doctoral school in microscopic physics and astrophysics at the ULB) and of a Collaboration meeting of the H1 experiment. M. Goeman was in charge of the secretariat of the Visitatie Natuurkunde at the VUB. A. De Coster took care of the library.

VII. REPRESENTATION IN ACADEMIC COUNCILS AND COMMITTEES

Daniel Bertrand
- Chairman Doctoral School in Microscopic Physics (MICAS),
- Responsible for the ULB Physics Department Erasmus Students Exchange Program,
- Member Doctoral and DEA Commission of the Physics Department,
- Chairman Physics department strategic plan commission.

Catherine De Clercq
- Member BaMa commissie faculteit Wetenschappen VUB,
- Member Commissie PR faculteit Wetenschappen of VUB
- Chairperson Examencommissie 1BA Fysica,
- Member Gelegenheidscommissie opvolging F. Lambert, VUB.

Jorgen D'Hondt
- Vice-chairman of the "Departement Natuurkunde", VUB

Pierre Marage
- Member CA Altair, asbl d'Histoire des Sciences attachée à l'ULB
- Member Bureau, secretary of the CA Centre de Culture scientifique de l'ULB à Charleroi, Parentville
- President Comité Scientifique Inforsciences, cellule de diffusion des sciences de la Faculté des Sciences de l'ULB
- Member Comité Scientifique Expérimentarium de Physique de l'ULB
- Member Conseil d'Administration Institut National des Radioéléments, Fleurus

S. Tavernier
- - Lid Bevorderingscommissie ZAP,
- - Lid commisie samenwerking VUB-China.
- - Voorzitter commissie Visitatie Natuurkunde
- - External referee for the promotion of Peter Hobson, to Personal chair, Brunel university, January 2005

Catherine Vander Velde
- Member Commission de classement du département de physique
- Member Commission de sélection des assistants du département de physique
- Chairperson Commission Bologne didactique de la Faculté des Sciences
- Member Commission Bologne didactique de l'Université
- Member Commission Bologne de la Faculté des Sciences
- Member Commission Scientifique de Michèle Sferazza
- Chairperson Commission Scientifique de Gilles de Lentdecker
- Chairperson Commission Scientifique de Claire Noel
- Chairperson Commission Scientifique de Laura Lopez Honorez
- Member Commission d'attribution des crédits pédagogiques du département de physique

Pascal Vanlaer
- Member Commission Bologne du departement de Physique,
- Coordinator ARC proposal: ULBGrid: towards a Grid platform at the ULB.

Pierre Vilain

- President Council of Physics Department,
- President College of Physics Department.

VIII. REPRESENTATION IN SCIENTIFIC COUNCILS AND COMMITTEES

Daniel Bertrand

- Member Representant of the FNRS ApPEC Steering Committee,
- Member Representant of the FNRS DESY Experiments Finance Review Board,
- Member Representant of the FNRS ILIAS Steering Committee,
- Member IIHE Cern fellows Belgian selection committee.

Othmane Bouhali

- Invited expert Commission national sur la grille de calcul, Morocco,
- Member IIHE BEgrid,
- Member IIHE Belgrid.

Peter Bruyndonckx

- Member Programme Committee of the annual congress of the European Association of Nuclear Medicine
- Member Programme Committee of the 2005 IEEE Nuclear science symposium
- Member Programme Committee of the 2005 IEEE medical imaging conference

Catherine De Clercq

- Member Belgian selection committee of CERN fellows,
- Member IISN commission des Hautes et Basses Energies,
- Member representant of FWO ASPERA Eranet board,
- Member representant of VUB Vlaamse Raad Voor Wetenschapsbeleid - commissie CFIS,
- Member representant of the FWO ApPEC steering committee,
- Member VRWB werkgroep voor Grote Internationale Onderzoeksinfrastructuren,
- Chairperson evaluation committee for the Nederlandse Onderzoekschool in Subatomaire Fysica,
- Member representant of Belgium Plenary ECFA.

Jorgen D'Hondt

- Belgian representative in the European Particle Physics Outreach Group

Pierre Marage

- Member titulaire Comité national de Logique, de Philosophie et d'Histoire des Sciences
- Coorganisator Séminaire Ilya Prigogine Penser la Sciences, ULB

S. Tavernier

- Member of the CMS collaboration board, finance board, tracker institution board and tracker finance board,
- Chairman of the Crystal Clear steering committee and executive committee,
- Member of the executive committee of CERIMED, Marseille.
- Member of the Scientific committee Conference on Inorganic Scintillators and their Applications (SCINT 2005)19-23 September 2005, Crimea (Ukraine)
- Chairman of the NATO advanced research workshop "Radiation detectors for medical applications", September, 2005, Alushta, Crimea, Ukraine
- Member of the scientific committee of the EUROMEDIM-2006 conference, European Conference on Nuclear
- Medical Imaging Techniques, Marseille, France, May 2006,
- Organiser convenor and session chairman of the session on "Small animal imaging" at the EUROMEDIM-2006 conference

- Member of the scientific committee of the 9th World congress of Nuclear medicine and Biology, October 2006, Seoul.

Catherine Vander Velde

- Member Subatomaire Fysica, FWO
- Member Belgium Outreach Subcommittee of the European Linear Collider Steering Group
- Member of the CMS Thesis Award Committee

Pierre Vilain

- Member Board of High Energy Physics section of European Physical Society.

Gaston Wilquet

- Member personnel Commision Hautes et Basses Energies, IISN-FNRS,
- Member FNRS Advisory Committee of CERN Users (ACCU),
- Member FNRS European Committee for Future Accelerators (ECFA).

IX. TEACHING ACTIVITIES

ACADEMIC YEAR 2004-2005

Daniel Bertrand

- "Stage de laboratoire" (0/0/75/0) 1ère Licence en Sciences Physique
- "PHYS-F-205", (36/0/0/0), Physique 2, BA2 Biology/Geography, Geology
- "INFO 162" (45/15/0/0), Année préparatoire à la licence en Informatique en horaire décalé

Othmane Bouhali

- PHYS106 "Techniques de la Physique expérimentale" (35) 2005, part time,
- "Practical work for the AMANDA experiment 1ere licence" (75 hours) 2005, part time.

Peter Bruyndonckx

- "Inleiding tot mathematica" (3/10/0/0) 1ste Ba, full time
- "Labo elementaire deeltjes (muon proef) ", (0/0/18/0) 1ste Lic, full time
- "Aanvullend practicum (beeldvormingstechnieken) " (4/0/0/0) 1ste Lic, full time
- "Recente ontwikkelingen in de medische fysica" (13/0/0/0) 2 GGS klinische en biologische ingenieurstechnieken, full time
- "Proefondervindelijke aspecten van de stralings- en kwantum fysica" (0/16/0/0) 2de Ba, full time

Catherine De Clercq

- "Meten en Experimenteren" (0/65/0/0), 1 BA, Fysica VUB, responsible
- "Elementaire Deeltjes Fysica" (0/26/0/0), 1 Lic. Natuurkunde VUB, parttime

Olivier Devroede

- "Labo Elementaire Deeltjes (muon proef)", 1ste Lic, part time

Jorgen D'Hondt

- "Statistiek" (26/0/0/0), 2nd Bachelor, VUB, Physics
- "Waarschijnlijkheidsleer en Statstiek" (13/0/0/0), 1ste Bachelor, VUB, Physics
- "Statistische analyse van experimentele gegevens" (13/0/0/0), 2nd Bachelor, VUB, Physics

Jan Heyninck

- "Meten en Experimenteren" (~ 30), 1ste Lic, part time

Cédric Lemaître

- WE-DNTK-9246 "Meten en experimenteren" (20), 2005-2006, part time

Steven Lowette

- WE-DNTK-11346 "Mechanica" (0/26/0>78), 2005, part time

Daan Hubert

- WE-DNTK-11347 "WPO - Elektromagnetisme, golven en trillingen" (0/39/0/6) 2005 Part time.

