HIP SUMMER JOBS IN 2025
INTERNATIONAL OPPORTUNITIES AT CERN AND AT ESRF

Research domain	**1. Higgs physics at the LHC**
Number of employees	1
Job description	Data analysis in the context of searching for a charged Higgs boson in CMS
Preferred student profile	Person interested in experimental particle physics.
Special skills required	Basic knowledge of particle physics, computing skills, familiar with UNIX/Linux environment, OO-programming in C++ and python.
Training period	1.6. - 31.8.2025
Contact person	Sami Lehti, supervisor Tel. +358 50 448 5621/+41 22 767 8595 Email: sami.lehti@cern.ch

****

Research domain	**2. Jet physics at the LHC**
Number of employees	1
Job description	Data analysis of jets (sprays of particles produced by quarks and gluons) produced in the high energy collisions in CMS experiment. We will use Monte Carlo simulations and high energy collision data to extract high-precision calibrations for light quark, gluon and bottom quark jets. These results are used for precise top quark mass and strong coupling constant measurements in order to better understand vacuum metastability.
Preferred student profile	Physics or applied/engineering physics student; three years or more of studies; interest to proactively work in a truly international team of researchers.
Special skills required	Programming experience, preferably c/c++; familiar with UNIX/linux
Training period	1.6. - 31.8.2025 (or as agreed)
Contact person	Mikko Voutilainen, supervisor Tel. +358 2 941 50565 Email: mikko.voutilainen@cern.ch

****

Research domain	**3. Higgs physics with boosted jets at the LHC**
Number of employees	1
Job description	By studying proton-proton collisions where two Higgs bosons are produced together, we can obtain valuable information about the Higgs potential and how the Higgs boson interacts with other particles. In this project, modern data analysis techniques, including machine learning (ML) tools, are applied to improve the sensitivity and/or extend the range of these "di-Higgs" measurements. The student will learn the basics of data analysis tools used in experimental high-energy physics, and contribute to the ongoing research as part of an international research team.
	Depending on the interests and competencies of the student, possible contributions include:
	(1) improving the event classification algorithms to better identify di-Higgs events,
	(2) modifying an existing di-Higgs analysis to search for new exotic signatures, such as heavy resonances, or
	(3) designing ultrafast FPGA-based preselection algorithms to identify di-Higgs events during future LHC runs.
Preferred student profile	Physics, data science, or computer science student curious about particle physics, preferably with three years of studies or more. Good communication skills and a proactive attitude are beneficial when working in an international research environment.
Special skills required	Familiarity with Linux/UNIX environment. Basic skills in Python, C++, or both. Experience in software development or ML is a plus
Training period	1.6. - 31.8.2025 (exact dates are negotiable)
Contact person	Santeri Laurila, supervisor Tel. +358 44 2630 995 email: Santeri.laurila@cern.ch

****

Research domain	**4. Data-based PF hadron calibration for the CMS experiment**
Number of employees	1
Job description	The CMS particle-flow (PF) algorithm aims to identify and reconstruct individually all of the particles produced in a collision, through an optimal combination of the information from the

entire detector. These particles are then used to build higher-level physics objects, such as jets, and the missing transverse momentum, with superior resolution.

The reconstructed charged and neutral hadrons' energies are calibrated to the energy scale of charged pions obtained from simulated data. For this project, the student will have the opportunity to extend the current PF calibration by developing a data-based calibration analysis to correct the energy scale differences between simulation and data

Preferred student profile	Physics, data science, or computer science student with an interest in particle physics, preferably with three years of studies or more. You should be ready to take your own initiative and communicate with other stakeholders at CERN.
Special skills required	Familiarity with Linux/UNIX environment. Decent programming experience, preferably with python and C++. Experience in software development is a plus.
Training period	1.6. - 31.8.2025 (exact dates are negotiable)
Contact person	Henning Kirschenmann, supervisor Nurfikri Norjoharuddeen, supervisor Tel. +358 2 941 50564 Email: henning.kirschenmann@cern.ch nurfikri.bin.norjoharuddeen@cern.ch

