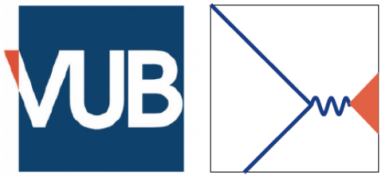


HIGH-ENERGY PHYSICS
RESEARCH CENTRE

High-Energy Physics

April 30th, 2018, Brussels; http://we.vub.ac.be/en/HEPVUB

Coordinator:

Jorgen D'Hondt

Group leaders:

Stijn Buitink	**High-Energy Astrophysics**
Ben Craps	**Theoretical Physics**
Jorgen D'Hondt	**Particle Physics Experiments**
Nick van Eijndhoven	**Astro-Particle Physics**

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Curiosity driven research

Observable universe

Visible with our eyes

~ 1.000.000.000.000.000.000.000.000.000 meter

~ 0.00000000000000000001 meter

Smallest particles

HIGH-ENERGY PHYSICS RESEARCH CENTRE

Curiosity driven research

Standard Model of Cosmology
Gravity

Standard Model of Particle Physics
Quantum Field Theory

~ 1.000.000.000.000.000.000.000.000.000 meter

~ 0.00000000000000000001 meter

IceCube/ARA @ South Pole
LOFAR @ Netherlands
Auger @ Argentina

CMS @ CERN
SoLid @ Belgium

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Curiosity driven research

Standard Model of Cosmology
Gravity

Standard Model of Particle Physics
Quantum Field Theory

~ 1.000.000.000.000.000.000.000.000.000 meter

~ 0.00000000000000000001 meter

IceCube/ARA @ South Pole
LOFAR @ Netherlands
Auger @ Argentina

CMS @ CERN
SoLid @ Belgium

For a profound understanding of Nature, we need to understand the interplay between high-energy phenomena on the largest and the smallest scales

HIGH-ENERGY PHYSICS RESEARCH CENTRE

VUB-scale in Flanders

The VUB represents about 10% in the Flemish academic landscape, hence "covers" about 0.6M inhabitants

Strategic Research choices are to be made in order to excel on the international level

In this context HEP@VUB was established to have a major impact in reaching these scientific objectives

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Research team

May 2017

8 professors
10 part-time professors
3 active emeriti
15 postdocs
24 PhD students

Gender:
19% professors female
23% postdocs female
38% PhD students female

Since 2012:
±850 publications*
±55k citations (h-index 112)
16 PhD thesis
>14 awards for PD/students

** many with 1000+ authors*

1 Odysseus-I
2 Odysseus-II
(more selected but declined)
1 ERC Starting Grant

Leverage through FWO fellowships in Flanders:
37% of postdoc years
20% of PhD student years
i.e. 35-40% of those available in physics
(while VUB is 10% fair share in Flanders)

Over 5 years:
±16.5M Euro external funds
±2.7M Euro PhD/PD mandates
1.3M Euro from SRP

International:
less than 10% of our postdocs obtained PhD at VUB

20% of our PhD students obtained Master at VUB
20% obtained Master at another Belgian university
60% obtained their Master abroad

Many of our postdocs have obtained a permanent academic position

HIGH-ENERGY PHYSICS RESEARCH CENTRE

Research team

May 2017

8 professors
10 part-time professors
3 active emeriti
15 postdocs
24 PhD students

Gender:
19% professors female
23% postdocs female
38% PhD students female

Since 2012:
±850 publications*
±55k citations (h-index 112)
16 PhD thesis
>14 awards for PD/students

** many with 1000+ authors*

1 Odysseus-I
2 Odysseus-II
(more selected but declined)
1 ERC Starting Grant

Leverage through FWO fellowships in Flanders:
37% of postdoc years
20% of PhD student years
i.e. 35-40% of those available in physics
(while VUB is 10% fair share in Flanders)

Over 5 years:
±16.5M Euro external funds
±2.7M Euro PhD/PD mandates
1.3M Euro from SRP

International:
less than 10% of our postdocs obtained PhD at VUB

20% of our PhD students obtained Master at VUB
20% obtained Master at another Belgian university
60% obtained their Master abroad

Many of our postdocs have obtained a permanent academic position

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Research team

May 2017

8 professors
10 part-time professors
3 active emeriti
15 postdocs
24 PhD students

Gender:
19% professors female
23% postdocs female
38% PhD students female

Since 2012:
±850 publications*
±55k citations (h-index 112)
16 PhD thesis
>14 awards for PD/students

** many with 1000+ authors*

1 Odysseus-I
2 Odysseus-II
(more selected but declined)
1 ERC Starting Grant

Leverage through FWO fellowships in Flanders:
37% of postdoc years
20% of PhD student years
i.e. 35-40% of those available in physics
(while VUB is 10% fair share in Flanders)

Over 5 years:
±16.5M Euro external funds
±2.7M Euro PhD/PD mandates
1.3M Euro from SRP

International:
less than 10% of our postdocs obtained PhD at VUB

20% of our PhD students obtained Master at VUB
20% obtained Master at another Belgian university
60% obtained their Master abroad

Many of our postdocs have obtained a permanent academic position

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Research team

May 2017

8 professors
10 part-time professors
3 active emeriti
15 postdocs
24 PhD students

Gender:
19% professors female
23% postdocs female
38% PhD students female

Since 2012:
±850 publications*
±55k citations (h-index 112)
16 PhD thesis
>14 awards for PD/students

** many with 1000+ authors*

1 Odysseus-I
2 Odysseus-II
(more selected but declined)
1 ERC Starting Grant

Leverage through FWO fellowships in Flanders:
37% of postdoc years
20% of PhD student years
i.e. 35-40% of those available in physics
(while VUB is 10% fair share in Flanders)

Over 5 years:
±16.5M Euro external funds
±2.7M Euro PhD/PD mandates
1.3M Euro from SRP

International:
less than 10% of our postdocs obtained PhD at VUB

20% of our PhD students obtained Master at VUB
20% obtained Master at another Belgian university
60% obtained their Master abroad

Many of our postdocs have obtained a permanent academic position

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Research team

May 2017

8 professors
10 part-time professors
3 active emeriti
15 postdocs
24 PhD students

Gender:
19% professors female
23% postdocs female
38% PhD students female

Since 2012:
±850 publications*
±55k citations (h-index 112)
16 PhD thesis
>14 awards for PD/students

** many with 1000+ authors*

1 Odysseus-I
2 Odysseus-II
(more selected but declined)
1 ERC Starting Grant

Leverage through FWO fellowships in Flanders:
37% of postdoc years
20% of PhD student years
i.e. 35-40% of those available in physics
(while VUB is 10% fair share in Flanders)

Over 5 years:
±16.5M Euro external funds
±2.7M Euro PhD/PD mandates
1.3M Euro from SRP

