

High-Energy Physics

Proposal for a VUB research center

Prof. Ben Craps (Theoretical High-Energy Physics)

Prof. Jorgen D'Hondt (Particle Collider Physics)

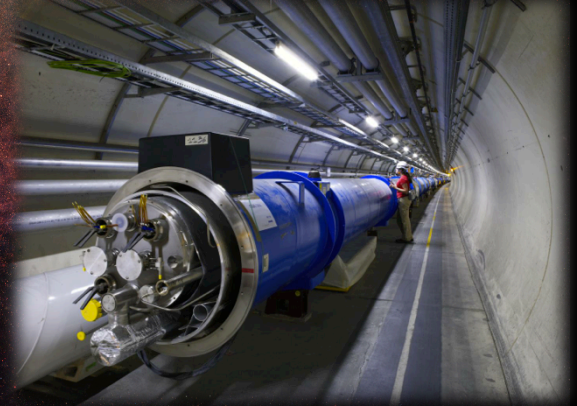
Prof. Nick Van Eijndhoven (Astro-particle Physics)

**Other staff members: Prof. Freya Blekman, Prof. Catherine De Clercq,
Prof. Robert Roosen, Prof. Alexander Sevrin, Prof. Walter Van Doninck**

In our quest to identify the fundamental content and structure of the Universe many outstanding questions remain...

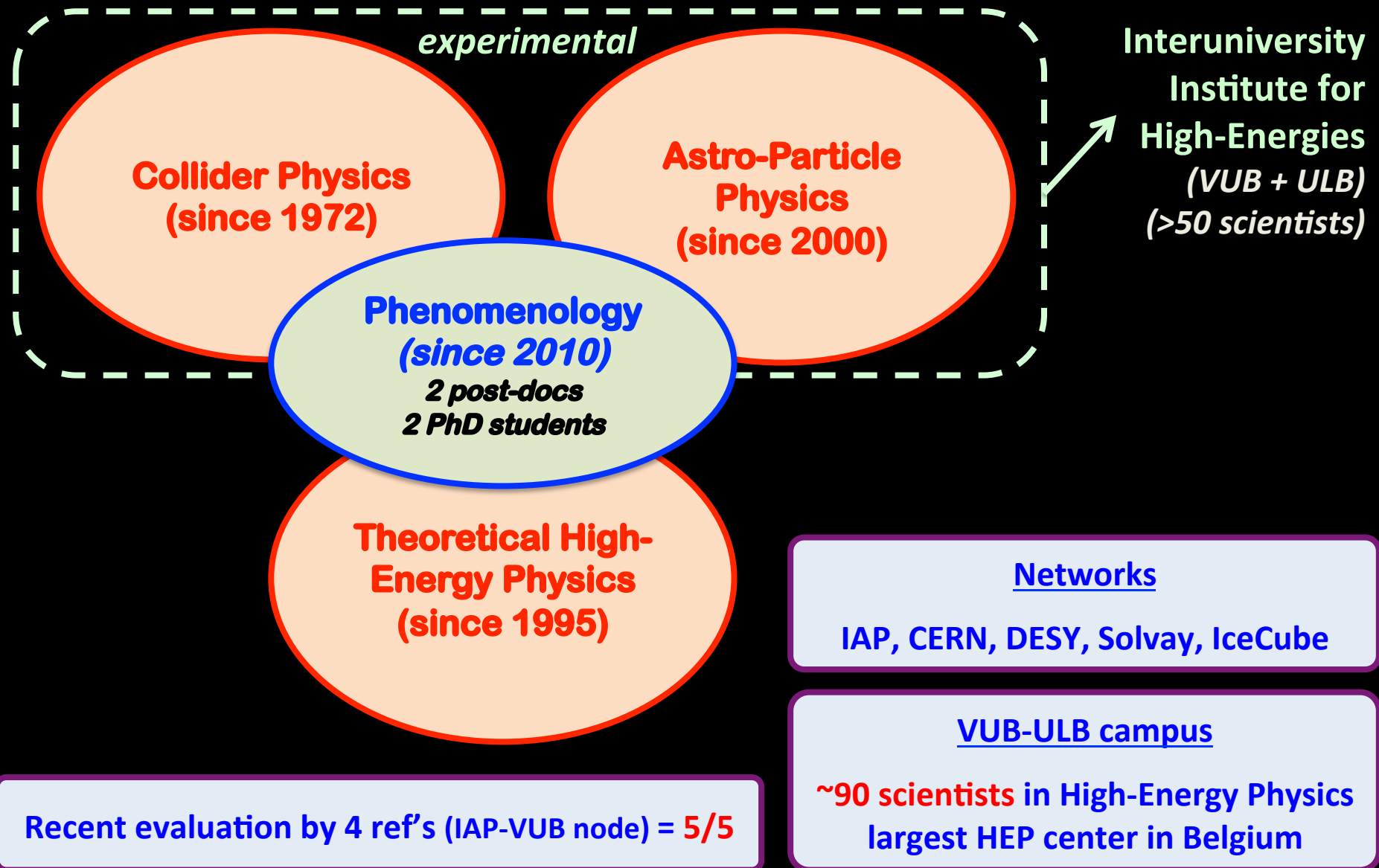
A booming research field with an enormous list of essential observations awaiting us in the next few years.