Denis Johnson

- DNTK Departement Nat "Natuurkunde Laboratorium voor Eerste Jaar Bach. Studenten, VUB (Bio-Ing., Biol.,Geog.,Geol.)" (2.5/2/30/20) 2005 Part time.

Pierre Marage

- PHYS096 "Histoire des sciences" (15/0/0/0) 2de Lic, 3 Ir, DEA, full time
- METH083 "Histoire des sciences et épistemologie" (15/0/0/0) AESS, full time
- PHYS-F-104 "Physique générale" (48/0/0/0) BA2, full time
- HIST-F-101 "Histoire des sciences" (24/0/0/0) BA, full time
- "Physique des particules élémentaires" (0/60/0/0) 1ère lic phys, full time
- PHIL-F-101 "Science, Guerre et Paix, Développement", BA, full time

S. Tavernier

- "Detectie van ioniserende stralingen" (13/13/0/0) 2de Licentie Natuurkunde,
- "Radiation protection and nuclear measurement" (12/12/0/0) BNEN-GGS nucleaire techniek,
- "Detectie van ioniserende stralingen, klinische dosimetrie, wetgeving en kwaliteitsbewaking" (30/30/0/10) GGS biomedische en klinische ingenieurstechnieken.

Catherine Vander Velde

- PHYS 163 "Eléments d'électromagnétisme" (36/0/0/0) 1ère Candi info,
- METH031 "Physique du secondaire et du supérieur" (30/0/110/0) AESS,
- PHYS026 "Electronique" (coordination (30h)) 2ème candi info

Pascal Vanlaer

- PHYS105 "TRAVAUX PRATIQUES DE PHYSIQUE (stages de 75h)" (0/0/75/0) 2005 Part time,
- PROJ007 "Projet de physique de 4e année Ingenieur Civil Physicien" (0/0/60/0) 2005 Part time,
- PHYS-F-104 "Physique générale" (0/108/0/36) 2005 Full time,
- PHYS-F-205 "Physique générale" (0/0/24/0) 2005 Full time.

Pierre Vilain

- PHYS109 "Introduction à la Physique des Particules" (26/0/70/0) 2005 Full time,
- PHYS115 "Questions approfondies de Physique des Particules" (16/0/35/0) 2005 Full time.

Gaston Wilquet

- PHYS106 "Techniques de la physique experimentale" (14/90/0) 2005 Full time.

X. PHD THESES, "MEMOIRES DE LICENCE" AND "LICENTIAATSVERHANDELINGEN" COMPLETED IN 2005

A. THESES D'AGREGATION A L'ENSEIGNEMENT SUPERIEUR

P. Vilain

- "Les courants neutres et les particules charmées en physique du neutrino"

G. Wilquet

- "Masses, mélange et oscillations de neutrino's"

B. PH.D THESES

Sophie Léonard

- "Spatial resolution of PET detector modules bases on LSO crystals and avalanche protodiode arrays", VUB, 2005

  Promotor : Stefaan Tavernier

C. "MÉMOIRES DE LICENCE" AND "LICENTIAATSVERHANDELINGEN"

Didier Van Den Broeck

- "Contribution à la recherché de matière noire à l'aide du telescope à neutrinos AMANDA", ULB, September 2005
  Promotor : D. Bertrand

Hadrien Van Loo

- "Contribution à l'étude de l'observabilité de modes de Kaluza-Klein au LHC"
  Promotor : B. Clerbaux

A. Elmhouti, J. Aitalla, A. Stitou

- "Installation d'une ferme de calcul à l'Université Abdelmalek Essaadi, Tanger, Morocco" June 2005 -
  Promotor : O. Bouhali (ULB) and C. El Amrani (UAE)

Y. Ali

- "Installation d'une plateforme de grille de calcul à l'Université Abdelmalek Essaadi" December 2005
  Promotor : O. Bouhali (ULB) and C. El Amrani (UAE)

A. Bendahmane

- Installation d'une autorité de certification de grille de calcul" December 2005
  Promotor: O. Bouhali (ULB) and C. El Amrani (UAE)

Roeland Geurts

- Detectiemogelijkheden van supersymmetrische deeltjes met de CMS detector
  Promotor : P. Van Mechelen

XI. SEMINARS AND ORAL PRESENTATIONS AT CONFERENCES, SCHOOLS AND COLLABORATION MEETINGS

XI.1. SEMINARS AT THE IIHE (ORGANISED BY L. FAVART)

The IIHE had the pleasure to welcome the following invited speakers :

- Dr. Ann VAN LYSEBETTEN (CERN): Characterisation and compensation of magnetic distortions for the pixel Hybrid Photon Detectors of the LHCb RICH detectors.

- Dr. Philipp Hägler (Dept. Astronomy and physics, Amsterdam): An introduction to lattice QCD and its application to the light quark structure of the nucleon

- Dr. Yves PIERSEAUX (ULB) Poincaré's relativistic kinematics

- Dr. Marc Dierckxsens (BNL): The MINOS Experiment

- Dr. Wolfram Erdmann (ETH– Zurich): Heavy Flavour Production and Identification at HERA

- Dr. Alison Lister (ETH Zurich) : QCD at the Tevatron (CDF)

- D. Gilles De Lentdecker (IIHE-ULB, Univ. of Rochester, NY) : Measurement of the forward-backward asymmetry of electron-positron pairs in $\bar{p}p$ collisions at $\sqrt{s}$ = 1.96 TeV

XI.2. SEMINARS

Othmane Bouhali
- "La grille de calcul : le calcul distribué à grande échelle" - Ecole Mohammadia des Ingenieurs, Rabat, Morocco, March 2005.
- "Dévelopements récents en Physique des hautes énergies" - Faculté des Sciences et Techniques, Tanger, Morocco March 2005.
- "Installing and operating a grid computing infrastructure at the Abdelmalek Essaadi University" - Tetouan, Morocco, June 2005
- "Introduction à la grille de calcul" – ULB, July 2005

Jan Heyninck
- "Status of $t\bar{t}$ semi-leptonic analyse" – CERN, Geneva, Switzerland, 21 May 2005

Steven Lowette
- "Top physics at the LHC" – IIHE, Brussels, Belgium, 29 February 2005

Pascal Vanlaer
- "Beyond the Sandwich Meetings (ULB Particle Physics Workshops)" - IIHE, Brussels, every 3 weeks,
- "Grid Computing: le calcul distribué à grande échelle" - ULB, Brussels, 1 July 2005
- "Grid Computing Tutorial" - IIHE, Brussels - 9 November 2005,
- "L'experience CMS aupres du futur collisionneur LHC au CERN- ULB, Brussels (seminaire aux etudiants Ingenieurs Civils Physiciens)" 17 November 2005.

XI. 3. ORAL PRESENTATIONS AT CONFERENCES, SCHOOLS AND COLLABORATION MEETINGS

Peter Bruyndonckx
- "Neural network based depth of interaction identification" – Lisbon, Portugal, 3 October 2005, CCC Collaboration meeting
- "Online coincidence sorting and time resolution in clearPET" – Lisbon, Portugal, 3 October 2005, CCC Collaboration meeting

Catherine De Clercq

- "Neutrino physics: AMANDA/IceCube, CHORUS, OPERA and related theory" - Site evaluation IAP V/27, ULB, Brussels, Belgium 5-12-2005.