International:
less than 10% of our postdocs obtained PhD at VUB

20% of our PhD students obtained Master at VUB
20% obtained Master at another Belgian university
60% obtained their Master abroad

Many of our postdocs have obtained a permanent academic position

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Research team

May 2017

8 professors
10 part-time professors
3 active emeriti
15 postdocs
24 PhD students

Gender:
19% professors female
23% postdocs female
38% PhD students female

Since 2012:
±850 publications*
±55k citations (h-index 112)
16 PhD thesis
>14 awards for PD/students

** many with 1000+ authors*

1 Odysseus-I
2 Odysseus-II
(more selected but declined)
1 ERC Starting Grant

Leverage through FWO fellowships in Flanders:
37% of postdoc years
20% of PhD student years
i.e. 35-40% of those available in physics
(while VUB is 10% fair share in Flanders)

Over 5 years:
±16.5M Euro external funds
±2.7M Euro PhD/PD mandates
1.3M Euro from SRP

International:
less than 10% of our postdocs obtained PhD at VUB

20% of our PhD students obtained Master at VUB
20% obtained Master at another Belgian university
60% obtained their Master abroad

Many of our postdocs have obtained a permanent academic position

HIGH-ENERGY PHYSICS
RESEARCH CENTRE

Research team

May 2017

8 professors
10 part-time professors
3 active emeriti
15 postdocs
24 PhD students

Gender:
19% professors female
23% postdocs female
38% PhD students female

Since 2012:
±850 publications*
±55k citations (h-index 112)
16 PhD thesis
>14 awards for PD/students

** many with 1000+ authors*

1 Odysseus-I
2 Odysseus-II
(more selected but declined)
1 ERC Starting Grant

Leverage through FWO fellowships in Flanders:
37% of postdoc years
20% of PhD student years
i.e. 35-40% of those available in physics
(while VUB is 10% fair share in Flanders)

Over 5 years:
±16.5M Euro external funds
±2.7M Euro PhD/PD mandates
1.3M Euro from SRP

International:
less than 10% of our postdocs obtained PhD at VUB

20% of our PhD students obtained Master at VUB
20% obtained Master at another Belgian university
60% obtained their Master abroad

Many of our postdocs have obtained a permanent academic position

HIGH-ENERGY PHYSICS RESEARCH CENTRE

Research team

May 2017

8 professors
10 part-time professors
3 active emeriti
15 postdocs
24 PhD students

Gender:
19% professors female
23% postdocs female
38% PhD students female

Since 2012:
±850 publications*
±55k citations (h-index 112)
16 PhD thesis
>14 awards for PD/students

** many with 1000+ authors*

1 Odysseus-I
2 Odysseus-II
(more selected but declined)
1 ERC Starting Grant

Leverage through FWO fellowships in Flanders:
37% of postdoc years
20% of PhD student years
i.e. 35-40% of those available in physics
(while VUB is 10% fair share in Flanders)

Over 5 years:
±16.5M Euro external funds
±2.7M Euro PhD/PD mandates
1.3M Euro from SRP

International:
less than 10% of our postdocs obtained PhD at VUB

20% of our PhD students obtained Master at VUB
20% obtained Master at another Belgian university
60% obtained their Master abroad

Many of our postdocs have obtained a permanent academic position

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Organisation

Theoretical physics

Prof. B. Craps
Prof. A. Sevrin

Part-time:
Prof. V. Balasubramanian
Prof. C. Blair
Prof. O. Evnin
Prof. L. Lopez Honorez
Prof. D. Thompson

Particle physics experiments

Prof. F. Blekman (Odysseus 2)
Prof. J. D'Hondt
Prof. S. Lowette (Odysseus 2)

Part-time:
Prof. P. Van Mulders

Active emeriti:
Prof. S. Tavernier
Prof. W. Van Doninck

Astro-particle physics

Prof. N. van Eijndhoven (Odysseus 1)

Part-time:
Prof. O. Scholten

Active emeriti:
Prof. C. De Clercq

High-energy astrophysics

Prof. S. Buitink (ERC Starting Grant)

Part-time:
Prof. J. Blommaert
Prof. G. Gentile
Prof. T. Huege

Guest professor:
Prof. D. Vanbeveren

Phenomenology

Prof. A. Mariotti

Part-time:
Prof. K. Mawatari

HEP@VUB Coordinator: Prof. J. D'Hondt

Secretariat: M. Fabre and M. Goeman

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Organisation

Theoretical physics

Prof. B. Craps
Prof. A. Sevrin

Part-time:
Prof. V. Balasubramanian
Prof. C. Blair
Prof. O. Evnin
Prof. L. Lopez Honorez
Prof. D. Thompson

Particle physics experiments

Prof. F. Blekman (Odysseus 2)
Prof. J. D'Hondt
Prof. S. Lowette (Odysseus 2)

Part-time:
Prof. P. Van Mulders

Active emeriti:
Prof. S. Tavernier
Prof. W. Van Doninck

Astro-particle physics

Prof. N. van Eijndhoven (Odysseus 1)

Part-time:
Prof. O. Scholten

Active emeriti:
Prof. C. De Clercq

High-energy astrophysics

Prof. S. Buitink (ERC Starting Grant)

Part-time:
Prof. J. Blommaert
Prof. G. Gentile
Prof. T. Huege

Guest professor:
Prof. D. Vanbeveren

Phenomenology

Prof. A. Mariotti

Part-time:
Prof. K. Mawatari

International Solvay Institutes

HIGH-ENERGY PHYSICS RESEARCH CENTRE

Organisation

Theoretical physics

Prof. B. Craps
Prof. A. Sevrin

Part-time:
Prof. V. Balasubramanian
Prof. C. Blair
Prof. O. Evnin
Prof. L. Lopez Honorez
Prof. D. Thompson

Particle physics experiments

Prof. F. Blekman (Odysseus 2)
Prof. J. D'Hondt
Prof. S. Lowette (Odysseus 2)

Part-time:
Prof. P. Van Mulders

Active emeriti:
Prof. S. Tavernier
Prof. W. Van Doninck

Astro-particle physics

Prof. N. van Eijndhoven (Odysseus 1)

Part-time:
Prof. O. Scholten

Active emeriti:
Prof. C. De Clercq

High-energy astrophysics

Prof. S. Buitink (ERC Starting Grant)

Part-time:
Prof. J. Blommaert
Prof. G. Gentile
Prof. T. Huege

Guest professor:
Prof. D. Vanbeveren

Phenomenology

Prof. A. Mariotti

Part-time:
Prof. K. Mawatari

Inter-university Institute for High Energies (IIHE), VUB+ULB

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Research

Theoretical physics

- string theory
- holography
- cosmology

Particle physics experiments

- high-energy colliders
- neutrino physics

① CMS experiment

② SoLid experiment

Astro-particle physics

- cosmic neutrinos
- dark matter
- multi-messenger observations

③ IceCube observatory

④ ARA observatory

⑤ Auger observatory

High-energy astrophysics

- radio transients
- binary evolution

⑥ LOFAR observatory

⑦ SKA observatory

Phenomenology

- theoretical model building
- relation between small and large scales
- dark matter signatures and simplified models

