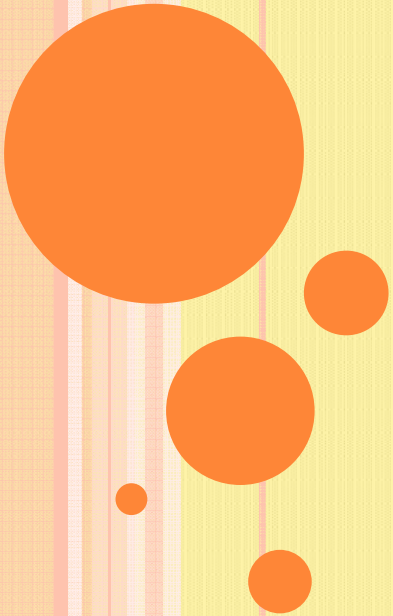
High Energy Physics in Belgium

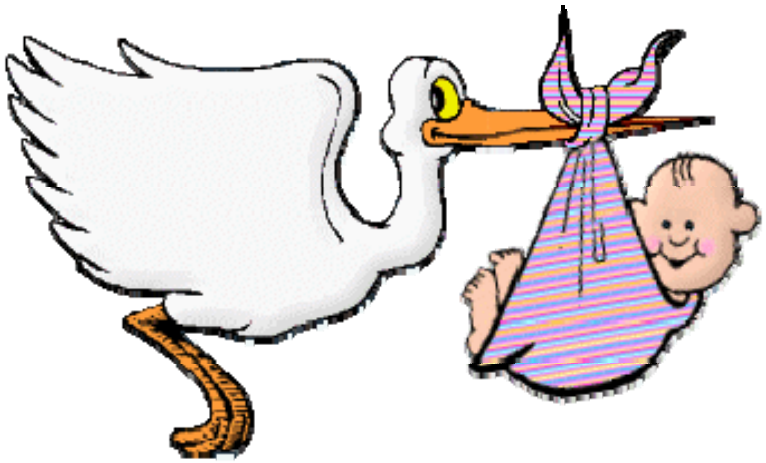
A historical overview in honour of Eddi

Catherine De Clercq
I.I.H.E. (ULB-VUB)



Where to start?

A STAR IS BORN



1911 Cosmic Rays

1945

1954 CERN

1961 BILHE

2010

1957 Collins report

- Many dispersed initiatives in nuclear and particle physics → structuring is needed
- Rather low visibility of Belgium on international scene
- IIKW-IISN asks George Collins (Brookhaven National Laboratory) for an analysis
- Proposal :
  - creation of an interuniversity laboratory for High Energy Physics → **BILHE** in **1961**
  - Training of young researchers abroad (Saclay, CERN, Berkeley)

The early years

The landscape before 1960

IIKW - IISN

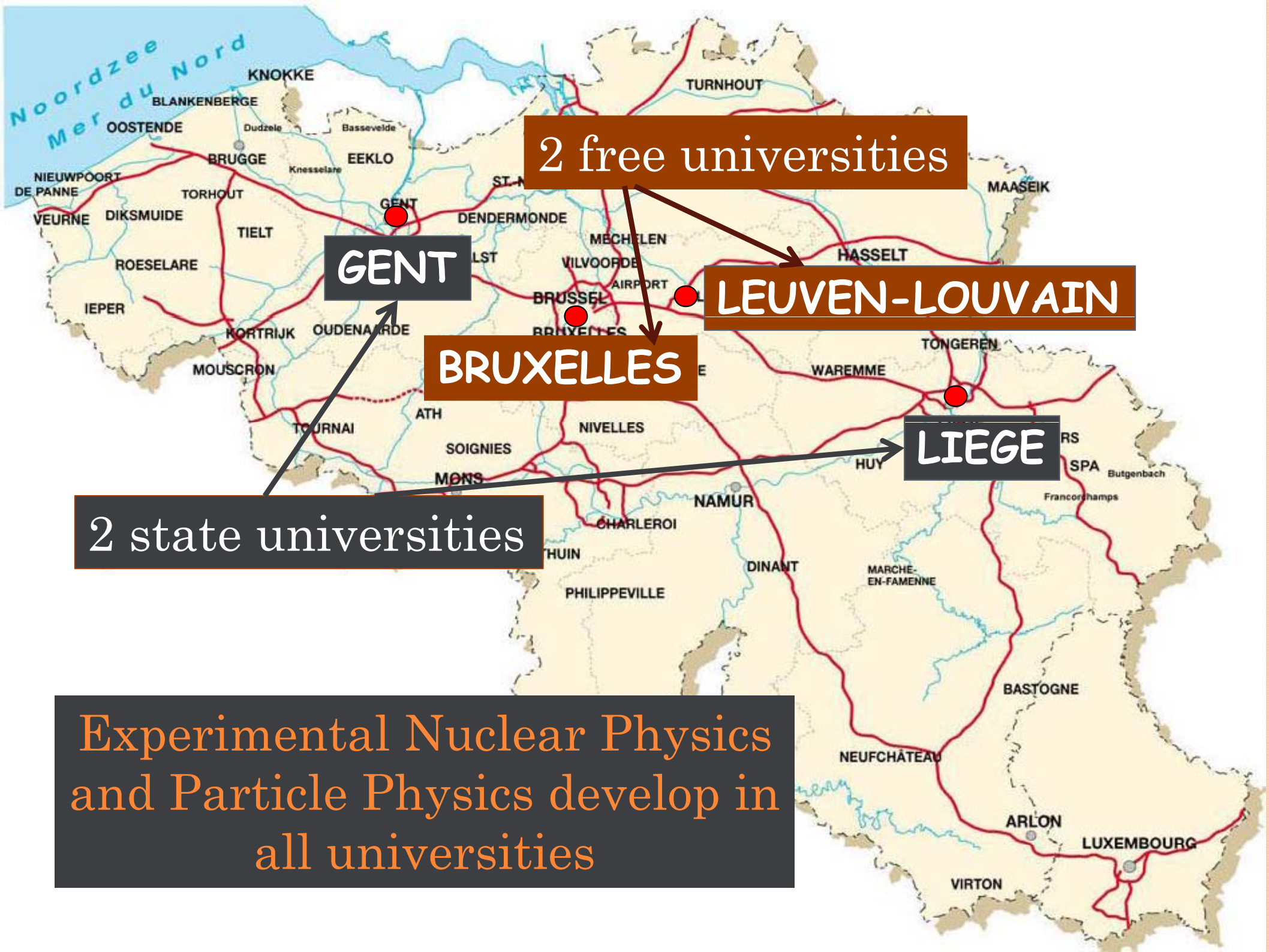
- 1928 NFWO-FNRS National Fund for Scientific Research - first director Jean Willems
- 1947 IINP Interuniversity Institute for Nuclear Physics
- 1952 IIKW-IISN replaces IINP

➢ *encourage, promote and coordinate fundamental research in nuclear sciences, with exclusion of applications*

