Application for the Big Science programme

Fonds Wetenschappelijk Onderzoek – Vlaanderen
Research Foundation - Flanders
Egmontstraat 5 – B-1000 BRUSSEL
Phone: 02 512 91 10 – Fax: 02 512 58 90
E-mail: bigscience@fwo.be
Website: http://www.fwo.be

To be filled in by the investigating departme
received date

number | file

What is the purpose of this form?
With this form you can apply for the Big Science programme through which FWO funds research projects conducted at major inte research facilities, the membership for which is paid for by the Belgian Federal or Flemish government.

How to submit this form?
This form has to be submitted to the FWO, at the e-mail address mentioned above.

How does the FWO handle the data in this form?
The FWO uses your information only for processing your candidature. The data will be handled confidentially and won't be disclos parties.

As soon as the FWO has processed your application, you will receive a notification message.

Administrative details

Title of the project

1 *By project is meant the totality of the research that you intend to perform, possibly spread over several years, and entirely or parti means of FWO funding. Make sure that the title of the project provides an adequate and precise description of its subject matter. limit the title length tot 240 characters. Please only use capital letters where it is grammatically necessary.*

2 **Enter the English title of the project**

The CMS experiment at the Large Hadron Collider at CERN

3 **Enter the Dutch title of the project**

Het CMS experiment bij de Large Hadron Collider te CERN

Membership fee

4 *For the eligibility of this application it is necessary to demonstrate the governmental support (by the Flemish Government or the B Federal Government) for the concerned international research infrastructure.*

5 **Does the government, either Flemish or Federal, pay a membership fee for this particular research infrastructu**

☒ yes

☐ no

6 **Indicate the annual membership.**

20M euro/year

the exact amount depends on the Euro to Swiss franc rate

7 **Specify any other kind of support (you may upload a PDF if necessary).**

the complete annual fee is paid by the Belgian Federal Government

Details of the Flemish supervisor(s) of the project

Details of the principal investigator

8 Enter the details of the principal investigator of the project.

first name and surname: Jorgen D'Hondt

legal domicile address: Helen-Bosstraat 65, 3350 Linter

private phone: 0496 70 48 65

department address: VUB, department of physics, Pleinlaan 2, 1050 Brussel

work phone: 0496 70 48 65

e-mail address: jodhondt@vub.ac.be

birthplace: Leuven

date of birth: day 2 9 month 1 2 year 1 9 7 7

nationality: Belgian

gender: ☒ m ☐ f

civil status: single / living together

9 List the past and current studies of the principal investigator.

degree	diploma	date (dd-mm-yyyy)	university	country
Licentiaat	Fysica	1999	VUB	Belgium
Doctoraat	Fysica	2003	VUB	Belgium

10 Fill in the career path of the principal investigator.

position	start date	end date	university	country
IWT beursaal	1999	2003	VUB	Belgium
FWO post-doc	2003	2009	VUB	Belgium
ZAP docent (first part-time, then full-time)	2006	2011	VUB	Belgium
ZAP hoofddocent	2012	now	VUB	Belgium

Details of other Flemish supervisors

11 *All co-supervisors must be researchers from postdoctoral level upwards, affiliated to a Flemish university, a Flemish research institute, a Flemish academic hospital or a federal scientific institute (with the co-supervisor belonging to the Dutch-speaking staff). Researchers working at foreign institutions may be involved as co-supervisors to the extent that this collaboration is relevant for the project; they will however not be eligible for FWO funding.*

The co-supervisors are the actual initiators of the project, and as such are responsible for it. The co-supervisors accept that the applicant will act as supervisor-spokesperson towards FWO. No funding may be requested to the benefit of the co- supervisors.

This page must be filled in for each co-supervisor affiliated to a Flemish university. Researchers working at foreign institutions (co-supervisors) must be indicated in question 30.

Details of the first co-supervisor

12 Enter the details of the first co-supervisor.

first name and surname: Pierre Van Mechelen

legal domicile address: Ter Voortlaan 97, 2650 Edegem

private phone: 03/4405082

department address: UA, department of physics, Groenenborgerlaan 171, 2020 Antwerpen

work phone: 03/2653573

e-mail address: Pierre.VanMechelen@ua.ac.be

birthplace: Wilrijk

date of birth: day 1 2 month 0 9 year 1 9 7 0

nationality: Belgian

gender: ☒ m ☐ f

civil status: Married

13 List the past and current studies of the first co-supervisor.

degree	diploma	date (dd-mm-yyyy)	university	country
Licentiaat	Fysica	July 1992	UIA	Belgium
Doctoraat	Fysica	May 1998	UIA	Belgium

14 Fill in the career path of the first co-supervisor.

position	start date	end date	university	country
navorser	06/07/1992	30/09/1998	UIA	Belgium
FWO postdoc	01/10/1998	31/12/2005	UA	Belgium
ZAPBOF docent	01/01/2006	31/12/2011	UA	Belgium
ZAPBOF hoofddocent	01/01/2012	now	UA	Belgium

Details of the second co-supervisor

15 Enter the details of the second co-supervisor.

first name and surname	Nick van Remortel
legal domicile address	Oversneslaan 22, 2610 Antwerpen
private phone	0475 841 601
department address	UA, department of physics, Groenenborglaan 171, 2020 Antwerpen
work phone	03 265 35 68
e-mail address	nick.vanremortel@ua.ac.be
birthplace	Beveren
date of birth	day 2 7 month 1 0 year 1 9 7 6
nationality	Belgian
gender	☒ m ☐ f
civil status	single / living together

16 List the past and current studies of the second co-supervisor.

degree	diploma	date (dd-mm-yyyy)	university	country
Licentiaat	Fysica	1998	UA and Utrecht	BE/NE
Doctoraat	Fysica	2003	UA	Belgium

17 Fill in the career path of the second co-supervisor.

position	start date	end date	university	country
aspirant FWO	1998	2002	UA	Belgium
postdoc FWO	2003	2004	UA	Belgium
post-doc	2004	2006	Univ. of Helsinki	Finland
ZAP docent	2008	now	UA	Belgium

Details of the third co-supervisor

18 Enter the details of the third co-supervisor.

first name and surname	Martin Grunewald
legal domicile address	Kerkstraat 5, 9820 Merelbeke
private phone	0488 645 415
department address	Universiteit Gent, Physics and Astronomy
	Proeftuinstraat 86, 9000 Gent
work phone	09 264 6512
e-mail address	Martin.Grunewald@UGent.be
birthplace	Hagen, Germany
date of birth	day 2 8 month 0 1 year 1 9 6 2
nationality	German
gender	☒ m ☐ f
civil status	Single

19 List the past and current studies of the third co-supervisor.

degree	diploma	date (dd-mm-yyyy)	university	country
Diploma	Physics	14-07-1988	RWTH Aachen	Germany
MSc	Physics	15-06-1990	CALTECH	USA
PhD	Physics	11-06-1993	CALTECH	USA
Habilitation	Physics	21-07-1999	HU Berlin	Germany

20 Fill in the career path of the third co-supervisor.

position	start date	end date	university	country
CERN Fellow	01-04-1993	31-07-1994	CERN	Switzerland
C1	01-08-1994	31-03-2001	HU Berlin	Germany
C2	01-04-2001	31-05-2002	RWTH Aachen	
Full Professor	01-06-2002	31-12-2007	UCD Dublin	Ireland
Full Professor	01-01-2008	n/a	U Gent	Belgium

Details of the fourth co-supervisor

21 Enter the details of the fourth co-supervisor.

first name and surname: Dirk Ryckbosch
legal domicile address: Gabriel Celisstraat 9, 9040 Gent
private phone: 09 329 5253
department address: UGent, Fysica en Sterrenkunde, Proeftuinstraat 86, 9000 Gent
work phone: 09 264 6543
e-mail address: Dirk.Ryckbosch@UGent.be
birthplace: Deinze
date of birth: day 30 month 12 year 1957
nationality: Belg
gender: ☒ m ☐ f
civil status: Married

22 List the past and current studies of the fourth co-supervisor.

degree	diploma	date (dd-mm-yyyy)	university	country
Licentiaat	Natuurkunde	03-07-1979	UGent	Belgium
PhD	Natuurkunde	23-11-1984	UGent	Belgium
Geaggr. Hoger Onderwijs	Kernfysica	23-03-1989	UGent	Belgium

23 Fill in the career path of the fourth co-supervisor.

position	start date	end date	university	country
Wet. Medewerker IIKW	01-10-1979	30-09-1987	UGent	Belgium
Aangesteld navorser NFWO	01-10-1987	30-09-1990		
Bevoegdverklaard Navorser NFWO	01-10-1990	30-09-1993		
Onderzoeksleider FWO	01-10-1993	30-09-1999	UGent	Belgium
Onderzoeksdirecteur FWO	01-10-1999	30-09-2000		
Hoofddocent	01-10-2000	30-09-2008	UGent	Belgium
Hoogleraar	01-10-2008	n/a	UGent	Belgium

Details of the fifth co-supervisor

24 Enter the details of the fifth co-supervisor.

first name and surname: Freya Blekman

legal domicile address: Arenbergstraat 2A, 1000 Brussel

private phone: 0494990738

department address: VUB, departement of physics, Pleinlaan 2, 1050 Brussel

work phone: 02 629 3211

e-mail address: freya.blekman@vub.ac.be

birthplace: Amsterdam, Nederland

date of birth: day 16 month 11 year 1974

nationality: Nederlandse

gender: ☐ m ☒ f

civil status: single

25 List the past and current studies of the fifth co-supervisor.

degree	diploma	date (dd-mm-yyyy)	university	country
M.Sc.	Fysica	2000	Universiteit van Amsterdam	Nederland
Ph.D.	Fysica	2005	NIKHEF/Universiteit van Amsterdam	Nederland

26 Fill in the career path of the fifth co-supervisor.

position	start date	end date	university	country
Onderzoeker in Opleiding (OIO)	2000	2005	FOM/NIKHEF	Nederland
post-doc	2005	2007	Imperial College London	UK
post-doc	2007	2010	Cornell University	USA
Onderzoeksprofessor (90%) - ZAP docent (10%)	2010	n/a	Vrije Universiteit Brussel	Belgium

Details of the research

Details of the host institution(s)

27 Select the host institution.
You may tick only one institution.

- ☒ VUB
- ☐ K.U.Leuven
- ☐ UGent
- ☐ UHasselt
- ☐ UA
- ☐ K.U.Brussel

28 Select additional host institution(s).

- ☐ VUB
- ☐ K.U.Leuven
- ☒ UGent
- ☐ UHasselt
- ☒ UA
- ☐ K.U.Brussel

29 List the names and addresses of additional host institutions (Flemish or federal scientific institution/ university college)

name	address

30 Select the appropriate scientific area(s).

- ☐ biological sciences
- ☐ humanities
- ☐ social sciences
- ☐ medical sciences
- ☒ science and technology
- ☐ interdisciplinary

Background of the research teams

31 Describe your experience in working at the concerned international research infrastructure.

The groups from the UA and the VUB have been participating in the CMS experiment since the start of this program about 20 years ago. Since 2007 they were joined by the UGent. The three groups have achieved an outstanding list of valuable contributions to both the construction and the exploitation of the CMS experiment. The construction of the Silicon Tracking device, the CASTOR forward calorimeter as well as the RPC muon system are key activities of our research teams. The development of a TIER-2 computing centre is yet another achievement of the Flemish groups which made it possible to analyze the proton collisions detected by the CMS experiment. These analyses aim to measure as well as to search for diverse physics phenomena. Several members of our research teams were nominated to observe a leading role in the CMS collaboration of about 3000 people, illustrating the excellence of the research in our Flemish institutions relative to these international settings.

32 Give a summary of results and conclusions of the recent work in the scientific area covered by the research proposal.

Give an overview of previous research activities which are related to this proposal.

The field of high-energy physics is a key domain in physics since World-War II, with about half of the Nobel prizes in physics connected to it. Our description of the fundamental interactions between the elementary particles summarized in the so-called Standard Model does agree with all measurements performed over the last decades. Nevertheless this tremendous success, there are phenomena like the mass of the particles and the abundance of Dark Matter in the universe which require a more profound explanation. Mechanisms to provide a mass to the elementary particles as well as extension of the Standard Model have been proposed in order to answer these and other open questions of the fundaments of Nature. Precision measurements of the Standard Model phenomena have indicated that these new phenomena should be observable within the proton collisions of 7 to 14 TeV. Today the Large Hadron Collider at CERN is the only infrastructure that does provide these collisions at 7 TeV, and the CMS experiment observed these collisions with great efficiency. The data taking efficiency of the CMS experiment reached values about 90% and the detector efficiency was above 95%, for some subdetectors even around 99%. These numbers illustrate the excellent performance of our experiment, and therefore makes is feasible to achieve thorough studies of the fundamental interactions with these proton collisions. The analyses of the collision data accumulated in 2010 but mainly in 2011 resulted in measurement of the Standard Model phenomena with sometimes unprecedented precision. The results of these research activities are published in a long list of journal publications and within their precision they do not deviate from their expectation. They cover topics in QCD with jet production cross sections, in Electro-Weak physics with the measurement of cross sections as well as properties of W and Z bosons, and detailed studies of the top quark sector. At the same time we have been searching for new physics phenomena in these collisions that could provide insights in the open questions of the Standard Model. The search for the Higgs boson was the driving benchmark for the detector design. The mass of the Higgs boson is the key parameter that defines the signatures of the collisions in which Higgs bosons appear. Using the 2011 data this search resulted in a very small mass window in which the Higgs boson can still be present, namely 115-127 GeV. This will allow us in 2012 to discover the Higgs boson or to rule out it existence in its most simple form. The search for supersymmetry phenomena in these proton collisions has resulted in very strong limits on low-energy supersymmetry particles. In gravity mediated models the existence of squarks and gluinos is excluded below about 1 TeV. Also the search for fourth generation quarks has almost excluded that these quarks can exist in a theory that is perturbative. The search for resonant particles in models with extra spacial dimensions has put lower limits of about 2 TeV on the mass of these particles. During the next decade these measurements and searches will continue with the CMS experiment at the LHC.

33 List foreign co-supervisors if applicable.

Indicate the name of the institution and the name of the co-supervisor, the position of the co-supervisor and the address of the institution (city and country).

34 Motivate the proposed collaboration between the partners.

The partners can be one or more (inter)national universities, institutions or third parties.

Clearly explain the contribution of each partner in the project.

The CMS Collaboration embraces today 189 institutions from 41 countries around the world. Within this framework about 3000 scientists work together on the CMS experiment. In a very natural way the members of our three Flemish institutions perform research in close collaboration with colleagues from around the world. They all have the same mission and therefore the same interest.

The Flemish contribution within the CMS collaboration is very strong and exceptionally visible relative to the scal of the financial investment. This is a result of an efficient collaboration between the three research teams and of the united effort in the logistical framework.

In the past (and still today) our three institutions have worked together to design and construct elements of the CMS detector, namely the Silicon Tracking device as well as the RPC muon system. Together we have built a TIER-2 computing centre for our data-analysis. Hence the maintenance and installation costs and personnel for the evolution of the TIER-2 centre during the next years are requested together. Also on the side of physics analyses we work together on topics related to top quark physics, supersymmetry and Higgs boson searches. This Flemish collaboration within an international collaboration has always been very productive, coherent and constructive. Also in the future we will continue to perform our research within this spirit.

Typically for the financial matrix within the CMS Collaboration the 189 institutions are first grouped according to funding agency or region. The three Flemish institutions are therefore grouped under the FWO umbrella when it comes to funding the experiment (for example the yearly M&O costs). The total required budget for Flanders is being calculated by the financial administration of the CMS Collaboration, and within the same spirit we apply together for these budgets towards the FWO.