Olivier Devroede

- "Geometrical calibration of the ClearPET scanner" – CERN, Geneva, Switzerland, CCC Collaboration meeting, 3 October 2005

Jan Heyninck

- "Jet calibration, ET-cut efficiency & start fake jet study for semileptonic $t\bar{t}$ events" – Physics week, Fermilab, USA, 13 April 2005

Daan Hubert

- "Search for neturalino dark matter with the AMANDA neutrino detector" - 29th International Cosmic Ray Conference, Pune, India, 6/8/2005
- "Solar neutralinos 00-03" - Icecube collaboration meeting, Lawrence Berkeley Laboratory, Berkeley, USA, 23/3/2005
- "Neutrino generators and dark matter Monte Carlo" - Icecube collaboration meeting, Imperial College, London, UK, 29/9/2005

Steven Lowette

- "Top physics at the LHC" – Lake Louise, Canada, 25 February 2005
- "B-tag Algorithm Calibration with Data" – Fermilab, USA, 13 April 2005
- "Offline Calibration of b-Jet Identification Efficiencies" – CERN, Geneva, Switzerland, 2 November 2005

S. Tavernier

- "Non pixelated PET detector modules", Nato Advanced research workshop Radiation Detectors for Medical Applications, September 19-23, 2005. Alushta, Crimea, Ukraine
- "Status of the ClearPET project", Invited talk - Nato Advanced research workshop Radiation Detectors for Medical Applications, September 19-23, 2005. Alushta, Crimea, Ukraine
- "Possible improvements to ClearPET", - CCC Collaboration meeting - Lisbon, Portugal, 3 October 2005

Pierre Marage

- "Les jeunes femmes face aux etudes et aux professions scientifiques : une perspective belge" – Colloque Etudes Supérieures – Où sont les filles ?, Lyon, France, 31 January 2005
- "La Belgique et la coopération scientifique internationale" – Groupe de contact FNRS Histoire comparée des sciences, 23 April 2005
- "Structure Function Parameterizations" – 6ht Annual graduate School of Particle Physics (Joint Belgian-Dutch-German School), Texel, the Netherlands, 26 September 2005

Pascal Vanlaer

- "Status of the Bs to J/psi phi benchmark analysis" - Fermilab, Batavia, USA 12 april 2005.
- "Track and vertex reconstruction in CMS for key physics processes" - VUB, Brussels 25 may 2005,
- "Tracking and Vertex reconstruction in CMS for key processes" - Les Diablerets, Switzerland 8 july 2005,
- "ULBGrid: proposal of a Grid platform for large-scale computing at the ULB" - ULB, Brussels, 2 december 2005

Gaston Wilquet

- "Neutrinos masses, mixing and oscillations" - Meeting of the IAP on Fundamental Interactions, VUB, Brussels 25/5/2005.

XI.4. POSTER PRESENTATIONS AT CONFERENCES, WORKSHOPS AND SCHOOLS

Congrès de la SFP, Lille, 1 September 2005 :

Jorgen D'Hondt, Steven Lowette, Pascal Vanlaer,

- "Calibration of b-quark identification performance in CMS" - Lille, France, 1 september 2005

Barbara Clerbaux, Tariq Mahmoud, Lionel Neukermans

- "Search for extra spatial dimension via the production of heavy Kaluza-Klein excitation of gauge bosons in the CMS experiment"

Gilles De Lentdecker

- "Measurement of the forward-backward charge asymmetry of electron-positron pair in pp-bar collisions at $\sqrt{s}$ = 1.96 TeV"

Jan Heyninck, Jorgen D'Hondt, Steven Lowette

- "Potential for measuring the top quark mass with the CMS detector at the LHC detector"

Daan Hubert

- "Search for neutralino dark matter with the AMANDA-II neutrino detector"

Barbara Clerbaux, Wim Beaumont, Vincent Lemaître

- "The Belgian contribution to the construction of the CMS tracker endcaps"

XII. SCIENTIFIC VULGARISATION AND OUTREACH ACTIVITIES

XII.1. WORLD YEAR OF PHYSICS 2005

Most of the IIHE physicists participated to the organisation of the European Masterclasses 2005. These events took place on :

- Saturday 12 and 19 March 2005, VUB and UA
- 7 March and 12 March 2005, ULB

Several members of the IIHE were involved in the organization of the exhibition “L’autre regard, expo Einstein”, “Anders bekeken, expo Einstein”, which took place from 15/12/2005 to 1/05/2006 at Turn & Taxis in Brussels.

XII.2. OTHER ACTIVITIES

Daniel Bertrand

- "New windows on the universe" - Seminar for the Physics Teachers permanent formation 18/02/2005
- "Cosmic Rays Detection" - Practicals for College Pupils Whole scholar year.

Othmane Bouhali

- "La semaine de la science, Tanger, Morocco" - Oral presentation March 2005

Catherine De Clercq

- "Meesterklas Elementaire Deeltjesfysica", master class excercises, 12 March 2005
- " visits to ULB Experimentarium" - several visits
- "Member of the Flemish Physics Olympiads Committee" - Physics Olympiads since 2005

Olivier Devroede

- "Meesterklassen Elementaire Deeltjesfysica", 12 maart 2005
- "Meesterklassen Elementaire Deeltjesfysica", 19 maart 2005

Jan Heyninck

- "E=mc² onder de loep" – Participation in the construction of the exhibition Einstein Anders bekeken, 02/05

Steven Lowette

- "Master Classes Elementaire Deeltjes Fysica" – Master Classes, 5 March 2005

Pierre Marage

- "Le cosmos des Crecs" – Conférence Journées helleniques, élèves ens. sec., Comm. Fr., 20 April 2005
- "Le vide à travers l’histoire" – Conf. Athenée Léon Lepage, 25 April 2005
- "Présentation du livre de F. Jerome : Einstein, un espion pour le FBI" – Lecture publique Librairie Libris, 25April 2005
- "Présentation du livre de F. Jerome : Einstein, un espion pour le FBI" – Interview RTBF1, 7h20, 26 April 2005
- "A propos d’Einstein et de l’Amérique" – Article espace de Libertés, num.332, pp. 26-27, June 2005

- "Les Conseils Solvay et les débuts de la physique moderne" – Conférence, Soc.Fr. de Physique, Strasbourg, 22 Octobre 2005
- "Faire du latin dans l'enseignement secondaire : pourquoi ? comment ?" – Table ronde Extension de l'ULB, Fontaine l'Evêque, 12 April 2005
- "Les Conseils Solvay et les débuts de la physique moderne" – Conférence, CEPULB, ULB, 21 November 2005
- "Femmes et Sciences : stéréotypes et réalités" – Association des diplômes en Sciences de l'ULB, 20 April 2005
- "How to attract students to scientific studies" – Conférence de presse organisée par l'Union Européenne, 23 September 2005
- "A l'occasion de la conférence de presse de l'UE : How to attract students to scientific studies" – Interview RTBF1, 24 September 2005
- "Albert Einstein dixit – Entre science et engagements" – Livre, 108p., ULB et VUB, ed. December 2005

Catherine Vander Velde

- "Sciences interdisciplinaires : les hommes et l'environnement, comment sensibiliser les élèves du 1e" – formation continue pour les enseignants du secondaire dans le cadres de l'IFC, 28 January 2005
- "Physique : particules elémentaire" – Formation continue pour les enseignants du secondaire dans le cadre de l'IFC, 18 February 2005
- "Physique des Particules" – Master class, 7 March 2005
- "Physique des Particules" – Master class, 11 March 2005
- "Physique des Particules" – Master class, 12 March 2005
- "Printemps des Sciences" – Encadrement de laboratoire pour les élèves du secondaire, March 2005

Pierre Vilain

- "With students of 3rd year in Physics" - visit of Cern 26 and 27-1-2005
- "La Physique des Particules" - Master class oral presentation 7,11 and 12-3-2005

XIII. ATTENDANCE TO CONFERENCES, WORKSHOPS AND SCHOOLS

XIII.1. CONFERENCES AND WORKSHOPS

Daniel Bertrand

- "EGEE General Workshop", Athens (Greece), 16-22 April 2005

Othmane Bouhali

- "Cluster Computing and Grid 2005", Cardiff, UK, 9-12 May 2005
- "Information and Communication Technologies International Symposium", Tetouan, Morocco, 3-6 June 2005 - oral presentation - session organizer - session chair-person.