➢ Closely associated to NFWO-FNRS - in same building @Egmonstraat, Brussels

➢ Funds researchers and technicians working in universities

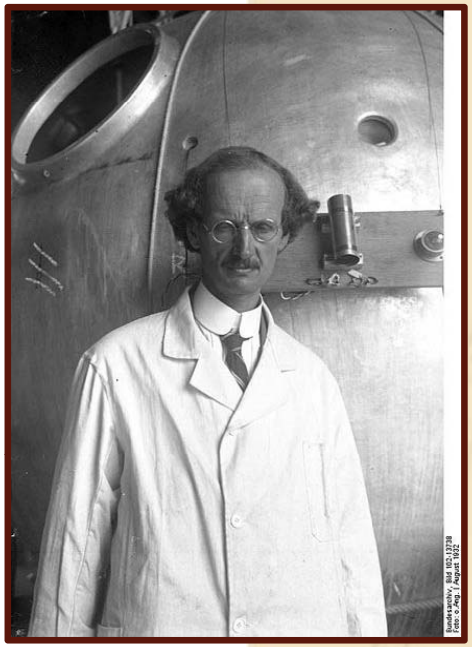
@Archief Univ. Stichting

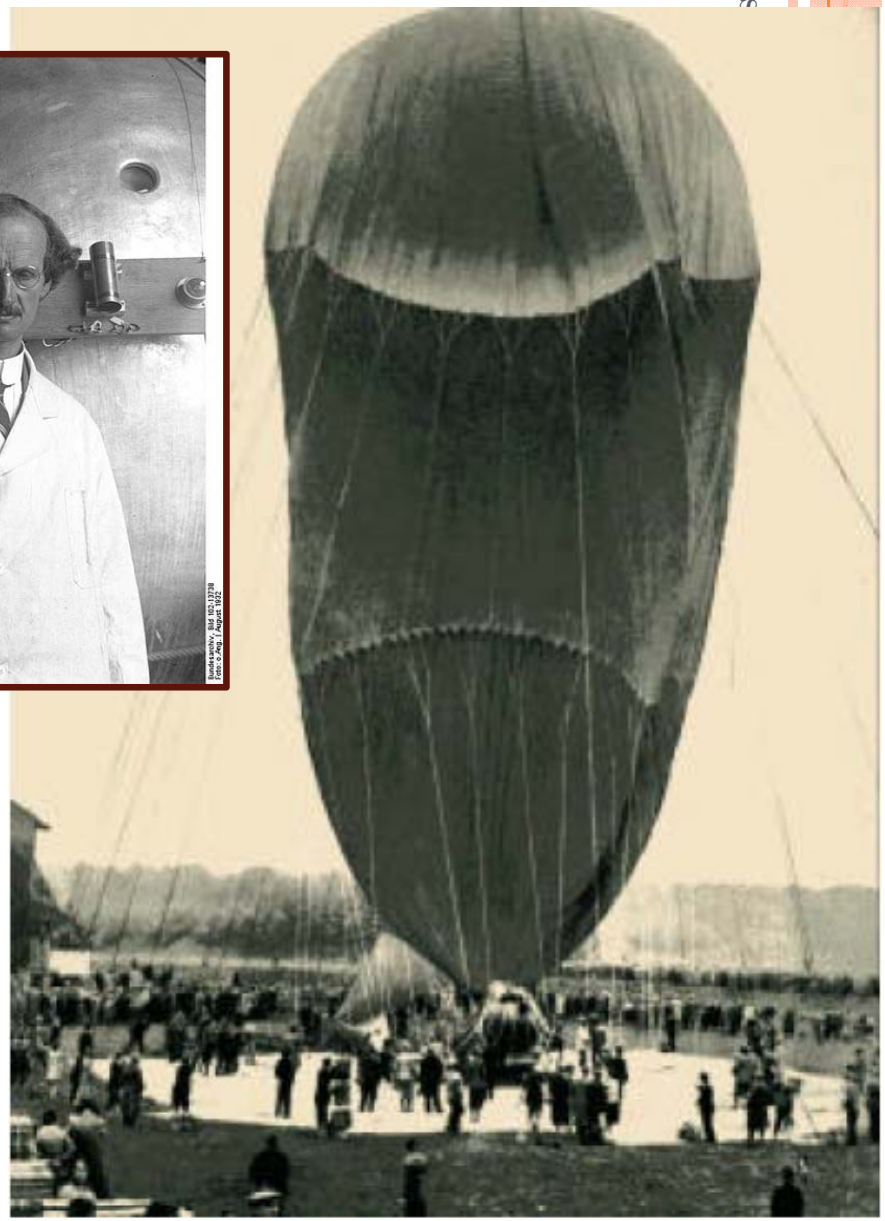


Experimental Nuclear Physics and Particle Physics develop in all universities

Cosmic rays in Brussels

- 1911 Hess discovers Cosmic Rays
- 1922 Polytechnics Faculty of ULB hires ***Auguste Piccard***, specialist in precision measurements and radioactivity
- Together with Paul Kipfer they form the *Institut des Mesures*
- They perform several manned balloon flights to study cosmic rays

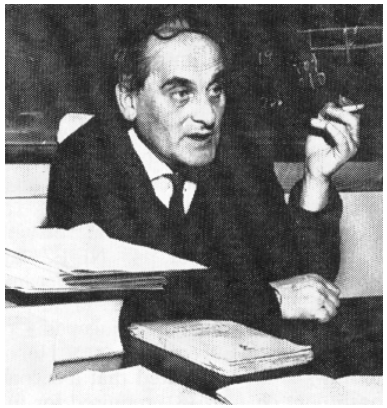


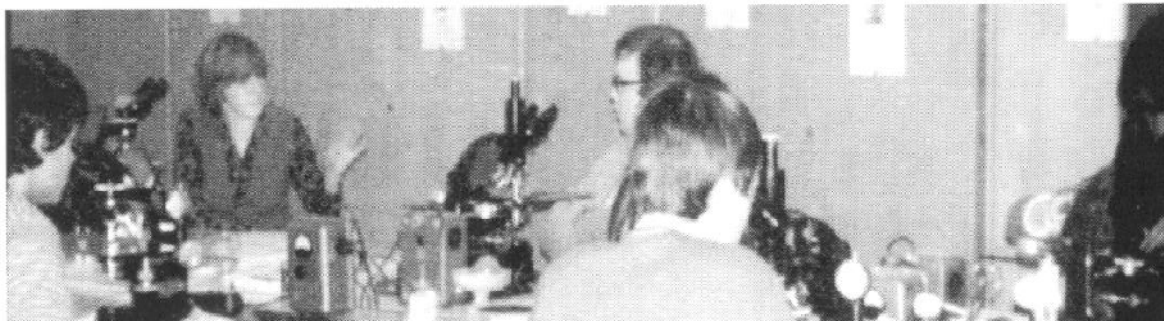


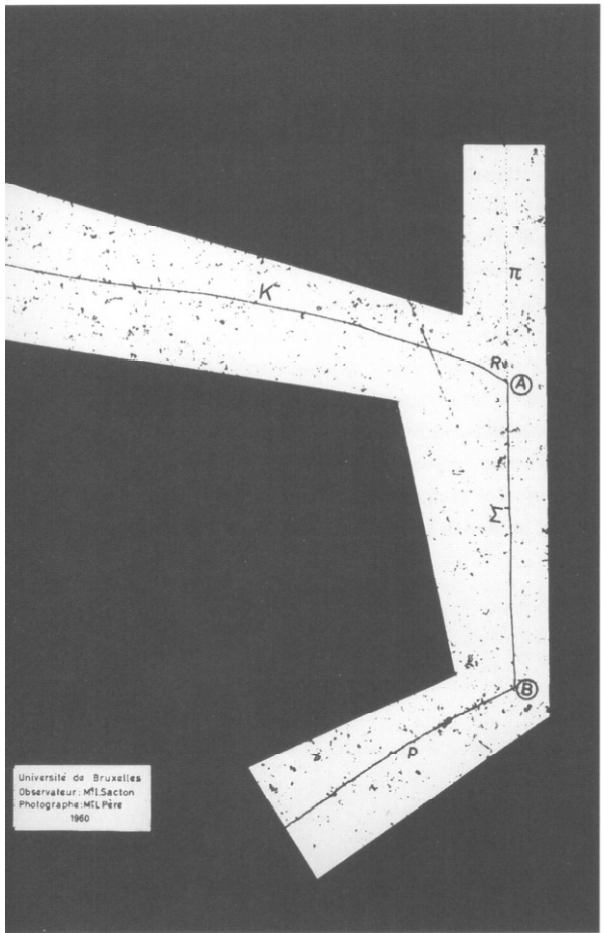
Le ballon FNRS d'Auguste Piccard, le 17 août 1931. (Collection Piccard).