In the following years the CMS detector needs an upgrade as foreseen in a long-term strategy. To achieve this the Flemish groups will again work together on the upgrade for the Silicon Tracker as well as the RPC muon system. When grouping our researchers and engineers in these activities we will make important contributions to the experiment. Along these lines we are able to make strategic decisions to optimize the use of our workspaces.

According to the constitution of the CMS Collaboration we always publish our results together.

35 Provide a detailed estimation of all financial means at your disposal to realize the project, and mention the sources of funding for staff and consumables.

In case you have requested funds for the same project elsewhere, indicate the institution or institutions concerned and the amount requested (e.g. Hercules Stichting, FWO, IWT, BOF).

In the period 2007-2012 the FWO Big Science program financed the logistic and organizational costs for the participation of the Flemish institutions in the CMS experiment. This budget was categorized similar as in the current proposal. It included budgets for the TIER-2 computing infrastructure, the M&O costs, budgets to support the service work to be provided within the constitution of the CMS Collaboration as well as the financing of the apartments nearby CERN.

The Big Science program is the adequate and a unique funding structure to request these budgets for the period 2013-2017. The specific budgets requested in this project have not been requested elsewhere.

The scientific mandates needed to support the explicit physics research of the measurements and searches explored with the collision data of the CMS experiment, are requested within the regular FWO commissions and they are reinforced with individual Odysseus programs in our teams. Our PhD students and post-doc traditionally apply for individual mandates at the FWO. Although our doctoral students used to obtain IWT scholarships with an excellent efficiency, the possibilities for these mandates in fundamental science at the IWT are strongly reduced since a few years.

The running FWO projects in 2013 connected to the CMS experiment are listed below:

FWO G.0177.10 "Commissioning project for the CMS experiment" (2010-2013)

VUB (per year): 60.000 euro "werking" and 60.000 euro personnel (1 scientific mandate)

UA (per year): 30.000 euro "werking" and 60.000 euro personnel (1 scientific mandate)

UGent (per year): 30.000 euro "werking" and 60.000 euro personnel (1 scientific mandate)

FWO G.0942.11 "Study of proton-proton interactions at a centre-of-mass energy of 7 TeV with the CMS detector at the Large Hadron Collider at CERN" (2011-2014)

VUB (per year): 5.000 euro "werking" and 60.000 euro personnel (1 scientific mandate)

UA (per year): 5.000 euro "werking" and 60.000 euro personnel (1 scientific mandate)

UGent (per year): 5.000 euro "werking" and 60.000 euro personnel (1 scientific mandate)

36 Provide a list of up to ten key peer reviewed publications for each supervisor and foreign co-supervisor that are relevant for this project.

Prof. Jorgen D'Hondt - Vrije Universiteit Brussel (these publications are a subset of publications which illustrate our contribution to the installation and commissioning of the CMS experiment)

The CMS experiment at the CERN LHC, by the CMS Collaboration, JINST 3:S08004 (2008)

CMS Tracking Performance Results from early LHC Operation, by the CMS Collaboration, Eur.Phys.J.C70:1165-1192 (2010)

The CMS tracker operation and performance at the Magnet Test and Cosmic Challenge, by W. Adam et al., JINST 3:P07006 (2008)

Performance studies of the CMS Strip Tracker before installation, by the CMS Tracker Collaboration, JINST 4:P06009 (2009)

Alignment of the CMS Silicon Tracker during Commissioning with Cosmic Rays, by the CMS Collaboration, JINST 5:T03009 (2010)

Commissioning and Performance of the CMS Silicon Strip Tracker with Cosmic Ray Muons, by the CMS Collaboration, JINST 5:T03008 (2010)

The effect of highly ionising particles on the CMS silicon strip tracker, by the CMS Tracker Collaboration, Nucl.Instrum.Meth.A543:463-482 (2005)

Distributed analysis in CMS, by Alessandra Fanfani et al., J.Grid Comput.8:159-179 (2010)

Determination of Jet Energy Calibration and Transverse Momentum Resolution in CMS, by the CMS Collaboration, JINST 6:P11002 (2011)

Missing transverse energy performance of the CMS detector, by the CMS Collaboration, JINST 6:P09001 (2011)

Prof. Pierre Van Mechelen - Universiteit Antwerpen

Aid S., et al. - Charged particle multiplicities in deep inelastic scattering at HERA.- In: Zeitschrift für Physik: C: particles and fields, 72(1996), p. 573-592

Adloff C., et al.- Inclusive measurement of diffractive deep-inelastic ep scattering.- In: Zeitschrift für Physik: C: particles and fields, 76(1997), p. 613-629

Adloff C., et al. - Multiplicity structure of hadronic final states in diffractive deep-inelastic scattering at HERA.- In: European physical journal: C: particles and fields, 5(1998), p. 439-452

Aktas A.,et al., Forward jet production in deep inelastic scattering at HERA.- In: European physical journal: C: particles and fields, 46:1(2006), p. 27-42

Aaron F.D., et al., - Three- and four-jet production at low x at HERA.- In: European physical journal C: particles and fields, 54:3(2008), p. 389-409

The CMS experiment at the CERN LHC, by the CMS Collaboration, JINST 3:S08004 (2008)

S. Chatrchyan et al., Observation of long-range, near-side angular correlations in proton-proton collisions at the LHC, J. High Energy Phys. 9 (2010) 091

S. Chatrchyan et al., Search for New Physics with a Monojet and Missing Transverse Energy in pp Collisions at root s=7 TeV, Phys. Rev. Lett. 107 (2011) 201804

F.D. Aaron et al., Measurement of the cross section for diffractive deep-inelastic scattering with a leading proton at HERA, Eur. Phys. J. C71 (2011) 1578

S. Chatrchyan et al., Charged particle multiplicities in pp interactions at root s=0:9, 2:36, and 7 TeV, JHEP 01 (2011) 079

Prof. Nick van Remortel - Universiteit Antwerpen (these publications summarize my track record with key relevance to the CMS experiment commissioning and early physics data analysis, I became member of the CMS collaboration in 2008)

Commissioning of the CMS experiment and the cosmic run at four tesla, by the CMS Collaboration, JINST 05:T03001 (2010).

Commissioning and Performance of the CMS Pixel Tracker with Cosmic Ray Muons, bt the CMS Collaboration, JINST 05:T03007 (2010).

CMS tracking performance results from early LHC operation, by CMS Collaboration, Eur. Phys.J. C70: 1165-1192, 2010.

Transverse-Momentum and Pseudorapidity Distributions of Charged Hadrons in pp Collisions at root s=7 TeV, by CMS Collaboration, Phys.Rev.Lett. 105:022002, 2010.

Transverse-momentum and pseudorapidity distributions of charged hadrons in pp collisions at root s=0.9 and 2.36 TeV, by CMS Collaboration, JHEP 02, 041, 2010.

Observation of long-range, near-side angular correlations in proton-proton collisions at the LHC, by CMS Collaboration, JHEP 09, 091, 2010.

First measurement of the underlying event activity at the LHC with sqrt(s)=0.9 TeV, by the CMS Collaboration, Eur. Phys.J. C70: 555-572, 2010.

Measurement of the Underlying Event Activity at the LHC with sqrt(s) = 7 TeV and Comparison with sqrt(s) = 0.9 TeV, by the CMS Collaboration, J. High Energy Phys. 09 (2011) 109

Charged particle multiplicities in pp interactions at √s=0.9, 2.36, and 7 TeV, by the CMS Collaboration, JHEP 01, 079, 2011.

Measurement of W+W- Production and Search for the Higgs Boson in pp Collisions at sqrt(s) = 7 TeV, by the CMS Collaboration, Phys. Lett. B 699 (2011) 25-47

Prof. Martin Grunewald - Universiteit Gent

Martin W. Grunewald, Experimental Tests of the Electroweak Standard Model at High Energies, Physics Reports, Volume 322, Issue 3 (1999) 125-346.

The D0 Collaboration, An Improved Measurement of the Top Quark Mass, Nature 429 (2004) 638-642.

The ALEPH, DELPHI, L3, OPAL, SLD Collaborations, the LEP Electroweak Working Group, the SLD Electroweak and Heavy Flavour Group, Precision Electroweak Measurements on the Z Resonance, Physics Reports 427 (2006) 257-456.

The CMS Collaboration, CMS Physics Technical Design Report Volume II: Physics Performance, J. Phys. G 34 (2007) 995-1579

The CMS Collaboration, The CMS experiment at the CERN LHC, JINST 3:S08004 (2008)

The CMS Collaboration, Commissioning of the CMS High-Level Trigger with Cosmic Rays, arXiv:0911.4889, J. Instrum. 5 (2010) T03005.

The D0 Collaboration, Measurement of the top quark pair production cross section in the lepton+jets channel in ppbar collisions at sqrt(s)=1.96 TeV, arXiv:1101.0124 [hep-ex], Phys. Rev. D 84, 012008 (2011).

The D0 Collaboration, Determination of the pole and MSbar masses of the top quark from the ttbar cross-section, arXiv:1104.2887 [hep-ex], Phys. Lett. B 703, 422 (2011).

The D0 Collaboration, Precise measurement of the top-quark mass from lepton+jets events at D0, arXiv:1105.6287 [hep-ex], Phys. Rev. D 84, 032004 (2011).

The CMS Collaboration, Measurement of the ttbar Production Cross Section in pp Collisions at 7 TeV using the Kinematic Properties of Events with Leptons and Jets, arXiv:1106.0902, Eur. Phys. J. C 71 (2011) 1721

Prof. Dirk Ryckbosch - Universiteit Gent

Alignment of the CMS Muon System with Cosmic-Ray and Beam-Halo Muons, The CMS Collaboration , J. Instrum. 5 (2010) T03020

Performance Study of the CMS Barrel Resistive Plate Chambers with Cosmic Rays, The CMS Collaboration , J. Instrum. 5 (2010) T03017

Commissioning of the CMS Experiment and the Cosmic Run at Four Tesla, The CMS Collaboration , J. Instrum. 5 (2010) T03001

Aligning the CMS Muon Chambers with the Muon Alignment System during an Extended Cosmic Ray Run, The CMS Collaboration , J. Instrum. 5 (2010) T03019

Search for Supersymmetry at the LHC in Events with Jets and Missing Transverse Energy, The CMS Collaboration , Phys. Rev. Lett. 107 (2011) 221804

Search for New Physics with Jets and Missing Transverse Momentum in pp collisions at \sqrt{s} = 7 TeV, The CMS Collaboration , J. High Energy Phys. 08 (2011) 155

Search for Supersymmetry in Events with b Jets and Missing Transverse Momentum at the LHC, The CMS Collaboration , J. High Energy Phys. 07 (2011) 113

Search for supersymmetry in events with a lepton, a photon, and large missing transverse energy in pp collisions at \sqrt{s} = 7 TeV, The CMS Collaboration , J. High Energy Phys. 06 (2011) 093

Missing transverse energy performance of the CMS detector, The CMS Collaboration , J. Instrum. 6 (2011) P09001

Inclusive search for squarks and gluinos in pp collisions at \sqrt{s} = 7 TeV, The CMS Collaboration , Phys. Rev. D 85 (2012) 012004

Prof. Freya Blekman - Vrije Universiteit Brussel

G. L. Bayatian et al. [CMS Collaboration], “CMS technical design report, volume II: Physics perfor- mance,” J. Phys. G G 34 (2007) 995.

V. M. Abazov et al. [D0 Collaboration], “The Upgraded D0 detector,” Nucl. Instrum. Meth. A 565 (2006) 463 [physics/0507191 [physics.ins-det]].

S. Chatrchyan et al. [CMS Collaboration], “The CMS experiment at the CERN LHC,” JINST 3 (2008) S08004.

V. M. Abazov et al. [D0 Collaboration], “A precision measurement of the mass of the top quark,” Nature 429 (2004) 638 [hep-ex/0406031].

V. M. Abazov et al. [D0 Collaboration], “Evidence for production of single top quarks and first direct measurement of —Vtb—,” Phys. Rev. Lett. 98 (2007) 181802 [hep-ex/0612052].

V. M. Abazov et al. [D0 Collaboration], “First measurement of the forward-backward charge asymmetry in top quark pair production,” Phys. Rev. Lett. 100 (2008) 142002 [arXiv:0712.0851 [hep-ex]].

G. L. Bayatian et al. [CMS Collaboration], “CMS physics: Technical design report,” CERN-LHCC- 2006-001.

V. Khachatryan et al. [CMS Collaboration], “Observation of Long-Range Near-Side Angular Correla- tions in Proton-Proton Collisions at the LHC,” JHEP 1009 (2010) 091 [arXiv:1009.4122 [hep-ex]].

V. Khachatryan et al. [CMS Collaboration], “First Measurement of the Cross Section for Top- Quark Pair Production in Proton-Proton Collisions at sqrt(s)=7 TeV,” Phys. Lett. B 695 (2011) 424 [arXiv:1010.5994 [hep-ex]].

S. Chatrchyan et al. [CMS Collaboration], “Search for Supersymmetry at the LHC in Events with Jets and Missing Transverse Energy,” Phys. Rev. Lett. 107 (2011) 221804 [arXiv:1109.2352 [hep-ex]].

37 Provide a list of the relevant publications of the last five years for each supervisor affiliated to a Flemish university.

In appendix the full list of publications of all supervisors is provided. Below 5 of the most relevant publications from 2006 onwards for each of the supervisors:

Prof. Jorgen D'Hondt - Vrije Universiteit Brussel

Search for neutral MSSM Higgs bosons at LEP, by the LEP Collaborations, Eur.Phys.J.C47:547-587 (2006)

CMS technical design report, volume II: Physics performance, by the CMS Collaboration, J.Phys.G34:995-1579 (2007)

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Background of the international research infrastructure

38 Give the official name of the research infrastructure.

Provide both abbreviation as full name.

CERN - European Organization for Nuclear Research

CMS - Compact Muon Solenoid

39 Give the address of the research infrastructure.

CERN

CH-1211 Geneve 23

Switzerland

40 Provide a brief description of the research infrastructures mission.

Indicate fields of research, type of experiments, techniques and applications, instruments, access modalities and procedure, structure etc.

CERN is a European laboratory for fundamental research in particle physics. The laboratory provides and maintains typically collider experiments. The Large Hadron Collider (LHC) is the particle collider that can reach the highest collision energies in the world. This circular collider has a circumference of 27km and is located about 100m underground. After the pre-acceleration of the protons with a chain of diverse types of accelerators the superconductive cavities in the LHC will accelerate the protons to energies of 4 TeV in 2012 and even up to 5-7 TeV from 2014 onwards. A series of superconductive magnets keep the charged protons on their circular track and focus the beams prior to collision. In total four collision points are used to study the fundamental interactions. Two specific and two general-purpose detectors are deployed around the collision points. The LHCb experiment is designed to study in detail events which involve bottom quarks while the ALICE experiment focuses on the study of the properties of the quark-gluon plasma. Both the ATLAS and CMS detectors have a very broad research program ranging from the precise measurement of already observed physics processes to the search of new physics phenomena. The possible discovery of new phenomena is both expected from theoretical arguments as well as wishful in order to unravel several yet unexplained elements in our theory to describe Nature both in the micro- and the macrocosmos.

The development and maintenance of the instruments to detect and reconstruct the particle collisions, like the CMS experiment, are achieved within international consortia. For most parts of the detector devices novel techniques and methods have to be developed to achieve the physics goals of the experiment. The CMS detector is a unique device that will always remain its own proto-type. Hence a continuous effort is required to maintain and operate the experiment resulting in the highest possible efficiency to accumulate data and reconstruct the observations which the best possible precision.