Peter Bruyndonckx

- "IEEE Nuclear Science conference and medical imaging conference", Puerto Rico, 23-29 October 2005 - poster

Catherine De Clercq

- "General meeting IAP V/27 Fundamental Interactions", Vrije Universiteit Brussel, 25 May 2005 - conference organisation.
- "Solvay workshop Dark Matters", ULB, Brussels, 18-20 May 2005 - conference organisation
- "IAP on-site evaluation", ULB, Brussels, 5 December 2005 - oral presentation

Olivier Devroede

- "International Conference on Inorganic Scintillators and their Industrial Applications", Alushta, Crimea, Ukraine, 19-23 September 2005

Daan Hubert

- "IceCube Collaboration meeting", Lawrence Berkeley Laboratory, Berkeley, USA,18-27 March 2005 - oral presentation
- "IceCube Collaboration meeting", Imperial College, London, UK,24-29 September 2005 - oral presentation

- "29th International Cosmic Ray Conference", Tata Institute of Fundamental Research, Pune, India, 3-10 August 2005 - oral presentation

Denis Johnson
- "H1 Collaboration Meeting", La Roche, Belgium, 19-23 September 2005 - conference organisation

Cédric Lemaître
- "42th General meeting CCC", CERN-Geneve, Switzerland, 2-3 March 2005
- "43th CCC meeting", Lisbon, Portugal, 3-4 October 2005

Steven Lowette
- "Lake Louise Winter Institute", Lake Louise, Canada, 20-26 February 2006 - oral presentation
- "CMS Physics week", Fermilab, USA, 11-15 April 2005 - oral presentation
- "General congress of the Société Française de Physique and the Belgian Physical Society", Lille, France, 29 August-2 September 2005 - poster

Pierre Marage
- "Colloque Etudes Supérieures – oμ sont les filles? ", Lyon, France, 31 January 2005 - Oral presentation
- "The 2005 International Linear Collider Workshop (LCWS05) ", Stanford, Ca, USA, 17-24 March 2005
- "Réunion Soc. Française de Physique consacrée au ILC", Paris, France, 2 April 2005
- "Réunion annuelle commune Sco. française de Physique et Soc. Belge de Physique", Lille, France, 29 August-2 September 2005 - Session chair person
- "Colloque Sciences, Paix et Citoyenneté", ULB, Brussels, 23-25 November 2005 - oral presentation Session chair-person

S. Tavernier
- "Radiation detectors for medical applications", September, 2005, Alushta, Crimea, Ukraine
- "SCINT2005, International conference on Inorganic scintillators and their industrial applications", September, 2005, Alushta, Crimea, Ukraine
- "IEEE Nuclear science Symposium and medical imaging conference", October 2005, Puerto Rico

Pascal Vanlaer
- "BELNET BEgrid meeting", ULB, Brussels, 2 December 2005 - oral presentation
- "Hadron Collider Physics", Les Diablerets, Switzerland, 4-9 July 2005 - oral presentation
- "General meeting of the IAP on Fundamental Interactions", VUB, Brussels, 25 May 2005 - oral presentation
- "CMS Physics week at Fermilab", Fermilab, Batavia, USA, 11-15 April 2005 - oral presentation ,
- "Journees de Rencontre des Jeunes Chercheurs", Aussois, France, 4-11 December 2005 - conference organisation ,
- "Joint SFP - BPS meeting", Lille, France, 28 August-2 September 2005 - poster

Pierre Vilain
- "EPS Conference on High Energy Physics", Lisbon, Portugal, 21-27 July 2005 - conference organisation, session chair-person,
- "SFP-BPS International Scientific Meeting", Lille, France, 29 August-2 September 2005

XIII.2. SCHOOLS

Alfio Rizzo

- "Joint Dutch Belgian German Graduate School", De Krim, Texel, the Netherlands, 19-30 September 2005
- "CERN School of Computing", Saint Malo, France, 4-17 September 2005

XIII.3. TECHNICAL FORMATIONS

Othmane Bouhali

- "Cisco Networking academy" from 01/2005 to 06/2005

XIII.4. RESPONSITIBLITIES IN EXPERIMENTS

Daniel Bertrand

- Member DELPHI Collaboration Board,
- Member IceCube Collaboration Board.

Peter Bruyndonckx

- Member Crystal Clear Collaboration Steering Committee

Catherine De Clercq

- Principal Investigator for VUB in the IceCube Collaboration Board,
- Member IceCube M&O scrutiny group.

S. Tavernier

- Spokesperson, chairman - Crystal Clear Collaboration board,
- Member CERIMED - CERIMED executive committee,
- Member CMS - CMS finance board,
- Member CMS - CMS institution board,
- Member CMS - CMS tracker institution board.

Catherine Vander Velde

- Member CMS Collaboration Board
- Member CMS Finance Board
- Member CMS Tracker Institution Board
- Member CMS Tracker Finance Board
- Responsible of the procurement CMS frames for the Si modules

Pascal Vanlaer

- Coordinator of Vertex reconstruction group CMS Physics Reconstruction and Selection (b/tau).

Pierre Vilain

- Member opera editorial board.

Gaston Wilquet

- Member CHORUS Collaboration Board,
- Member OPERA Collaboration Board,
- Member CHORUS Academic and Editorial Board.

XIII.5. MEMBERSCHIP IN ACADEMIC JURY'S

Daniel Bertrand

- G. Wilquet, Agregation Thesis ULB, "Masses, Mélange et oscillations de neutrinos" - Secretary
- P. Vilain, Agregation Thesis ULB, "Les courants neutres et les particules charmées en physique du neutrino" - Secretary
- V. Bouchat, PhD Thesis ULB, "Le tetraneutron: mythe ou realite ? " - Member
- D. Van Den Broeck, Small Thesis ULB, "Contribution a la recherche de matiere noire a l'aide du telescope a neutrinos AMANDA" - Promotor

Othmane Bouhali

- A. Stitou, J. Alla, A. Mhoutti, Université Abdelmalek Essaadi, "Installation d'une ferme de calcul à l'Université Abdelmalek Essaadi" - Promotor
- Y. Ali, Universite Abdelmalek Essaadi, "Instalaltion d'une plateforme de grille de calcul à l'Université Abdelmalek Essaad" - Promotor
- A. Bendahmane, Université Abdelmalek Essaadi, "Installation d'une autorité de certification de grille de calcul" - Promotor

Peter Bruyndonckx

- Steven Sourbron, Ph.D VUB, "Perfusion quantification with bolus-trackiing MRU" - secretary

Catherine De Clercq

- Didier Van Den Broeck, Master thesis, Universite Libre de Bruxelles, "Contribution a la recherche de matière noire a l'aide du télescope a neutrinos AMANDA" - Member
- Sopie Léonard, Ph. D. Vrije Universiteit Brussel, "Spatial resolution study of PET detector modules based on LSO crystals and Avalanche Photodiode Arrays" - Member

S. Tavernier

- Sopie Léonard, Ph. D. Vrije Universiteit Brussel, "Spatial resolution study of PET detector modules based on LSO crystals and Avalanche Photodiode Arrays" - Promotor
- G. Wilquet, Agregation Thesis ULB, "Masses, Melange et oscillations de neutrinos" - Member

Catherine Vander Velde

- Christophe Delaere, PhD thesis, UCL, "Study of WW decay of a Higgs boson with ALEPH and CMS detectors" Member

Pierre Vilain

- S. Kalinin, Ph. D. Thesis UCL "Charm studies in emulsion" - Member

XIV. LIST OF PUBLICATIONS, REPORTS AND CONTRIBUTIONS TO CONFERENCES

XIV.1. PUBLICATIONS

A. NEUTRINO PHYSICS : CHORUS

Measurement of Topological Muonic Branching Ratios of Charmed Hadrons produced in Neutrino-Induced Charged-Current Interactions
A. Kayis-Topaksu et al.
Phys. Lett. B. 626 (2005) 24-34