① International mobility is very large and intrinsic to our field

② Unique range of topics in Belgium, from large to small scales

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Feedback evaluation panel

- **Interview with panel in May 2017, positive conclusion was communicated to us in September 2017 together with an assessment (cfr. next slides).**

- **Before we continue to present our current and planned research overview, we briefly summarize the conclusions from the panel.**

HIGH-ENERGY PHYSICS
RESEARCH CENTRE

Feedback evaluation panel

Programme coordinator and other group leaders

- Young and energetic group leaders, internationally recognized in their respective communities.
- Positive, interesting concept of 10% part-time professor appointments (ZAP, funded by the faculty) for scientists mainly active at other institutions (MIT, Bangkok, Swansea, Groningen, KULeuven), present at the VUB for certain weeks or on fixed weekdays to help reach a broader coverage.

+ very positive statements on the group leaders

HIGH-ENERGY PHYSICS RESEARCH CENTRE

Feedback evaluation panel

Activities and achievements during the 1st term

- The SRP's achievements as well as future goals are extremely impressive.
- The teams have achieved leading roles in their respective areas of expertise, which is not a small feat especially in the large experimental groups such as for example CMS and IceCube.
- The progress made in the development of the teams is very impressive, increasing to a critical mass for further important impact.
- The teams were able to impressively increase the external funding by an order of magnitude compared to the SRP investment.
- The cooperation between experimentalists and theorists has produced important original contributions.
- The formation of the phenomenology group to support the existing experimental activities was an important milestone.
- The scientific output is excellent This applies to theory as well as to the important, very visible contribution to the CMS and IceCube results. These results are published in highly renowned journals and, like the discoveries of the Higgs boson and the highest energy cosmic neutrinos, attracted attention of the general public. Also conference contributions are numerous.

Proposed research programme for the 2nd term

- Excellent, exciting, original and impressive extended proposal, addressing the most pressing questions in the domain of fundamental physics of particles and interactions (origin of dark matter, neutrino oscillations, physics beyond the Standard Model, cosmology, origin of the Universe) using world-leading detectors and observatories (this applies also to the new projects: SoLid, LOFAR).
- The programme is focused between theory and experiment from the largest to the smallest scale of high energy physics (from quark to cosmos). It stresses the interactions between the various teams and the added value of pursuing this programme in parallel and together. The wide range covered is coherently packaged, unique for Belgium, and made the VUB a leader at international level. There is large potential for synergies across the research groups which will allow the groups to make unique contributions. The introduction of the phenomenology group as the link between the various research goals is very promising.
- The well composed and very well thought through proposal makes the right choices in developing ongoing activities and expanding into new projects. The plans for the participation in the CMS upgrade are ambitious but are the right choice to further develop the very visible and leading position in the collaboration. Similarly, the active role in the studies for IceCub-Gen2 is important and timely.
- The SRP budget is used as seed money to hire new researchers and to start with new research topics, and for collaborative events and an international visitors program, important to exploit the full potential of the participating groups. Its impact is clearly situated in the phenomenology area bringing the other blocks together in a unique way. The researchers are very active in applying for international funds. Obtaining external funding for the expanded scientific program in the 2nd term may be more difficult, increasing the importance of SRP funds to guarantee continuity.
- The excellent presentation by the applicants during the panel meeting is exemplary for what is expected.

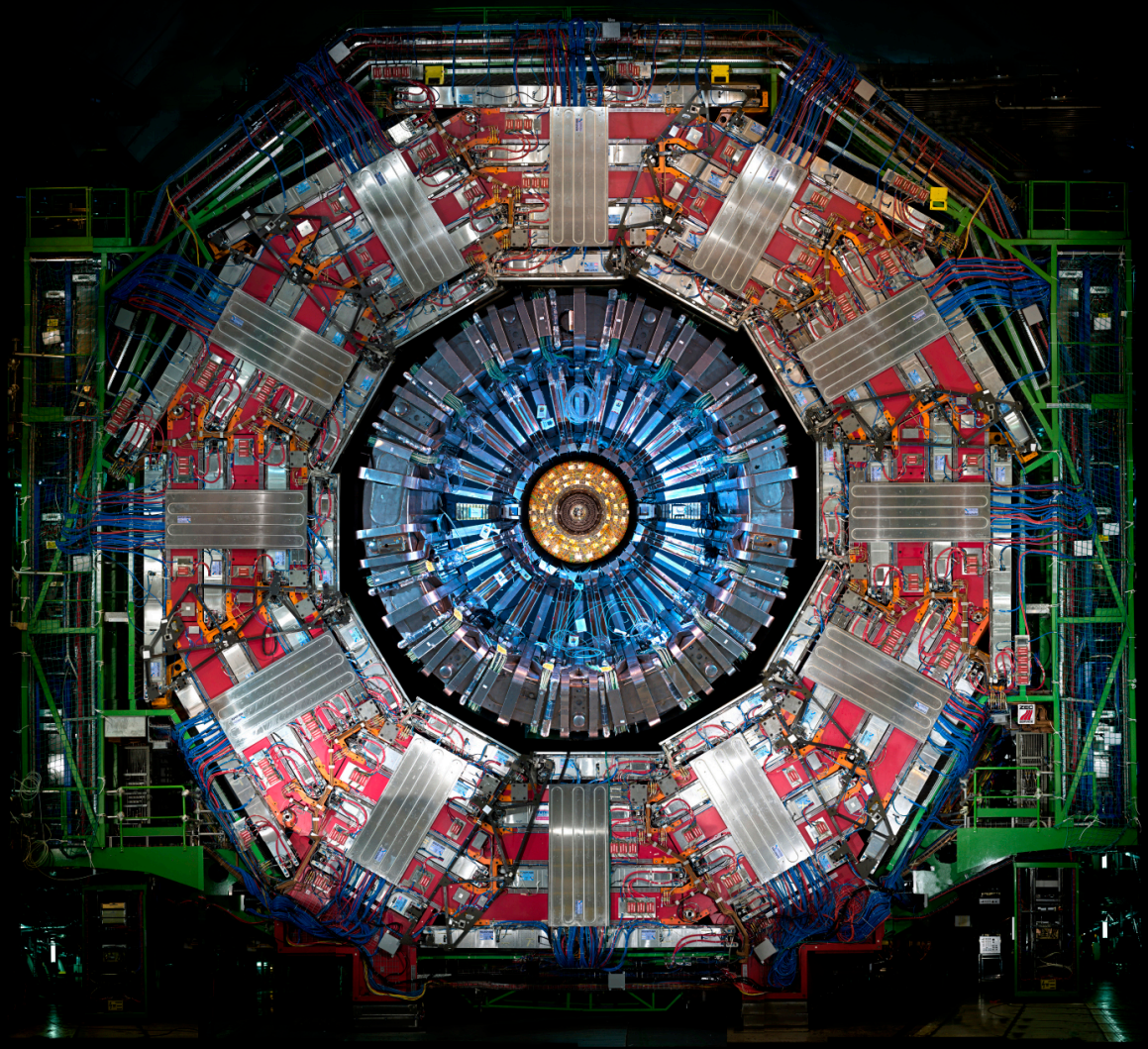
HIGH-ENERGY PHYSICS
RESEARCH CENTRE

Experiments

Some experiments where we are involved in the construction, operation and exploitation.

