



# Laboratoire de Physique des Hautes Energies

**LPHE  
for future  
Master  
students**

Fred Blanc  
Guido Haefeli  
Radoslav Marchevski  
Olivier Schneider  
Lesya Shchutcka

April 5, 2023

- **Experimental particle physics**
  - participation in several international collaborations
    - LHCb at the LHC at CERN
    - NA62 at the SPS at CERN
    - SND@LHC at CERN
    - CMS at LHC at CERN
    - DAMPE/HERD in space (astroparticles)
  
- **36 scientists**
  - 17 PhD students
  - 13 postdoctoral researchers
  - 6 teachers
    - Dr. C. Perrina
    - Dr. F. Blanc (MER)
    - Dr. G. Haefeli
    - Prof. R. Marchevski
    - Prof. O. Schneider
    - Prof. L. Shchutska

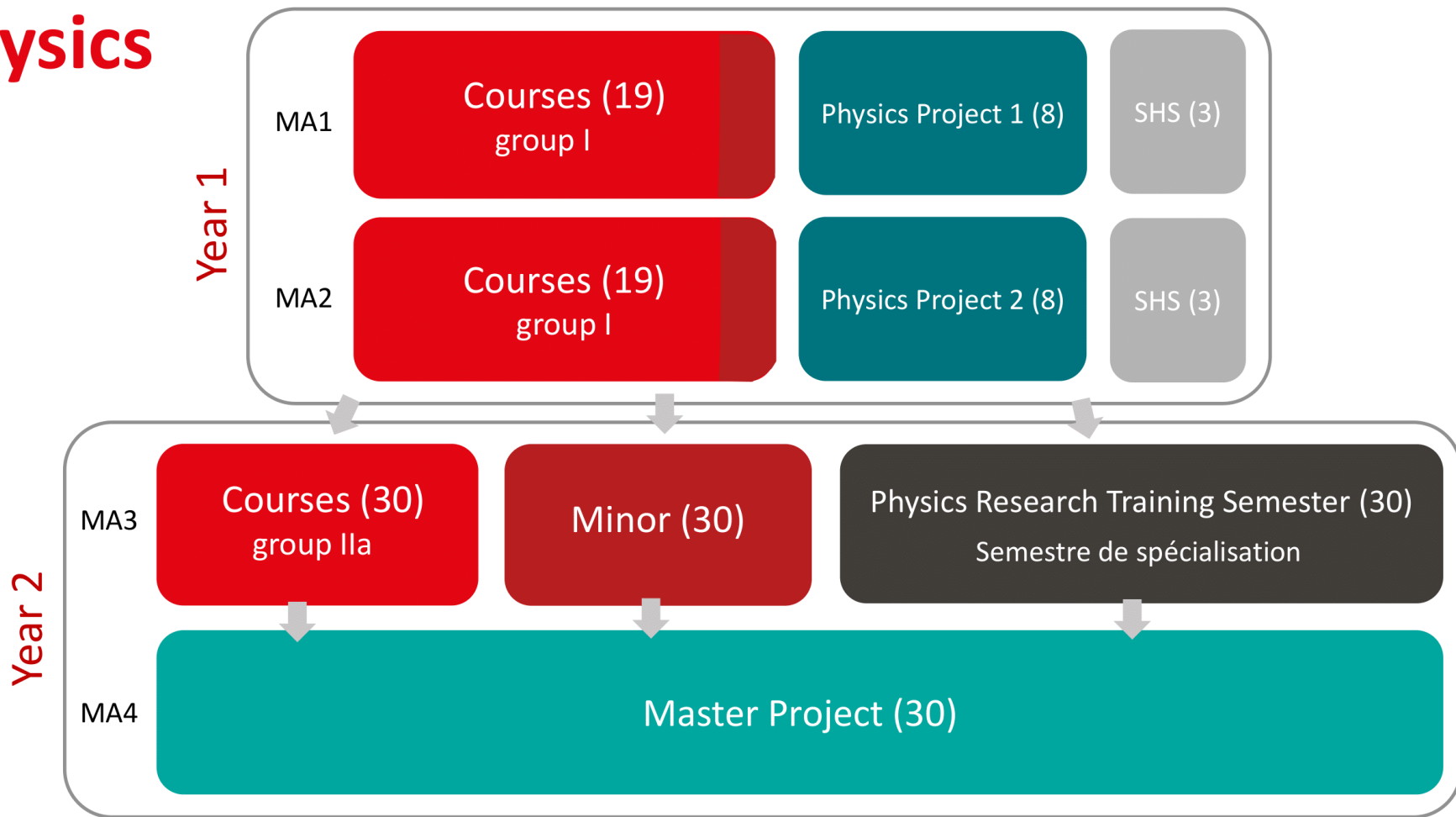
BSP (=Cubotron), 6<sup>th</sup> floor + labs 2<sup>nd</sup> floor