Measurement of D*+ Production in Charged-Current Neutrino Interactions
G. Onengut et al.
Phys. Lett. B 614 (2005) 155-164

Search for Superfragments and Measurement of the Production of Hyperfragments in Neutrino-Nucleus Interactions
G. Onengut et al.
Nucl.Phys.B 718 (2005) 35-54

Measurements of D0 Production and of Decay Branching Fractions in Neutrino-Nucleon Scattering
G. Onengut et al.
Phys. Lett. B 613 (2005) 105-117

B. NEUTRINO PHYSICS : ICECUBE

Flux Limits on Ultra High Energy Neutrinos with AMANDA-B10
J. Ahrens ,et al
Astroparticle Physics 22 (2005) 339

Search for Extraterrestrial Point Sources of High Energy Neutrinos with AMANDA-II using Data Collected in 2000-2002
Ackermann M.,et al
Physical Review D 71,077102 (2005)

Search for Extraterrestrial Point Sources of High Energy Neutrinos with AMANDA-II using Data Collected in 2000-2002
Ackermann M.,et al
Physical Review D 71,077102 (2005)

C. ep PHYSICS : H1

Measurement of Dijet Cross Sections in ep Interactions with a Leading Neutron at HERA
A. Aktas, et al.
Eur. Phys. J. C 41 (2005) 273-286, 01/05

A Direct Search for Stable Magnetic Monopoles Produced in Positron-Proton Collisions at HERA
A. Aktas, et al.
Eur. Phys. J. C 41 (2005) 133-141, 01/05

Search for Light Gravitinos in Events with Photons and Missing Transverse Momentum at HERA
A. Aktas, et al.
Phys.Letters B 616 (2005) 31-42, 01/05

Measurement of F_2^{cc} and F_2^{bb} at High Q^2 using the H1 Vertex Detector at HERA
A. Aktas, et al.
Eur. Phys. J. C40 (2005) 349-359,11/04

Inclusive Production of D^+, D°, D_s^+ and D^{*+} Mesons in DIS at HERA
A. Aktas, et al.
Eur. Phys. J. C38 (2005) 447-459, 08/04

Measurement of Prompt Photon Cross Sections in Photoproduction at HERA
A. Aktas, et al.
Eur. Phys. J. C38 (2005) 437-445, 07/04

Measurement of Beauty Production at HERA Using Events with Muons and Jets Reference
A. Aktas, et al.
Eur. Phys. J. C41 (2005) 453-467, 02/05

Measurement of Charm and Beauty Photoproduction at HERA using D_μ^* Correlations
A. Aktas, et al.
Phys. Lett. B 621 (2005) 56-71, 03/05

Measurement of Deeply Virtual Compton Scattering at HERA
A. Aktas, et al.
Eur. Phys. J. C44 (2005) 1-11, 05/05

Search for Leptoquark Bosons in ep Collisions at HERA
A. Aktas, et al.
Phys. Lett. B 629 (2005) 9-19, 06/05

D. e^+e^- PHYSICS : DELPHI

Coherent Soft Particle Production in Z decays into Three Jets

J. Abdallah et al.
Physics Letters B 605 (2005) 37-48

Measurement of the Energy Dependence of Hadronic Jet Rates and the Strong Coupling α_s from the Four-jet Rate with the DELPHI Detector at LEP
J. Abdallah, et al.
Euro.Phys.Journal C 38 (2005) 413-426

Photon Events with Missing Energy in e^+e^- Collisions at $\sqrt{s}$ = 130 to 209 GeV
J. Abdallah et al.
Euro.Phys.Journal C 38 (2005) 395-411

Determination of A_{FB}^b at the Z pole using Charge Reconstruction and Lifetime Tagging
J. Abdallah, et al.
Euro. Phys. Journal C 40 (2005) 1-25

Flavour Independent Searches for Hadronically Decaying Neutral Higgs Bosons
J. Abdallah, et al.
Euro. Phys. Journal C 44 (2005) 147-159

Bose-Einstein Correlations in W+W- Events at LEP2
J. Abdallah, et al.
Euro. Phys. Journal C 44 (2005) 161-174)

Charged Particle Multiplicity in Three-Jet Events and Two-Gluon Systems
J.Abdallah et al.
Eur.Phys.Journal C44 (2005) 311-331

Production of Ξ_c^o and Ξ_b in Z decays and lifetime measurement of Ξ_b '.
J. Abdallah et al.
Eur. Phys. Journal C44 (2005) 299-309

Flavour independent h°A° search and two Higgs doublet model interpretation of neutral Higgs boson searches at LEP.
G. Abbiendi et al.
Eur. Phys. J. C40 (2005) 317-332

Search for radions at LEP2
G. Abbiendi et al.
Phys. Lett. B609 (2005) 20-34

Measurement of R_b in e^+e^- collisions at 182 GeV-209 GeV
G. Abbiendi et al.
Phys. Lett. B609 (2005) 212-225

Measurement of event shape distributions and moments in $e^+e^- \rightarrow$ hadrons at 91 GeV–209 GeV and a determination of α_s

G. Abbiendi et al.
Eur. Phys. Journal C40 (2005) 287-316

E. p-p PHYSICS : CMS

Vertex Reconstruction in CMS
E. Chabanat, et al.
NIM A Vol.549 (2005) 188-191

The Effect of Highly Ionising Particles on the CMS Silicon Strip Tracker
W.Adam, et al.
Nucl. Instr. and Methods A543 (2005) (2-3) 463-482

The efficiency of the CMS level-1 trigger for supersymmetric events
L. Boldizsar et al.
Eur. Phys. Journal C40-S2 (2005) 1-13

Diffractive and forward physics at the LHC
A. De Roeck
Nucl. Phys. A755 (2005) 591-594

Physics potential and experimental challenges of the LHC luminosity upgrade
F. Gianotti et al.
Eur. Phys. Journal C39 (2005) 293-333

F. APPLIED R&D AND SPINOFF

The ClearPET Project: Development of a 2nd Generation High Performance Small Animal PET Scanner
K.Ziemons,et al.
Nucl. Instr. Meth., A 537 (2005) 307-311

A High Resolution PET Detector based on Continuous Scintillators
S.Tavernier et al.
Nucl.Instr.Meth. A537 (2005) 321-325

XIV.2. CONFERENCE PROCEEDINGS

A. NEUTRINO PHYSICS : ICECUBE

Results From the AMANDA Neutrino Telescope
Ahrens J.,et al
Proceedings of the 10th International Workshop on Neutrino Telescopes, Venice, Italy, 11-14 Mar 2003 Nucl.Phys.Proc.Suppl.138:167-170,2005

B. p-p PHYSICS : CMS

Impact of Silicon Tracker Misalignment on Track and Vertex Reconstruction
P.Vanlaer et al.
NIM. Proceedings of the International Workshop on Tracking in High Multiplicity Environment. Zurich, Switserland 3-7 October 2005

Vertex Fitting in the CMS Tracker
T.Speer et al.
NIM. Proceedings of the International Workshop on Tracking in High Multiplicity Environment. Zurich, Switserland 3-7 October 2005

Top physics at the LHC
S. Lowette
Proceedings of the "Lake Louise Winter Institute 2005", Lake Louise, Canada, 20-26 February 2005

Calibration of b-quark identification performance in CMS
S. Lowette
Physicalia, Proceedings of the "General congress of the Société française de physique and the Belgian physical society, 29 August-2 September 2005

C. ep PHYSICS : H1

Experimental review of diffractive phenomena
L. Favart
Proceedings of the 10th International Baryons Conference BARYONS2004, [hep-ex/0501052]

Hadronic final states in diffraction at H1
T. Anthonis
Proceedings of the International workshop on deep-inelastic scattering and QCD, Madison, Wisconsin, USA, April 2005

HERA and the LHC
A. De Roeck
Proceedings of the Workshop on New Trends in HERA Physics, Ringberg Castle, Tegernsee, Germany, October 2005

Charged multiplicities at HERA
E.A. De Wolf

Proceedings of the HEP2005 Europhysics Conference, Lisboa, Portugal, July 2005

D. APPLIED R&D AND SPINOFF

Investigation of Crystal Identification Methods for ClearPET Phoswich Detector
P.Bruyndonckx, et al.
Proceedings of the Nato Advanced research workshop Radiation Detectors for Medical Applications September 19-23, 2005. Alushta, Crimea, Ukraine

Status of the ClearPET project
E.Auffray, et al.
Proceedings of the Nato Advanced research workshop Radiation Detectors for Medical Applications, September 19-23, 2005. Alushta, Crimea, Ukraine

Digital Pulse Shape Discrimination Methods for Phoswich Detectors
D.Wisniewski,et al.
Proceedings of the IEEE NSS/MIC conference October 2005, Puerto Rico.

