The European Organization for Nuclear Research (CERN) hosts the biggest particle accelerator in the world, the Large Hadron Collider (LHC). The LHC has four collision points, where particle detector assemblies are placed to track and measure the outcome of the primary collision. Among these, the Compact Muon Solenoid (CMS) Experiment, composed of several types of particle detectors, including gaseous detectors, used to detect and track Muons in the outmost layers of the detector complex. One of the detector technology used are the Resistive Plate Chambers (RPCs), present in the CMS Experiment since Run 1 with around one thousand chambers installed over the full surface of the experiment.

The RPCs make use of a particular gas mixture, composed of R134a (95.2%), iC4H10 (4.5%) and SF6 (0.3%). The aim of the gas system is to deliver such a mixture with precise composition, pressure and flow to ensure high detector performance. Given the significant volume of the detectors and gas system, the 90% of the gas flow is recirculated while the 10% is exhausted in the atmosphere. However, the main component of the gas mixture – R134a –, is characterized by a high Global Warming Potential (GWP, ~ 1430). As CERN is taking steps to reduce its Greenhouse emissions, one of the strategies to reduce the emission from particle detectors can be recuperating the gas that would be exhausted in the atmosphere. Therefore, in 2020 the campaign for R134a recuperation has started.

In the past 2 years, a first prototype of the R134a recuperation system was built and tested to study the feasibility and the efficiency of the separation and recuperation processes. The recuperation plant takes advantage of distillation processes to separate R134a from the other gases taking into account that R134a and iC4H10 form an azeotrope mixture. Currently, the construction and commissioning of the full-scale recuperation system is foreseen for November 2022, to be tested and operational in the CMS experiment during the first months of 2023.

The student participating to the project will have the opportunity to work on the following activities during the 6-month internship:

- Studies on tests performed on the prototype by the previous students
- Studies on the integration of the recuperation plant with the CMS RPCs gas system for re-using the recuperated gas
- Construction of the recuperation plant, interfacing with specialized technicians (mechanics, welders and electricians)
- Tests on final system efficiency and reliability
- Commissioning and monitoring of the system operation