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

CMS experiment @ CERN



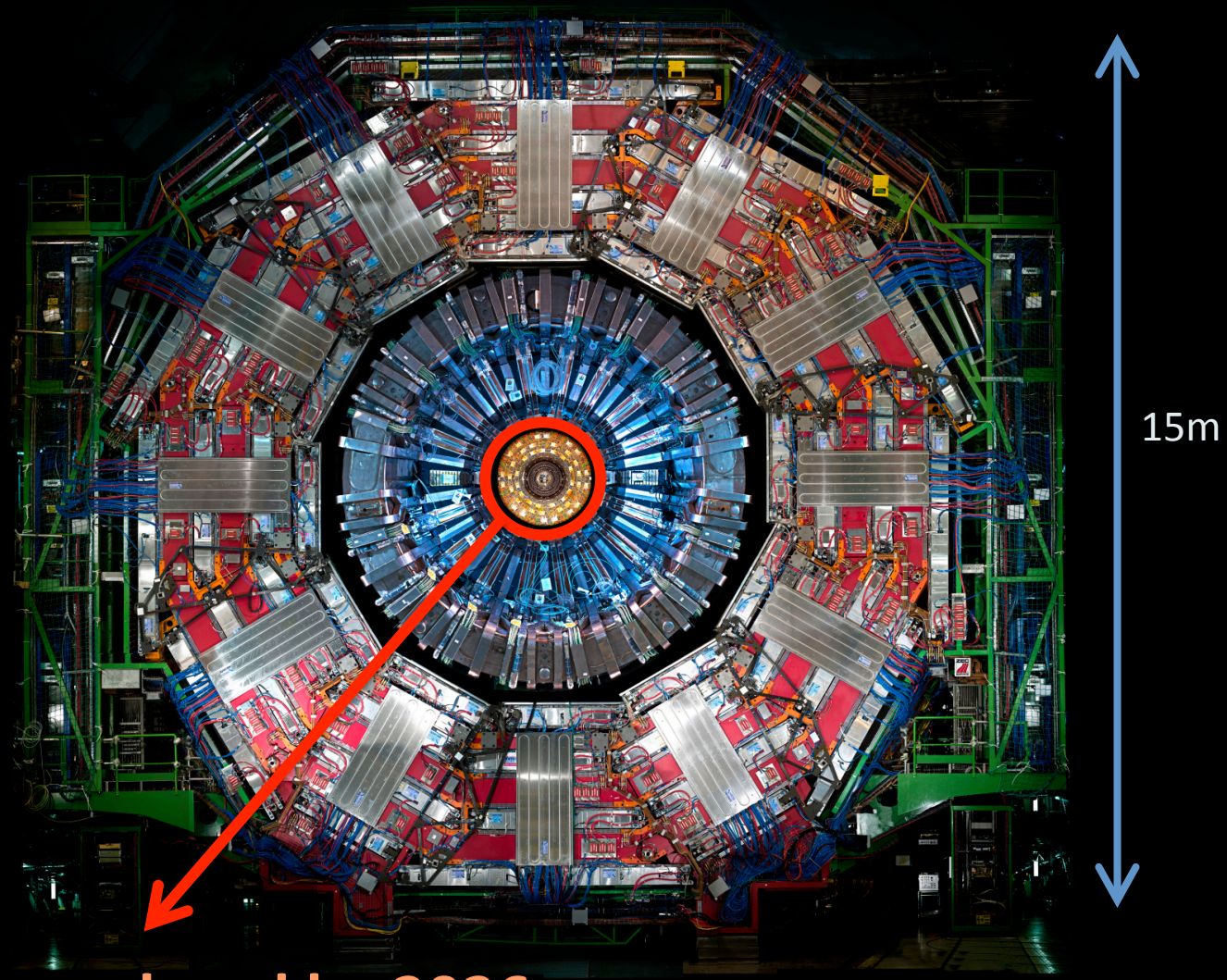
15m

BREAKTHROUGH of the YEAR
The HIGGS BOSON
2012

related to Nobel Prize in 2013

HIGH-ENERGY PHYSICS
RESEARCH CENTRE

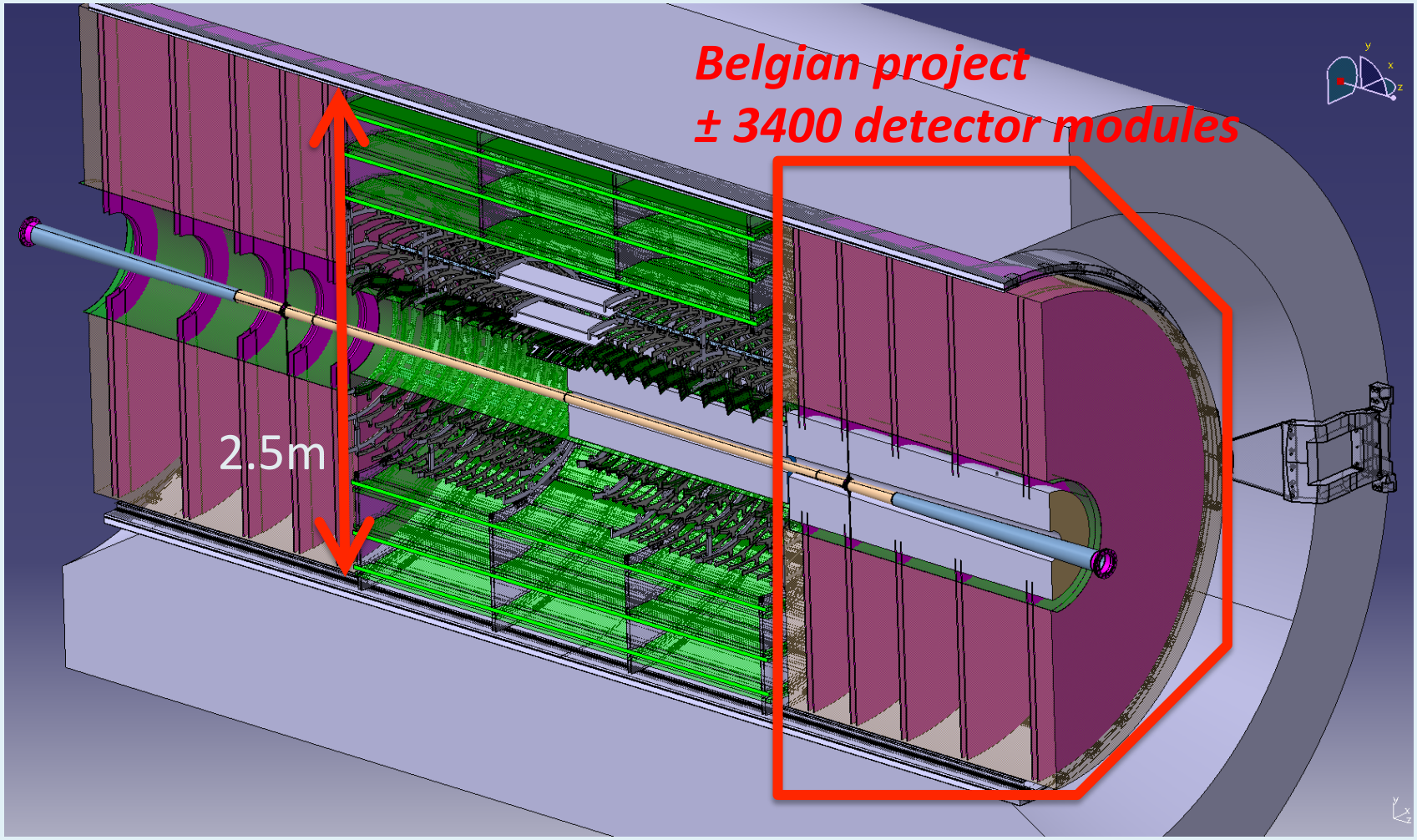
CMS experiment @ CERN



To be replaced by 2026

HIGH-ENERGY PHYSICS
RESEARCH CENTRE

Construct new detector



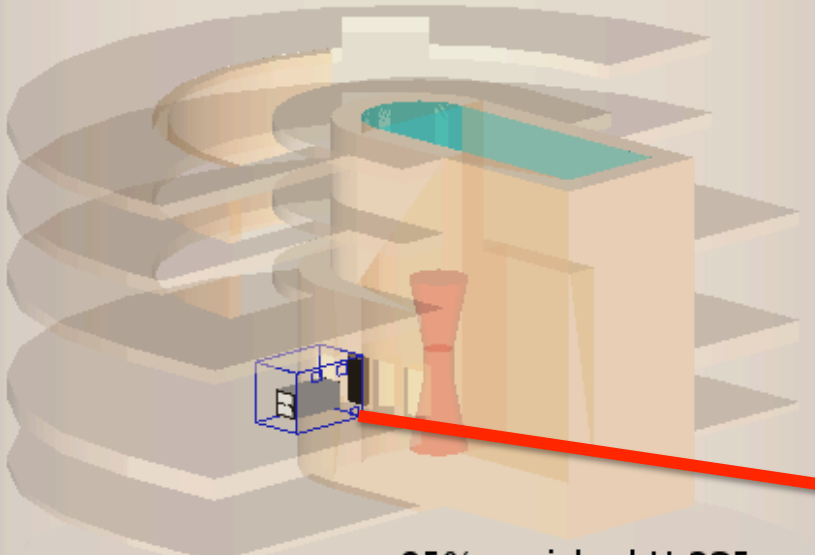
Jorgen D'Hondt is PI of this Belgian project with >10M Euro core budget secured, and >5M Euro human resources cost

