

The logo for Vrije Universiteit Brussel (VUB), consisting of the letters 'VUB' in white on a blue square background.

VRIJE  
UNIVERSITEIT  
BRUSSEL

# THEORETICAL HIGH ENERGY PHYSICS (TENA)

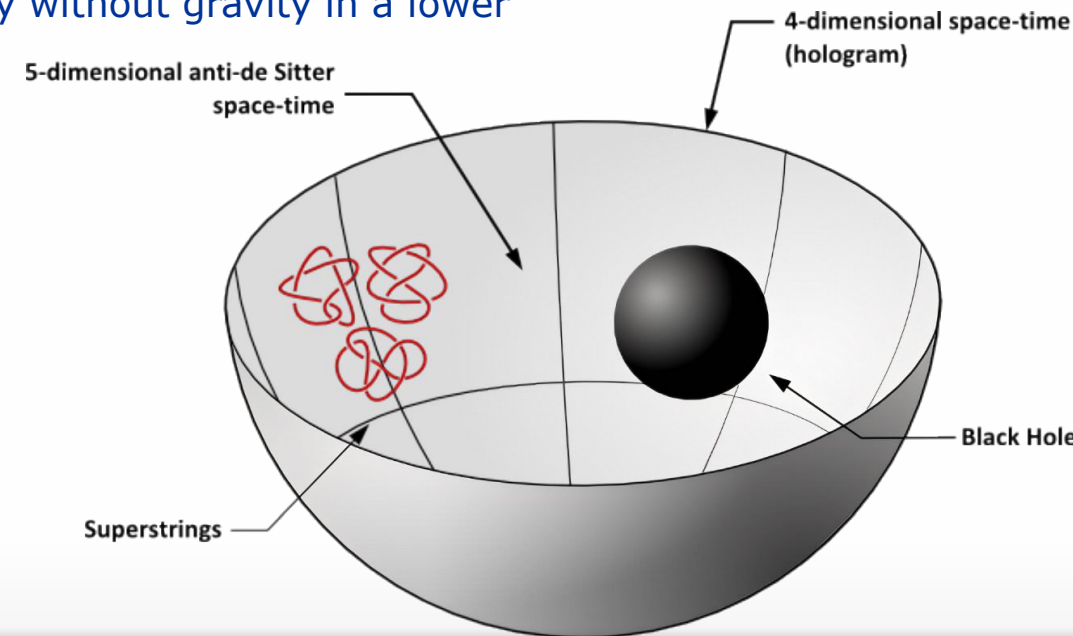
[HTTPS://WE.VUB.AC.BE/NL/THEORETICAL-PARTICLE-PHYSICS](https://we.vub.ac.be/nl/theoretical-particle-physics)

Alexander Sevrin

# RESEARCH: TWO MAIN LINES OF RESEARCH

- **Quantum gravity**

- General relativity + quantum mechanics = trouble
- Prime candidate for a theory of quantum gravity: **string theory**
- Particles are not necessarily point like objects but can be extended (strings, membranes, ...)
- Two main lines of research:
  - Holography – a theory with gravity (black holes) = a theory without gravity in a lower dimension (**see presentation Prof. Ben Craps**)
    - Close connection to quantum information theory
  - Geometry: an extended object perceives the ambient geometry in a very different way compared to a point particle. (**Alexander Sevrin**)
    - Generalization of differential geometry



## RESEARCH: TWO TARGETS

- **Gravitational Waves** (see presentation Prof. Alberto Mariotti)
  - Predicted in 1916 by Einstein, first observed in 2015 by the LIGO-Virgo collaboration
  - We are active in **Virgo** (part of the LIGO-Virgo-Kagra collaboration) and the **Einstein Telescope** (ET)
  - Group focusses on the **stochastic gravitational wave background** (SGWB). Can have two origins: astrophysical or cosmological
    - SGWB of astrophysical origin
      - Originates from numerous unresolved astrophysical sources, first observation expected in 2023
        - Development of data analysis techniques
        - Data analysis
    - SGWB of cosmological origin
      - Originates from cataclysmic events in the early universe
        - Theoretical modeling of sources (first order phase transitions, domain walls, ...)
- **Note** for those interested in applied physics: we are also involved in ETpathfinder, the R&D lab for ET and Cosmic Explorer -> close collaboration with B-Phot, faculty of engineering

