Particle physicists study Nature at its most fundamental level by observing particle collisions. By understanding the properties of the various types of particles and the forces that govern their interactions, we learn about the origins of the Universe itself.

Skills you learn

Get deeper insight into the standard model of particle physics and search for new physics

Learn the most advance analysis tools: artificial neural networks, multivariate analysis techniques, deep learning

Acquire many software skills: data analysis tools (ROOT), programming (C++, Python), distributed computing (GRID), statistical analysis tools

Design and develop new type of detectors: operate and calibrate the most sensitive detectors of the LHC

Work and collaborate in an exciting international collaboration!

THERE ARE MANY AVAILABLE RESEARCH PROJECTS IN ALL THESE AREAS WITH 3-12 MONTHS DURATION

MORE INFORMATION AT
HTTP://WWW.PHYSIK.UZH.CH/GROUPS/CMS
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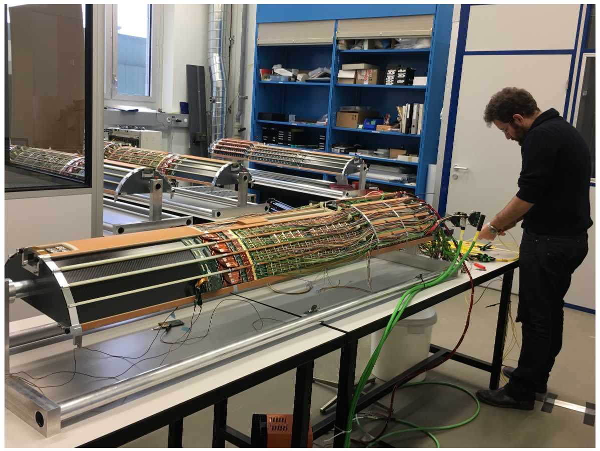
Experimental Particle Physics at CMS

Bachelor and Master Projects 2021-22

Detector development

The physics analyses of our group are only possible due to a superbly working detector, as well as sophisticated triggering, and software reconstruction. Our groups are major contributors to the CMS inner tracking detector (silicon pixel detector), which takes 65 Megapixel images of each LHC collision, at a rate of 40 million times per second. This precision tracker identifies particles that travel less than a millimeter before decaying with 30-micrometer precision. This enables the measurement and search for particles that decay to b quarks and tau leptons, such as the Higgs boson, the top quark, and leptoquarks. We have helped build the currently operating detector, which was installed in 2017, and we are calibrating and operating this system as we prototype a new, improved version with more tracking layers, less material, and higher data rates to be installed in 2024.



Searches for new physics

We search for signatures of extra spatial dimensions and new strong interactions that could mean some of our "fundamental" particles are really composite objects of new particles.

Top quarks, Higgs boson

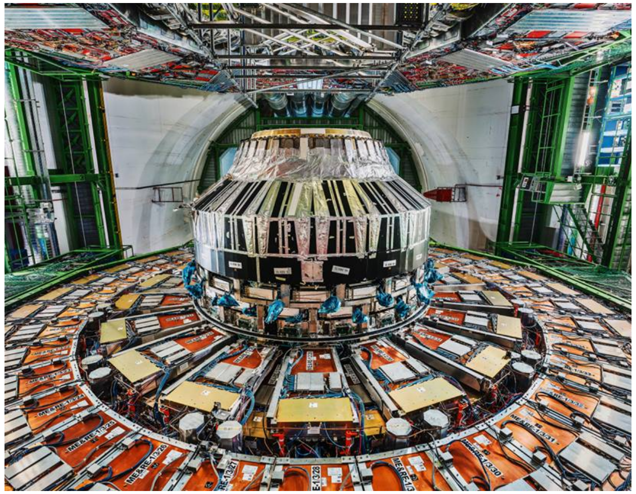
Our group performs in-depth investigations of the top quark properties the most massive particle known to exist, and its relationship with the Higgs boson.

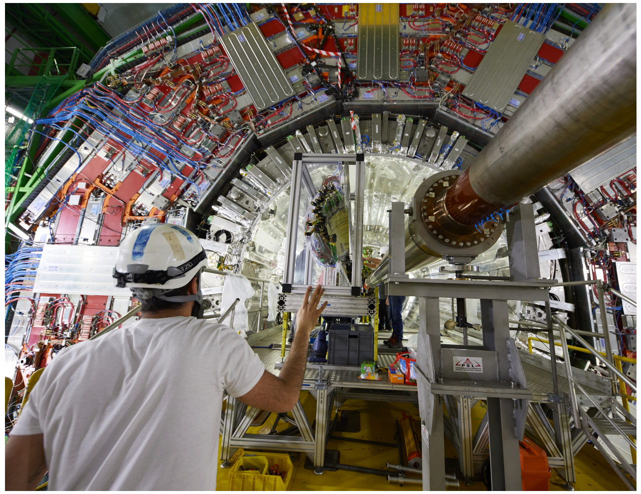
Third generation

The third generation of particles includes the top quark, but also the tau lepton and the b quark. These particles have the most complex decays, and may also be the first to reveal new physics.

Dark matter

Dark matter particles are predicted by many theories to be able to be produced at the LHC. Our group searches for evidence of dark matter candidates with the CMS data.





Collider Physics

We focus on the big questions of particle physics using the CMS experiment at the Large Hadron Collider (LHC) at CERN, a large laboratory underneath Switzerland and France. In the LHC, two proton beams are accelerated to energies of 6.5 Tera-electron volts (TeV), and are brought into collision in the center of the CMS detector about 40 million times per second. The detector consists of several layers of sub-detectors, each of which is optimized for the detection and measurement of one or more particles produced in the collisions. We are able to detect the decays of "long-lived" particles whose lifetimes are only a few picoseconds (10^{-12} seconds). One can then reconstruct the decays of heavier, short-lived particles starting from these long-lived particles.

The CMS experiment has the capability to search directly for new particles, beyond the standard model, which can appear as bumps or resonances in the mass distribution of their expected final state particles.