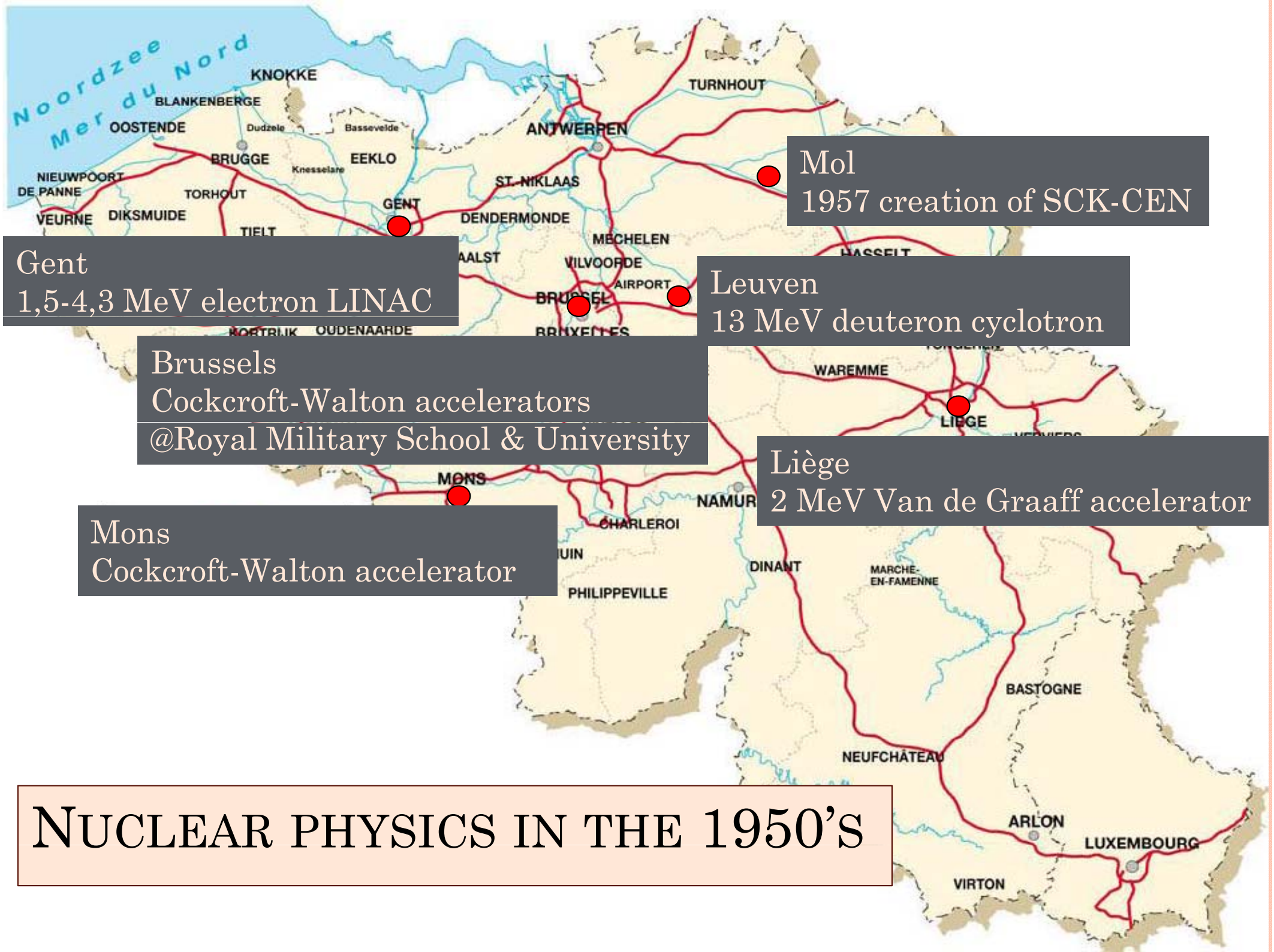
Nuclear emulsions

- 1947 creation of Centre for Nuclear Physics
- 1948 ULB hires Giuseppe « Beppo » Occhialini, specialist in the nuclear emulsion technique and co-discoverer of pion





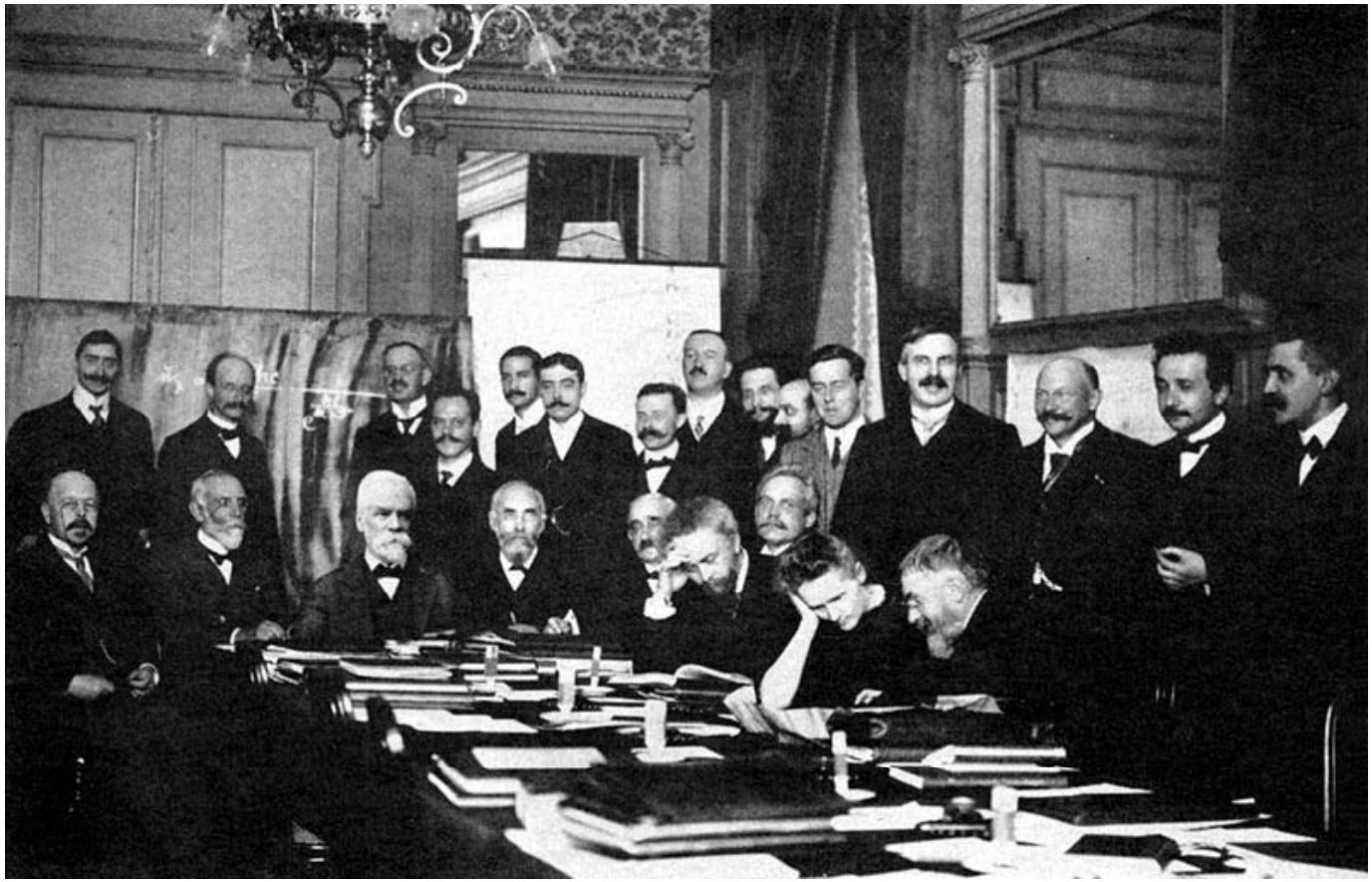




NUCLEAR PHYSICS IN THE 1950'S

The Solvay conferences

- 1911 at the initiative of Ernest Solvay a meeting of eminent physicists is called in Hotel Metropole @ Brussels



THEORY

- Georges Lemaître (KUL-UCL) : Big Bang theory of the evolution of the Universe, Cosmic Rays, …
- Léon Rosenfeld : professor @ Liège 1930-41, fundations of quantum mechanics, close to Bohr – founder of review *Nuclear Physics*
- Théophile De Donder & Jules Géhéniau (ULB), field theory, QED, general relativity
- Jules-Emile Verschaffelt (Gent) assisted to Solvay Congresses

Belgium and CERN

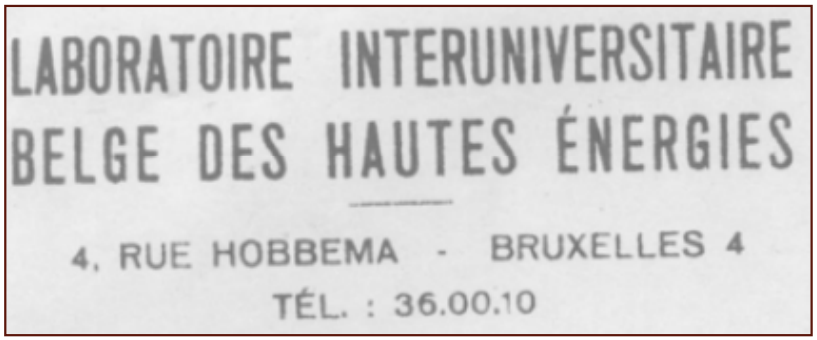
- 1954 12 European countries sign the agreement for the creation of the Centre Européen pour la Recherche Nucléaire in Geneva
- Belgium is one of the founding states

