HELSINKI INSTITUTE OF PHYSICS

HIP SUMMER JOBS IN 2026

INTERNATIONAL OPPORTUNITIES AT CERN AND AT ESRF

1. Higgs physics at the LHC
2. Jet physics at the LHC
3. Di-Higgs physics with boosted jets at the LHC
4. Vector boson scattering and [quantum] machine learning
5. Jet calibration for CMS Prompt data
6. Characterisation of detectors for particle physics experiments
7. Research and development for instrumentation in nuclear and material physics at ISOLDE
8. Discovery physics with CMS-TOTEM at the LHC
9. R & D of gaseous detectors
10. Experimental particle physics in ALICE
11. Mechanical engineering (Design, Manufacture, Testing)
12. Technology Programme, Academia-Industry Collaboration
13. Automated workflows for open data
14. Design and optimisation of compact synchrotron for medical applications
15. Research at the European Synchrotron Radiation Facility ESRF (www.esrf.eu)

Updated 28.11.2025

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. – 31.8.2026
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 study detailed properties of 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. - 31.8.2026 (or as agreed)
Contact person	Mikko Voutilainen, supervisor Tel. +358 2 941 50565 Email: mikko.voutilainen@cern.ch

Research domain	**3. Di-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 classical machine learning (ML) or quantum computing (QC) algorithms, are applied to improve the sensitivity and/or extend the range of these "di-Higgs" measurements. The student will learn the basics of data formats and software 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 skills of the student, possible contributions include:

(1) benchmarking and improving ML-based collision event classification algorithms to better identify di-Higgs events,
(2) applying QC methods or quantum-inspired classical algorithms such as tensor networks in di-Higgs data analysis,
(3) studying compression techniques for ultrafast FPGA-based ML models to preselect di-Higgs events in future LHC runs.

Preferred student profile	Physics student with strong computer/data science skills, or vice versa, 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 and good skills in Python. Some experience with C++ and with git(hub) helps. Depending on the project, knowledge of standard ML libraries, QC methods and tools, or edge ML techniques, is a bonus.
Training period	1.6. - 31.8.2026 (exact dates are negotiable)
Contact person	Santeri Laurila, supervisor Tel. +358 44 2630 995 Email: Santeri.laurila@cern.ch

Research domain	**4. 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. - 31.8.2026 (exact dates are negotiable)
Contact person	Henning Kirschenmann, supervisor Tel. +358 2 941 50564 Email: henning.kirschenmann@cern.ch Nurfikri Norjoharuddeen, supervisor Email: nurfikri.bin.norjoharuddeen@cern.ch

Research domain	**5. Jet calibration for CMS Prompt data**
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. - 31.8.2026 (or as agreed)
Contact person	Tapio Lampén, supervisor Tel. +358 2 941 50597 Email: tapio.lampen@cern.ch

Research domain	**6. Characterisation of detectors for particle physics experiments**
Number of employees	1

Job description

Detectors are essential for general particle physics experiments such as CMS. You will experiment with state of the art detectors for sensing ionising radiation. Examples of possible study projects are: radiation hardness of Low Gain Avalanche Detectors (LGAD) for precise time of arrival measurements; properties of sensors made of Magnetic Czochralski silicon; studying performance of hybrid silicon pixel modules for operation in non-uniform radiation fields. The actual topic depends on R&D interest of our research group at the time of the internship next summer.

Preferred student profile	Physics student (third year and beyond) interested in instrumentation for experimental particle physics.
Special skills required	Basic knowledge of particle physics, computing skills, familiar with UNIX/Linux environment, C++ or python skills for data analysis. Knowledge of structure of matter and electronics is of advantage. Experience of working with laboratory devices such as usage of oscilloscopes or data acquisition systems is an asset.
Training period	1.6. - 31.8.2026
Contact person	Erik Brücken, supervisor Tel. +358 50 448 5617 Email: jens.brucken@helsinki.fi Panja Luukka, supervisor Email: panja.luukka@lut.fi

Research domain	**7. Research and development for instrumentation in nuclear and material physics at ISOLDE**
Number of employees	1-2

Job description

Project 1: 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 2: 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 tests of the new digital data acquisition system using beta and gamma sources, and possibly also PET isotopes provided by the Geneva hospital. This will involve operating the DAQ and detector electronics and some programming in ROOT and C++, and possibly also simulations in Geant4.

Project 3: 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 projects 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.
Special skills required	-
Training period	1.6. - 31.8.2026 (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 detected with so-called Roman Pots. 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. - 31.8.2026 (the dates are flexible)
Contact person	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 tests of a Gas Electron Multiplier based Time Projection Chamber (GEM-TPC) using as a newly developed MaxiRoc Front-end concentrator for the readout of the VMM3a chip, and, to carry out the analysis of the data collected. Under the supervision of several experts from the Gaseous Development Detector (GDD) laboratory.

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. - 31.8.2026
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

ALICE experiment at CERN LHC investigates the properties of deconfined QCD matter, the quark-gluon plasma (QGP), created in relativistic heavy-ion collisions. We offer an opportunity to contribute either to data analysis or to detector upgrade and performance studies.

Data analysis: You would take part in ongoing analyses of the collective behavior of the QGP or the properties of heavy-flavor jets, using experimental data from ALICE.