The access to the collision data is granted within the constitution of the CMS Collaboration to all participating institutions, among which the three Flemish universities being the UA, the UGent and the VUB. To facilitate this data access as well as to make sure our researchers can deploy the most powerful analysis techniques, two TIER-2 computing centres are deployed and maintained in Belgium. One is hosted at the ULB-VUB computing centre, the other one at the UCL computing centre. Because the overall financial support for this infrastructure is covered by all Belgian universities together, the access to this facility is granted uniformly to all researchers associated to our teams.

CERN is responsible for the accelerator facilities, while the individual institutions are responsible for the installation of the particle detector experiments as well as the computing facilities to analyse the data.

41 Demonstrate the international level of the research infrastructure.

Indicate collaborations, stakeholders, users etc.

Today CERN has 20 member states, of which Belgium is a founding member since 1954. The member state contribute on a yearly basis to the funding of CERN according to their Gross National Product (GNP). A long list of observer states, like the USA, the Russian Federation and India, are allowed to use the facilities. CERN is one of the largest centres for scientific research in the world. About 10.000 scientists from 608 institutions in 113 countries use the facilities provided by CERN of which about 2,5% are Belgian or connected to a Belgian institution.

Project description

42 Give the project summary in layman's terms.

If the application is approved, some details of the project may be used for the FWO external communication (press release or popular publications). This text might be used in future press releases.

Use up to 1500 characters including spaces – ca. 250 words.

The quest to explore and understand the fundamental building blocks of Nature has intrigued humanity since ever. Revealing the way they build up the matter around us as well as the Universe is the topic of particle physics. Our state-of-the-art theory in particle physics does not provide an empirically verified answer to key questions like how these particles acquire their observed mass nor for the abundance of Dark Matter in the Universe. Experiments are being built to unravel these elements by discovering new physics phenomena beyond our current theory and to measure very precisely the properties of the known phenomena. The Large Hadron Collider at CERN is the unique particle accelerator which is at the forefront of this research by colliding protons at the highest energies. The Compact Muon Solenoid experiment is built and operated by an international consortium of institutions to detect and reconstruct the particle collisions. The Universiteit Antwerpen, the Universiteit Gent and the Vrije Universiteit Brussel have very active teams of researchers that construct, operate and maintain the experiment as well as analysing the accumulated data of the CMS detector in the search for an understanding of the fundamental interactions in Nature. This project embraces all the detector, logistical and operational costs for the Flemish contribution to one of the largest scientific experiments ever.

Project outline

43 Indicate the status quaestionis concerning the topic or topics you want to investigate.

Use up to 1800 characters including spaces – ca. 300 words.

The domain of experimental particle physics embraces all studies related to the fundamental interactions in Nature. On the basis of experimental observations the Standard Model of particle physics has been constructed during the last decades as the mathematical framework to describe the elementary particles and their interactions at an energy scale of around 100 GeV. This theory does however leave some key elements unanswered. The fundamental mechanism to provide a mass to the elementary particles has not yet been revealed. The general thinking is that the mechanism of spontaneous symmetry breaking or the Brout-Englert-Higgs mechanism is at the origin of these masses. The Higgs boson which acts in this mechanism as the omnipresent scalar field to provide these masses to the particles embedded in this field, has not yet been discovered. It is however clear that the Large Hadron Collider at CERN will give a final answer on the existence or not of the Higgs boson. The theory also does not provide an answer to the Dark Matter component which is observed in our Universe. Diverse theoretical models which extend the Standard Model could explain the Dark Matter as they embed new stable particles. A traditional example is to invoke supersymmetry in our description of Nature, in which the lightest supersymmetric particle could provide a Dark Matter candidate. The presence of supersymmetry in Nature has not yet been established experimentally, but when observed in the proton collisions of the LHC, is can answer a series of puzzling pieces of the Standard Model. With the LHC at CERN we will explore fundamental interactions at energy scales of multi TeV, hence beyond the energy scale at which we believe the Standard Model is correct and where new phenomena addressing open questions should appear.

44 Describe the envisaged research and the research hypothesis.

Indicate why it is important to the field, what impact it could have, whether and how it is specifically unconventional and challenging.

Use up to 6000 characters including spaces – ca. 1000 words.

The LHC experiments ATLAS and CMS are at the frontline of high-energy physics. They collide particles at the highest energies achievable in a laboratory and study the fundamental interactions between elementary particles. The Belgian teams decided two decades ago to join the CMS experiment. With this leading experiment we are able to study the most intriguing questions in our field of fundamental interactions. The search for the so-called Higgs particle is a key element in our research program. Our field of particle physics is searching for empirical evidence for the spontaneous symmetry breaking mechanism since decades. The presence of scalar particles in Nature would be a major breakthrough in our understanding of Nature as it is embedded in most of our mathematical descriptions of fundamental interactions. The CMS experiment, together with the ATLAS experiment, has the potential to either discover the Higgs particle or to exclude its existence. Although this statement it remains an important challenge to differentiate the signal of the Higgs particle from all other collisions at the LHC. To formulate a solid discovery statement the particle should be observed in a diversity of process types as well as decay types. After a discovery the research program shifts to a measurement project to determine the properties of the Higgs particle and compare these results with the expectations of our physics models.

The search for supersymmetrical phenomena in proton collisions is another key element of our physics program. By including supersymmetry in our description of Nature we can make our theory more coherent and consistent. Supersymmetry has been the main route beyond the Standard Model of particle physics for many decades now. Although the broad theoretical research in supersymmetry started decennia ago, no experimental signal has been observed yet which confirms the existence of supersymmetry. The experimental search for supersymmetry phenomena is non-trivial because the list of free parameters in a supersymmetric theory could be larger than 100, which results in little guidance for the experimenter. Constrains among the model parameters are introduced on the basis of physical arguments to reduce the dimensionality of the parameter space, resulting in specific signatures in proton collisions at the LHC. The research program of the CMS experiment will shed light on the validity of most of the parameter space of these

constrained supersymmetric models, with the possibility to confirm the presence of supersymmetry or to exclude it. The ATLAS and CMS experiments at the LHC are the only experiments who can provide direct information on the existence of supersymmetry, indicating the importance to the field. It remains a challenge however to cover the largest part of the parameter space of supersymmetric models due to the dimensionality of this parameter space. Therefore a long series of different signatures has to be looked for.

The CMS and ATLAS experiments are also unique to study the properties and predictions of the Standard Model of particle physics at the highest energy scales. Cross sections predicted by the theoretical model should be confronted with experimental measurements in order to test the Standard Model in these extreme situations. The top quark is the elementary particle with the largest observed mass, hence an excellent window to test the Standard Model. For the first time in our field we are in a unique situation where a gigantic collection of top quark processes will be detected and studied. This opens new possibilities to test the Standard Model properties to a yet unexplored precision. Understanding the details of the reconstruction as well as the physics details of these processes is a challenge because of the complexity of these collision events.

In parallel to the challenges in the unique physics program, the operation of the machine and detector remain challenging. Both the accelerator and the detector are their own proto-type and therefore have to be treated with the greatest care. This project envisages participating in the operational aspects of the CMS detector. Developing adequate tools to monitor the detector performance as well as the reconstruction methods is essential and a pre-requisite for an efficient physics program. Many technologies applied in the CMS detector are new in our (and other) fields of science. Each subdetector has been designed to be operational in the vicinity of an extreme high rate of high energetic particles, and this with the highest efficiency and for many years. Over the years we learn to operate these devices and optimize their functionality. This experience will be crucial when designing next generation particle detectors for future collider experiments.

Also the computing infrastructure deployed to analyse the collision data is unique and requires novel tools and methods to be able to connect with GRID technology hundred thousands of computing elements around the world. Operating a computing network at this scale is a continuous learning process to optimize the use of the equipment. A strong collaboration among IT experts around the world, including those in our teams, guarantees a successful project. Since the start of the CMS physics program the infrastructure has tripled in size and its use has been evolving very fast to higher rates of analysis jobs.

In all aspects of this unique project we are at the frontline of technology and science. Important progress is however made in the project with a solid and strong worldwide collaboration. This international endeavour will remain at the leading edge of fundamental science during the next decade.

45 Describe the different envisaged steps in your research, including intermediate goals.

Be as detailed as necessary for a clear understanding of what you propose. Indicate how you will handle unforeseen circumstances, intermediate results and risks. Show where the proposed methodology is according to the state of the art and where it is novel.

Use up to 9000 characters including spaces – ca. 1500 words.

The Big Science research performed at contemporary particle colliders spans over decades and can be factorized into a series of work packages, each with their own challenges and foreseen individual achievements. Only when uniting all these achievements the open scientific questions on fundamental interactions can be addressed.

The Large Hadron Collider has been designed in the nineties and constructed during the first decade of this century. This was made possible only due to the collaboration between researchers from all over the world and the invention of mostly innovative techniques. Because the accelerator is unique it will always remain its own proto-type and therefore each step forward in our physics program is a novel challenge. The more than successful data-taking period in 2011 illustrated the excellence of CERN. Although the energy of the collisions as well as the rate are enhanced gradually, this is performed with great care. Prior to each step forward all applied methods are commissioned to guarantee a safe use of the equipment. In total four large experiments are placed at the proton collisions points around the LHC. ATLAS and CMS are the two main general purpose experiments which are deployed by unprecedented international consortia. In 2011 a total of about 5/fb of integrated luminosity has been provided by the accelerator to each experiment, In 2012 it is foreseen to collect at least 15/fb of data. The years 2013 and 2014 will be used to continue the analysis of this unique data as well as to adapt our experiment wherever needed to accommodate larger collision energies from 2015 onwards. From 2018 it is foreseen to accumulate collisions at an even higher rate to discover and/or measure rare phenomena which could lead to a multitude of new insights in particle physics.

The CMS experiment consists of diverse subdetectors, of which the tracking device and the muon detection system are very crucial. The Flemish universities UA, UGent and VUB have built part of these subdetectors, and do maintain them. The CMS experiment has to be upgraded however to remain efficient within the higher collision rate expected from 2018 onwards. Each of these detectors are unique and one can only realize these devices with innovative R&D, both in the design and the applied technology.

WP1: Operating and maintaining the current CMS experiment (M&O and service work).

The detector devices deployed within the CMS experiment have been developed specially for their unique purpose of detecting and reconstructing with the best precision the proton collisions at the LHC. Due to the novely of these devices, a continuous monitoring of the performance is essential. The insights accumulated with this constant monitoring are crucial to operate the devices with the largest efficiency. Data Quality Monitoring (DQM) systems are developed and deployed for this purpose. Also the performance of the methods to reconstruct the hundreds of observed objects that are produced in the collision is to be monitored. Calibration factors and efficiency corrections have to be determined to allow a detailed physics analysis of the phenomena in the collisions. These tasks are part of the service responsibility of the

institutes towards the CMS Collaboration. Although the idea of monitoring techniques is not novel, the development is unique for its purpose within the CMS experiment. Our researchers have a diversity of expertize to design and develop these tools which guarantees a successful outcome.

WP2: Developing, operating and maintaining the computing infrastructure (TIER-2).

After the online data reduction or trigger, the computing infrastructure of the CMS experiment receives data at a rate of about 300 MB per second. And our computing centres should provide at an equivalent rate also the simulation collisions using Monte Carlo techniques. The development of a world-wide computing network based on GRID technology is essential to reconstruct the data as well as to use all possible computing power to analyse the data with advanced statistical techniques. Because the reconstruction software is constantly evolving, also the computing infrastructure has to adapt synchronously. The Belgian TIER-2 infrastructure deployed, maintained and used by our researchers needs constant testing of availability, as well as continuous updates of the software. Older hardware (disks and CPU) has to be replaced, and the researchers have to be guided in their use of this powerful infrastructure.

WP3: Analysing the collision data (based on regular FWO funding requests different from the Big Science program)

Once the detector and computing infrastructure is operational with an excellent performance, the physics program of the experiment can be executed. Our researchers will study the proton collisions to search for new physics phenomena as well as to measure precisely the properties of the phenomena described by the Standard Model. The focus in the search analyses is on the design of innovative methods to differentiate the new physics signal events from the known physics signals which are considered as background collisions. Upon a discovery of new phenomena we can continue by measuring the properties of these phenomena, while when no discovery is made we can exclude the hypotheses made in the search resulting in exclusion limits in the parameter space of the models beyond the Standard Model. In both scenarios we will obtain novel insights on fundamental interactions. More specifically we will search for the existence of supersymmetry in the nature of fundamental interactions as well as the presence of the Higgs boson. Supersymmetry duplicates the particle content of the Standard Model by postulating for each particle the existence of a super-partner. Because super-partners with the same mass as the Standard Model particles have not been observed in our experiments, the exact supersymmetry must be broken. There are several theoretical methods to break this supersymmetry which all result in different phenomenology and therefore other signatures in the collisions at the LHC. Our experimental search strategies need to cover as many as possible supersymmetry breaking models. The choices made in these search analyses are model specific and the result is presented in the parameter space of the specific model. The projection of the analysis results into simplified models beyond the Standard Model with very few parameters will allow the community to obtain limits on all possible models beyond the Standard Model. Also the precise measurements of the properties of known processes, like top quark production, are important aspects of our research. When the measurement deviates from the expectation within the Standard Model, we obtain indirect insights in the properties of the new physics phenomena which extend the Standard Model. An important aspect for the analyses at these advanced and unique particle detectors is to control the systematic influences on the result. Using both simulation events as well as data-driven estimations of the background and other systematic influences the analysis strategies will be optimized to reach the best possible precision or sensitivity for the discovery of new physics phenomena.

WP4: Upgrading the experiment for the future physics program

The planning of the LHC operation foresees few long shutdown periods of usually 1,5 to 2 years. During these shutdown periods the accelerator as well as the detector will be prepared for the next phase of the program, hence higher collision energies and/or higher instantaneous luminosity. The CMS Collaboration proposed an upgrade plan, with both a financial and a scientific section, to the RRB (Resource Review Board) to allow research of proton collisions at the highest energies and the highest luminosities after the second long shutdown foreseen around 2018. The Flemish groups plan to participate in the creation of adequate muon detectors and tracking devices within this upgrade project. The high rate of particles is a challenge for the RPC based muon detection system as well as for the silicon based tracking devices. We need to study the geometry and the technology of the upgraded detector systems, and develop adequate trigger systems which make use for the first time of a silicon tracker with these large dimensions. This part of the requested budget is a pre-requisite to allow the Flemish groups to participate in this unique experiment also beyond 2018. The physics motivation to operate the LHC machine at the highest energies and luminosities is to study rare phenomena and to measure the Standard Model properties (and the potentially new discovered particles or phenomena) with a very high precision. This will allow us to test our models for particle physics in a unique way, and will result in new insights in the nature of fundamental interactions.

With the efficiency for the analysis of the collision data as in the year 2011 it can be expected that a publication rate of 100 peer reviewed papers per year will be achieved. The results from the LHC experiments also dominate all major international conferences in high energy physics.

This project is not the explicit funding of PhD students or post-doctoral researchers performing the physics analyses with the CMS experiment, but sets the basis for all Flemish scientific contributions and achievements at the forefront of experimental high-energy physics. In the participating Flemish institutions a total of about 8 PhD projects are defended each year.

46 Describe the different work packages (WP) the proposed research work will be divided in.

Indicate for each WP the time that it will possibly take. You can use a table or another type of scheme to clarify the work plan.

Although due to the scale of this Big Science project at the LHC at CERN it is puzzling to divide the research program in few work packages, we have defined four general work packages in previous section of this project (section 45). Below it is indicated what the timelines of these WP's are.