High Energy Physics in the 1960's

Two sites: The national Laboratory BILHE and the University of Brussels

+ a Belgian group based at CERN (Macq, Stroot)

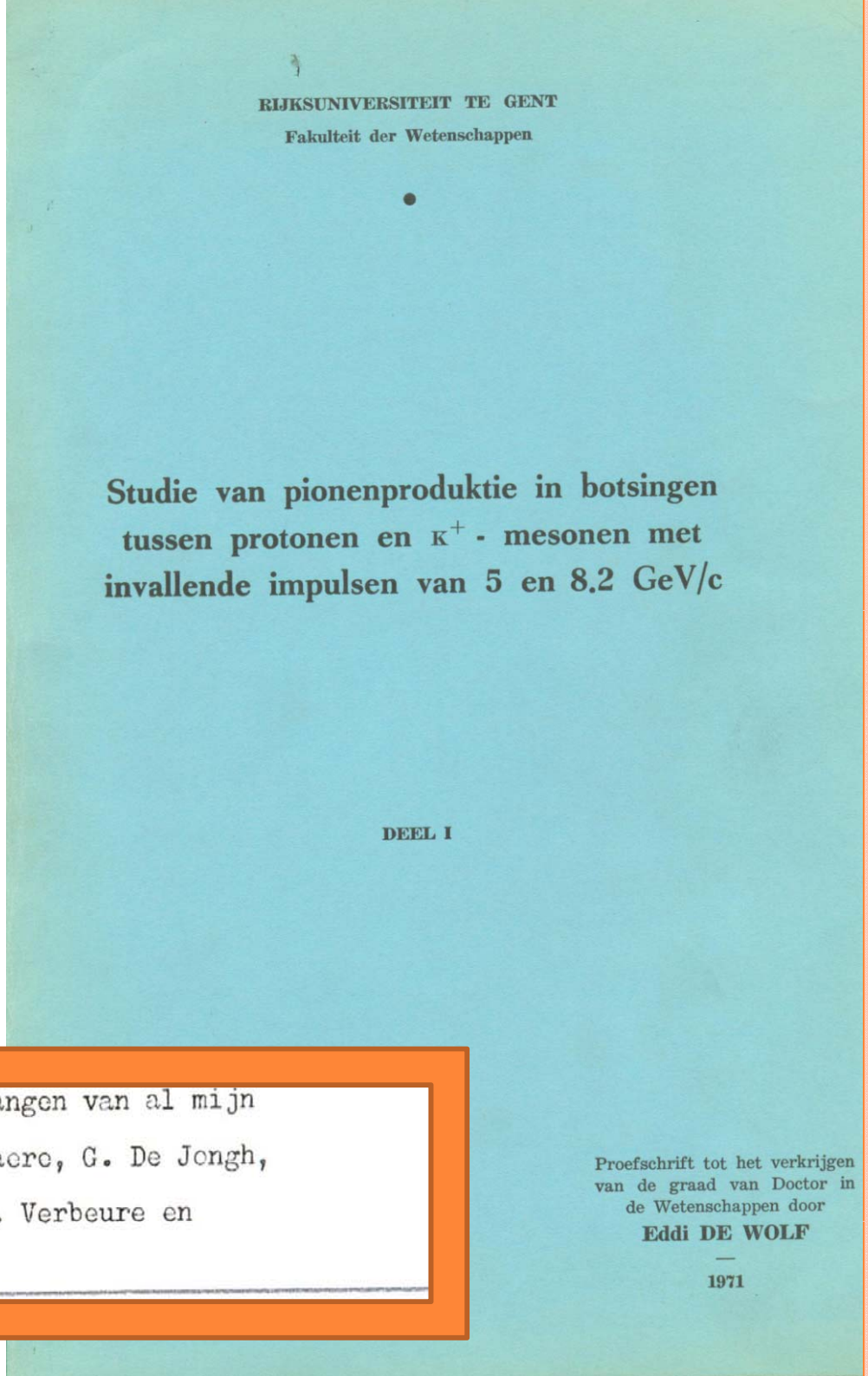
NATIONAL LABORATORY



- 1961 creation of the *Belgian Interuniversity Laboratory for High Energies* **BILHE** proposed in Collins report
- located in Brussels @ Royal Military School
- Funded by IIKW-IISN
- First direction committee : André Berthelot (Saclay), Yves Goldschmidt-Clermont (CERN) and Emile Thomas (Royal Military School)
- 1964 director Fernand Grard (Faculté Polytechnique Mons)
- 1969 three directors : Fernand Grard, Jacques Lemonne (VUB), Jean Sacton (ULB)

Research program at BILHE

- Study of resonances in kaon, proton and deuteron interactions in Bubble Chamber experiments
- Researchers from universities perform their experimental work at the national laboratory



RIJKSUNIVERSITEIT TE GENT
Fakulteit der Wetenschappen

Studie van pionenproduktie in botsingen tussen protonen en K^+ - mesonen met invallende impulsen van 5 en 8.2 GeV/c

DEEL I

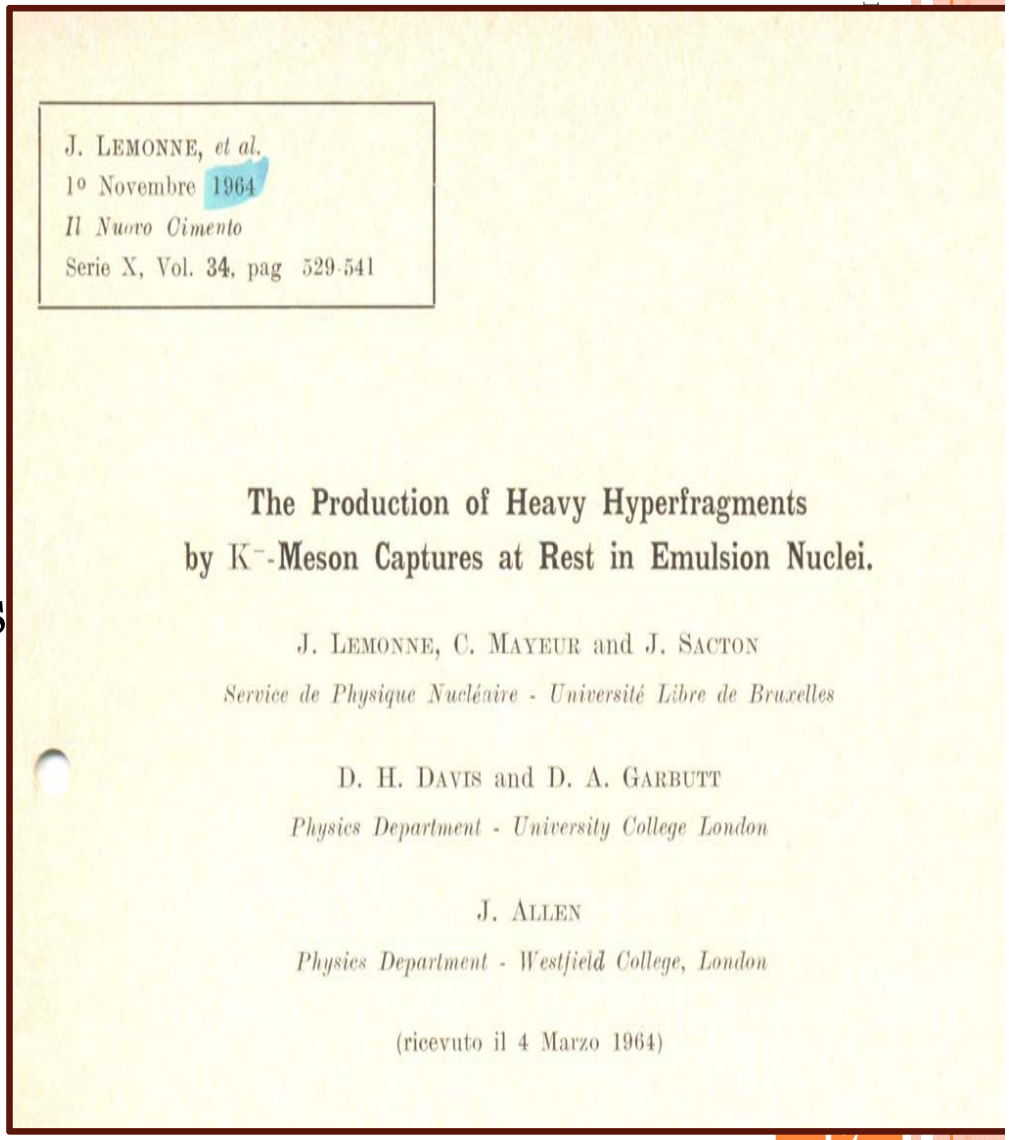
Proefschrift tot het verkrijgen van de graad van Doctor in de Wetenschappen door
Eddi DE WOLF