- You can join our team of excellent master students for both Physics Project 1&2 (1<sup>st</sup> year) and specialization/Master projects (2<sup>nd</sup> year)



# Physics



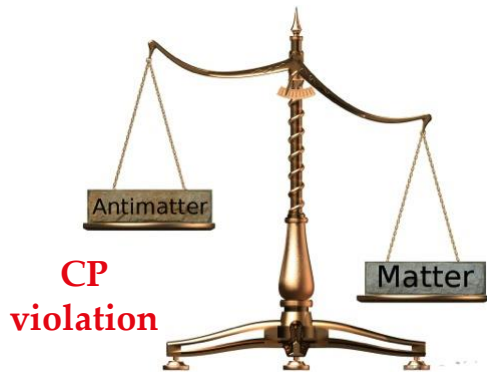
- The students interested in doing their Physics Master degree at LPHE will
  - obtain general knowledge about particle physics phenomena and particle detection
  - be introduced to advanced concepts in modern particle physics with emphasis on relevant research topics
  - conduct small but complete particle physics experiments in teams of 2-3 students
    - beta spectrometer, “measurement” of the neutrino mass, measurement of muon lifetime and magnetic moment, development of a cosmic ray detector
  - get involved in particle physics research
    - working on small individual projects
    - completing a semester-long specialization
    - master thesis on a specific research topic
- At the end of the program the students will have the necessary skillset to pursue a doctoral degree
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- **Year 2023-2024:** all courses are optional apart from the one in BA5
- **We encourage students interested in particle physics to look at theory or accelerator course**
  - e.g. Machine learning for physicists, Quantum Field Theory (LPTP), Introduction to particle accelerators (LPAP)
  - for more info see <https://www.epfl.ch/schools/sb/sph/en/master/master-in-physics/>

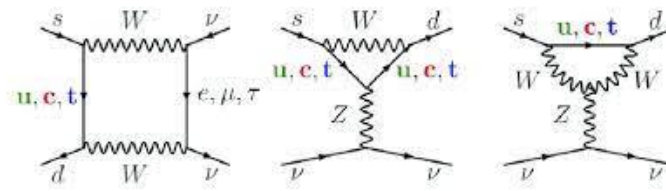
Course title	Code	Semester	Hours/week	Teacher(s)
Physique nucléaire et corpusculaire I	<a href="#">PHYS-311</a>	BA5	2C + 2E (4 ECTS)	O. Schneider
Physique nucléaire et corpusculaire II	<a href="#">PHYS-312</a>	BA6	2C + 1E (3 ECTS)	O. Schneider
Particle Physics I	<a href="#">PHYS-415</a>	MA1	2C + 2E (4 ECTS)	R. Marchevski
Particle Physics II	<a href="#">PHYS-416</a>	MA2	2C + 2E (4 ECTS)	L. Shchutskia
Particle detection	<a href="#">PHYS-440</a>	MA1	2C + 2E (4 ECTS)	G. Haefeli
Selected topics in nuclear and particle physics	<a href="#">PHYS-400</a>	MA2	2C + 2E (4 ECTS)	F. Blanc
Particle physics: the flavour frontiers	PHYS-??	MA2	2C + 2E (4 ECTS)	R. Marchevski
Introduction to astroparticle physics	<a href="#">PHYS-439</a>	MA2	2C + 2E (4 ECTS)	C. Perrina A. Neronov

## Particle physics: the flavour frontiers

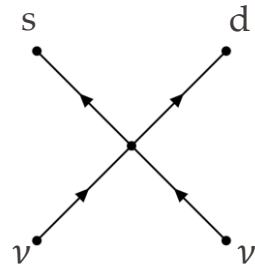
- explore the mysteries of the flavour structure in the Standard Model of particle physics
- CP violation and its connection to matter-antimatter asymmetry observed in the Universe
- differences between the flavour interactions of strange, charm, beauty quarks
- study of rare or forbidden by the SM processes and understand why they can have discovery potential far beyond the energy frontier