WP1: Operating and maintaining the current CMS experiment

In 2012 the program of the LHC experiments is to collect data with 8 TeV proton collisions. This could have a tail in the year 2013, motivated by the discovery project of the Higgs particle. During this period we need to operate the experiment with the highest efficiency. In 2013-2014 the first long shutdown is planned for the accelerator. Therefore the maintenance of the experiment is important and to prepare it for the higher energy operation from the end of 2014 onwards. This will require our team members to be present at CERN to help in these preparations. From the end of 2014 onwards to early 2017, we will operate the experiment again with the aim to reach the highest efficiencies for the performance of our detector devices. The requested human resources as well as the requested M&O budgets cover the expenses for this work package.

WP2: Developing, operating and maintaining the computing infrastructure

During the operation of the CMS experiment more collision data is accumulated as well as more simulated proton collisions are produced. Therefore the memory size of our data sets is growing over the years 2011-2012 when the accelerator is operational. To analyse more data requires also more computing power, hence the need to increase our computing infrastructure (TIER-2 centre). Also during the shutdown years 2013 and 2014, the size of our simulated and real data samples will increase because more optimal calibration factors will arise from detailed studies. Therefore the collected datasets will be reprocessed with these new calibration factors resulting in a larger size of the datasets as well as the need for more computing power to run also on these sets. Also more detailed physics studies will be performed for which dedicated simulated event samples need to be prepared. At the same time, the simulation for the new physics runs from the end of 2014 have to be prepared. From 2015 onwards the machine will be operational resulting in again growing datasets. Therefore our TIER-2 centre needs to evolve accordingly in scale. The operational aspects of a growing infrastructure become more complex and challenging. Therefore the requested human resources will constantly follow this evolution and develop adequate tools for the physicists to analyse the collision data.

WP3: Analysing the collision data

This part of the project is not covered by the Big Science project, but from regular FWO projects. The data analysis is a continuous activity. During the operational time of the experiment, the main focus is on the general search for new phenomena as well as precise measurements of a selection of expected phenomena, while during long shutdown periods the focus moves to more detailed measurements and searches which require more time due to their complexity.

WP4: Upgrading the experiment for the future physics program

In order to be ready with an upgraded detector by 2018, the R&D starts now. Technical design reports will be written in 2013 to detail the goals and planning. Our teams participate in the design of this planning, and are requested to take up responsibilities. From 2013 to 2018, an important part of the activities of the CMS Collaboration will be devoted to this upgrade plan. This Big Science project covers the budgets requested from us by the CMS Collaboration through the Resource Review Board of CERN. The project also includes the human resources needed to participate in this obligatory part of the CMS project. The timeline of the upgrade project fits very well the timeline of the Big Science program. A full replacement of the CMS Tracker is foreseen for a third long shutdown period around 2021. Given the time used to create the current tracking device, we know it will take about 8-10 years of R&D and construction work to develop the upgraded tracking device.

47 Give a list of references used in the preparation of the project outline.

The project covers mainly the operational aspects of the CMS experiment and not the human resources for physics analyses. Therefore the key documents used in the preparation of the project outline are formal documents provided by the CMS Collaboration to the funding agencies through the Resource Review Board where in the CMS section the FWO is represented by Prof. Jacques Lemonne. In many cases these documents can be found on public websites.

RRB documents (http://committees.web.cern.ch/Committees/all/welcomeLHCRRB.html)

(1) CERN-RRB-2011-077 : information on the upgrade planning (http://indico.cern.ch/getFile.py/access?resId=0&materialId=paper&contribId=42&sessionId=5&subContId=0&confId=149413)

(2) CERN-RRB-2011-079 : information on the M&O budgets (we learn from these documents that the costs will remain equal throughout the whole period of the Big Science program, unless the Swiss franc to Euro conversion rate will change; this potential change has not been taken into account in our budget requests) (http://indico.cern.ch/getFile.py/access?contribId=39&sessionId=5&resId=0&materialId=paper&confId=149413)

TIER-2 documents (http://lcg.web.cern.ch/lcg/resources.htm)

(1) The computing resources per experiment for 2012 and 2013 are described in a document (https://espace.cern.ch/WLCG-document-repository/Pledges/Experiments_resources/CRSG%20recommendations%20261111.pdf) and a fraction of this is allocated to Belgium

(2) CERN-RRB-2011-107: The computing RRB is part of the general RRB at CERN, and therefore the documents concerning budgets can also be found via the above mentioned RRB website, from these documents it can be observed that a rather stable investment is required for the computing infrastructure, this is also what our teams have experienced in the previous years; both these documents and our past experience have been used to define the requested budget (http://indico.cern.ch/getFile.py/access?contribId=26&sessionId=3&resId=0&materialId=1&confId=149413)

48 Indicate whether you think the results of the proposed research will be suitable to be communicated to a non-expert audience and how you will undertake such communication.

FWO encourages its fellows to disseminate the results of their research widely, and valorize those where possible.
Use up to 1800 characters including spaces – ca. 300 words.

The LHC experiments at CERN are in the spotlights of both the international audio-visual and written media. The concept of the particle accelerator is well embedded in the Flemish community. The media department of CERN as well as the outreach group of the CMS experiment create a diversity of documentation and supporting media files to communicate our scientific results. Since several years the promotor of this project is the Belgian delegate in the International Particle Physics Outreach Group (IPPOG) which discusses the communication and educational aspects of our research field. This group organizes each year the international master classes in particle physics in which our institutions participate with 14-18 year old students. All this provides an excellent platform for an efficient and effective communication to the Flemish society. The long series of media appearances of the promotors during the last years illustrates the attention of the society for our research. Participation in talk shows, news journals, dedicated documentaries, radio interviews and articles in popular magazines are examples of our outreach. Also at the major international gatherings we organize in Belgium we invite the national press. Our researchers are invited regularly to give seminars for a general audience. The possible discovery of the so-called Higgs particle could lead to the first Nobel prize in physics for Belgium, namely for F.Englert (ULB). The press conference organized by us at the start of the LHC collision program will certainly be repeated when discoveries are made in our research. At a rate of about 1 press release per month CERN communicates to the society on topics related to our research. For important items Dutch translations are foreseen to facilitate our communication to the Flemish media. Also in the future of our research program important media attention is expected. The promotors of this project will pro-actively seek to inform the society about our results which addresses fundamental aspects in Nature and uses one of the most fascinating instruments build by humanity.

Financial plan and funds per host institution

49 Fill in the overview of the budget applied for by each host institution (i.e., only the funds requested directly from FWO).

You are not allowed to request funding for foreign institutions or institutions belonging to the French-speaking community of Belgium. Make sure that the amounts are identical to those mentioned elsewhere in the application. In contrast to the regular projects it is possible to request funds for staff and consumables that exceed those requested for in the first year.

For personnel, the same flat rates apply as for regular FWO research projects:
– 1 FTE scientific staff (sc.) = 60.000 euros
– ½ FTE scientific staff = 30.000 euros
– 1 FTE technical staff (tech.) = 50.000 euros
– ½ FTE technical staff = 25.000 euros.

Please stick to these four amounts and do not recalculate yourself. In the table below, indicate the number of units for each category (0,5 – 1 – 1,5 etc) and the corresponding amount.

The budget for personnel and consumables is interchangeable to a certain extent. See general regulations on FWO research projects for more details.

name of the host institution: Vrije Universiteit Brussel

year	yearly total	personnel			consumables
		number of units (FTE)		amount	
		scientists	technicians		
2013	450.000	2	1	170.000	280.000
2014	450.000	2	1	170.000	280.000
2015	450.000	2	1	170.000	280.000
2016	450.000	2	1	170.000	280.000
2017	450.000	2	1	170.000	280.000
total	**2.250.000**	**10**	**5**	**850.000**	**1.400.000**

name of a second (additional) host institution, if any: Universiteit Antwerpen

year	yearly total	personnel			consumables
		number of units (FTE)		amount	
		scientists	technicians		
2013	365.000	1	1,5	135.000	220.000
2014	365.000	1	1,5	135.000	220.000
2015	365.000	1	1,5	135.000	220.000
2016	365.000	1	1,5	135.000	220.000
2017	365.000	1	1,5	135.000	220.000
total	**1.775.000**	**5**	**7,5**	**675.000**	**1.100.000**

name of third (additional) host institution, if any: Universiteit Gent

year	yearly total	personnel			consumables
		number of units (FTE)		amount	
		scientists	technicians		
2013	365.000	2	0.5	145.000	220.000
2014	365.000	2	0.5	145.000	220.000
2015	365.000	2	0.5	145.000	220.000
2016	365.000	2	0.5	145.000	220.000

2017	365.000	2	0.5	145.000	220.000
total	**1.825.000**	**10**	**2.5**	**725.000**	**1.100.000**

name of a fourth (additional) host institution, if any:

year	yearly total	personnel			consumables
		number of units (FTE)		amount	
		scientists	technicians		
2013					
2014					
2015					
2016					
2017					
total					

name of a fifth (additional) host institution, if any:

year	yearly total	personnel			consumables
		number of units (FTE)		amount	
		scientists	technicians		
2013					
2014					
2015					
2016					
2017					
total					

Motivation of the requested staff

50 Please make for each host institution a clear motivation of the choice of scientific, technical and administrative staff (including gender balance).

The responsibilties of the institutions collaborating in a large international consortium are defined into a mutual agreement between the CMS collaboration and the funding agencies into a Memorandum of Understanding (MoU). The collaborating institutions need to provide services to the general experiment in terms of financial budgets and human resources. The amount of service work per institution is determined taking into account that for each researcher connected to the institution 3 months of service work is to be provided to the collaboration per year. The three Flemish universities (UA, UGent, VUB) request one scientific mandate each, usually on post-doctoral level, for an adequate and efficient contribution to the operation of the CMS experiment. The UGent has already a person in place for the operational work over the next year, hence a name is indicated, while for the UA and VUB new personnel is to be hired.

We are also requested to contribute to the continuous construction of the experimental settings which need to be upgraded to establish the foreseen research program. We are active in the construction of the muon detector system of the experiment with Resistive Plate Chambers (RPC's) detectors as well as in the Silicon Strip Tracker which requires a complete replacement by 2018. In order to perform the R&D for this upgrade each of the three Flemish universities (UA, UGent, VUB) request one scientific or technical mandate, usually on post-doctoral level or a high level engineer. This personnel will either focus on the scientific studies to steer the design of the upgraded detector (scientific mandate) and/or on the technical R&D and construction of elements relevant for the upgraded detector (technical mandate). It is only a coherent combination of both efforts that will result in the most optimal upgraded detector. While the UA group will focus on the technical aspects with an experienced engineer, the UGent and VUB groups will focus on the scientific studies for which new personnel is to be hired.

The scientific mandates are foreseen to be opened with an international call for candidates, to select the best researchers. Our current post-doctoral researchers usually do not have a contract which runs beyond the 1 or 2 year period. Therefore we cannot quote names (in most of the cases) for the to be hired scientific staff, although we have

demonstrated in the past that we are very efficiency in finding adequate people. During the last years we have hired researchers with an overall balanced gender distribution.

In our participation we are also requested to contribute in the deployment of computational tools. Over the years we have constructed a TIER-2 centre, located at the VUB/ULB computing centre. This system needs a continuous upgrade to accommodate the increasing rate of collision data over the years to come and to replace old computing elements. The Belgian institutions are requested to contribute to the computing power of the CMS Collaboration according to the amount of researchers. Because we are about 5% of the researchers in the collaboration and their are about 50 TIER-2 centres, it is foreseen that indeed 2 TIER-2 centres are built in Belgium. One is located at the UCL computing centre, the other in the VUB/ULB computing centre. Although the universities foresee the infrastructure and the power consumption, we are requested to maintain and upgrade the equipment. Therefore the VUB request a 1 FTE technical mandate because of the TIER-2 being located at the VUB, and the UA and the UGent request each a 0.5 FTE technical mandate to support their researchers in the use of this large scale computing system as well as to develop the relevant software tools to allow our researchers to analyse the collision data.

For the technical staff connected to the computing infrastructure, we have experienced people at our institutions which are currently budgeted on other (ending) budgets.

51 Enter the names of the scientific staff.

Mention, for each host institution, the names of the staff to be hired and clearly indicate who will work at which institution. Put "N" if the name is not known yet. Add also a short CV of the staff members already involved.

first name	surname	host institution	employment	
NN	NN	VUB	☒ full-time	☐ part-time
NN	NN	VUB	☒ full-time	☐ part-time
NN	NN	UA	☒ full-time	☐ part-time
Nicolas	Zaganidis	UGent	☒ full-time	☐ part-time
NN	NN	UGent	☒ full-time	☐ part-time
			☐ full-time	☐ part-time

52 Enter the names of the technical and/or administrative staff.

Mention, for each host institution, the names of the staff to be hired and clearly indicate who will work at which institution. Put "N" if the name is not known yet. Add also a short CV of the staff members already involved.

first name	surname	host institution	employment	
Abdel	Ouchene	VUB	☒ full-time	☐ part-time
Joris	Maes	UA	☐ full-time	☒ part-time
Wim	Beaumont	UA	☒ full-time	☐ part-time
Olivier	Devroede	UGent	☐ full-time	☒ part-time
			☐ full-time	☐ part-time
			☐ full-time	☐ part-time

Motivation of requested consumables

53 Enter the details of the consumables.

Please make for each host institution a detailed description of the choice for consumables and motivate for each host institution the type of cost and requested funding. Confirm the FWO regulations you are responsible for the correctness of the budget yourself.

type of cost	year	host institution	requested funding
Upgrade	2013-2017	VUB & UA & UGent	33.333 euro/year/institution (a total of 100.000 euro per year)
Travel	2013-2017	VUB & UA & UGent	20.000 euro/year/institution (a total of 60.000 euro per year)
TIER-2	2013-2017	VUB & UA & UGent	66.666 euro/year/institution (a total of 200.000 euro per year)
M&O	2013-2017	VUB & UA & UGent	100.000 euro/year/institution (a total of 300.000 euro per year)
Appartements	2013-2017	VUB	60.000 euro/year
AN APPENDIX IS ADDED EXPLAINING THE DETAILS OF THESE BUDGET REQUESTS			

External referees

54 Provide names and contact details of five potential referees.

From this list the FWO might select and invite a number of referees to evaluate the application in writing, but the FWO can also invite and select other external referees. The proposed referees should not be members of a FWO Expert Panel or of the FWO's board of trustees and should not be co-authors of publications over the last three years. Neither should there be any current joint research projects. The proposed referees must be affiliated to a foreign university or research institution. The applicant is responsible for the eligibility of the proposed referees. The applicant may not have any contact with the proposed referees.

first and surname	e-mail address	institution	department	current occupation

Sergio Bertolucci	Sergio.Bertolucci@cern.ch	CERN		scientific director, professor
Frank Linde	f.linde@nikhef.nl	NIKHEF		director, professor
Tatsuya Nakada	Tatsuya.Nakada@cern.ch	ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE (EPFL)	School of Basic Sciences	Chairman of the European Strategy Preparatory Group, professor
Michel Spiro	michel.spiro@cnrs-dir.fr	CNRS		director, professor
Dorothee Schaile	Dorothee.Schaile@Physik.Uni-Muenchen.DE	Ludwig-Maximilians-Universität München	Particle Physics	chair of research group, professor

55 You may state at most three persons who are considered not suitable to act as a referee.

This reservation must be motivated.

This box is used to mention the publication traditions within the field of experimental high-energy physics. The field is dominated by large scale international collaborations covering most of the active researchers in the field. These large collaborations publish journal papers with an author list covering all members of the collaboration. Many of the promotors of this project have been involved in the past in other experiments than the CMS experiment. Therefore if we want to keep a high profile for the proposed referees it is impossible that all Flemish promotors have had no publications in the past with our referees. In the above list however, none of the five persons is a member of the CMS Collaboration which is an enterprise of about 3000 people. Hence for the research mentioned in this project we have not worked together with either of the five referees.