1971

Hulp, interesse en sympathie mocht ik ontvangen van al mijn medewerkers, in het bijzonder van de Heren W. De Baere, G. De Jongh, P. Dufour, P. Herquet, P. Peeters, S. Tavernier, F. Verbeure en R. Windmolders.

Particle physics at University of Brussels

- 1960 Jean Sacton continues and leads particle physics research in ULB
- Study of K, Λ, Σ particles and hypernuclei produced in kaon interactions with nuclear emulsion and bubble chambers
- End 1960's they join the neutrino program in the heavy liquid bubble chamber Gargamelle @ CERN PS



J. Lemonne, *et al.*
1° Novembre 1964
Il Nuovo Cimento
Serie X, Vol. 34, pag 529-541

The Production of Heavy Hyperfragments by K^--Meson Captures at Rest in Emulsion Nuclei.

J. Lemonne, C. Mayeur and J. Sacton
Service de Physique Nucléaire - Université Libre de Bruxelles

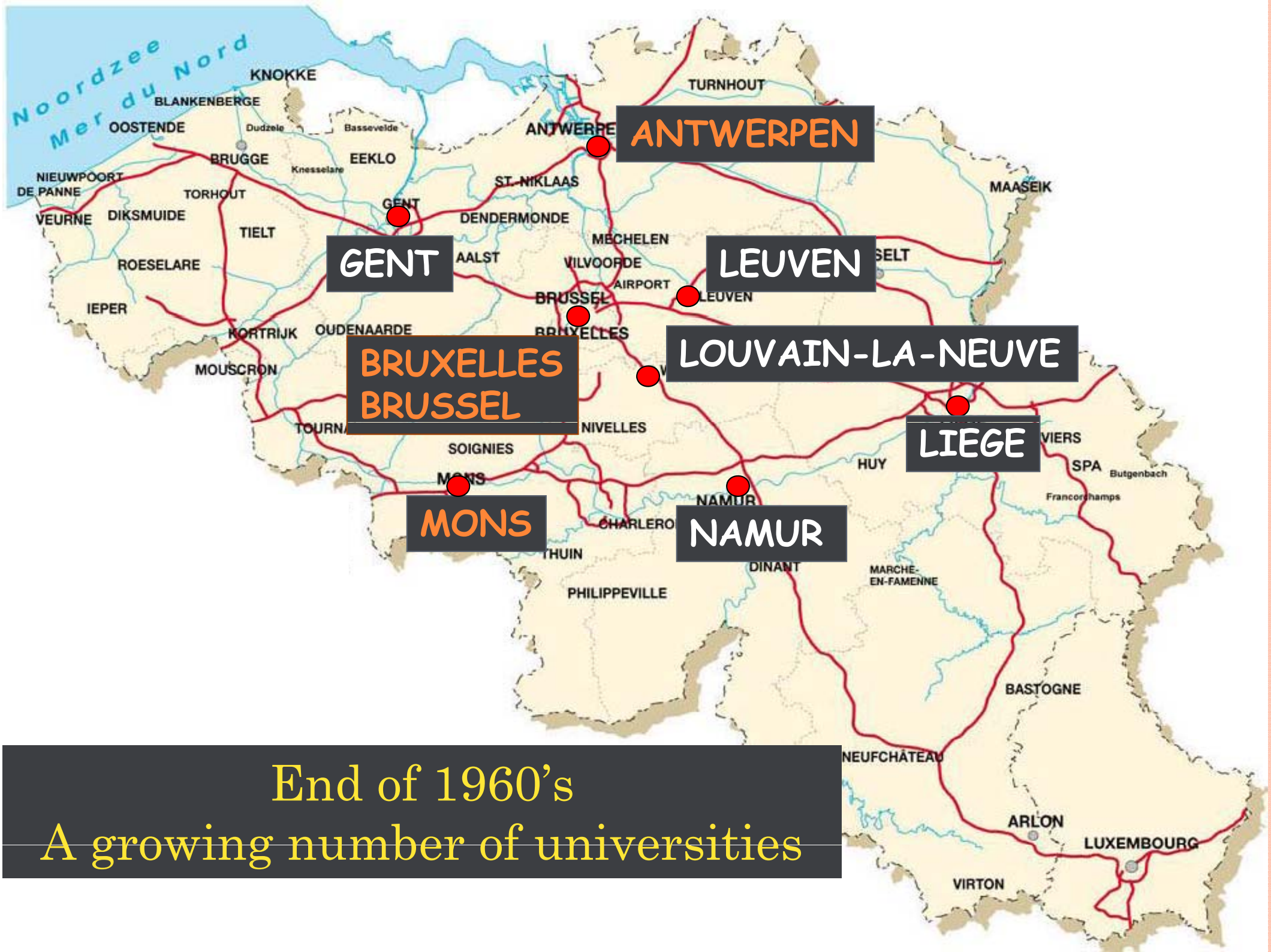
D. H. Davis and D. A. Garbutt
Physics Department - University College London

J. Allen
Physics Department - Westfield College, London

(ricevuto il 4 Marzo 1964)

The 1970s

Regrouping in the I.I.H.E.(ULB-VUB) and Mons



End of 1960's
A growing number of universities

Creation of the I.I.H.E.(ULB-VUB)

- New Vrije Universiteit Brussel in 1970 with *Dienst Fysica der Elementaire Deeltjes*, head Jacques Lemonne
- *Service de Physique des Particules Elémentaires*, head Jean Sacton
- 1972 ULB and VUB sign agreement for creation of *Interuniversity Institute for High Energies*
- Equipment and technical staff can be made accessible to all Belgian experimental particle physicists
- 1976 BILHE is closed , IIHE is transferred to new VUB campus in Etterbeek

MINUTES OF THE MEETING OF THE SCIENTIFIC COMMITTEE OF THE INSTITUTE FOR HIGH ENERGIES (ULB - VUB) HELD ON DECEMBER 18, 1972.

Those present were : M. DEMEUR (ULB), F. GRARD (Mons), J. LEMONNE (VUB), P. MACQ (UCL), D. PERKINS (Oxford), J. REIGNIER (VUB), J. SACTON (ULB). J. HOSTE (Gent) could not attend the meeting.

It was mentioned that F. VERBEURE, recently nominated as a Professor at the Universitaire Instelling Antwerpen, has expressed his interest in having access to the Brussels facilities. He is presently working with the Brussels group. An ENEDEP scanning table will be located in Antwerp for didactic purposes.