Strongly internationally embedded & recently a solid connection between theoretical and experimental high-energy physics.



The VUB has a leading role in HEP in Flanders and our teams are strategically deployed to contribute optimally in this field.

High-Energy Physics at the VUB – Research teams



High-Energy Physics at the VUB – Research topics

Collider Physics (Prof. Jorgen D'Hondt)

- Construction and R&D of particle detectors (eg. leading role in the muon chambers of DELPHI, the Central Tracker of H1, the Silicon Tracker of CMS)
- Largest data analysis Computing Centre (Brussels)
- Key measurements and searches (2011 highlights @ LHC, eg. best limit on fourth generation quarks, most precise measurement of matter versus anti-matter top quarks,...)
- New innovative directions: new physics phenomena connected to top quarks, Dark Matter searches in collisions
- Many key positions within collider experiments, eg. first manager of the team of around 150 members working on research connected to the top quark, multiple coordinator positions
- Leading role in Flanders since 40 years

CMS Week @ Brussels (2011)
Top Quark Conference (2010)

4 professors
4 post-docs
6 PhD students
+ engineers/technicians/IT

Federal Government - CERN
FWO Big Science funding
Various FWO projects
Odysseus-II mandate

CMS Thesis Awards
Dr. S. Lowette (2007)
Dr. J Heyninck (2008)

High-Energy Physics at the VUB – Research topics

Astro-particle Physics (Prof. Nick Van Eijndhoven)

- R&D on detector modules of Amanda/IceCube
- Installation of detector modules on South Pole
- Key measurements and searches with IceCube
 - Cosmic transients (leading γ -ray bursts research)
 - Dark Matter (one of the leading European centers)
 - Search for cosmic pointsources
- Nature publication on γ -ray bursts with a strong world-wide press interest (April 2012)
- New innovative research for GZK neutrinos with radio detection (ARA experiment), including participation in the R&D for timing and tracking
- Many key positions within the IceCube experiment, leading analysis initiatives
- Initiated astro-particle physics in Flanders

IceCube Week @ Brussels
(2011)

2 professors
5 post-docs
3 PhD students

Various FWO projects
Odysseus-I mandate

Belgian Physics Society
D. Diederix (2010)
best Master thesis prize

High-Energy Physics at the VUB – Research topics

Theoretical High-Energy Physics (Prof. Ben Craps)

- **Geometric aspects of string theory & supersymmetry**
- **Cosmological aspects of string theory**
- **Generally highly successful in obtaining individual FWO grants for PhD students and post-docs**
(anno 2012: 4 FWO-postdocs & 3 FWO-PhD-mandates)
- **Recently initiated theoretical research projects with a strong connection to phenomenology and observations**
 - **String theory techniques applied on the physics of Heavy Ion collisions**
 - **Supersymmetry breaking models**
illustration on next slide
- **Both hot topics at the LHC at CERN.**

Organized numerous Solvay Workshops

**2 professors
5 post-docs
4 PhD students**
(all post-docs & half of the PhD students internationally recruited)

**FWO grant
7 individual FWO fellowships**

**Belgian Physics Society
W. Staessens (2008)
best Master thesis prize**

Illustration of the connection theory – pheno:

theory collaborator (ULB)

GOA pheno research team (VUB)