Ethics

56 Indicate the correct answer for this proposal

I confirm that none of the issues, mentioned in question 57, apply to my proposal.	☒ yes	☐ no

57 Indicate the correct answer for each item

If you have indicated 'yes' for at least one of the following items, you must submit your proposal to the research ethics committee of your host institution for ethical clearance. Your fellowship can only start when this clearance has been formally given.

informed consent

The proposal involves children.	☐ yes	☒ no
The proposal involves patients or persons not able to give consent.	☐ yes	☒ no
The proposal involves adult healthy volunteers.	☐ yes	☒ no
The proposal involves human genetic material.	☐ yes	☒ no
The proposal involves human biological samples.	☐ yes	☒ no
The proposal involves human data collection.	☐ yes	☒ no

research on human embryo or fetus

The proposal involves human embryos.	☐ yes	☒ no
The proposal involves human foetal tissue or cells.	☐ yes	☒ no
The proposal involves human embryonic stem cells.	☐ yes	☒ no

privacy

The proposal involves processing of genetic information or personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction).	☐ yes	☒ no
The proposal involves tracking the location or observation of people.	☐ yes	☒ no

research on animals

The proposal involve research on animals.

☐ yes

Are those animals transgenic small laboratory animals?	☐ yes	☒ no
Are those animals transgenic farm animals?	☐ yes	☒ no
Are those animals cloned farm animals?	☐ yes	☒ no
Are those animals nonhuman primates?	☐ yes	☒ no

☒ no

research involving developing countries

For my research I make use of local resources.	☐ yes	☒ no

dual use

The research has a direct military application.	☐ yes	☒ no
The research has the potential for terrorist abuse.	☐ yes	☒ no

ICT implants

The proposal involves clinical trials of ICT implants.	☐ yes	☒ no

Mandatory attachments

58 Enclose the following documents with this form and tick them in the tick list.

☒ a letter of acceptance from the international research infrastructure.
The acceptance to perform the requested project at the concerned international research infrastructure should be signed by a person authorized by the administrative authority of this international research infrastructure.

☒ a letter from the Flemish partner(s).
This letter (one per institution), signed by a person authorized by the administrative authority of the host research institution(s), should describe the nature and level of support that will be available to the applicant.

☒ an abbreviated curriculum vitae of all the staff members already involved

Big Science program

"Flemish contribution to the CMS experiment in the framework of the Big Science program"

March 2012

Contact persons:

Prof. Jorgen D'Hondt (Vrije Universiteit Brussel)
☎ 0496/704865 ; ✉ Jorgen.DHondt@vub.ac.be
Prof. Pierre Van Mechelen (Universiteit Antwerpen)
☎ 0498/056879 ; ✉ Pierre.VanMechelen@ua.ac.be
Prof. Dirk Ryckbosch (Universiteit Gent)
☎ 0494/842158 ; ✉ Dirk.Ryckbosch@UGent.be

This appendix with the general Big Science project application provides the motivation for the requested budgets in the section consumables. These budgets are defined to maintain the current Flemish contribution to the CMS experiment, not to extend the current contribution. Budgets connected to the operational work and the installation of the experiment are included, not the salaries or running budgets of our researchers who perform the physics analyses of the collected collision data.

Necessary yearly budgets for the period 2013-2017

The participation of our institutions in these high-energy physics experiment within a large international collaboration are defined by a Memorandum of Understanding between the participating institutions and the international consortium. This documents defines the financial and logistical costs of the experiment as well as the responsibilities of the participating institutions.

1. "Maintenance & Operational" (M&O) costs are defined and communicated by the relevant committees at CERN, for example the CMS section of the Resource Review Board (RRB) where Prof. Jacques Lemonne represents the FWO. It has been decided that in the future the M&O costs per funding agency will be based on the number of researchers with a PhD involved in the experiment and connected to an institute related to the funding agency. Given the amount of researcher with a PhD connected to the Flemish institutions and the commitment taken by the institutions to operate and maintain the CMS detector, an estimate has been made of the future costs. The total amounts to 300.000 € per year for Flanders taking into account a realistic average of 25 researchers with a PhD in our research teams. This budget is obtained by taking the sum of the general costs for the experiment and the specific costs connected to the different subdetector devices where the Flemish groups take responsibility. For the first category an average of 7000 € per year per researcher with a PhD is taken, while for the second category an average of 5000 € per year per researcher is accounted for. These budgets are calculated and defined by CERN in Swiss Francs, and with the recent increase of the conversion rate of this currency to Euro, an increase can be expected for these numbers. Such an M&O cost is typical for the research field of particle physics, both in volume as well as in procedure.
2. Two apartments are foreseen today for the mobility stays of our Belgian researchers. This is too few however given the current Flemish contribution to the CMS experiment. The rent and maintainance of in total two apartments with each 3 bedrooms is needed for the Flemish FWO teams. This amount is equal to what is foreseen in the previous Big Science program. A total budget of 60.000 € per year has proven to be realistic given previous experience. The VUB group follows the administration of these facilities, hence the budget is allocated to the VUB in our request. Nevertheless, all the members of our three research groups do use these apartments.
3. The agreement between the CMS Collaboration and the participating institutions foresees a contribution to the operational activities of the experiment. For each of the participating Flemish universities we request a scientific collaborator to cover these operational activities at CERN. According to the same agreement each individual researcher is also requested to contribute to the services to operate the CMS

experiment. This is the same size of human resources as allocated in the previous Big Science program. Travelling budgets are requested to support our researchers to accomplish their duties within the CMS Collaboration.

4. The agreement with the CMS Collaboration includes a contribution to the central computing infrastructure that is needed to analyse the collision data. Our contribution is the development and building of a TIER-2 computing infrastructure in the Calculation Centre of the VUB/ULB but usable for all Belgian researchers at the CMS experiment. For the next years, older computing equipment need to be replaced by better performing elements. Also because the experiment collects always more collision data, an increase of the computing infrastructure is requested. For both categories together a budget of 200.000 € per year should be foreseen for Flanders, as well as human resources of 2 FTE per year to maintain the TIER-2 infrastructure. A total of 1 FTE will be located at the VUB because of the location of the TIER-2, and two 0.5 FTE will be located at respectively the UA and the UGent to support our researchers in the use of the TIER-2. The electricity bill of about 43.000 € per year is paid by the VUB/ULB.
5. The CMS experiment has to be upgraded to receive higher energies as well as higher luminosities that are needed to go beyond our current scientific knowledge and search for rare phenomena. The relevant CERN committees have defined a detailed planning for this part of the project which covers the needs in the coming years. For Flanders a budget of 100.000 € per year is requested. And we need 1 FTE scientific mandate per institution to perform the foreseen R&D.

The total of the operational and logistic budget for the participation of the Flemish institutions (UA, UGent, VUB) in the CMS experiment is 1.18M € per year. Nevertheless the strong expansion of our Flemish research teams in the CMS Collaboration, this budget is essentially similar to the one allocated to us in the previous Big Science program, because it also includes budgets that were requested traditionally at the regular FWO committees. For example the costs for the construction (now upgrade) of the CMS experiment are now included in this Big Science application while they were part of regular FWO projects in the past. Hence our request is a regrouping of the construction, operational and logistical costs of the three Flemish institutions for the participation in the CMS experiment, and adapted to the current situation.

ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Laboratoire Européen pour la Physique des Particules
European Laboratory for Particle Physics

Professor Sergio BERTOLUCCI
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Dr. Ir. Elisabeth MONARD
Secretary-General
Secretaris-Generaal van het FWO
Egmontstraat 5
B - 1000 BRUSSELS

Our reference: DRC-2011-028/0

Geneva, 9 March 2012

Subject: **Letter of acceptance of the Flemish institutes**

Dear Secretary-General, Dr. Ir. Monard,

The CMS experiment at CERN is an international collaboration of more than 180 institutions in 40 countries with over 3500 scientists. The Universiteit Antwerpen, Vrije Universiteit Brussel and Universiteit Gent and are three Flemish institutions, which are part of this collaboration. The first two institutions have joined CMS since the very beginning, in 1990, and the latter in 2007. We confirm that the researchers of all these institutions according to the Memorandum of Understandings (Construction and Maintenance and Operations) signed between CERN and FWO, and according to the constitution of the CMS Collaboration, are accepted to join the research programme and the use of the experimental facilities of the CMS experiment.

On behalf of the CERN and CMS Collaboration, we would like to express our strong support for the application of the Flemish institutions for the new 5-year programme.

We remain at your disposal, should you require any further information.

Yours Sincerely,

ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE CERN

Dr. Sergio Bertolucci
Director for Research and Computing
CERN, Geneva (Switzerland)

Prof. Joseph Incandela
CMS Spokesperson
CERN, Geneva (Switzerland)
UC Santa Barbara (USA)

Vrije Universiteit Brussel

R&D DEPARTEMENT
ONDERZOEKSCOÖRDINATIE

Uw kenmerk
Ons Kenmerk RE/R&D/2012/1994
Contactpersoon Christl Vereecken
E-mail RD.secretariaat@vub.ac.be
Tel +32 2 629 2108
Bijlagen
Datum 14/03/2012

To whom it may concern

Since about 2 decades the VUB participates in the CMS experiment at the Large Hadron Collider at CERN. This is one of the leading experiments in modern science and required 20 years of preparation. The accelerator as well as the detector is operational since 3 years and explores the fundamental interactions between the smallest building blocks of Nature at unprecedented energies. Over the next decade our research team will be able to analyze proton collisions with this unique infrastructure.

The research team for experimental high energy physics at the VUB and ULB are united in the Inter-university Institute for High Energies since 40 years. This institute with about 75 members is an excellent example for successful fundamental research in Belgium and is housed in the buildings of the VUB. It therefore obtains the highest support from the authorities of the university. The computing centre of the VUB-ULB houses also the large scale computing infrastructure (TIER-2) needed to analyze the collision data. For example the energy bill of about 45.000 euro per year is financed by the ULB-VUB. This support will continue.

In conclusion the VUB does support the application of Prof. Jorgen D'Hondt to the Big Science program for the participation to the CMS experiment at the LHC at CERN, and provides in-kind support to this outstanding research.

Prof. dr. Paul De Knop
Rector
Vrije Universiteit Brussel

Universiteit Antwerpen
Departement Onderzoek

ADOC - CMI - MIDDELHEIMLAAN 1 - 2020 ANTWERPEN

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Gebouw A
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CONTACTPERSOON
ANNELEEN BAERTS

ONS KENMERK
UA/ADOC/AB/sp/2012.089

DATUM
07/02/2012

BIJLAGE

Concerning: Support for Big Science Applicant Prof. dr. Pierre Van Mechelen, University of Antwerp

L.S.,

As chairman of the Research Council of the University of Antwerp I want to declare officially that the University of Antwerp fully supports the application of professor Pierre Van Mechelen for the Big Science project titled 'The CMS experiment at the Large Hadron Collider at CERN'.

The University of Antwerp has a long and outstanding tradition in experimental and phenomenological research on particle collisions as investigated with the largest particle accelerators in the world (e.g. the large hadron collider at CERN). Elementary Particle Physics is part of one of our key research domains at the University of Antwerp ('Materials Characterization'). These key domains are billboards of our research excellence, focus points for research funding and possible connector points for collaboration with industry.

Firstly, the applicant receives support in terms of staff costs. Professor Van Mechelen was appointed as a ZAPBOF research professor at our university since 01/01/2006. ZAPBOF research professors are tenured academic staff members (appointed by the University Board) who mainly carry out research activities and whose payroll costs are transferred and charged to the University Research Fund. This position limits the teaching commitments of professor Van Mechelen and allows him to focus on his research activities. Professor Van Remortel has a position as a tenured academic staff member since 01/01/2008.

Secondly, the applicant is supported in terms of consumables. The Elementary Particle Physics group received € 11.790 of consumables from the Faculty of Sciences in the current year (2012).

Thirdly, professor Van Mechelen (as Principal Investigator) and professor Van Remortel (as co-supervisor) recently got granted a large 'TOP-BOF' research project by the Research Council of the University of Antwerp, with a total budget of € 500.000 over the period 2010–2013. These resources are drawn from the University Research Fund.

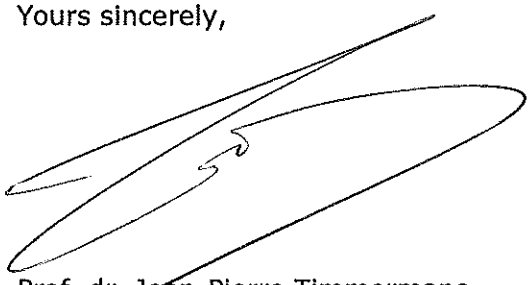
The project is titled 'Study of the heavy flavour content of the proton with the CMS detector at the Large Hadron Collider in CERN' and is directly linked to the research activities proposed in this Big Science application.

Forthly, the University of Antwerp nominated professor Van Remortel for an Odysseus Grant by the Research Foundation Flanders. The Odysseus initiative is intended to offer start-up funding to a number of outstanding researchers who have built up a career outside Flanders, in order to develop a research group within a Flemish university. Professor Van Remortel was selected by an international jury and is an Odysseus beneficiary since 01/07/2008. His Odysseus project is titled 'Exploration of the light Higgs Boson sector at the LHC' (€ 660.000).

Finally, the University of Antwerp provides accomodation and administrative support to the Elementary Particle Physics team.

The preceeding clearly demonstrates that the University of Antwerp strongly supports the research team of prof. dr. Van Mechelen in various ways.

Yours sincerely,



Prof. dr. Jean-Pierre Timmermans

Chair of the Research Council of the University of Antwerp

UNIVERSITEIT GENT

DEPARTMENT OF **RESEARCH AFFAIRS**

Research Co-ordination Office

Your reference	**our reference** DOZA-AOC/IL/DDC/LH/2012-008	**date** 13 March 2012
contact Lieve Huys	**e-mail** Lieve.Huys@UGent.be	**phone and fax** T +32 9 264 30 28 F +32 9 264 35 83

To whom it may concern

I have been informed of the fact that Prof. M. Grunewald and Prof. D. Ryckbosch of Ghent University will participate in a Big Science project that will be submitted by Prof. J. D'Hondt of the Vrije Universiteit Brussel, as principal investigator.

The title of the proposed project is "The CMS experiment at the Large Hadron Collider at CERN".

Ghent University fully supports this application and guarantees that, in case this project is granted, the award holder will be provided with the support, research infrastructure and access to facilities necessary to carry out the proposed research.