UIA associated to IIHE

EXPERIMENTAL PROGRAM

- Four Belgian players: UIA, IIHE(ULB-VUB), UMons
- Involved in several bubble chamber experiments studying hadron and neutrino interactions

Z. Physik C, Particles and Fields 2, 285–290 (1979)

Zeitschrift für Physik C Particles and Fields
by Springer-Verlag 1979

BEBC bubble chamber @ CERN

Cross Sections and Multiplicity Distributions for $K^+ p$ Interactions at 70 GeV/c

M. Barth, C. De Clercq, E. De Wolf[1], J. J. Dumont, M. Gijsen, D. P. Johnson, J. Lemonne, and P. Peeters
Inter-University Institute for High Energies, (ULB-VUB), B-1000 Brussels, Belgium

H. Drevermann, Y. Goldschmidt-Clermont, G. Harigel, J. P. Porte, R. T. Ross, and A. Stergiou
CERN, European Organization for Nuclear Research, CH-1211 Geneva 23, Switzerland

C. Caso, R. Contri, R. Monge, S. Squarcia, and U. Trevisan
Sezione INFN and Istituto di Scienze Fisiche, I-16132 Genova, Italy

J. F. Baland, J. Beaufays, F. Grard, and J. Kesteman
Faculté de Science, Université de l'Etat, B-7000 Mons, Belgium

P. A. van der Poel, W. Kittel, W. J. Metzger, D. J. Schotanus, and R. T. Van de Walle
University of Nijmegen, Nijmegen, Netherlands[2]

Y. A. Belokopitov, P. V. Chliapnikov, A. B. Fenyuk, S. V. Klimenko, V. M. Kubic, S. B. Lugovsky, V. N. Nikolaenko, Y. L. Petrovikh, V. M. Ronjin, A. P. Vorobjev, and V. A. Yarba
Institute for High Energy Physics, Serpukhov, USSR[3]

G. Alexander, S. Dagan, D. Lissauer, and C. Milstene
University of Tel-Aviv, Tel-Aviv, Israel

1 Bevoegdverklaard Navorser, NFWO Belgium; also at the Universitaire Instelling, Antwerpen, Belgium

Post 1980 era

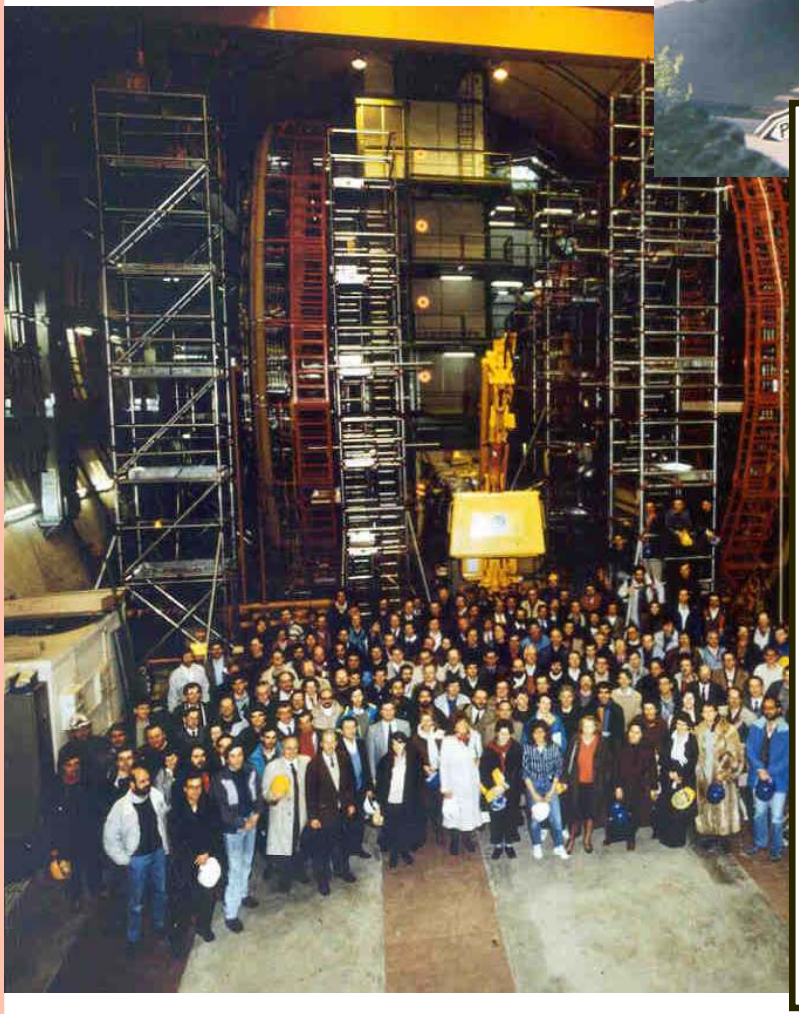
Switching to electronic detectors

A need for larger collaborations

LEP COLLIDER IN CERN

- 1980s Move from bubble chambers to large electronic detectors at particle colliders
- 1982 Belgium decides to join one LEP experiment - DELPHI - as one group
- 1982-1988 R&D and construction of the detector
- construction and maintenance of the Forward Muon Detector by consortium of **UIA, IIHE, UMH**
- 1989-2000 data taking

DELPHI



doi:10.1016/0168-9002(91)91105-5 | How to Cite or Link Using DOI

The forward muon detector of the DELPHI experiment at LEP

J. Buytaert, L. De Boeck and F. Verbeure

C. Bricman, F. Cao, C. De Clercq, L. Etienne, B. Goorens, J. Lemonne, F. Stichelbaut, S. Tavernier, G. Van Beek, C. Vander Velde, W. Van Doninck, L. Van Lancker and J. Wickens

E. Daubie, F. Defontaines, F. Grard, J. Kesteman, O. Pingot and C. Poiret

Physics Department, Universitaire Instelling Antwerpen, Universiteitsplein 1, B-2610, Wilrijk, Belgium

Inter-University Institute for High Energies, ULB-VUB, B-1050, Brussels, Belgium

Université Mons Hainaut, B-7000, Mons, Belgium

Received 22 July 1991. Available online 9 October 2002.

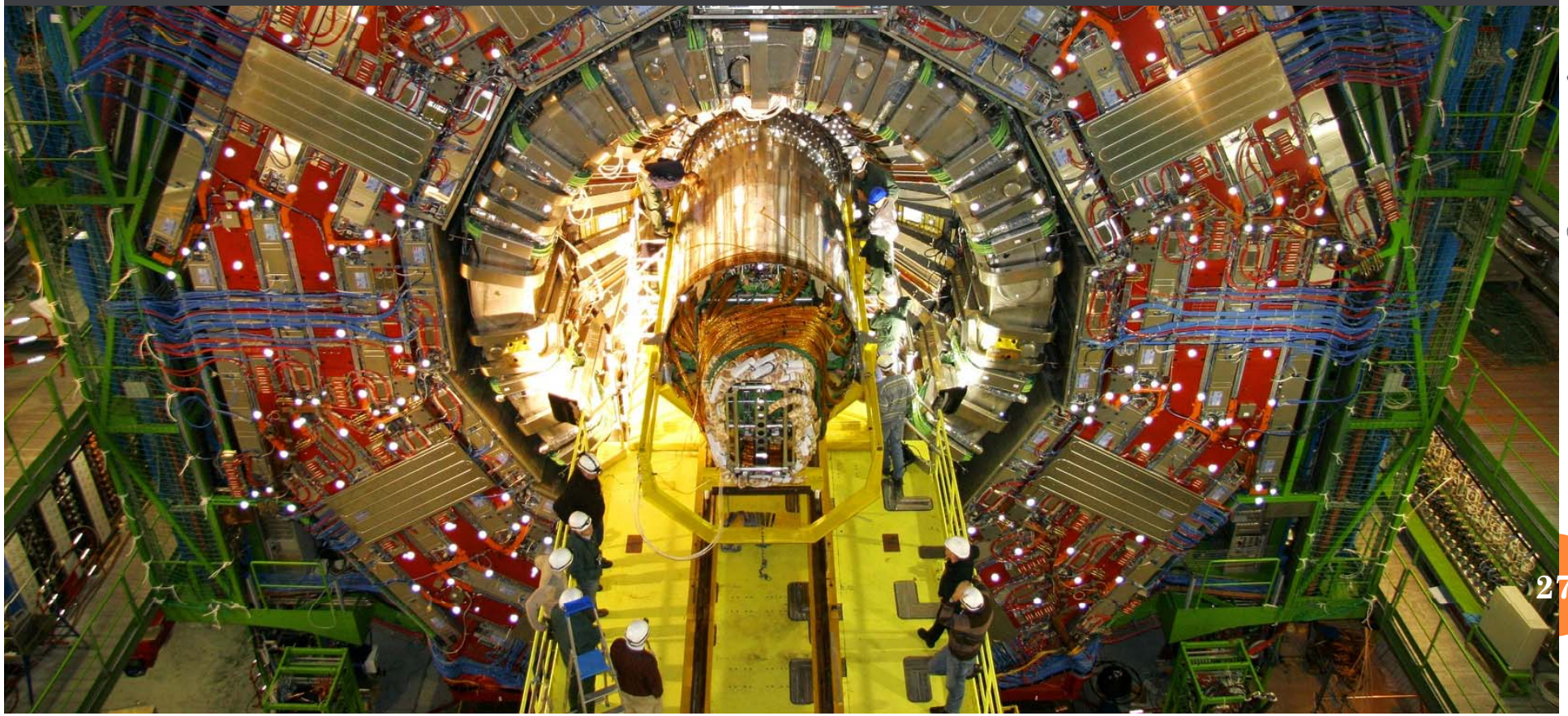
HERA COLLIDER IN DESY HAMBURG

- 1987 **UIA** and **IIHE** join H1 experiment
- Construction & maintenance of
  - **C**entral **O**uter **P**roportional chamber
  - **V**ery **F**orward **P**roton **S**pectrometer