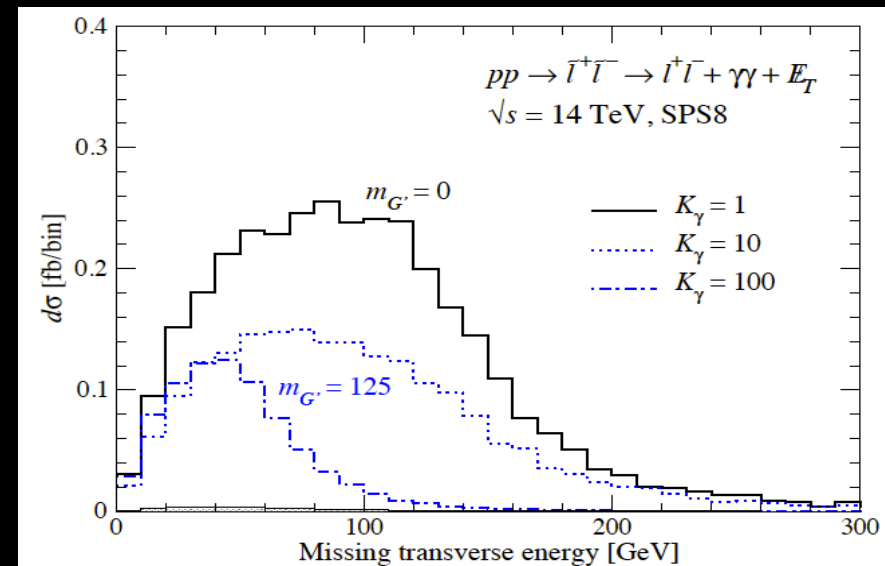
Collider signatures of goldstini
in gauge mediation

arXiv:1112.5058v1 [hep-ph] 21 Dec 2011

Riccardo Argurio^{1,5}, Karen De Causmaecker^{2,5}, Gabriele Ferretti³
Alberto Mariotti^{2,5}, Kentarou Mawatari^{2,5}, and Yoshitaro Takaesu⁴

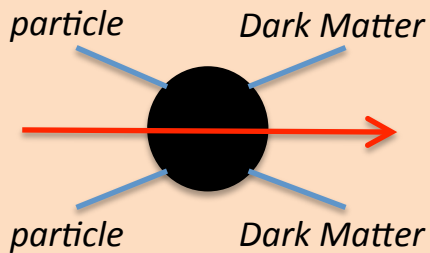
theory research team (VUB)

illustration in reply to one of the referees



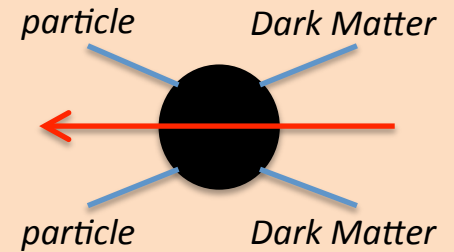
Example of collaboration: “Dark Matter”

Collider Physics



detector

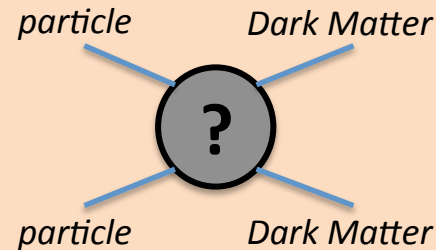
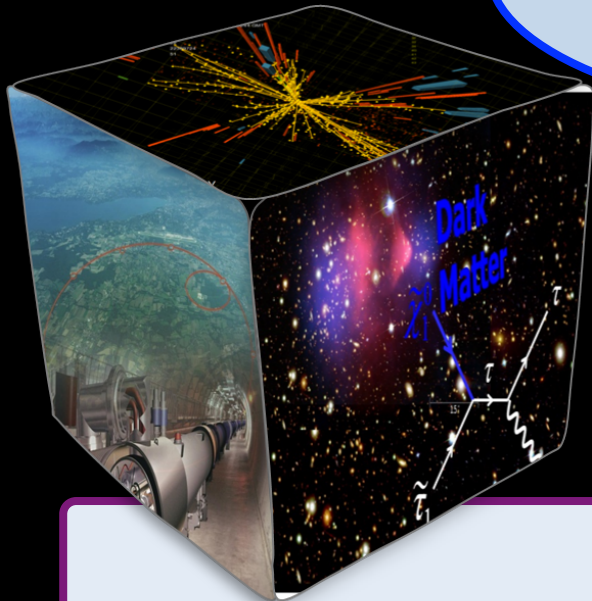
Astro-Particle Physics