****

Research domain	**5. Vector boson scattering and [quantum] machine learning**
Number of employees	1
Job description	Vector Boson Scattering (VBS) processes at the Large Hadron Collider offer a pathway to test the symmetry-breaking mechanism in the Standard Model (SM) of Particle Physics. Measurements of these processes are difficult due to their low rate of production and the large rate of background processes which can mimic the signature of VBS processes. Our group is actively involved in analysing CMS data to measure VBS processes in final states involving hadronically decaying vector bosons. The student will be able to contribute to the analysis in the following possible topics:

1) Background prediction and suppression: Investigate new approaches to predict and suppress the background processes.

2) Vector-boson polarization identification: Develop and validate new techniques to identify jets from hadronically decaying vector bosons of different polarization states.

In either of the topics, you may explore various machine learning approaches, including emerging quantum algorithms, to reach optimal performance.

Preferred student profile	Physics, data science, or computer science student interested in particle physics, preferably with three years of studies or more. You should be ready to take your own initiative and communicate with other stakeholders at CERN.
Special skills required	Familiarity with Linux/UNIX environment. Programming experience, preferably with C++ and python. Experience in software development and [quantum] machine learning algorithms are appreciated.
Training period	1.6. - 31.8.2025 (exact dates are negotiable)
Contact person	Henning Kirschenmann, supervisor Nurfikri Norjoharuddeen, supervisor Tel. +358 2 941 50564 Email: henning.kirschenmann@cern.ch nurfikri.bin.norjoharuddeen@cern.ch

****

Research domain	**6. Operation and Calibration of CMS Experiment at LHC**
Number of employees	1
Job description	Calibration is a key element for success in cutting-edge scientific measurements and research. In this summer job, the student will learn aspects of jet calibration at the CMS detector and will participate efforts of our team in developing automatic jet calibration for the promptly reconstructed data of the CMS experiment. This works aims to provide nearly up-to-the-minute conditions, making possible efficient monitoring as well as high-quality physics analyses quickly after data-taking.
Preferred student profile	Physics or applied/engineering physics student; three years of studies (or more); interest to proactively work in a truly international team of researchers.
Special skills required	Programming experience, preferably c/c++ and python; experience with git and software development tools is appreciated.
Training period	1.6. - 31.8.2025 (or as agreed)
Contact person	Tapio Lampén, supervisor Tel. +358 2 941 50597 Email: tapio.lampen@cern.ch

****

Research domain	**7. Research and development for instrumentation in nuclear and material physics at ISOLDE**
Number of employees	1 - 2
Job description	**Project 1:** Improving analysis tools for experiments with the Miniball gamma-ray spectrometer

Project 1: Improving analysis tools for experiments with the Miniball gamma-ray spectrometer
The Miniball gamma-ray spectrometer, which comprises eight modules of three high-purity germanium crystals clustered together, is used to investigate structural properties of radioactive nuclei produced at the ISOLDE facility at CERN. In this project, the student will analyze in-beam data previously acquired at Miniball with the objective of implementing different analysis procedures and characterizing their impact on the data quality. Moreover, the student will have the opportunity to participate in physics experiments, measuring the properties of exotic nuclei by taking shifts and performing online data analysis. The project will require basic programming experience with C++ and ROOT and, preferably, knowledge of detection techniques.

Projects 2: Alpha-decay spectroscopy at CERN-MEDICIS
CERN-MEDICIS is a dedicated isotope mass separation facility hosted in the ISOLDE class A laboratory for non-conventional radionuclides dedicated to biomedical research. Important part of the programme is to assess the ion implantation rate and radionuclidic purities of the collected samples for generators of alpha emitters of complex progeny chains, such as Ra-223, Ra-224 and Ra-225, that decay into important treatment medical isotopes Ac-225 and Pb-212. The project will consist in the investigation with a dedicated silicon detector and measurement chain of different tests samples to establish detection limits and activity conversions factors along ion collection times.