Performance of APD-Based monolithic-crystal detectors for small Animal PET
M. C. Maas et al.
Proceedings of the IEEE symposium on Nuclear science and medical imaging, Puerto Rico, October 2005

High Resolution Imaging with ClearPET™Neuro - First Animal Images
M. Khodaverdi, et al.
Proceedings of the IEEE symposium on Nuclear science and medical imaging, Puerto Rico, October 2005

Image Reconstruction for the ClearPET Neuro
Simone Weber,et al.
to be published in the Proceedings of the ITBS Conference,September 2005

Track and vertex reconstruction in CMS for key physics processes
P. Vanlaer
Proceedings of the Hadron Collider Physics Conference, Les Diablerets, Switzerland, 4-9 July 2005

XIV.3. REPORTS

Top physics at the LHC
S. Lowette
CMS CR 2005/008

Selection of top-pair events with CMS

M. Grunewald et al., … J. D'Hondt, S. Lowette, …
CMS AN-2005/071

Offline calibration of b-jet identification efficiencies
S. Lowette, J. D'Hondt, J. Heyninck and P. Vanlaer
CMS AN/2005/030

Light quark jet energy scale calibration using the W mass constraint in single-leptonic ttbar events
J. D'Hondt, J. Heyninck, S. Lowette and S. Kasselman
CMS AN 2005/027

Fitting of event topologies with external kinematic constraints in CMS
J. D'Hondt et al.,
CMS AN 2005/025

Electron and muon reconstruction insingle leptonic tt bar events
J. D'HOndt, S. Lowette and J. Heyninck
CMS AN 2005/024

Thermal conductivity measurement of the silicon sensor support frames of the CMS tracker
B. Clerbaux, F. Udo, C. Vander Velde, M. Vancaldenhoven, L. Van Lancker
CMS-note 2005/009

Track and vertex reconstruction in CMS for key physics processes
P. Vanlaer
CMS-CR 2005/025

Impact of silicon tracker misalignment on track and vertex reconstruction
P. Vanlaer, N. De Filippis, T. Speer, O. Buchmueller, F.-P. Schilling
CMS AN 2005/015

Vertex fitting in the CMS tracker
T. Speer, K. Prokofiev, R. Frühwirth, W. Waltenberger, P. Vanlaer
CMS AN 2005/022

TeV electron and photon saturation studies
B. Clerbaux, T. Mahmoud, C. Collard, M.C. Lemaire, V. Litvin
CMS AN 2005/049

Grid computing activities at the IIHE
D. Bertrand, O. Bouhali, S. Rugovac, S. Tavernier, P. Vanlaer, S. De Weirdt
Internal report, December 2005

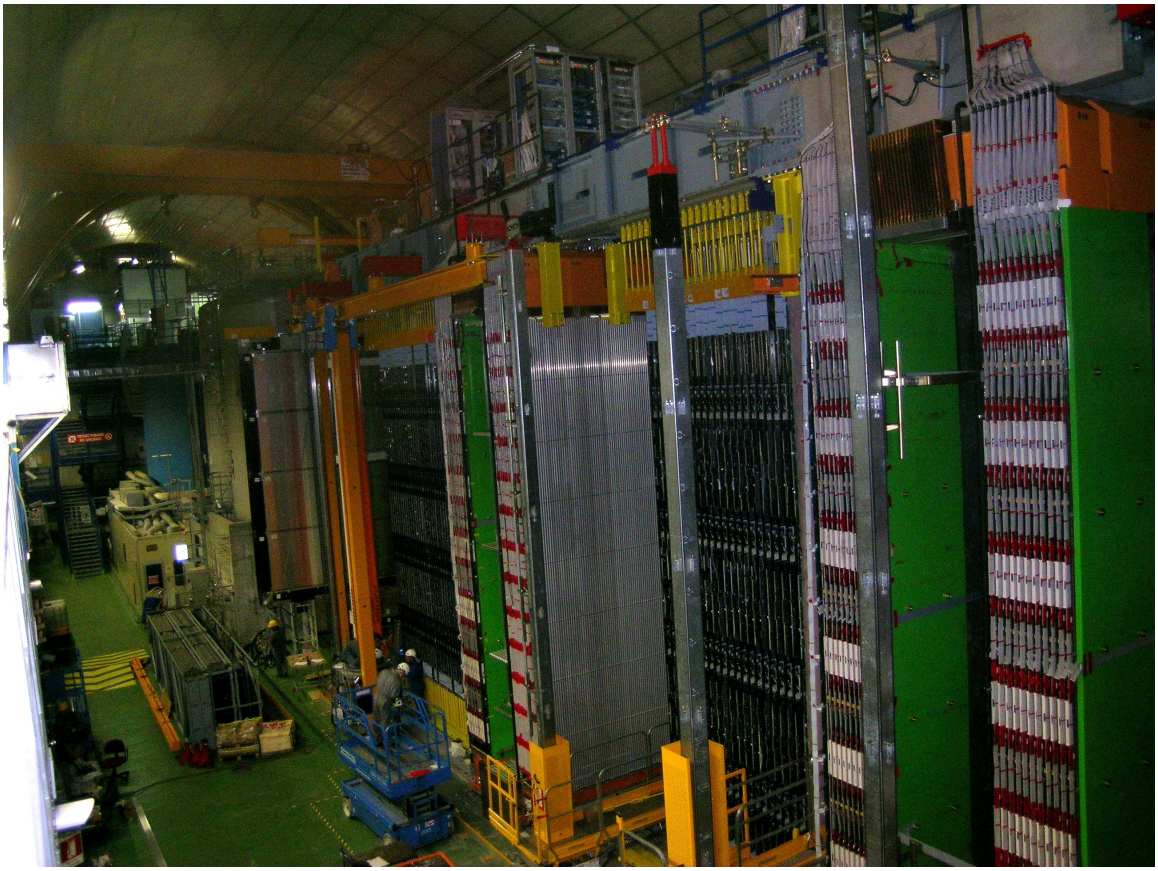

Figure 1

The OPERA detector in construction in the Gran Sasso Underground Laboratory

• T1: the 31 walls of the lead/emulsion target interleaved with planes of plastic scintillatorstrips tracker of super-module 1

• M1a & M1b: the two sides of the dipole magnet instrumented with planes of resistive plate chambers of super-module 1

• HPc1: the rear module of high precision drift tubes planes of super-module 1: the front plane is not seen and the middle plane will be inserted in the space between M1a and M1b.