detector

Phenomenology

match empiric observations of fluxes with theoretical models

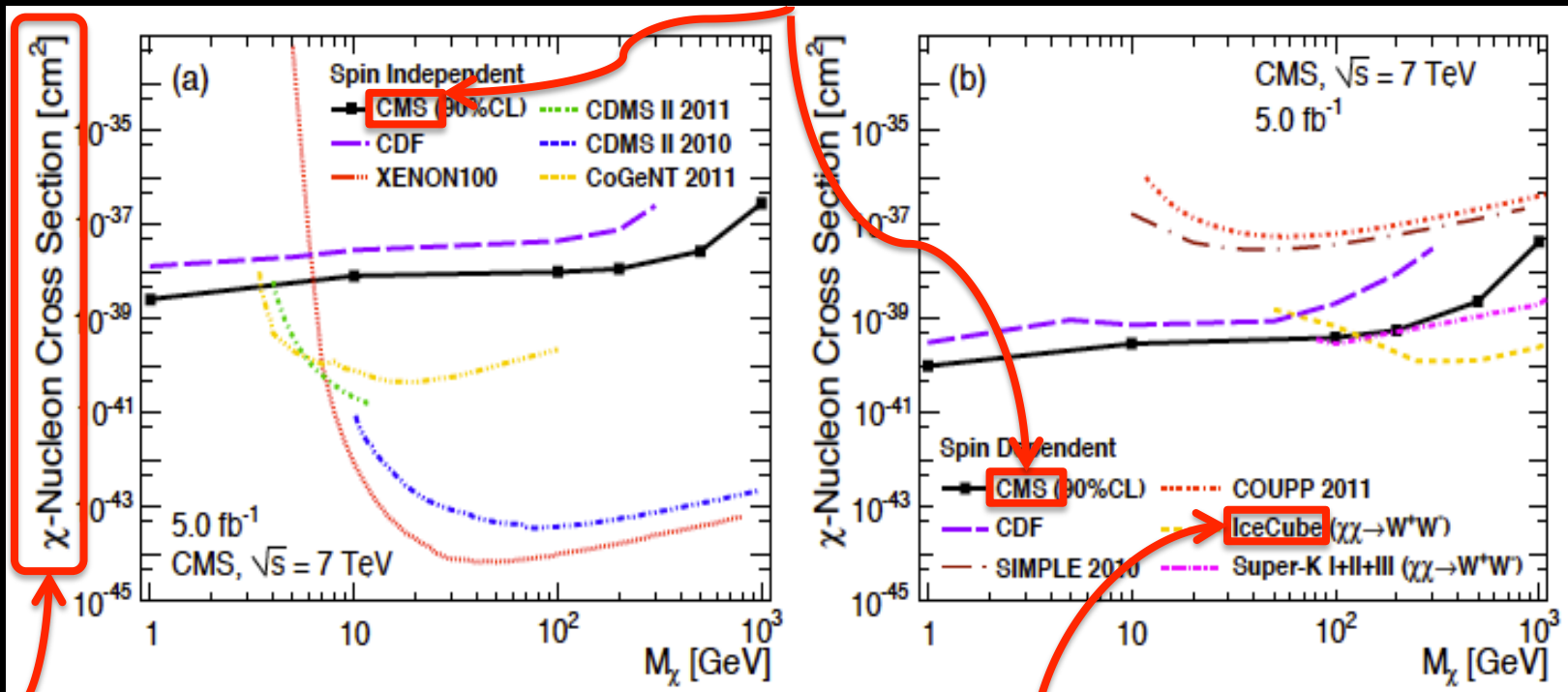


Theoretical HEP Physics

Other examples: Supersymmetry, Gamma Ray Burst, ...