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

SoLid @ BR2 reactor

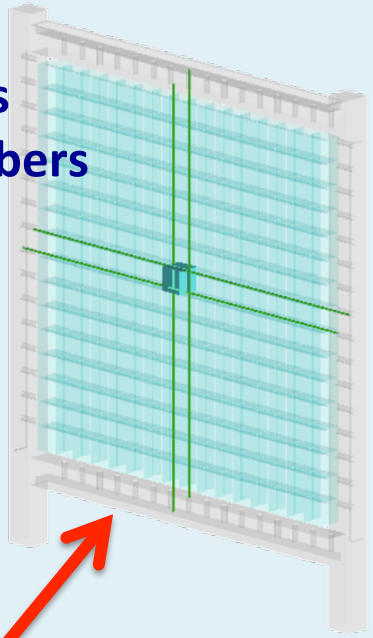
BR2 @ SCK-CEN
Belgium

6 to 11m from reactor core

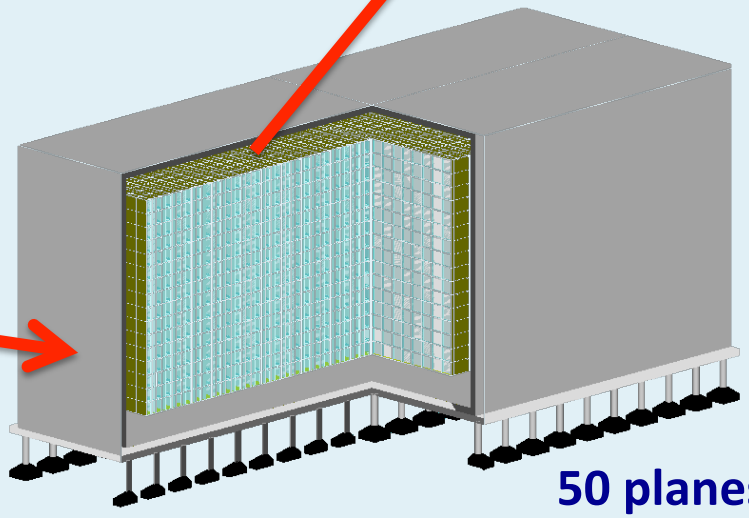


95% enriched U-235
0.5m core diameter
access ports for experiments

12800 cubes
3200 readout fibers



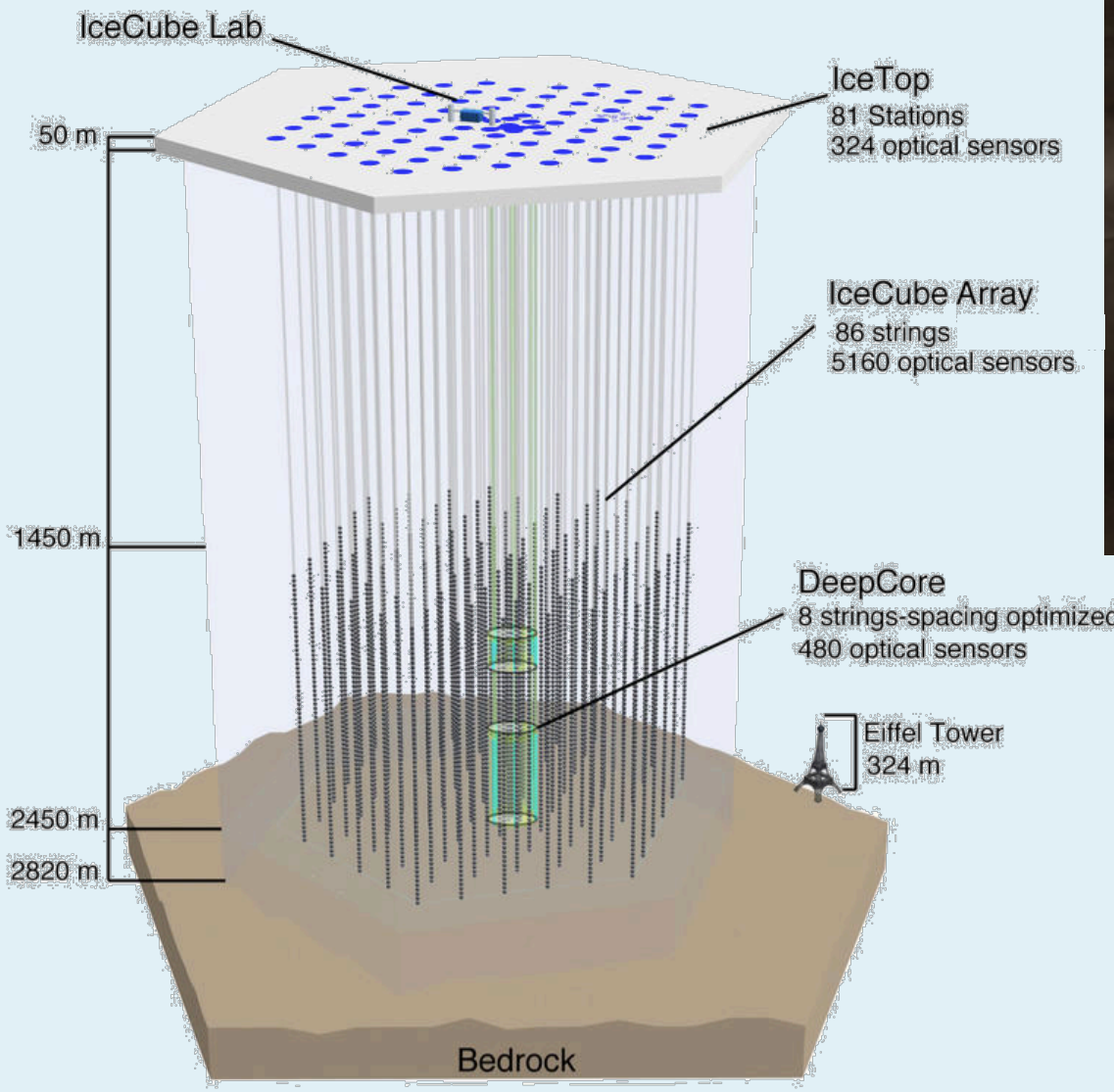
related to Nobel Prize in 2015

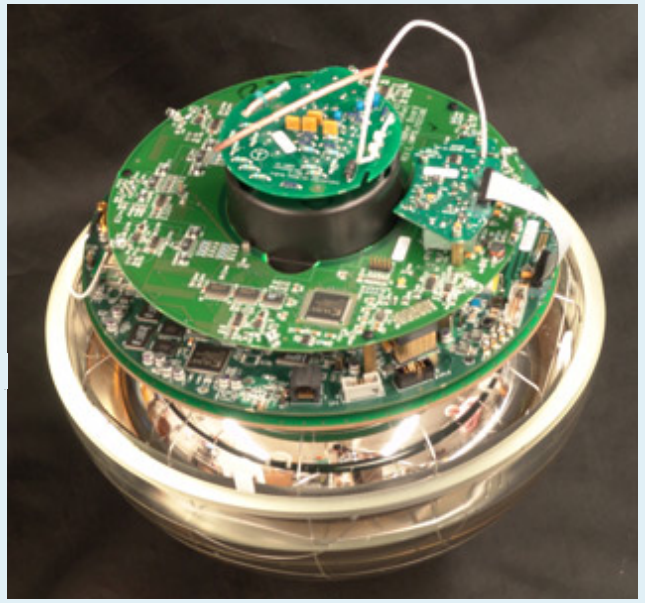


50 planes
1.5 ton

HIGH-ENERGY PHYSICS
RESEARCH CENTRE

IceCube @ South Pole

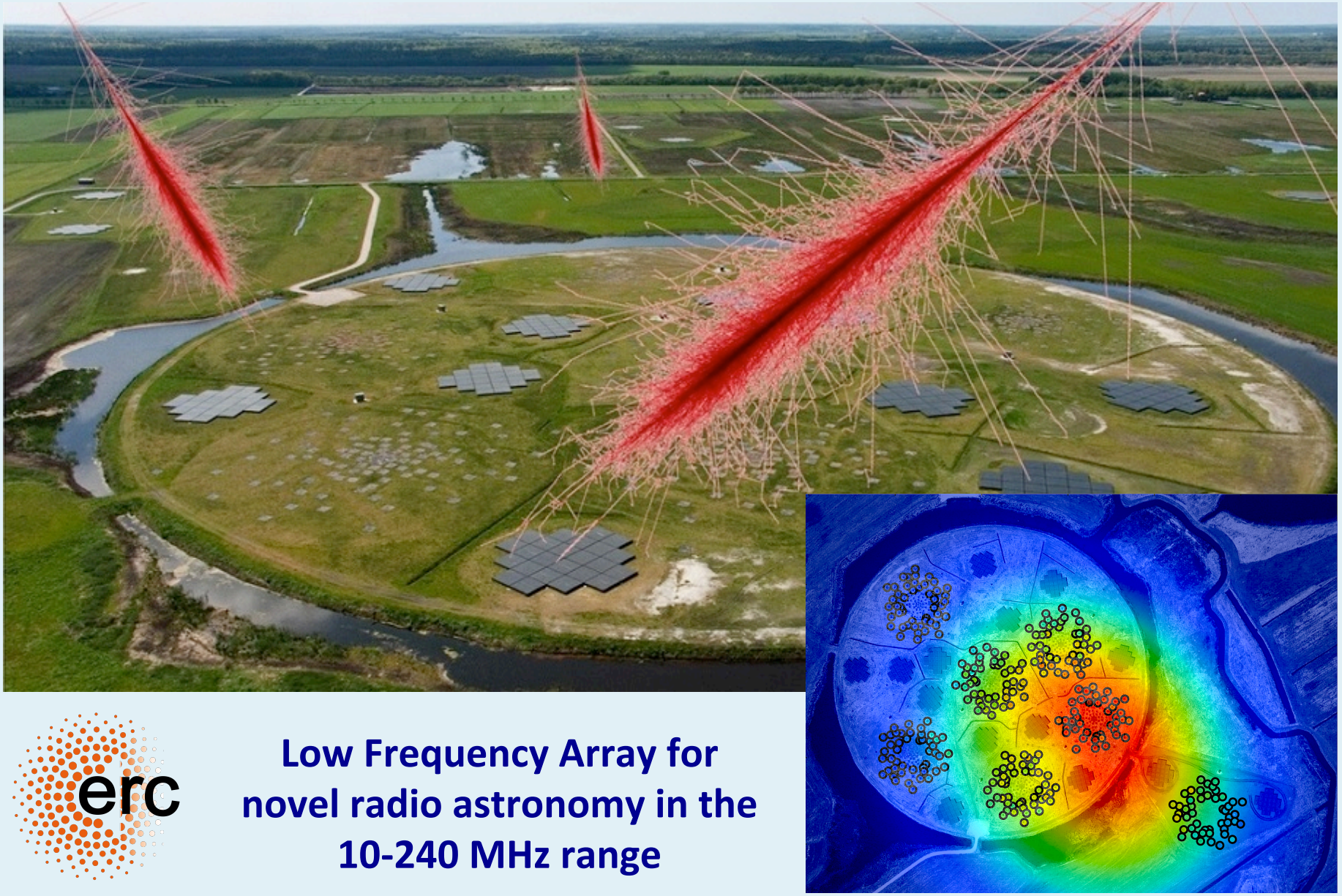




physicsworld
BREAKTHROUGH OF THE YEAR
2013

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

LOFAR @ Netherlands



erc

Low Frequency Array for novel radio astronomy in the 10-240 MHz range

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

High-Energy Physics – 2010

Theoretical physics

- string theory

Prof. B. Craps
Prof. A. Sevrin

Particle physics

- high-energy colliders

Prof. J. D'Hondt

Ending FWO positions:
Prof. R. Roosen
Prof. W. Van Doninck

Active emeriti:
Prof. S. Tavernier

Astro-particle physics

- neutrino telescope

Prof. C. De Clercq

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

New since 2010

Theoretical physics

- string theory
- holography
- cosmology

Prof. B. Craps
Prof. A. Sevrin

Part-time:
Prof. V. Balasubramanian
Prof. C. Blair
Prof. O. Evnin
Prof. L. Lopez Honorez
Prof. D. Thompson

Particle physics experiments

- high-energy colliders
- neutrino physics

Prof. F. Blekman (Odysseus 2)
Prof. J. D'Hondt
Prof. S. Lowette (Odysseus 2)

Part-time:
Prof. P. Van Mulders

Active emeriti:
Prof. S. Tavernier
Prof. W. Van Doninck

Astro-particle physics

- cosmic neutrinos
- dark matter
- multi-messenger observations

Prof. N. van Eijndhoven (Odysseus 1)

Part-time:
Prof. O. Scholten

Active emeriti:
Prof. C. De Clercq

High-energy astrophysics

- radio transients
- binary evolution

Prof. S. Buitink (ERC Starting Grant)

Part-time:
Prof. J. Blommaert
Prof. G. Gentile
Prof. T. Huege

Guest professor:
Prof. D. Vanbeveren

Phenomenology

Prof. A. Mariotti

Part-time:
Prof. K. Mawatari

① Strong evolution since 2010 (i.e. strategic choices)

② Enhanced connections and enlarged research portfolio

HIGH-ENERGY PHYSICS RESEARCH CENTRE

Projection beyond 2020

Theoretical physics

- string theory
- holography
- cosmology

Prof. B. Craps
Prof. A. Sevrin

Part-time:
~~Prof. V. Balasubramanian~~
~~Prof. C. Blair~~
~~Prof. O. Evnin~~
~~Prof. L. Lopez Honorez~~
~~Prof. D. Thompson~~

Particle physics experiments

- high-energy colliders
- neutrino physics

Prof. F. Blekman (Odysseus 2)
Prof. J. D'Hondt
Prof. S. Lowette (Odysseus 2)

Part-time:
~~Prof. P. Van Mulders~~

Active emeriti:
~~Prof. S. Tavernier~~
~~Prof. W. Van Doninck~~

Astro-particle physics

- cosmic neutrinos
- dark matter
- multi-messenger observations

Prof. N. van Eijndhoven (Odysseus 1)

Part-time:
~~Prof. O. Scholten~~

Active emeriti:
~~Prof. C. De Clercq~~

High-energy astrophysics

- radio transients
- binary evolution

Prof. S. Buitink (ERC Starting Grant)

Part-time:
Prof. J. Blommaert
Prof. G. Gentile
~~Prof. T. Huege~~

Guest professor:
Prof. D. Vanbeveren

Phenomenology

Prof. A. Mariotti

Part-time:
~~Prof. K. Mawatari~~

① Temporary faculty members might not be possible
② Need to create (unpaid) structural connections now

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Important recognitions

- **Typically leading research on the national level, involved in one EoS project**