• T2, M2a & M2b: similarly for super-module 2

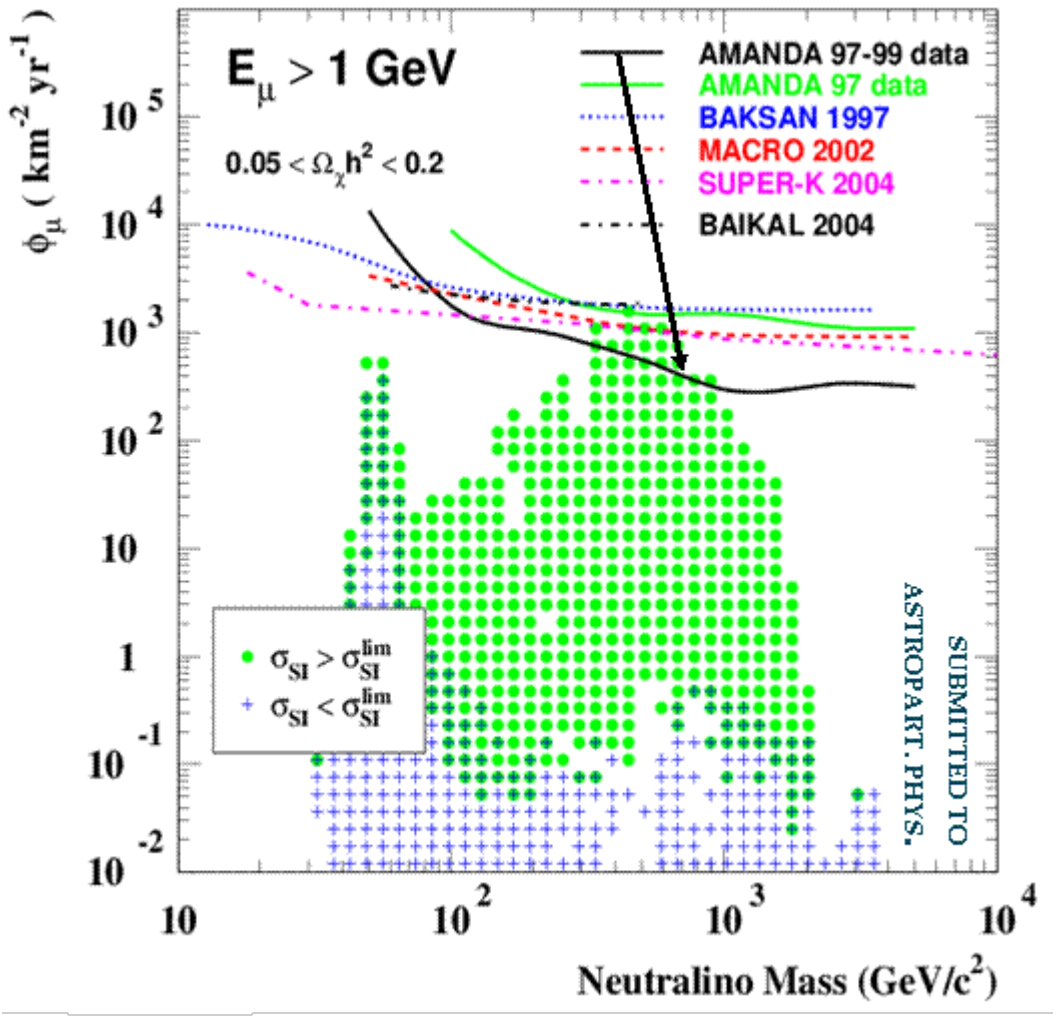

Figure 2

The AMANDA limits on the muon flux from neutralino annihilation at the center of the Earth for the three year 1997-99 combined data set compared with earlier results (AMANDA 97 data) and those of Baksan, Macro, Super-Kamiokande and Baikal. MSSM model predictions with new estimates on the WIMP diffusion in the solar system are also shown, with the dots indicating models that are disfavored by CDMS. The plus signs mark those not probed by CDMS.