Sincerely

Prof. L. Moens, Vicerector
For the rector, absent
14 March 2012

Short scientific Curriculum Vitae

Jorgen D'Hondt

Professor of Physics

Vrije Universiteit Brussel

Inter-university Institute of High Energies

Pleinlaan 2, 1050 Brussels, Belgium

✉ **jodhondt@vub.ac.be**

☎ **+32 496 704865**

Member of the CMS Collaboration since 2003 and participated in divers activities from building up our experiment to the writing of final journal papers:

- Institute representative of the Vrije Universiteit Brussel in the Collaboration Board as deputy team leader since 2007, and as team leader since 2009;
- Coordinated the Silicon Strip Tracker Module assembly in Brussels (2003-2006);
- As first Top Quark PAG convenor in 2007 and 2008 I have setup this analysis group, prepared the organization as well as the initial analyses to absorb the first data taking and organized the creation of the Top Quark Analysis Framework which was the precessor of the PAT structure;
- Coordinated the Analysis Support Task Force which was the basis of the Analysis Operation group in our Computing Project;
- Paper editor, ARC-chair or member (11 in total, in divers POG's and PAG's), reviewer of divers documents of our collaboration;
- Member of the Tracker Institution Board as well as the Tracker Phase-2 Upgrade Steering panel;
- Co-author of 50 notes within the CMS Collaboration;
- Promotor (or co-promotor) of two CMS Thesis Award winners (Steven Lowette and Jan Heyninck);
- Organisor (or co-organisor) of several international workshops, for example the TOP2010 workshop in Bruges (~130 participants) and the CMS Physics Week in Brussels (~350 participants);

- Guided or co-guided divers groups to the CMS experiment from policy makers and royalties to students;
- More then 50 outreach presentations as well as a list of articles in popular magazines;
- With the team of which I am team leader we have contributed during the recent years in divers domains within our experiment, eg. cosmic ray studies, alignment and calibration, Tracker DQM, production of MC simulation, electron reconstruction, triggers in PAT, MadGraph deployment, b-tagging, JetMET, top quark physics, exotica (fourth generation), supersymmetry, ...
- Host institution for a TIER-2;

Previously I was involved in two experiments at the LEP collider, namely the ALEPH experiment for a short period and the DELPHI experiment. I was active in the field of W boson physics measuring the W boson mass and width, as well as in the field of soft-QCD phenomena like Bose-Einstein correlations and colour reconnection.

Responsibilities in my research institute (IIHE), at my university (VUB) or within Belgium:

- Director of the VUB part of the Inter-university Institute for High Energies (IIHE) with a total of about 70 members (since 2011);
- President of the Department of Physics at the VUB (since 2012), when elected I will resign from this function;
- Vice-president of the Department of Physics at the VUB (2005-2008);
- Representative of the Physics Department in the Education Board of the Faculty of Science;
- Vice-president of the Education Board of the Faculty of Science and deputy representative of the Faculty of Science in the Education Council of the university (since 2012), when elected I will resign from this function;
- Representative of the Physics Department in the Doctoral Research Board of the Faculty of Science;
- Belgian representative in the International Particle Physics Outreach Group;
- Member of and representing the university in the expert Commission International Collaboration of the FWO funding agency;
- Promotor (or co-promotor) of divers projects for the participation of the Flemish universities in the CMS Collaboration;
- Co-promotor of the phenomenology group on supersymmetry at the VUB;
- In total 13 finished or ongoing PhD projects as promotor;
- Long list of media appearances both in written and audio-visual press;
- Accumulated more then 20 different research funds (grants, budgets, travelbudgets,...);
- PI of about 4.0M euro research funds as UA+UGent+VUB promotor, plus another 1.8M euro as co-PI (only the VUB part of the budget is quoted);
- PI of a GOA research grant of 1.2M euro at the VUB (together with Ben Craps);
- About 250 publications (source SPIRES, Stanford University);
- About 100 conference or workshop presentations, invited seminars;

Prof. Dr. Pierre Van Mechelen
Departement Fysica
Elementaire-Deeltjesfysica
Groenenborgerlaan 171
2020 Antwerpen, Belgium

☎ +32-3-265-3573

✉ Pierre.VanMechelen@ua.ac.be

Prof. Dr. Pierre Van Mechelen
Short Curriculum Vitae

Education

Master of Physics, Universiteit Antwerpen, July 1992 (with greatest honours)
Ph.D. in Physics, Universiteit Antwerpen, May 1998 (with greatest honours)

Scientific Activities

1992-2007: Study of electron-proton collisions with the H1 detector at the HERA collider (DESY /Hamburg)
- Convener of the H1 Physics Working Group "Diffractive Phenomena" from 1998-2000.
- Librarian of the H1 software package for Physics Analysis (H1PHAN, fortran-based) since 1998.
- H1 Internal Referee and Run Coordinator.

2006-present day: Study of proton-proton collisions with the CMS detector at the LHC (CERN/Geneva)
- Convener of the CMS Forward and Small-x QCD Physics Analysis Group (2011-2012)
- CASTOR software coordinator since 2008.
- Analysis Review Committee member on several occasions

Publications and talks/seminars

More than 300 publications with average 31.76 average citations, h-index 50 (source: Web of Science)
More than 30 presentations at international conferences

Board memberships

CMS Collaboration Board
UA Research Council
CASTOR Steering Committee
FNRS expert
International Advisory Committee of the International Symposium on Multiparticle Dynamics
International Advisory Committee of the Workshop on Low-x QCD Physics

Teaching Activities

Bachelor courses on Special Relativity, Subatomic and Particle Physcis
Master course on Accelerator Physics
Promotor of 6 current PhD students

Outreach Activities

EOS Start to Know and Scilogs weblogs
Organizer of masterclasses and open courses

Prof. dr. Nick van Remortel

Department of Physics
Elementary Particle Physics
Groenenborgerlaan 171
2020 Antwerpen
Belgium
Tel : +32 3 265 35 68
Email: nick.vanremortel@ua.ac.be

Current Position:

- Tenured Professor at the University of Antwerpen, since 2008

Committees:

- UA Steering group on internal and external communication
- Belgian representative in the European Committee for Future Accelerators (ECFA)
- Member of jury prize SCK-CEN Roger Van Geen (2011-2012)
- Co-convener of national steering group on future HEP experiments
- Permanent member of international advisory committee ISMD conference series

Publications:

- Total Number of publications in 1999-2012: 510
- Total Number of publications in 2007-2012: 330
- Total number of citations (excl. self citations): 7386
- h-index: 42

Invited colloquia, seminars, conference talks:

- Invited academic seminars & colloquia: 14
- Invited conference talks: 11

Organization of Scientific events:

- Organization of 1 local and 1 international workshop & conference

PhD supervision and jury's:

- PhDs finished:1
- PhDs active: 5
- Member of external PhD jury's: 3

Teaching:

- Bachelor level courses: 3 courses of totally 15 ECT credits
- Master level courses: 3 courses of totally 9 ECT credits

Outreach:

- Co-organizer of the Flemish Physics Olympics
- Co-organizer of masterclasses in particle physics
- More than 20 public lectures and seminars on particle physics
- A dozen of press articles and interviews on TV and radio
- Science blog on particle physics

Short CV of **Dirk Ryckbosch**, March 2012

- Current position
  - Full professor Ghent University
  - Head of Department of Physics and Astronomy
- Committees
  - International Advisory committee for about 15 conferences, mainly in QCD/hadronic physics.
  - FWO (Fund for Scientific Research - Flanders) evaluation committee E5 "Subatomic physics" (2002-2009).
  - FWO Expert Panel W&T2: Physics, Vice-chair (2010).
  - DESY Strategygruppe "Teilchenphysik" (2002-2003)
  - Member of HERMES Collaboration council
  - Member of IceCube Collaboration board
  - Member of Belgian National Committee for Physics (Belgian interface to IUPAP)
- Publications
  - Total number of publications in 2001-2011: 216
  - Total number of publications: 291 (Web of Science, March 2012)
  - Total citations: 6930
  - Total citations for most cited publication: 324
  - h-index: 39
- Conferences, Summerschools & Seminars
  - Invited talks at 56 international conferences
  - Organizer of 10 International workshops
  - Organized in Gent International Collaboration meetings for the HERMES (2000, 170 participants) and IceCube (2007, 175 participants) collaborations.
  - Lecture series at 6 Summer/Winter schools
  - Seminars at 13 universities/institutes
- Supervision of PhDs
  - PhDs finished: 11
  - PhDs active: 10
- Outreach activities
  - Coordinator of activities in "World Year of Physics -2005" at Ghent University
  - Organizer of "Masterclasses in Elementary Particle Physics" at Ghent University
  - Member of Organization Committee for "Vlaamse Fysica Olympiade" (Flemish Physics Olympiads)

Since 2008, co-promoter Martin W. Grünewald is full professor in the Department of Physics and Astronomy of Ghent University. Being a member of three large collaborations in high-energy physics at lepton and hadron colliders, L3 in the past, D0, and since a few years CMS, he shares about 700 publications, all published in the high-impact journals Physics Letters B, European Physical Journal C, Journal of High Energy Physics, Physical Review Letters, Physical Review D, Physics Reports and Nature.

Prof. Grünewald leads the UGhent research group in top-quark and Higgs physics with CMS at the LHC, currently consisting of five post-docs, five graduate students and one undergraduate student. He is a member of the institutional board of the D0 experiment at the Tevatron, and of the collaboration board of the CMS experiment at CERN. At L3 and D0 he is a member of several editorial boards reviewing many analyses for publication, while at CMS he is coordinating the technical integration team for the high-level trigger system.

He is chairing the LEP electroweak working group and initiated its twin at the Tevatron. Since several years he is a member of the Particle Data Group, sharing responsibility for including measurements pertaining to the W and Z boson in the PDG reviews. He serves as referee for both international journals such as PRL, PRD and EPJC, and several foreign funding agencies. He is a member of the board overseeing the School of Theoretical Physics at the Dublin Institute for Advanced Studies, appointed by the Irish government. He has given about thirty seminars and the same number of physics-school, workshop and conference presentations. For outreach, Prof. Grünewald has given several presentations on LHC physics to the general public and was interviewed on radio.

Prof. Grünewald has taught physics courses at universities in Germany, Ireland and Belgium, as well as serving on search and selection boards for both academic and technical positions, and being a member of departmental, faculty and university boards. He has participated in quality assurance and quality improvement assessment reviews as well as physics degree accreditation, and in implementing changes to make the science degree programme structure compatible to the EU-wide Bologna framework.

FREYA BLEKMAN: CURRICULUM VITAE

Contact details

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Belgium
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Academic Career

2010-	Research professor at Vrije Universiteit Brussel (CMS), 10% ZAP.
2007-2010	Research associate at Cornell University (CMS)
2005 – 2007	Research associate at Imperial College London (CMS / D0)
2005	Research assistant at Nikhef (ATLAS)
2000 – 2005	PhD experimental High Energy Physics at Nikhef (D0). Subject: top quark pair production in proton antiproton collisions
1993 – 2000	Diploma experimental physics at Universiteit van Amsterdam (LHCb) Experimental work: LHCb outer tracker R&D

Prizes

Recipient of an Odysseus II grant starting October 2011.

Research Activities

2011 -	Co-convening the CMS exotica searches in top quark topologies
2011 -	Coordinating the use of b-quark jet identification in the CMS top quark group.
2011 -	Contributing to analysis on the search for the production of 4 top quarks.
2010 -	Leading the analysis on the first observation of single top quark production in the Wt channel.
2009 - 2010	Top physics with the use of b-tagging. Leader of the effort to use secondary vertex b-quark tagging for very early data in CMS top physics, working in the electron+jets+btag event topology.
2008 - 2009	Convenor CMS pixel offline software (also known as Detector Performance Group). Responsible for offline and high-level trigger pixel reconstruction software, i.e. simulation, digitization and reconstruction of pixel detector data, data quality monitoring, databases and calibration.
2007 - 2008	Author of missing transverse energy significance algorithm, a novel approach that uses the compatibility with zero missing energy as a an additional measurement in the reconstruction, thus increasing the discriminative power for separating signal from background in events with missing transverse energy.
2007 - 2008	Pixel database contact person. Responsible for the CMS pixel databases including development, maintenance and release management.
2007 - 2008	Author of the calibration software for the CMS pixel detector. Author of the CMS pixel gain & pedestal database and the software that measures the values of these for each separate pixel.
2007 - 2008	Developer in the CMS Physics Analysis Tools (PAT) group, focusing on documentation and analysis examples.
2007	Measurement tau jet energy scale, 2007 CMS computing challenge.
2005 - 2007	Responsible for the development and testing of Grid-based CMS analysis at Imperial College. Focus: Particle flow reconstruction and tau identification,

	leading towards Higgs boson physics in various tau channels. Author CMS reconstruction software tutorials and CMS reconstruction software expert.
2005 - 2007	Author of the analysis used to measure the top quark pair cross section in the all hadronic channel, using 450 pb^{-1} of D0 data. This analysis uses secondary vertex reconstruction for b-jet identification in combination with a topological analysis and multivariate techniques. This analysis is still the most accurate published D0 result in this particular top decay channel.
2005	Silicon module electronics tests for the ATLAS-SCT end caps.
2002 - 2005	Responsible for the development of D0 top quark physics triggers in multi jet events. Studies on top quark pair cross section in the all-hadronic channel on early Tevatron data samples.
2001 - 2003	Global D0 data acquisition and tracker commissioning expert. Author of the D0 tracker pedestal database and its monitoring software.
2000 - 2001	Participated in the commissioning of the D0 microstrip tracker.
1999	Development software of robot used in CMS tracker module wire bonding.
1998 - 2000	Prototype testing for the LHCb outer tracker drift chamber.

Outreach, Public presentations & Teaching

- Teaching 2nd year master course (Physics students) "simulation of physical processes and modern physics detectors"
- Member of CMS outreach executive committee. Responsible for the Dutch language version of the CMS brochure and CMS contact person for Dutch language outreach.
- Numerous newspaper and television interviews.
- Presented popular science lectures on Particle Physics for the general public.
- Official CERN guide. CMS guide during the CERN open day 2008.
- Science ambassador for the European commission SET-Routes program on the improvement of science role models and gender bias in high school science education.

Publication Record

(Co) Authered 281 publications which received over 11k citations and resulting in a Hirsch index h=51 (source: Inspire, SLAC, Stanford University, March 2012)

Leadership and management experience

- Chair of several editorial boards inside CMS collaboration (internal peer review).
- 2011-: Responsible for coordinating the analysis activities in the exotica searches in top quark topologies (management of 15 physics analysis teams working within the CMS collaboration).
- Responsible for the Vrije Universiteit Brussel (IIHE) web page.
- Organiser of the Vrije Universiteit Brussel (IIHE) internal seminars.
- PR-responsible for the Vrije Universiteit Brussel Physics group.
- 2010: Local organising committee CMS physics week (300 person conference).
- 2009-2011:Member of CMS Collaboration board advisory group (executive body advising 3000 person international collaboration).
- 2008-2009: CMS Pixel DPG convenor (manager of scientific project of 50 international scientists).
- 2007-2009: Seat on CMS tracker DPG steering committee and pixel commissioning task force (executive body in charge of Silicon tracking software CMS collaboration).

Professor dr. Walter Van Doninck
Research director FWO Vlaanderen
Professor of experimental physics VUB
Vrije Universiteit Brussel
Pleinlaan 2
B-1050 Brussels
Belgium

Born 31/10/1948 in Bergisch Gladbach (GE)
Nationality: Belgian
Fluent in Dutch, French, German and English

On leave of absence since January 2000 to the
CERN laboratory (Geneva-Switzerland)
Tel: office: +41 22 76 71539
GSM: +41 76 487 2781
E-mail : Walter.Vandoninck@cern.ch

University studies in Antwerp (RUCA) and Brussels (VUB) ended July 1971.
PhD in Sciences VUB October 1977 with greatest distinction.
PhD thesis on the experimental discovery of "weak neutral currents" in 1973 in the "Gargamelle" experiment at the CERN PS neutrino beam ; as up to today, still considered as the greatest discovery at CERN, with a Nobel price for the theoretical proposers of this model : S.Glashow, A.Salam and S.Weinberg in 1979.
Publication with more than 800 citations.
Neutrino physics in the Gargamelle and the Big European Bubble chamber (BEBC). Scientific spokesperson for the calorimeter project inside BEBC.
Project leader of the forward-backward muon system of the DELPHI experiment at the LEP e+-e- collider at CERN, coordinating 4 Belgian universities (UA,VUB,ULB and UMH); directing R&D, conception, construction and operation of this system.
Precision measurements in the framework of the "Standard Model of Particles and Force fields" at the LEP collider.
Coordinator for the development of the CMS forward "Micro Strip Gas Chamber" component of the CMS Tracking detector at the "Large Hadron Collider" of CERN, involving the universities UA,VUB,ULB,UCL,UMH and including the laboratories of Aachen, Karlsruhe, Strasbourg, Lyon, and Novosibirsk. Since January 2000 on leave of absence from Belgium: Coordinator for the forward-backward RPC system of the CMS experiment at the LHC involving laboratories from China, Corea and Pakistan; recently the universities of Ghent, VUB and UCL have joined this muon project still under my coordination for which an upgrade programme is foreseen for the LHC design luminosity. I also acted in the technical coordination team of CMS as the integration and assembly responsible for the CMS inner end caps (YE1).