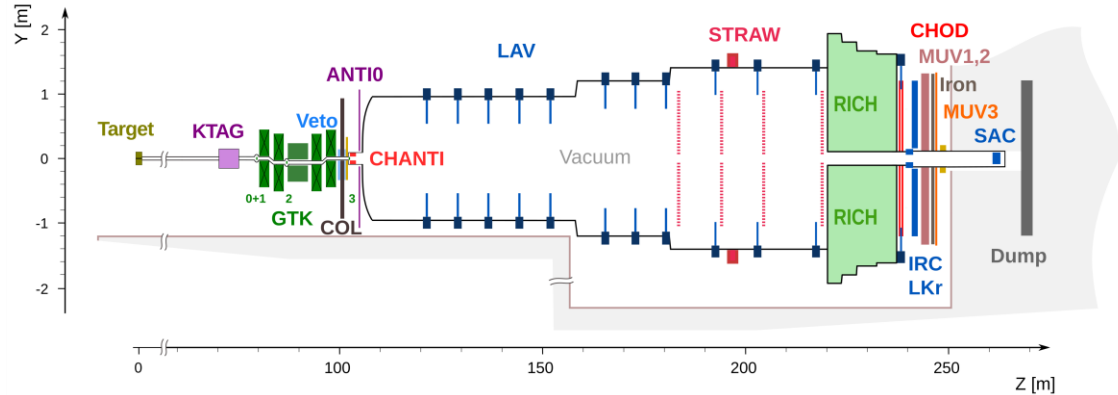
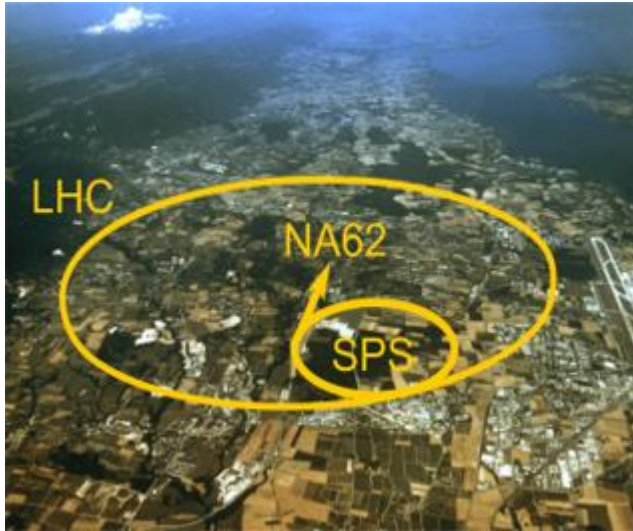


### Loop processes



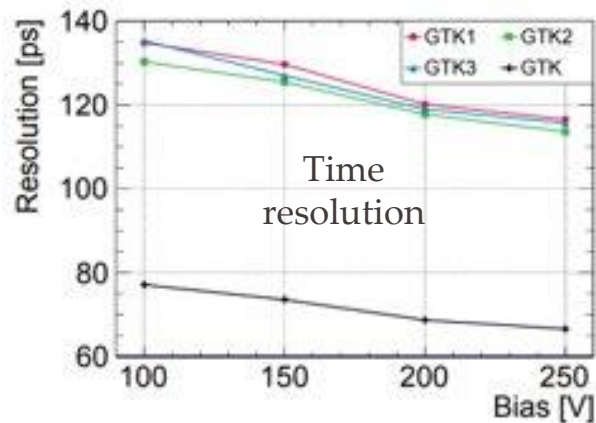
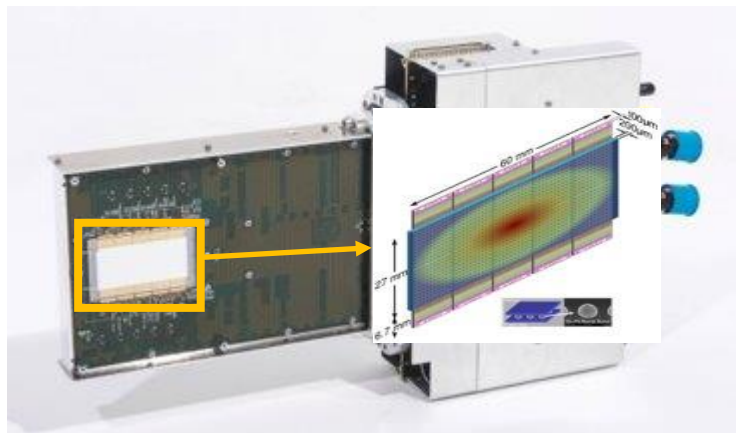
### New Physics?





- Fixed-target flavour physics experiment at the CERN SPS studying kaon decays
- Main goal: measurement of one of the golden modes of flavour physics  $K^+ \rightarrow \pi^+ \bar{\nu} \nu$ 
  - $BR(K^+ \rightarrow \pi^+ \bar{\nu} \nu) = (8.4 \pm 1.0) \times 10^{-11}$
- Broader physics program: rare/forbidden kaon decays and searches for exotic particles
- LPHE has a strong involvement in NA62: operation, tracking, physics analysis





- LPHE is responsible for the GigaTracker (GTK) detector
  - silicon pixel tracker providing 4D track reconstruction
  - operating at very large particle rates (~750 MHz of particles)
  - one of the most crucial detectors in NA62 used for tracking and background suppression
- Performance studies and operational aspects using data collected after 2021
  - effects of intensity on the detector (time resolution, sensor irradiation, track reconstruction efficiency, etc.)
  - calibration of the detector (pixel-by-pixel time calibration, alignment, etc.)