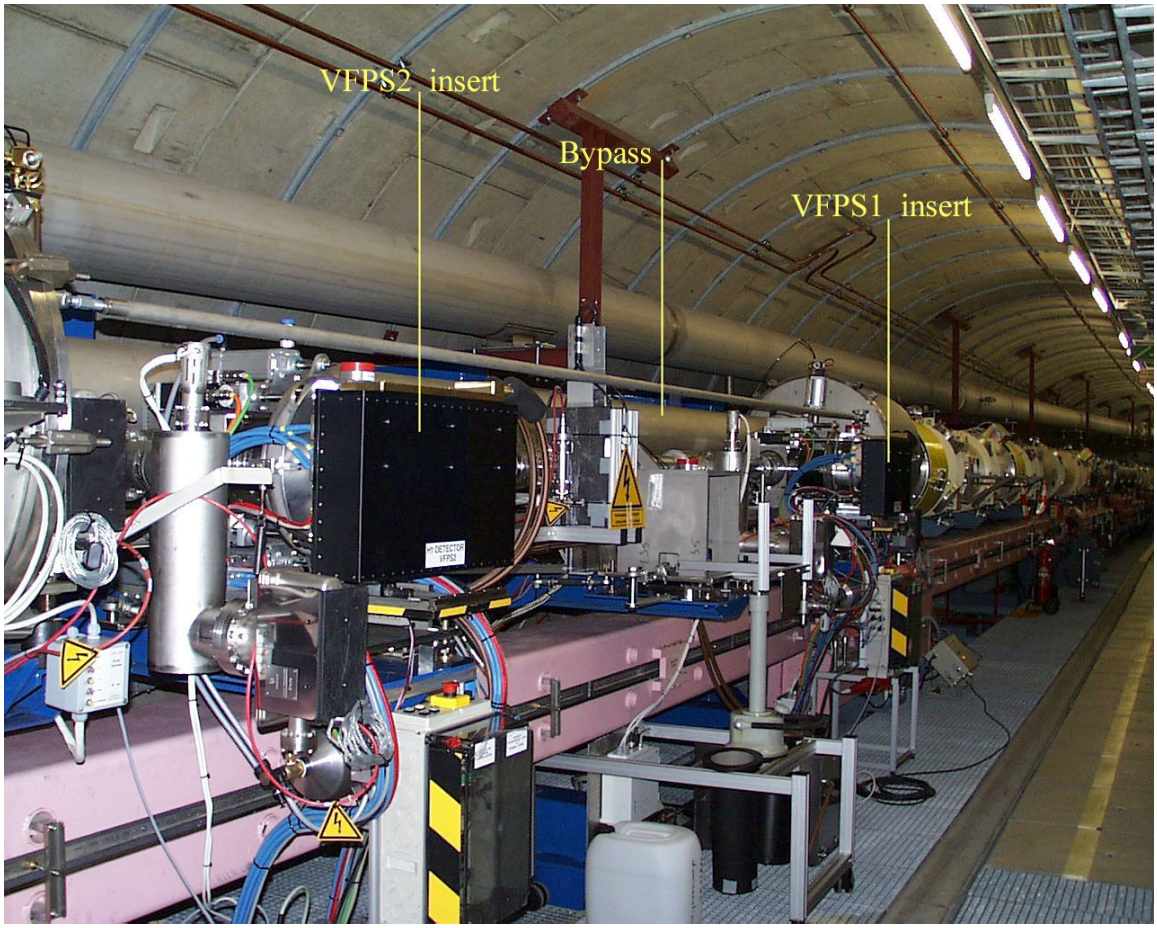

Figure 3
View on the VFPS Spectrometer in the HERA tunnel

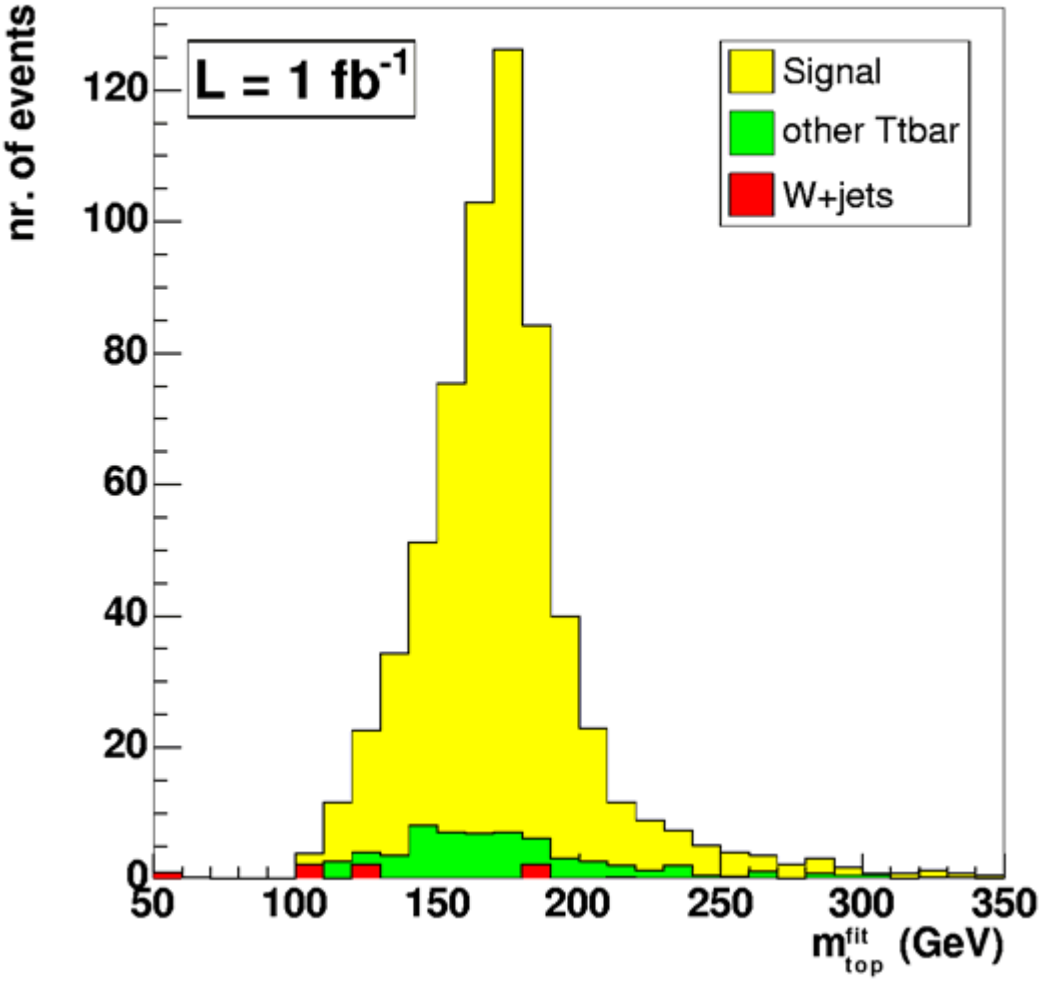

Figure 4

Distribution of the mass of the hadronic decaying top quark for the selected events in the CMS detector after applying the kinematic fit. The contribution of all relevant background processes is shown

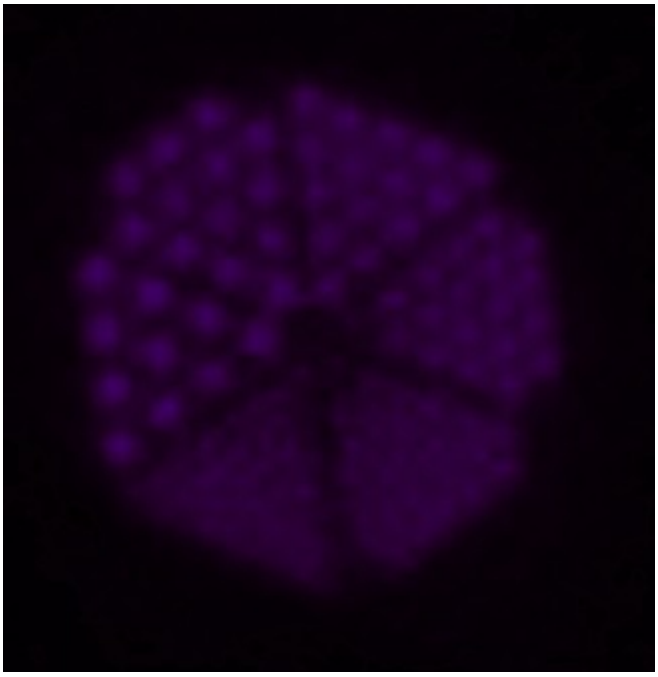

Figure 5
Image of a Derenzo phantom acquired with The ClearPET@™ Rodent and reconstructed using listmode OSEM. he hole diameters in the phantom are 1.0 mm, 1.2 mm, 1.4 mm, 1.6 mm, 1.8 mm en 2.0 mm

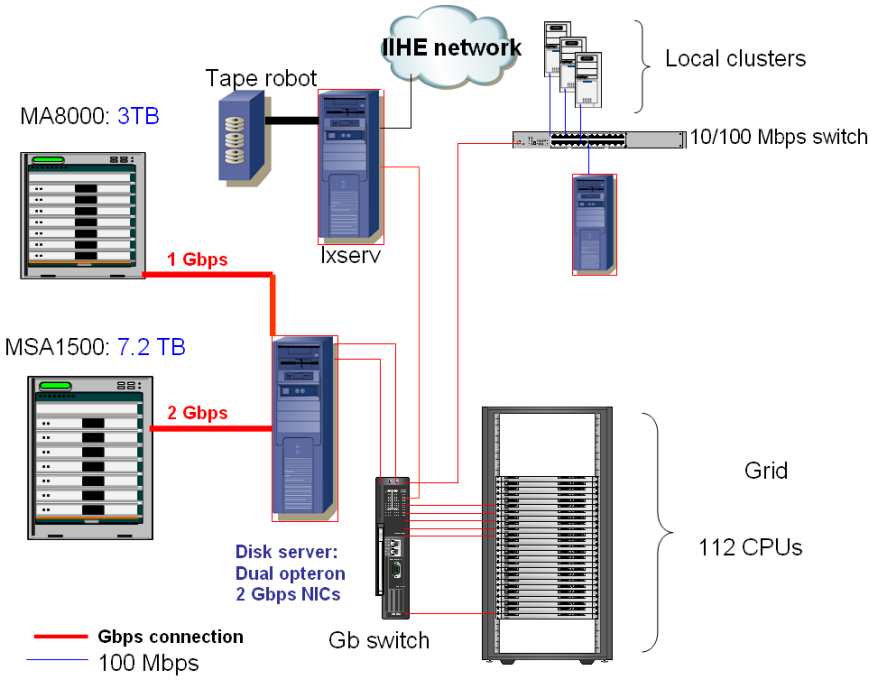

Figure 6
Schematic view of part of the IIHE Network

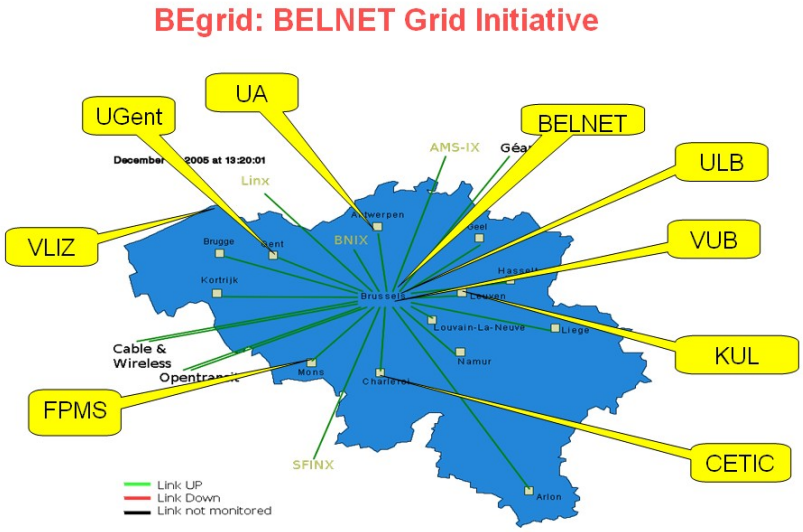

Figure 7
The BEgrid participating institutes