Project 3: Beta-gamma angular correlations from laser-polarized radioactive beams at VITO
The setup is used for polarizing nuclear spins with laser light and then using the polarized nuclei for a versatile research program ranging from nuclear physics to chemistry and biology. In this project, the student will assist in the assembly of a setup for angular correlations between beta and gamma radiation emitted by polarized beams. Beta and gamma detectors will be mounted and tested with sources, before possible tests with polarized beams.

.

Project 4: Decay spectroscopy experiments of exotic nuclei
The ISOLDE Decay Station (IDS) is a flexible and versatile array of gamma, charged-particle and neutron detectors used for beta-decay spectroscopic studies of the low-energy radioactive beams delivered by ISOLDE. The present project aims to implement the

upgraded mechanical support frame geometry of IDS in to the Geant4 simulation package. The HPGe, LaBr3(Ce) detectors and the SPEDE spectrometer will be characterized using calibration sources and compared with existing simulations. Finally, the detectors will be virtually placed within the new mechanical frame and the absolute detection efficiency curves will be simulated for various geometries. The project will require basic knowledge of detection techniques and, optionally, programming experience with C++ and ROOT.

Preferred student profile	In general, these project are aimed for third year students with basic courses in physics and interest to work in a laboratory environment with an international team of researchers. Students that like experimental physics, assembling and testing of experimental new equipment at the hardware level are preferred.
Training period	1.6. - 31.8.2025 (flexible)
Contact person	Janne Pakarinen Tel. +358 40 805 4900 Email: janne.pakarinen@jyu.fi The individual projects will be supervised by local researchers within ISOLDE.

****

Research domain	**8. Discovery physics with CMS-TOTEM at the LHC**
Number of employees	1
Job description	A rather novel way to search for new physics phenomena is by detecting intact protons scattered only very little in the proton-proton collision and combine their information with particle systems measured using the central part of the experiment. The task would be to participate in physics analysis of the data taken with the CMS and TOTEM experiments at the Large Hadron Collider (LHC) focusing on physics signals containing very forward protons. The work will consist of analysis of real data together with simulating corresponding processes with dedicated software.
Preferred student profile	Physics (or physics interested computer science) student eager to learn new things.
Special skills required	Basic programming skills are necessary, knowledge of Python is recommended. Knowledge of C++ and/or data analysis framework ROOT is a plus. Basic knowledge of statistical methods and data analysis is also an advantage.
Training period	1.6. - 31.8.2025 (the dates are flexible)

Contact persons	Kenneth Österberg, supervisor Tel. +358 50 522 5166 Email: kenneth.osterberg@helsinki.fi

****

Research domain	**9. R & D of gaseous detectors**
Number of employees	1
Job description	Generic development and testing of Micro Pattern gaseous detectors. Hands-on in gaseous detectors, including laboratory tests. A core task will be to perform test of a Gas Electro Multiplier based Time Projection Chamber (GEM-TPC) using as a readout a TimePix chip, and, to carry out the analysis of the data collected.
Preferred student profile	Physics Student – with interest interaction of radiation with matter, some elementary knowledge of electronics and programming.
Special skills required	Master student with basic knowledge of interaction of radiation with matter, programming C++, statistics methods, and electronics and very well motivated to work in a multicultural environment.
Training period	1.6. - 31.8.2025
Contact person	Francisco García, supervisor Tel. +358 50 559 9570 Email: Francisco.Garcia@helsinki.fi

****

Research domain	**10. Experimental particle physics in ALICE**
Number of employees	1 - 2
Job description	We offer a summer trainee position within the ALICE experiment where the main goal is to study the deconfined QCD matter produced in relativistic lead-lead collisions at the LHC. The selected candidate will participate into data analysis or to ALICE detector upgrade work. In the data analysis, the candidate can participate to analysis of the collective behavior of the strongly interacting matter created in various collision systems or study heavy flavored jets with the new pp data measured by ALICE. In the detector performance studies, the candidate would participate into the new forward calorimeter (FoCal) upgrade of the ALICE experiment.
Preferred student profile	Physics student who has studied basics of particle physics

and is interested in data-analysis.