- **UGent** participates to HERMES experiment and builds RICH & Recoil detector

CMS EXPERIMENT AT THE LHC COLLIDER IN CERN

- 1992 Consortium of 5 Universities builds part of the tracking detector : IIHE(ULB-VUB), UA, UCL, UMons
- UA contributes to construction of CASTOR detector
- 2007 UGent contributes to construction of RPC Muon Detector

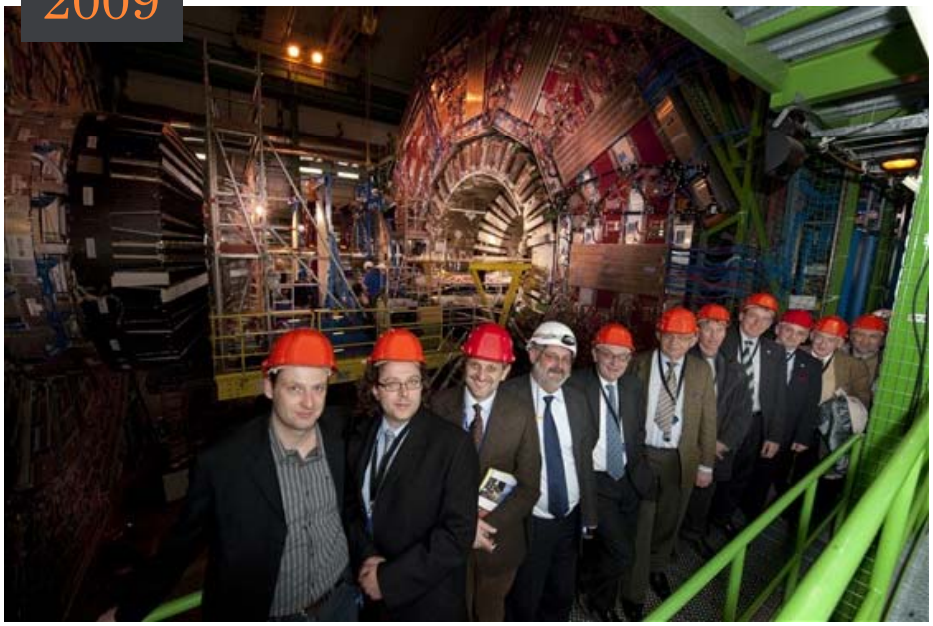


VIP VISITS

Bureau FWO

2010

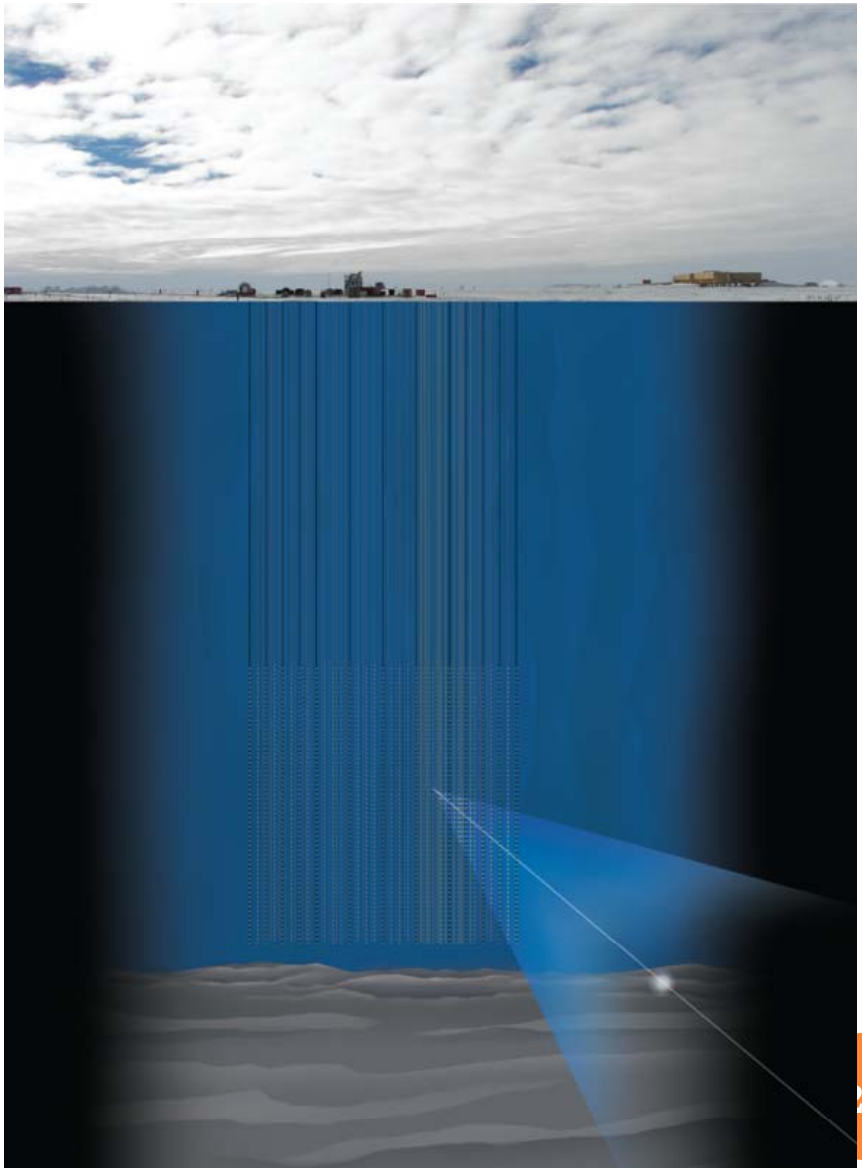
2009



2009

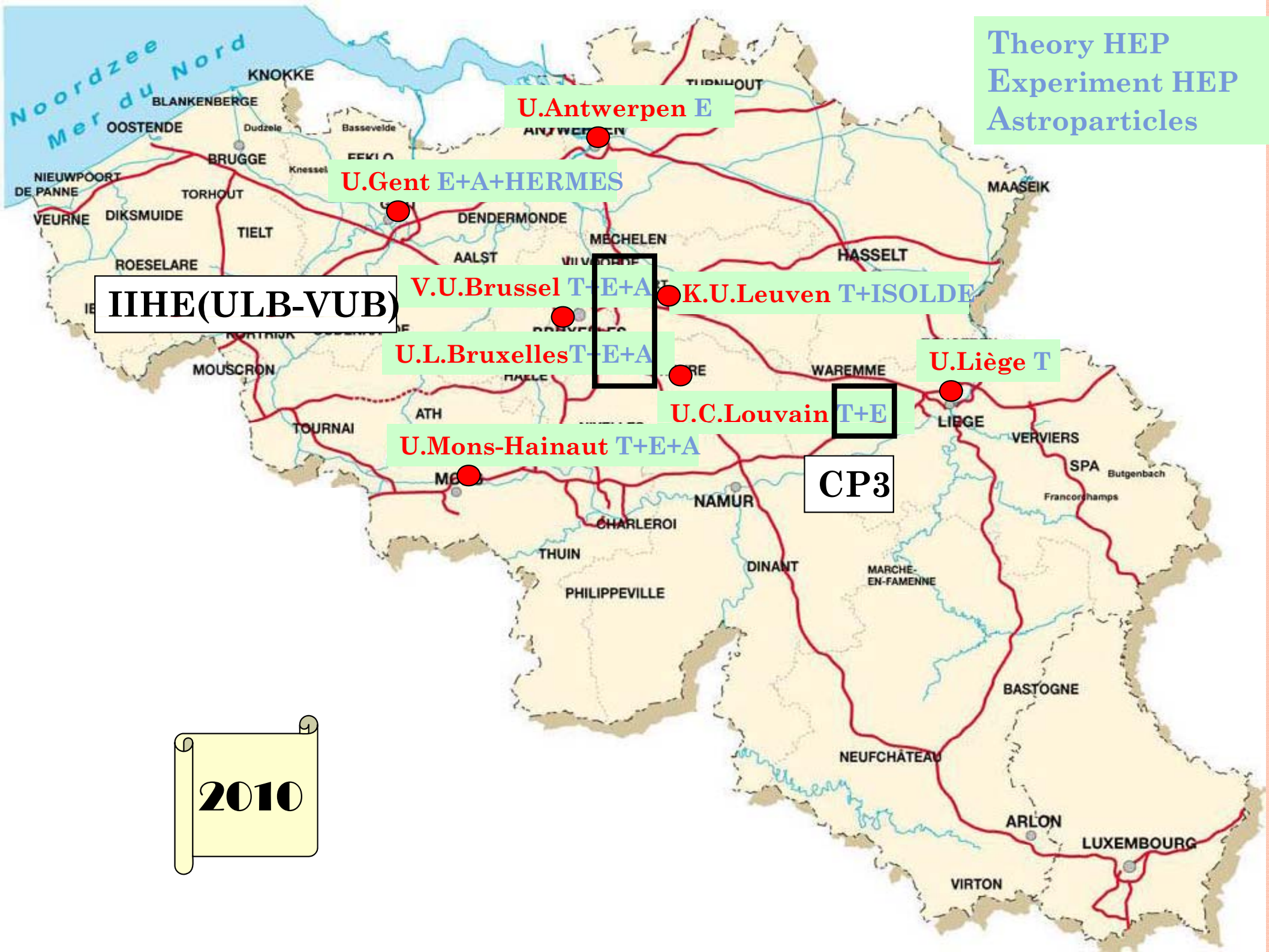
Belgi

Astroparticle physics



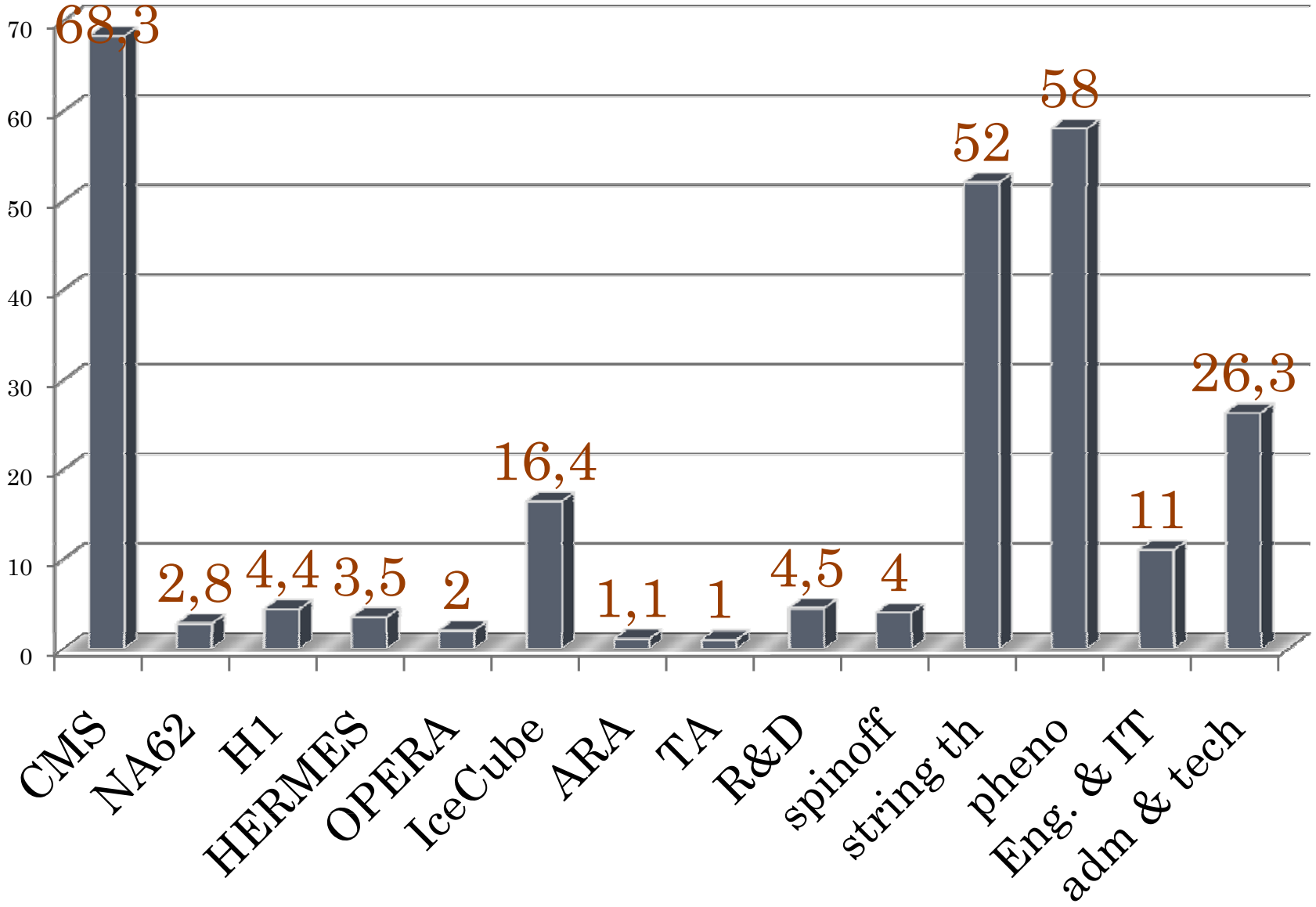
- End of 1990's Belgium joins AMANDA neutrino experiment at South Pole – later IceCube
- IIHE-UGent-UMons collaboration
- Search for high energy neutrinos from outer space

The landscape today


Theory HEP
Experiment HEP
Astroparticles
U.Antwerpen E
U.Gent E+A+HERMES
IIHE(ULB-VUB)
V.U.Brussel T+E+A
K.U.Leuven T+ISOLDE
U.L.Bruxelles T+E+A
U.Liège T
U.C.Louvain T+E
U.Mons-Hainaut T+E+A
CP3
2010
Noordzee
Mer du Nord
KNOKKE
BLANKENBERGE
OOSTENDE
