HIGH-ENERGY PHYSICS
RESEARCH CENTRE

High-Energy Physics

May 3, 2022, Brussels (online)

Coordinator: *in total 8 promotors*

Jorgen D'Hondt

Group leaders of VUB research groups :

Stijn Buitink	Astrophysics (AARG)
Ben Craps	Theoretical Physics (TENA)
Jorgen D'Hondt	Experimental High-Energy Physics (ELEM)
Alberto Mariotti	Phenomenology (AARG+TENA+ELEM)

Other promotors:

Krijn de Vries, Steven Lowette, Alexandre Sevrin, Nick van Eijndhoven

High-Energy Physics (HEP): Curiosity driven research

observable universe
8.8 10^{26}m

visible with our own eyes

quarks
> 10^{-19}m

~ 1˙000˙000˙000˙000˙000˙000˙000˙000˙000 meter

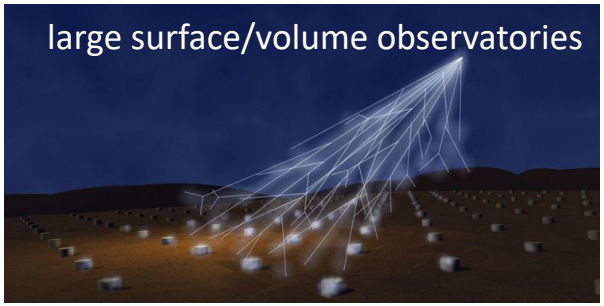
- distance to galactic center
- distance light travels in one year
- farthest human object from Earth (Voyager 1)
- distance Earth-sun

~ 0.000˙000˙000˙000˙000˙000˙01 meter

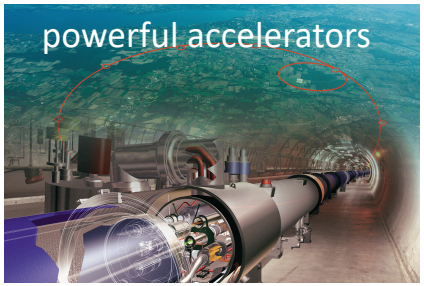
- biological cell
- atoms
- proton neutron

High-Energy Physics (HEP): Curiosity driven research

observable universe
8.8 10^{26}m



visible with our own eyes



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proton neutron

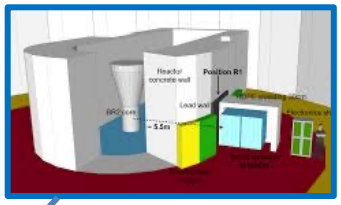
General objective

Describe how nature behaves in this space and time

LIGO/VIRGO/KAGRA Gravitational Wave Interferometers

Radio Neutrino Observatory Greenland

SoLid @ BR2

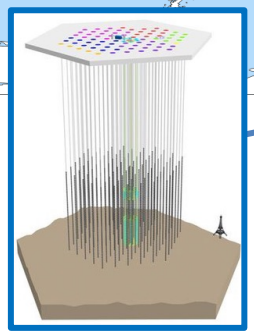


LOFAR Radio Telescope

CMS @ LHC

We are involved in a vast portfolio of running research facilities

Pierre Auger Cosmic Ray Observatory



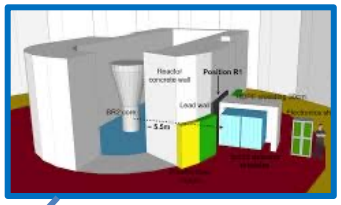
IceCube Neutrino Observatory

Askaryan Radio Array

LIGO/VIRGO/KAGRA Gravitational Wave Interferometers

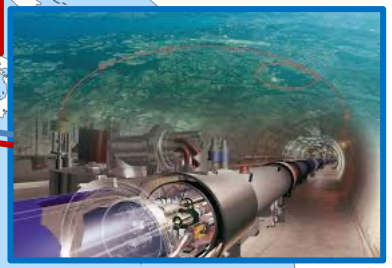
Radio Neutrino Observatory Greenland

SoLid @ BR2



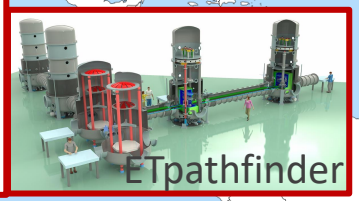
LOFAR Radio Telescope

CMS @ LHC



HL-LHC

Einstein Telescope



… and we prepare for new ones

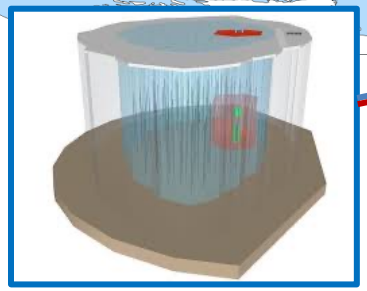
GRAND

FUTURE CIRCULAR COLLIDER

RADAR ECHO TELESCOPE

SKA
SQUARE KILOMETRE ARRAY

Pierre Auger Cosmic Ray Observatory



Gen2

IceCube Neutrino Observatory

Askaryan Radio Array

HIGH-ENERGY PHYSICS RESEARCH CENTRE

High-Energy Physics – pre-HEP@VUB

<2010

Theoretical physics

• string theory

Prof. B. Craps
Prof. A. Sevrin

Particle physics experiments

• 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. De Clercq

HIGH-ENERGY PHYSICS RESEARCH CENTRE

High-Energy Physics – TODAY

Coordinator: Prof. J. D'Hondt

Secretariat: N. Hindrikx and S. Van den Bussche

Theoretical physics

- string theory
- holography
- cosmology
- gravitational waves

Prof. B. Craps
Prof. A. Sevrin

Part-time:
Prof. V. Balasubramanian
Prof. C. Blair
Prof. M. Sakellariadou
Prof. D. Thompson