Membership in national and international committees during the past or at present:
- **Member of the FWO commission E5 "subatomaire fysica"**
- **Member of the board of directors of the Belgian Physical Society**
- **Member of the board of directors of the European Physical Society (HEPP)**
- **Member of the ECFA and Restricted ECFA committees**
- **Chair of the MSGC steering committee**
- **Member of the CMS Management, Collaboration, and Finance Boards**
- **Chief editor of the CMS bulletin**
- **Scientific referee for MIUR (Italy) and IEEE projects and conferences**

- **Belgian delegate to the CERN Council**

Publications:

- **Author or co-author of more than 300 scientific publications in refereed international journals (Physics letters, Nuclear Physics, Zeitschrift fur Physik, Nuclear Instruments and Methods etc…)**
- **Contribution to the book:**
  Revue des questions scientifiques
  Tome 174 2003 nos 1-2 IISN 035-2160

Honors:

- **Laureate of the 2009 EPS HEPP Prize awarded to the "Gargamelle" collaboration for the observation of weak neutral currents**

Education:

- **More than 50 invited talks at international conferences, schools and seminars**
- **Promotor or co-promotor of more than 10 PhD theses in Belgium (VUB, ULB, UMH, UCL and UA) and member of several international PhD juries**
- **Chair of several courses in the curriculum of the VUB and the Vesalius college**

Mobility:

- **Major stays of several months in the USA (Stanford, Berkeley and Fermi lab)**
- **Major stay of several weeks at KEK Japan**
- **Since January 2000 detached at CERN as scientific associate**

Publications since 2006 for each supervisor

Prof. Jorgen D'Hondt – Vrije Universiteit Brussel

1) Search for microscopic black holes in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration [arXiv:1202.6396] CMS-EXO-11-071 (Feb 2012)

2) Search for quark compositeness in dijet angular distributions from pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration [arXiv:1202.5535] CMS-EXO-11-017 (Feb 2012)

3) Jet momentum dependence of jet quenching in PbPb collisions at sqrt(sNN)=2.76 TeV. By CMS Collaboration [arXiv:1202.5022] CMS-HIN-11-013 (Feb 2012)

4) Inclusive b-jet production in pp collisions at sqrt(s)=7 TeV. By CMS Collaboration [arXiv:1202.4617] CMS-BPH-11-022 (Feb 2012)

5) Search for the standard model Higgs boson decaying to bottom quarks in pp collisions at sqrt(s)=7 TeV. By CMS Collaboration [arXiv:1202.4195] CMS-HIG-11-031 (Feb 2012)

6) Search for neutral Higgs bosons decaying to tau pairs in pp collisions at sqrt(s)=7 TeV. By CMS Collaboration [arXiv:1202.4083] CMS-HIG-11-029 (Feb 2012)

7) Deployment of the CMS software on the WLCG grid. By W. Behrenhoff, et al., J.Phys.Conf.Ser.331:072041,2011.

8) Search for large extra dimensions in dimuon and dielectron events in pp collisions at $\sqrt{s} = 7$ TeV. By CMS Collaboration [arXiv:1202.3827] CMS-EXO-11-087 (Feb 2012)

9) Search for the standard model Higgs boson in the H to ZZ to ll tau tau decay channel in pp collisions at sqrt(s)=7 TeV. By CMS Collaboration [arXiv:1202.3617] CMS-HIG-11-028 (Feb 2012)

10) Search for the standard model Higgs boson in the H to ZZ to 2l 2nu channel in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration [arXiv:1202.3478] CMS-HIG-11-026 (Feb 2012)

11) Search for the standard model Higgs boson in the decay channel H to ZZ to 4 leptons in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration [arXiv:1202.1997] CMS-HIG-11-025 (Feb 2012)

12) Search for the standard model Higgs boson decaying to a W pair in the fully leptonic final state in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration

[arXiv:1202.1489] CMS-HIG-11-024 (Feb 2012)

13) Combined results of searches for the standard model Higgs boson in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration [arXiv:1202.1488] CMS-HIG-11-032 (Feb 2012)

14) Search for the standard model Higgs boson decaying into two photons in pp collisions at sqrt(s)=7 TeV. By CMS Collaboration [arXiv:1202.1487] CMS-HIG-11-033 (Feb 2012)

15) Search for a Higgs boson in the decay channel H to ZZ(*) to q qbar l-l+ in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration [arXiv:1202.1416] CMS-HIG-11-027 (Feb 2012)

16) Measurement of the inclusive production cross sections for forward jets and for dijet events with one forward and one central jet in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration [arXiv:1202.0704] CMS-FWD-11-002 (Feb 2012)

17) Suppression of non-prompt J/psi, prompt J/psi, and Y(1S) in PbPb collisions at sqrt(sNN) = 2.76 TeV. By CMS Collaboration [arXiv:1201.5069] CMS-HIN-10-006 (Jan 2012)

18) Centrality dependence of dihadron correlations and azimuthal anisotropy harmonics in PbPb collisions at sqrt(s[NN]) = 2.76 TeV. By CMS Collaboration [arXiv:1201.3158] CMS-HIN-11-006 (Jan 2012)

19) Measurement of isolated photon production in pp and PbPb collisions at sqrt(sNN) = 2.76 TeV. By CMS Collaboration [arXiv:1201.3093] CMS-HIN-11-002 (Jan 2012)

20) Measurement of the charge asymmetry in top-quark pair production in proton-proton collisions at sqrt(s) = 7 TeV. By CMS Collaboration Phys.Lett.B709:28-49,2012. [arXiv:1112.5100]

21) Search for signatures of extra dimensions in the diphoton mass spectrum at the Large Hadron Collider. By CMS Collaboration [arXiv:1112.0688] FERMILAB-PUB-11-693-CMS (Dec 2011)

22) Exclusive photon-photon production of muon pairs in proton-proton collisions at sqrt(s) = 7 TeV. By CMS Collaboration JHEP01:052, 2012. [arXiv:1111.5536]

23) J/psi and psi(2S) production in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration JHEP 1202:011,2012. [arXiv:1111.1557]

24) Measurement of the Production Cross Section for Pairs of Isolated Photons in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration JHEP 1201:133,2012.

[arXiv:1110.6461]

25) Measurement of the Rapidity and Transverse Momentum Distributions of Z Bosons in pp Collisions at sqrt(s)=7 TeV. By CMS Collaboration Phys.Rev.D85:032002,2012. [arXiv:1110.4973]

26) Jet Production Rates in Association with W and Z Bosons in pp Collisions at sqrt(s) = 7 TeV. By CMS Collaboration JHEP 1201:010,2012. [arXiv:1110.3226]

27) Measurement of the weak mixing angle with the Drell-Yan process in proton-proton collisions at the LHC. By CMS Collaboration Phys.Rev.D84:112002,2011. [arXiv:1110.2682]

28) Measurement of energy flow at large pseudorapidities in pp collisions at $\sqrt{s} = 0.9$ and 7 TeV. By CMS Collaboration JHEP 1111:148,2011,Erratum-ibid.1202:055, 2012. [arXiv:1110.0211]

29) Forward Energy Flow, Central Charged-Particle Multiplicities, and Pseudorapidity Gaps in W and Z Boson Events from pp Collisions at 7 TeV. By CMS Collaboration Eur.Phys.J.C72:1839,2012. [arXiv:1110.0181]

30) Search for a Vector-like Quark with Charge 2/3 in t + Z Events from pp Collisions at sqrt(s) = 7 TeV. By CMS Collaboration Phys.Rev.Lett.107:271802,2011. [arXiv:1109.4985]

31) Search for Supersymmetry at the LHC in Events with Jets and Missing Transverse Energy. By CMS Collaboration Phys.Rev.Lett.107:221804,2011. [arXiv:1109.2352]

32) Measurement of the t $\bar{t} Production Cross Section in pp Collisions at 7 TeV in Lepton + Jets Events Using b-quark Jet Identification. By CMS Collaboration Phys.Rev.D84:092004,2011. [arXiv:1108.3773]

33) Measurement of the Differential Cross Section for Isolated Prompt Photon Production in pp Collisions at 7 TeV. By CMS Collaboration Phys.Rev.D84:052011,2011. [arXiv:1108.2044]

34) Measurement of the Drell-Yan Cross Section in pp Collisions at sqrt(s) = 7 TeV. By CMS Collaboration JHEP 1110:007,2011. [arXiv:1108.0566]

35) Search for B(s) and B to dimuon decays in pp collisions at 7 TeV. By CMS Collaboration Phys.Rev.Lett.107:191802,2011. [arXiv:1107.5834]

36) Dependence on pseudorapidity and centrality of charged hadron production in PbPb collisions at a nucleon-nucleon centre-of-mass energy of 2.76 TeV. By CMS Collaboration JHEP 1108:141,2011. [arXiv:1107.4800]

37) Measurement of the Inclusive W and Z Production Cross Sections in pp Collisions at sqrt(s) = 7 TeV. By CMS Collaboration JHEP 1110:132,2011. [arXiv:1107.4789]

38) Search for Resonances in the Dijet Mass Spectrum from 7 TeV pp Collisions at CMS. By CMS Collaboration Phys.Lett.B704:123-142,2011. [arXiv:1107.4771]

39) Determination of Jet Energy Calibration and Transverse Momentum Resolution in CMS. By CMS Collaboration JINST 6:P11002,2011. [arXiv:1107.4277]

40) Search for Three-Jet Resonances in pp Collisions at sqrt(s) = 7 TeV. By CMS Collaboration Phys.Rev.Lett.107:101801,2011. [arXiv:1107.3084]

41) Search for supersymmetry in pp collisions at sqrt(s)=7 TeV in events with a single lepton, jets, and missing transverse momentum. By CMS Collaboration JHEP 1108:156,2011. [arXiv:1107.1870]

42) A search for excited leptons in pp Collisions at sqrt(s) = 7 TeV. By CMS Collaboration Phys.Lett.B704:143-162,2011. [arXiv:1107.1773]

43) Inclusive search for squarks and gluinos in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration Phys.Rev.D85:012004,2012. [arXiv:1107.1279]

44) Measurement of the Underlying Event Activity at the LHC with $\sqrt{s}= 7$ TeV and Comparison with $\sqrt{s} = 0.9$ TeV. By CMS Collaboration JHEP 1109:109,2011. [arXiv:1107.0330]

45) Missing transverse energy performance of the CMS detector. By CMS Collaboration JINST 6:P09001,2011. [arXiv:1106.5048]

46) Search for New Physics with a Mono-Jet and Missing Transverse Energy in pp Collisions at $\sqrt{s} = 7$ TeV. By CMS Collaboration Phys.Rev.Lett.107:201804,2011. [arXiv:1106.4775]

47) Search for New Physics with Jets and Missing Transverse Momentum in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration JHEP 1108:155,2011. [arXiv:1106.4503]

48) Measurement of the Strange B Meson Production Cross Section with J/Psi phi Decays in pp Collisions at sqrt(s) = 7 TeV. By CMS Collaboration Phys.Rev.D84:052008,2011. [arXiv:1106.4048]

49) Search for Supersymmetry in Events with b Jets and Missing Transverse Momentum at the LHC. By CMS Collaboration JHEP 1107:113,2011. [arXiv:1106.3272]

50) Measurement of the t-channel single top quark production cross section in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration Phys.Rev.Lett.107:091802,2011. [arXiv:1106.3052]

51) Search for Light Resonances Decaying into Pairs of Muons as a Signal of New Physics. By CMS Collaboration JHEP 1107:098,2011. [arXiv:1106.2375]

52) Search for Same-Sign Top-Quark Pair Production at sqrt(s) = 7 TeV and Limits on Flavour Changing Neutral Currents in the Top Sector. By CMS Collaboration JHEP 1108:005,2011. [arXiv:1106.2142]

53) Search for Physics Beyond the Standard Model Using Multilepton Signatures in pp Collisions at sqrt(s)=7 TeV. By CMS Collaboration Phys.Lett.B704:411-433,2011. [arXiv:1106.0933]

54) Measurement of the Top-antitop Production Cross Section in pp Collisions at sqrt(s)=7 TeV using the Kinematic Properties of Events with Leptons and Jets. By CMS Collaboration Eur.Phys.J.C71:1721,2011. [arXiv:1106.0902]

55) Measurement of the Ratio of the 3-jet to 2-jet Cross Sections in pp Collisions at sqrt(s) = 7 TeV. By CMS Collaboration Phys.Lett.B702:336-354,2011. [arXiv:1106.0647]

56) Measurement of the Inclusive Jet Cross Section in pp Collisions at sqrt(s) = 7 TeV. By CMS Collaboration Phys.Rev.Lett.107:132001,2011. [arXiv:1106.0208]

57) Measurement of the t t-bar production cross section and the top quark mass in the dilepton channel in pp collisions at sqrt(s) =7 TeV. By CMS Collaboration JHEP 1107:049,2011. [arXiv:1105.5661]

58) Search for First Generation Scalar Leptoquarks in the evjj channel in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration Phys.Lett.B703:246-266,2011. [arXiv:1105.5237]

59) Indications of suppression of excited Υ states in PbPb collisions at $\sqrt{S_{NN}}$ = 2.76 TeV. By CMS Collaboration Phys.Rev.Lett.107:052302,2011. [arXiv:1105.4894]

60) Search for supersymmetry in events with a lepton, a photon, and large missing transverse energy in pp collisions at sqrt(s) = 7 TeV. By CMS Collaboration JHEP 1106:093,2011. [arXiv:1105.3152]

61) Measurement of $W\gamma$ and $Z\gamma$ production in pp collisions at $\sqrt{s} = 7$ TeV. By CMS Collaboration Phys.Lett.B701:535-555,2011. [arXiv:1105.2758]

62) Long-range and short-range dihadron angular correlations in central PbPb

collisions at a nucleon-nucleon center of mass energy of 2.76 TeV. By CMS Collaboration JHEP 1107:076,2011. [arXiv:1105.2438]

63) Measurement of the Polarization of W Bosons with Large Transverse Momenta in W+Jets Events at the LHC. By CMS Collaboration Phys.Rev.Lett.107:021802,2011. [arXiv:1104.3829]

64) Charged particle transverse momentum spectra in pp collisions at sqrt(s) = 0.9 and 7 TeV. By CMS Collaboration JHEP 1108:086,2011. [arXiv:1104.3547]

65) Search for new physics with same-sign isolated dilepton events with jets and missing transverse energy at the LHC. By CMS Collaboration JHEP 1106:077,2011. [arXiv:1104.3168]

66) Measurement of the B0 production cross section in pp Collisions at sqrt(s) = 7 TeV. By CMS Collaboration Phys.Rev.Lett.106:252001,2011. [arXiv:1104.2892]

67) Measurement of the differential dijet production cross section in proton-proton collisions at sqrt(s)=7 TeV. By CMS Collaboration Collaboration Phys.Lett.B700:187-206,2011. [arXiv:1104.1693]