BRUGGE
NIEUWPOORT
DE PANNE
VEURNE
DIKSMUIDE
TORHOUT
TIELT
ROESELARE
MOUSCRON
TOURNAI
ATH
DENDERMONDE
AALST
MECHELEN
HASSELT
MAASEIK
WAREMME
LIEGE
VERVIERS
SPA
Francorchamps
NAMUR
CHARLEROI
THUIN
PHILIPPEVILLE
DINANT
MARCHE-EN-FAMENNE
BASTOGNE
NEUFCHÂTEAU
ARLON
LUXEMBOURG
VIRTON

Manpower in H.E.P.

105 FTE experiment + 108 FTE theory + 37 FTE technical support

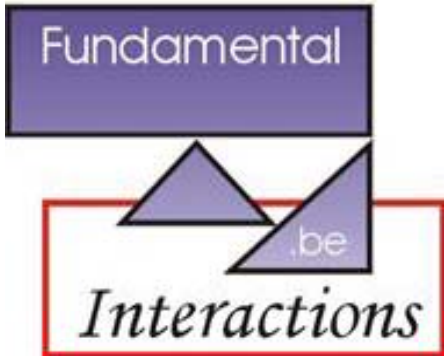


IUAP-PAI

Fundamental Interactions: at the boundary between Theory, Phenomenology and Experiment

- Structural network of all (14) Belgian groups involved in H.E.P.
- Coordinator ULB (J.M. Frère)
- 4 European partners : NIKHEF, Durham, Pisa, Paris Sud

- A collaboration across several borders



To conclude

Looking back at many years of pleasant collaboration

1995

1980's

My first impression

My wishes for an exciting future

QUEEN ELISABETH COMPETITION

violin12

Calendar

15/01/2012 : deadline for sending applications

30/04/2012 > 05/05/2012: first round
07/05/2012 > 12/05/2012: semi-final
21/05/2012 > 26/05/2012: final