- **Leading functions in international collaborations with up to thousands of members, both in the coordination of physics research and in the management up to the highest level; example for CMS@CERN with >4400 members (numbers only available for Belgium)**

±3% funding from Belgium

- 5.3% of PhD students
- 6.6% of physics conveners
- 8.3% of major conference talks
- 33% of Best Thesis Awards
- 1 out of 6 elected Collaboration Board chairs

- **Several invited Opening and/or Plenary talks at major conferences**
- **Members in IUPAP C18 Mathematical Physics, Restricted European Committee for Future Accelerators (RECFA), Intern. Particle Physics Outreach Group (IPPOG), Eur. Physics Society board (EPS), Intern. Cosmic Ray Conferences board (ICRC), CERN Council (vice-president)**
- **Several national and international awards and prizes (e.g. World Economic Forum, guest professors, Distinguished Researcher Fermilab LPC, etc.)**

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Some research highlights

Theoretical physics

- Interpretation of new Planck satellite data for dark matter models
- Thermalization properties of strongly coupled systems
- Investigating whether anti-de Sitter spacetime is unstable

Particle physics experiments

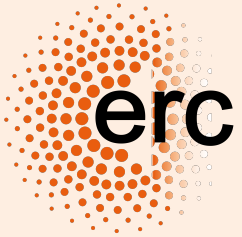
- Discovery of the Higgs particle (CMS)
- Leading contributions in top quark physics measurements and searches (CMS)
- Searches for dark matter and displaced supersymmetry (CMS)
- Commissioning of a real-scale proto-type of the SoLid detector

Astro-particle physics

- Discovery of cosmic high-energy neutrinos (IceCube)
- Most stringent limits on Earth and Solar dark matter (IceCube)
- Most stringent limit on cosmic ray flux from Gamma-Ray Bursts (IceCube)
- Leading investigation for novel radio detection and radar reflection in ice (ARA)