Special skills required:	Programming skills (C/C++) and basic knowledge of Linux help in getting into work. Prior experience in using the ROOT data analysis framework is appreciated but not required.
Training period	1.6. - 31.8.2025

Contact person	Sami Räsänen, supervisor Tel. +358 40 805 4725 Email: sami.s.rasanen@jyu.fi	DongJo Kim, supervisor Tel. +358 50 313 7868 Email: djkim@cern.ch

****

Research domain	**11. Mechanical engineering (Design, Manufacture, Testing)**
Number of employees	1
Job description	Design, manufacture, measurements and testing of structures and/or cooling circuitries for the upgrade of CERN's CMS experiment. A new high-precision tracking detector is being constructed in carbon composite materials, light metals, plastics, thin-walled cooling pipes and two-phase CO_2 cooling system. The trainee will work in a multi-disciplinary team in the CERN EP-DT group, https://ep-dep-dt.web.cern.ch/. Depending on the trainee's profile and interests, the tasks will consist of one or several amongst the following areas: CAD modelling and drawing preparation, engineering calculations, part manufacture, assembly, quality control and testing of equipment, 3D geometry measurements, setting up and making thermal performance tests. Note: After the trainee period there may be further job opportunities in the groups working in the CMS tracker project.
Preferred student profile	University students in mechanical engineering. The tasks will be chosen and tuned following the study background, experience and interests of the trainee.
Training period	3 months, 1.6. - 31.8.2025 (the exact dates can be adjusted)
Contact person	Antti Onnela, supervisor, CERN EP-DT Tel. +41 75 411 0673 Email: antti.onnela@cern.ch

****

Research domain	**12. Open data in use**
Number of employees	1 - 2
Job description	The HIP Education and Open Data project promotes the use of authentic scientific data in teaching at the high-school level. We

provide resources, including Jupyter notebooks, that utilize open data from the CMS experiment and other sources. Examples are provided in the material bank at https://opendata-education.github.io/index

Preferred student profile	Physics, Mathematics or Natural Science teacher student with interest in open data and education
Special skills required	Familiarity with Python or other programming languages. Knowledge of git is an advantage but can be learned during the traineeship. Proficiency in Finnish
Training period:	26.5. - 25.8.2025 (or as agreed)
Contact person:	Kati Lassila-Perini, supervisor Tel. +41 22 767 9354 Email: kati.lassila-perini@cern.ch

****

Research domain	**13. Research at the European Synchrotron Radiation Facility ESRF (www.esrf.eu)**
Number of employees	1
Job description	An opportunity to participate in exploratory research at the European Synchrotron Radiation Facility in Grenoble, France The intern will perform resonant inelastic X-ray scattering experiments using world leading synchrotron light source and beamline for selected compound semiconductor materials (e.g. GaAs). The aim of the project is to investigate the coupled motion of the electrons and the nuclei with resonant inelastic X-ray scattering at the beamline ID20 (https://www.esrf.fr/home/UsersAndScience/Experiments/EMD/ID20.html). The primary tasks are to perform the experiments and data analysis under the guidance of the beamline staff.
Preferred student profile	The project is perfectly suited for a M.Sc. thesis topic and aims to a peer-reviewed international publication.
Training period	1.6. - 31.8.2025 (or as agreed)
Contact person	Simo Huotari, supervisor Tel. +358 2941 50638 Email: simo.huotari@helsinki.fi The individual projects will be supervised by local researchers at ESRF