Guest professor:
Prof. O. Evnin
Prof. L. Lopez Honorez

TENA

Particle physics experiments

- high-energy colliders
- neutrino physics

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

Active emeriti:
Prof. S. Tavernier

ELEM

Astro-particle physics

- cosmic neutrinos
- dark matter
- multi-messenger observations

Prof. K. de Vries
(ERC Starting Grant)
Prof. N. van Eijndhoven
(previous Odysseus 1)

Part-time:
Prof. K. Kotera

Active emeriti:
Prof. O. Scholten

ELEM

High-energy astrophysics

- radio astronomy
- cosmic rays
- lightning
- binary evolution

Prof. S. Buitink
(previous ERC Starting Grant)

Part-time:
Prof. J. Blommaert
Prof. T. Huege
Prof. K. Kolenberg

Guest professor:
Prof. D. Vanbeveren
Prof. J. Horandel
(ERC Advanced Grant)

AARG

Phenomenology

Prof. A. Mariotti

AARG – ELEM – TENA

HIGH-ENERGY PHYSICS RESEARCH CENTRE

High-Energy Physics – TODAY

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Theoretical physics

- string theory
- holography
- cos
- gra

Prof.
Prof.

Part-
Prof.
Prof.
Prof.
Prof.

Gues
Prof.
Prof.

Particle physics experiments

- high-energy colliders
- neutrino physic

Astro-particle physics

- cosmic neutrinos
- dark matter

High-energy astrophysics

- radio astronomy
- cosmic rays

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News: two new vacancies for professors

Experimental high-energy physics

Theoretical high-energy physics

In total 24 professors in high-energy physics
to connect the large and small scales,
and experiment and theory

We are highly dependent on the SRP program
to provide a unique seed budget

HIGH-ENERGY PHYSICS RESEARCH CENTRE

VUB-scale in Flanders

As a university, 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

HEP@VUB aims to create a prolific and inclusive environment for novel research to emerge and for the best researchers to thrive in seeking answers to these open questions in high-energy physics.

Such a consortium is unique in the Belgian context and rare in the European context.

VUB HIGH-ENERGY PHYSICS RESEARCH CENTRE

Some numbers

10 professors
14 part-time professors or emeriti
17 postdocs
28 PhD students

Gender:
18% professors female
(after one left for another high-level position)
21% postdocs female
15% PhD students female

Since 2012:
>1330 publications*
>145k citations
h-index 176
>42 PhD thesis

** many with 1000+ authors*

1 Odysseus-I (2M EUR)
2 Odysseus-II (2 x 750k EUR)
(more selected but declined)
2 ERC Starting Grant (2 x 1.5M EUR)

Through FWO in Flanders:
>1/3 of the resources in physics committee
(while VUB is only 1/10 fair share in Flanders)

Running & awarded since 2018:
>25M Euro external funds
11 FWO projects
13 FWO PhD grants
16 FWO postdoc grants

1.3M EUR from SRP program (~30k EUR/year/prof)
General leverage x20-25

International:
All (but two) our postdocs obtained their PhD elsewhere

Most of our PhD students obtained their Master abroad

Many of our postdocs have obtained a permanent academic position

International recognitions

- **Typically, leading research on the national level**
- **Long list of invited Opening and Plenary talks at all major conferences in the field**
- **Leadership at the international level, e.g.**
  - J. D'Hondt: chair of the European Committee for Future Accelerators
  - S. Lowette: convenorship Exotica research team in CMS
  - N. van Eijndhoven: PI and chair Executive Board of RNO-Greenland
  - K. de Vries: scientific PI of the Radar Echo Telescope for Cosmic Rays
  - S. Buitink: PI of the LOFAR Cosmic Ray Key Science Program
- **Several national and international awards and prizes, e.g.**
  World Economic Forum, valorisation prize, science communication, guest professors, Distinguished Researcher Fermilab LPC, thesis awards, etc.

HIGH-ENERGY PHYSICS RESEARCH CENTRE

Added value of the HEP@VUB budget

- **Instrumental and unique as seed budget**
  - supporting initial explorations of unknown territories
  - external resources leverage on this initial investment
    e.g. young researchers apply for individual FWO grants and promotors apply for FWO research projects based on the outcomes of the pilot investigations
  - our engagement in new projects would not have been possible without the initial exploration supported by the HEP@VUB budget
    e.g. SoLid (2x FWO project), VIRGO/LIGO (1x iBOF), FCC (1x FWO project)
- **Strengthening our capacity to explore inter-disciplinary aspects**
  - between the extremes in our high-energy physics research field
  - allows the promotors to enhance their horizon beyond the mono-disciplinary research
  - often results in opportunities for collaborations with external partners
    e.g. over the last 5 years we have 19 joint-PhD students and 4 externally funded projects jointly with other institutions and involving mainly joint-PhD
- **Flexibility to act and react fast on novel scientific insights**

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)	15
Crosstalk Workshops (3)	15
Visitor program (10)	15
Logistics, Outreach & Coordination	30
Advisory Board	2,7
Allocation per staff member (8)	27.5 (x 8) = 220
	297.7

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 55k euro.

HIGH-ENERGY PHYSICS RESEARCH CENTRE

Rebuttal

① Elaborate more on the risk evaluation and measures

Several key risks were identified, and our measures described.

② Enhance diversity in the research team

We have confirmed that we do not observe a passive role, but actively promote diversity in our organisation (incl. gender).

③ Provide more concrete work packages

We argued that HEP@VUB is a broad research programme and provided several mono- and interdisciplinary examples.

HIGH-ENERGY PHYSICS RESEARCH CENTRE

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