High-energy astrophysics

- Opened a unique radio observation window for the study of cosmic rays (LOFAR)
- Mass composition of cosmic rays (LOFAR)



Phenomenology

41 publications & 16 preprints
2200 citations, h-index 21

- Exploration of the Higgs sector & Higgs characterization
- Supersymmetry phenomenology
- Dark Matter simplified models

① Large potential for breakthroughs in the interplay of our research
② Enhanced by connecting our research through phenomenology

HIGH-ENERGY PHYSICS RESEARCH CENTRE

Future opportunities

Theoretical physics

- Holography (gauge/ gravity duality): far-from-equilibrium aspects & role of quantum entanglement in the emerge of spacetime
- String theory: geometric nature of spacetime & its dualities

Particle physics experiments

- Leading actors in displaces signatures from dark sectors
- Interplay top quark and Dark Matter, and top quark and Higgs
- SoLid oscillation analysis & background estimation
- Construction of CMS Tracker Endcap: new 120 m^2 clean room

Astro-particle physics

- Neutrinos from Gamma Ray Bursts & Active Galactic Nuclei
- Neutrinos related to gravitational waves
- Detection of GZK neutrinos (cosmic ray interactions with the CMB)
- Feasibility IceCube-Gen2 upgrade

High-energy astrophysics

- Signals from particle cascade on lunar surface & atmosphere
- Mass composition of cosmic rays (galactic & extragalactic origin)
- Search for extremely energetic particles from lunar surface (sensitive to physics beyond the SM)

Phenomenology

- Research on the interplay between the large and the small scales

① Large potential for breakthroughs in the interplay of our research

② Enhanced by connecting our research through phenomenology

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Essential research synergies

Phenomenology

Hierarchy problem

Multi-messenger observations

Theoretical physics

Particle physics experiments

Astro-particle physics

High-energy astrophysics

Dark Matter

Sterile neutrinos

Recently installed a new social room to facilitate people to connect

HIGH-ENERGY PHYSICS RESEARCH CENTRE

Essential research synergies

Phenomenology

Hierarchy problem

Multi-messenger observations

Theoretical physics

Particle physics experiments

Astro-particle physics

High-energy astrophysics

Dark Matter

Sterile neutrinos

Recently installed a new social room to facilitate people to connect

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Essential research synergies

Phenomenology

Hierarchy problem

Multi-messenger observations

Theoretical physics

Particle physics experiments

Astro-particle physics

High-energy astrophysics

Dark Matter

Sterile neutrinos

Recently installed a new social room to facilitate people to connect

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Essential research synergies

Phenomenology

Hierarchy problem

Multi-messenger observations

Theoretical physics

Particle physics experiments

Astro-particle physics

High-energy astrophysics

Dark Matter

Sterile neutrinos

Recently installed a new social room to facilitate people to connect

HEP@VUB BRUSSELS: 1ST CROSSTALK WORKSHOP

THE FATE OF STERILE NEUTRINOS

January 18th, 2017
Vrije Universiteit Brussel, Belgium

Invited speakers:
Joachim Kopp (Mainz University): ***Global Fits with Sterile Neutrinos***
Jordi Salvado (Valencia University): ***IceCube and sterile neutrino results (pheno)***
Maria Archidiacono (Aachen University): ***Cosmological aspects of sterile neutrinos***
Antonin Vacheret (Imperial College London): ***Solid and reactor experiments***
Sebastian Boser (Mainz University): ***IceCube and sterile neutrino results (exp)***
Denise Hellwig (Aachen University): ***Double Chooz and the theta13***

Please register on the Website:
hep.vub.ac.be

Local Organisers:
Alberto Mariotti, Laura Lopez Honorez

HEP@VUB BRUSSELS

VUB VRIJE UNIVERSITEIT BRUSSEL

The HEP@VUB centre is a Strategic Research Program on High-Energy Physics at the Vrije Universiteit Brussel

① The fate of sterile neutrinos, January 2017

② The fate of naturalness, June 2017

③ Flavour anomalies, March 2018

HIGH-ENERGY PHYSICS RESEARCH CENTRE

Valorisation successes

Royal Academy Award 2013 for Science Communication Jorgen D'Hondt

Long list of appearances on television, radio and newspapers

"90 degrees South" contest & event

International Particle

Participation to Bright Club Bxl

Kwantumrevolutie documentary (selected for several festivals)

Regular Belgian VIP visits to CERN

Strong connections and appearances in New Scientist

Solvay Public Lectures

VUB annual Prize 2014 for Science Valorisation (150k Euro) Jorgen D'Hondt

Long list of public lectures

Workshops for kids

Royal Academy Award 2016 for Science Communication Freya Blekman

Royal Academy Award 2017 for Science Communication Gwen De Wasseige

HIGH-ENERGY PHYSICS RESEARCH CENTRE

valorisation opportunities

① **Continue to participate in outreach programs & organize HEP@VUB Crosstalk Workshops**

② **Focused outreach around each "HEP@VUB Crosstalk Workshop":**

- Use multi-media with short interviews and movies to highlight the specific high-energy physics topic
- Create work packages for teachers in schools (potentially STEM oriented)
- Create printable folders and posters

③ **Explore opportunity for "SRP Crosstalk" workshops**

HIGH-ENERGY PHYSICS RESEARCH CENTRE

Investment to connect

One-day **workshops** with invited international experts focusing on contemporary topics on the interplay between our groups.

Bi-weekly invited **seminars** both topical as well as on the interplay between our groups.

Short term **visitors** that help us making the bridge between groups.

	Annual Budget (kEuro)
Seminars (20)	11.25
Crosstalk Workshops (3)	10
Visitor program (10)	10.5
Logistics, Outreach & Coordination	20
Advisory Board	2,5
Allocation per staff member (8)	25.7 (x 8)
	260

Guido Tonelli (Pisa)
Dieter Lust (Munich)
Francis Halzen (Madison)

Professors need to work on **joint projects** to hire a PhD student or postdoc. Salary and bench-fee of PD or student is around 50-55k euro.

① **Unique funding program to explore connections in our research**
② **Flexibility to act and react fast on novel scientific insights**

Summary

HEP@VUB: *investment to connect*

① Strong international recognition of our groups

② Research groups are successful in funding requests

③ Need to explore the interplay of our research towards potential breakthroughs connecting the large and the small scales in our universe

④ Successful strategic hiring choices make us unique in Belgium and internationally very competitive to reach these objectives

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Questions

HEP@VUB: *investment to connect*

① How to further strengthen the pheno activities taking into account a starting professor?

② Are there other opportunities to further explore joint projects and synergies among groups?

③ Based on our application, what might be evaluation criteria within 4-5 years, or weaknesses?

④ We probably reached our maximum capacity in size and depth. What might be appropriate next challenges for HEP@VUB?