Recent results: "Dark Matter" (April 2012)

Collider research



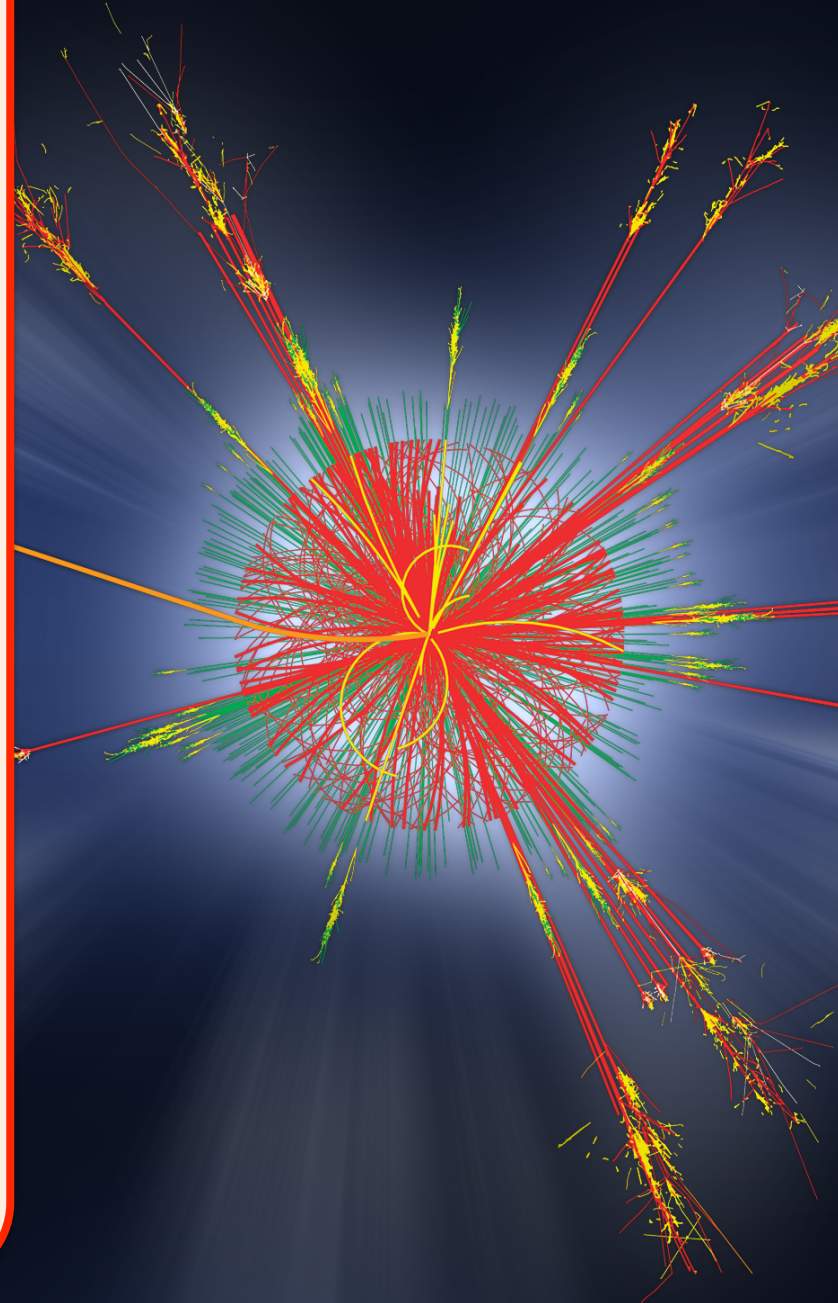
Phenomenological work

Astro-particle research

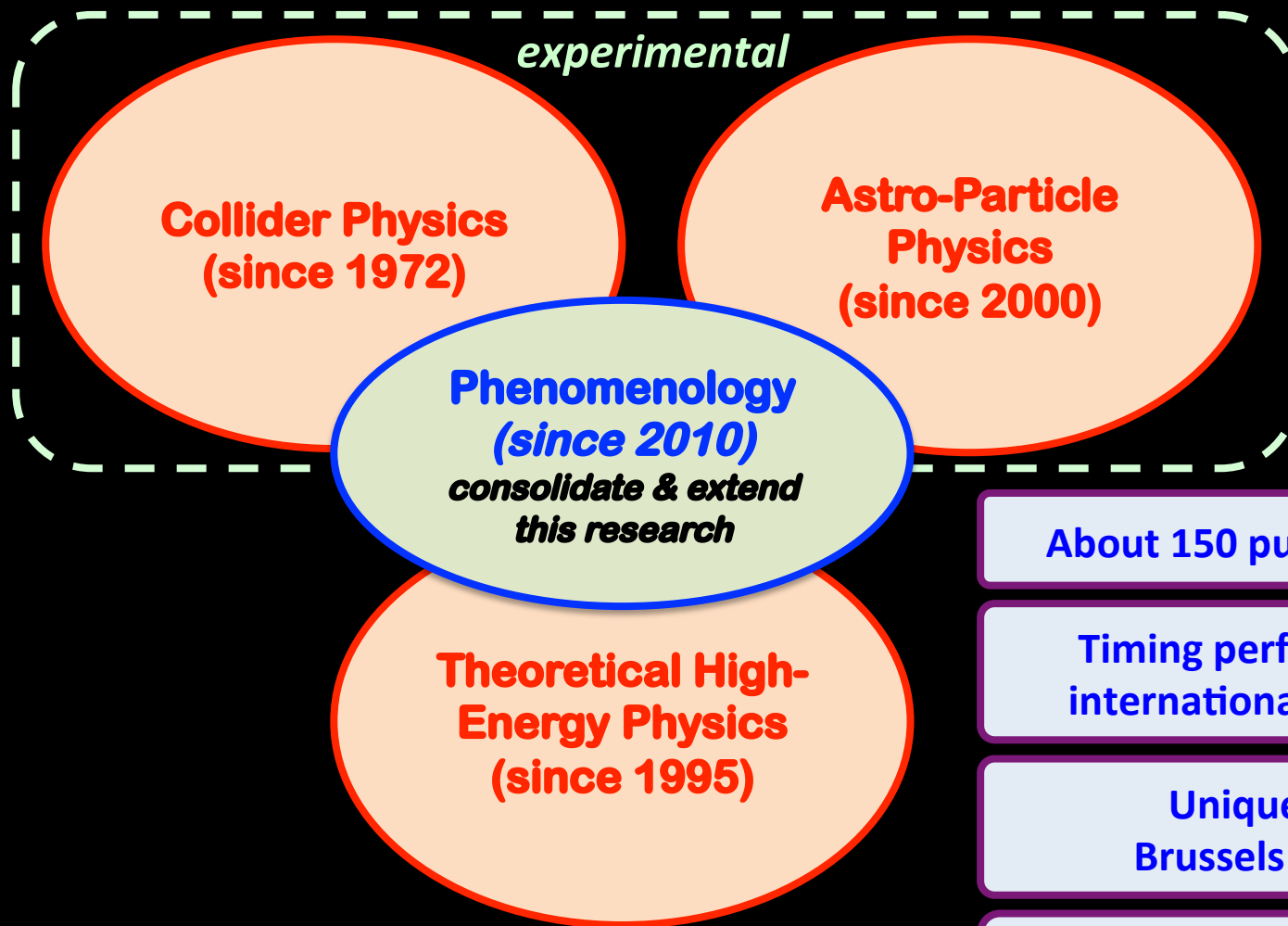
Theoretical models

Outreach, Education and Valorisation

- **National coordinator within the IAP for Outreach** (Prof. Alexander Sevrin)
- **Representing Belgium within the International Particle Physics Outreach Group** (Prof. Jorgen D'Hondt)
- **Organizer of the Belgian Press Conference for the start of the LHC** (Prof. Jorgen D'Hondt)
- **Outreach activities of the Solvay Institutes** (Prof. Ben Craps & Prof. Alexander Sevrin)
- **About 40 media appearances in 4 years** (written and audio-visual)
- **Experimental spin-offs developed in PET/PEM scanners and computing**
- **Part of the organisation of the annual**
 - *Belgian-Dutch-German summer school for experimental high-energy physics*
 - *CERN Winter School on Supergravity, Strings and Gauge Theory*
 - *Amsterdam-Brussels-Paris school for theoretical high-energy physics*



High-Energy Physics research center



About 150 publications per year.

Timing perfectly aligned with international schedule of HEP.

Unique in Flanders;
Brussels center for HEP

Funding to consolidate the phenomenology research, with typically strong leverage.

Recent evaluation (IAP; VUB node) = 5/5