68) Search for Neutral MSSM Higgs Bosons Decaying to Tau Pairs in pp Collisions at $\sqrt{s}=7$ TeV. By CMS Collaboration Phys.Rev.Lett.106:231801,2011. [arXiv:1104.1619]

69) Measurement of the Inclusive Z Cross Section via Decays to Tau Pairs in pp Collisions at $\sqrt{s}=7$ TeV. By CMS Collaboration JHEP 1108:117,2011. [arXiv:1104.1617]

70) Search for Large Extra Dimensions in the Diphoton Final State at the Large Hadron Collider. By CMS Collaboration JHEP 1105:085,2011. [arXiv:1103.4279]

71) Measurement of the lepton charge asymmetry in inclusive W production in pp collisions at $\sqrt{s} = 7$ TeV. By CMS Collaboration JHEP 1104:050,2011. [arXiv:1103.3470]

72) Search for Physics Beyond the Standard Model in Opposite-Sign Dilepton Events at $\sqrt{s} = 7$ TeV. By CMS Collaboration JHEP 1106:026,2011. [arXiv:1103.1348]

73) Search for Resonances in the Dilepton Mass Distribution in pp Collisions at $\sqrt(s) = 7$ TeV. By CMS Collaboration JHEP 1105:093,2011. [arXiv:1103.0981]

74) Search for Supersymmetry in pp Collisions at $\sqrt{s} = 7$ TeV in Events with Two Photons and Missing Transverse Energy. By CMS Collaboration

Phys.Rev.Lett.106:211802,2011. [arXiv:1103.0953]

75) Search for a $W^\prime$ boson decaying to a muon and a neutrino in pp collisions at $\sqrt{s} = 7$ TeV. By CMS Collaboration Phys.Lett.B701:160-179,2011. [arXiv:1103.0030]

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236) Measurement of the top quark mass in the dilepton channel. By D0 Collaboration Phys.Lett.B655:7-14,2007. [hep-ex/0609056]

237) Limits on anomalous trilinear gauge couplings from $W W \to e^{+} e^{-}$, $W W \to e^\pm \mu^\mp$, and $W W \to \mu^{+} \mu^{-}$ events from $p\bar{p}$ collisions at $\sqrt{s}$ = 1.96-TeV. By D0 Collaboration Phys.Rev.D74:057101,2006,Erratum-ibid.D74: 059904,2006. [hep-ex/0608011]

238) Search for pair production of scalar bottom quarks in $p \bar{p}$ collisions at $\sqrt{s}$ = 1.96-TeV. By D0 Collaboration Phys.Rev.Lett.97:171806,2006. [hep-ex/0608013]

239) Experimental discrimination between charge 2e/3 top quark and charge 4e/3 exotic quark production scenarios. By D0 Collaboration Phys.Rev.Lett.98:041801,2007. [hep-ex/0608044]

240) Measurement of the ratios of the Z/gamma* + >= n jet production cross sections to the total inclusive Z/gamma* cross section in p anti-p collisions at s**(1/2) = 1.96-TeV. By D0 Collaboration Phys.Lett.B658:112-119,2008. [hep-ex/0608052]

241) Search for scalar leptoquarks in the acoplanar jet topology in $p \bar{p}$ collisions at $\sqrt{s}$ = 1.96-TeV. By D0 Collaboration Phys.Lett.B640:230-237,2006. [hep-ex/0607009]

242) Search for the Standard Model Higgs Boson in the $p \bar{p} \to$ ZH $\to \nu \bar{\nu} b \bar{b}$ channel. By D0 Collaboration Phys.Rev.Lett.97:161803,2006. [hep-ex/0607022]

243) Search for neutral, long-lived particles decaying into two muons in $p \bar{p}$ collisions at $\sqrt{s}$ = 1.96-TeV. By D0 Collaboration Phys.Rev.Lett.97:161802,2006. [hep-ex/0607028]

244) Search for associated Higgs boson production WH $\to$ WWW* $\to \ell^\pm \nu \ell^\prime$+- $\nu^\prime$ + X in $p \bar{p}$ collisions at $\sqrt{s}$ = 1.96-TeV. By D0 Collaboration Phys.Rev.Lett.97:151804,2006. [hep-ex/0607032]

245) Search for $W^\prime$ boson production in the top quark decay channel. By D0 Collaboration Phys.Lett.B641:423-431,2006. [hep-ex/0607102]

246) Search for a heavy resonance decaying into a $Z +$ jet final state in $p \bar{p}$ collisions at $\sqrt{s}$ = 1.96-TeV using the D0 detector. By D0 Collaboration Phys.Rev.D74:011104,2006. [hep-ex/0606018]

247) Search for R-parity violating supersymmetry via the LL anti-E couplings λ_{121}, λ_{122} or λ_{133} in $p \bar{p}$ collisions at $\sqrt{s}$ = 1.96-TeV. By D0 Collaboration Phys.Lett.B638:441-449,2006. [hep-ex/0605005]

248) Search for neutral Higgs bosons decaying to τ pairs in $p \bar{p}$ collisions at $\sqrt{s}$ = 1.96-TeV. By D0 Collaboration Phys.Rev.Lett.97:121802,2006. [hep-ex/0605009]

249) Search for resonant second generation slepton production at the Tevatron. By D0 Collaboration Phys.Rev.Lett.97:111801,2006. [hep-ex/0605010]

250) Search for particles decaying into a Z boson and a photon in $p\bar{p}$ collisions at $\sqrt{s}$ = 1.96 TeV. By D0 Collaboration Phys.Lett.B641:415-422,2006, Erratum-ibid.B670:455-458,2009. [hep-ex/0605064]

251) Search for the rare decay $B^0_{s} \to \phi \mu^{+} \mu^{-}$ with the D0 detector. By D0 Collaboration Phys.Rev.D74:031107,2006. [hep-ex/0604015]

252) Multivariate searches for single top quark production with the D0 detector. By D0 Collaboration Phys.Rev.D75:092007,2007. [hep-ex/0604020]

253) Search for squarks and gluinos in events with jets and missing transverse energy in $p \bar{p}$ collisions at $\sqrt{s}$ = 1.96-TeV. By D0 Collaboration Phys.Lett.B638:119-127,2006. [hep-ex/0604029]

254) Search for excited muons in $p \bar{p}$ collisions at $\sqrt{s}$ = 1.96-

TeV. By D0 Collaboration Phys.Rev.D73:111102,2006. [hep-ex/0604040]

255) A Precise measurement of the B^0_{s} lifetime. By D0 Collaboration Phys.Rev.Lett.97:241801,2006. [hep-ex/0604046]

256) Measurement of B($t \to$ Wb) /B($t \to$ Wq) at $\sqrt{s}$ = 1.96-TeV. By D0 Collaboration Phys.Lett.B639:616-622,2006. [hep-ex/0603002]

257) First direct two-sided bound on the B^0_{s} oscillation frequency. By D0 Collaboration Phys.Rev.Lett.97:021802,2006. [hep-ex/0603029]

258) Search for pair production of second generation scalar leptoquarks in p anti-p collisions at $\sqrt{s}=$ 1.96-TeV. By D0 Collaboration Phys.Lett.B636:183-190,2006. [hep-ex/0601047]

259) CMS physics: Technical design report. By CMS Collaboration CERN-LHCC-2006-001 (2006) 521p.

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Né le 21 septembre 1961 à Thessaloniki(Grèce), marié + 2 enfants, nationalité grecque

POSTES OCCUPES :

2006-2008	Physicien CERN**,**	division TS
2005 -2006	Physicien chercheur,	Université de Genève / HUG
2000 -2004 :	Ingénieur Physicien,	société Scanditronix (Meyrin)
1997 -1999	Physicien de recherche	société CDS (Thoiry)
1995 -1996	Physicien de recherche	société Biospace Instruments
1991 -1993 :	Physicien CERN,	division PPE
1987 -1990 :	Physicien CERN,	division PPE
1984 -1987 :	Doctorant	Commissariat Energie Atomique - FR

RESPONSABILITES exercées :
Physicien – Chercheur.
Domaines d'application : Détecteurs pour les expériences de la Physique de Particules au CERN et Instrumentation appliquée à l'Imagerie Bio- Médicale. R&D et coordination technique.

LANGUES :
Anglais, français et grec.

EXPERIENCES PROFESSIONNELLES :

- **2008 (depuis Juin)**

…>> CERN – Expérience CMS
Participation dans le commissioning des chambres RPC du End cap pour la détection des muons émis à l'avant.
Participation dans les tests de Haute Tension, Basse tension, circulation du gaz, le contrôle et la lecture des cartes Front-End pour les stations RE+1, RE+2 et RE+3.

- **2006 (septembre) - 2008 (mai)**

...>> CERN - division TS – Groupe EL – Section Fibres Optiques
Etude, installation, surveillance et maintenance des réseaux de fibres optiques pour le LHC et les expériences.
Réalisation du réseau en fibres optiques pour la distribution des signaux TTC/BST aux

quatre expériences.
Réalisation du réseau des fibres optiques pour le contrôle des collimateurs du LHC.
Cablage des chambres a muons CSC de CMS avec des fibres optiques pour la lecture des données : Conception et réalisation
Equipement des plusieurs parties du détecteur LHC-b avec des fibres optiques de communication de type MPO.
Coordination avec des operateurs externes et des services pour l'installation des câbles optiques sur le domaine du CERN.
Participation à l' adaptation pour les besoins du CERN de la base de données de réseaux optiques NETiD développée par DRAKA.

- 2005 -2006.

…>> Université de Genève & Hôpitaux Universitaires de Genève :
Etude des spectres obtenus par SELDI, spectrometrie de masse TOF. (Time of flight).
Etude des caractéristiques physiques de l'appareil (Ciphergen) et optimisation des conditions d'utilisation de l'appareil. Conception d'un flux de travail en vue de garantir la qualité et la reproductibilité de spectres de masse dans la perspective de l'extraction de connaissances à effectuer.
Développement de techniques et d'outils pour la visualisation, l'analyse exploratoire et le contrôle de qualité des spectres de masse protéomiques
Elaboration d'une stratégie pour le prétraitement des données, évaluation. Extraction de l'information (signature protéomique) pour un type de pathologie cérébrale (stroke) par classification des échantillons à l'aide des méthodes statistiques (langage R) dans le but de mettre en évidence de nouveaux bio - marqueurs.

- 2000 – 2004

…>> Scanditronix S.A. :
Réalisation d'une étude de faisabilité d'un accélérateur linéaire spécifique pour la radiochirurgie intracrânienne en conditions stéréotaxiques produisant un mini faisceau de photons de 6 MV
Analyse des contraintes en milieu clinique (taille de champs, dosimétrie, localisation spatiale des tumeurs, prescriptions thérapeutiques), recherche documentaire et analyse des techniques existantes et en cours de développement, analyse des droits juridiques, élaboration d'un brevet (en collaboration avec un cabinet externe). Analyse des contraintes : concurrence, normes
Identification des coûts et de besoins de financement.

- 1997 – 1999

…>> CDS S.A. :
Etude de faisabilité d'un appareil d'imagerie portale pour la vérification du positionnement des patients avant traitement radio thérapeutique.

Définition des concepts réalisables à l'aide de Simulation (GEANT 3 et EGS) des interactions particules matière pour une étude du rapport signal/bruit et optimisation des caractéristiques du capteur pour la radiothérapie de petits champs (10x10).
Evaluation de sa commercialisation.

Développement et suivi des systèmes d'outils de veille technologique par ordinateur (VAO) en collaboration avec l'ARIST- Rhônes – Alpes (Agence régionale d'information scientifique et technique), création de bases de liens, édition de bulletin d'information scientifique interne, analyse de l'état de l'art

- 1995 – 1996

… >> BIOSPACE Instruments S.A.:

Développement d'un détecteur gazeux a faces parallèles (PPAC) des particules beta plus et électrons de faible énergie avec deux étages d'amplification et à lecture optique. Adaptation du détecteur pour l'autoradiographie numérique à deux dimensions, issus de la désintégration des traceurs radio -isotopiques (3H, 35S, 33P, ...) :

- R & D :
  Développement des programmes d'imagerie bidimensionnelle pour une exploitation interactive des données.
  Etude des sources de bruit de fond des images obtenues et développement des algorithmes d''extraction du signal et d'amélioration du contraste.
- fabrication du prototype :
- lancement de son industrialisation
  Réalisation du dossier de fabrication, mise en place du réseau des sous traitants, coordination de la production,
- Suivi et assistance technique
  Contact direct avec les clients en vue de l'optimisation de l'instrument

- 1987 – 1993

… >> CERN

<u>Développements en Physique Instrumentale</u>:

Groupe de G. Charpak et de F. Sauli :

Etude et développement des détecteurs gazeux pour la localisation des rayonnements ionisants. Développement et mise au point des chambres à faces parallèles (PPAC) à lecture optique. Etude du gain, de la stabilité. Etude de la formation des avalanches électroniques et de la quantité de lumière émise. Etude du fonctionnement des capteurs CCD et adaptation aux conditions des PPAC.

Chambres

Conception et essais d'un détecteur RICH à lecture optique pour les collisions d'ions lourds relativistes (expérience NA 44) .

Développement d'un prototype de calorimétrie électromagnétique à base de cristaux BaF2.

Développement d'un détecteur gazeux à amplification pour la lecture des échantillons d'autoradiographie marqués au tritium.

Participation aux groupes R&D du CERN pour le LHC. Concepts des systèmes d'acquisition pour le LHC (groupe n° 13) , étude d'un prototype d'un détecteur de type TRD (Transition Radiation Chamber, groupe n° 5)

- 1984 – 1987

…>> CERN + Commissariat Energie Atomique (F-Saclay)

Analyse des données :

Expérience UA1 : Etudes des événements proton - antiproton produits au collisionneur SppS, mesure de la contribution de la production des neutrinos tau, comparaison avec les prédictions théoriques et recherche des nouveaux phénomènes (énergie manquante). Développement des programmes d'extraction des événements du bruits de fond et analyse des données en comparaison avec les prédictions théoriques. Développement des programmes de simulation et analyse des données. Etude des théories supersymmetriques et recherche de nouvelles particules.

Participation dans le sous-groupe de Express-Line de UA1 pour l'analyse rapide et quasi en ligne des événements produits lors des collisions proton-antiproton..

DIPLOMES :

1999 : Certificat Complémentaire en Histoire et Philosophie des sciences
Université de Genève

1987 : Diplôme de Doctorat en Sciences Physiques
Spécialité : Physique expérimentale section Hautes Energies
Sujet : "Etude des événements ayant une grande énergie transverse manquante dans l'expérience UA1. Quelques interprétations possibles et leurs perspectives."
EX – CEA N 2565, 1988, Mention "Très honorable"
Commissariat à l'Energie Atomique / DphPE / F -91 400 Saclay

1984 : DEA Physique Nucléaire - Université Paris XI

1983 : Maîtrise de physique – Université de Paris XI

1982 : Licence de Physique – Université Paris X1

1979 : Baccalauréat scientifique Lycée Franco-Hellénique, Grèce

FORMATIONS :

1989 : L'innovation technologique - CERN - Genève

1988 : Programmation C/C+ , applications pour les systèmes d'acquisition des données et de sélection en ligne des événements cibles.

1987 : Introduction aux méthodes numériques (applications mathématiques dans la modélisation des systèmes physiques)

ENSEIGNEMENT :

Encadrement d'étudiants d'été et des doctorants
Travaux dirigés de Physique Nucléaire, Université Paris XI

PUBLICATIONS Scientifiques

41 articles scientifiques
3 brevets en contribution directe.
Domaine : Instrumentation Scientifique – biomédicale