Detector development: You would participate in the Forward Calorimeter (FoCal) upgrade project, which aims to enable studies of so-called gluon saturation phenomena.

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. - 31.8.2026
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 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 CO2 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, high-resolution 3D geometry measurements, pipework pressure and leak tests, thermal performance measurements.
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.
Special skills required	-
Training period	3 months, 1.6. - 31.8.2026 (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. Technology Programme, Academia-Industry Collaboration**
Number of employees	1

Job description

The Technology Programme is one of the major research programs of Helsinki Institute of Physics (HIP). Our focus areas are Accelerator technologies, Materials for accelerators and other big science installations, Radiation detection technologies as well as Academic and Industrial collaboration.

High-temperature superconductor (HTS) cables can carry large electric currents without resistive losses. Using HTS cables in future accelerator magnets can provide higher performance and lower operational cost than low-temperature superconductors (LTS). One of the unsolved problems with HTS cables is their protection from overheating in case of a quench, which means that the material loses its superconducting state and starts to generate resistive losses. It is more difficult to detect a quench in HTS cables than in LTS cables because the quench initiation and propagation are slower and the measurable resistive voltage increases slowly. This project focuses on numerical simulations of HTS cables. The student performs parametric analyses of quench initiation and propagation in HTS cables with different configuration and composition, followed by a multivariate analysis of the results. The goal is to understand the correlation between quench characteristics and cable design variants.

Preferred student profile	MSc student majoring in Electrical engineering. Interested in in international R&D&I projects.
Special skills required	Good communication skills in English. Independent, analytical mind-set, and systematic way of working. Experience in computational physics and Python, Matlab or a similar tool is an advantage.
Training period	1.6. - 31.8.2026 (some flexibility on dates possible)
Contact person	Tiina Salmi, Academy Research Fellow Tampere University Tel. +358 40 849 0415 Email: tiina.salmi (at) tuni.fi Luca Bottura, Senior Staff, Applied Physicist/CERN Email: luca.bottura (at) cern.ch

Research domain	**13. Automated workflows for open data**
Number of employees	1

Job description

The HIP Open Science in Research and Education project promotes the reusability of open data from the CMS experiment. The task consists of defining standard workflows for commonly expected end-user tasks: such as enriching the slimmest open data format with user-specific variables from the larger, or generating new simulated data compatible with released collision data. These workflows can be used as a proof of principle for available open science resources, such as EOSC (European Open Science Cloud) computing nodes.

Preferred student profile	Physics, or Data science student with interest in open science and automated workflows
Special skills required	Familiarity with Python or other programming languages. Knowledge of git and software container technology is an advantage but can be learned during the traineeship.
Training period	1.6. – 31.8.2026 (or earlier if convenient)
Contact person	Kati Lassila-Perini, supervisor Tel. +41 22 767 9354 Email: kati.lassila-perini@cern.ch

Research domain	**14. Design and optimisation of compact synchrotron for medical applications**
Number of employees	1

Job description

The Next Ion Medical Machine Study (NIMMS) collaboration at CERN develops advanced accelerator technologies for cancer therapy with ions, one of its main objectives being to reduce the size of the accelerator structures. HeLICS (Helium Light Ion Compact Synchrotron) is a novel synchrotron design developed within NIMMS for acceleration of protons and light ions, in particular alpha particles. In this project, charged-particle optics design tools, such as Xsuite, are used to simulate the beam dynamics of HeLICS. The selected candidate will assist in optimizing the design of the accelerator and propose improvements based on various constraints, such as available space, beam dynamics and aperture requirements. The student will have the opportunity to familiarize themselves with the concepts of accelerator physics and particle beam dynamics, as well as Python programming and the use of simulation tools, while contributing to the ongoing research work of an international research group.

Preferred student profile	University student in physics or applied/engineering physics interested in accelerator physics or medical physics and motivated to work with an international team of researchers.
Special skills required	Familiarity with Python or other programming languages. Elementary knowledge of accelerator physics is appreciated but not required.
Training period	1.6. - 31.8.2026 (or as agreed)
Contact person	Heli Huttunen Tel. +358 44 0242 971 Email: heli.huttunen@cern.ch

Research domain	**15. 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. We propose two alternative topics to choose from depending on your interest.
1) Developing a new inverse-problem related data-analysis method for a novel x-ray imaging method based on multi-analyser X-ray Raman scattering experiments, in close collaboration with the ESRF Algorithm and Data Analysis group. The data originate from measurements of scattering from a sample by a focused “pencil”-shaped x-ray beam, while several individual detectors collect hyperspectral data cubes from different directions (Huotari et al., Nature Mater. 10, 489 (2011).
2) Participating in preparation and conducting experiments to probe the element-specific chemistry in artificial solid-electrolyte interphase in an electrochemical cell. We focus on lithium-mediated nitrogen reduction reaction (LiNRR) is an electrochemical process that converts nitrogen gas into ammonia, using electrodeposited lithium metal as a catalyst. We will investigate the role of an artificial solid-electrolyte interface with a hypothesis that it will supress organic electrolyte degradation.

Website of the site of research:
https://www.esrf.fr/home/UsersAndScience/Experiments/EMD/ID20.html

Preferred student profile	The project is perfectly suited for a M.Sc. thesis topic and aims to a peer-reviewed international publication.
Special skills required	-
Training period	1.6. - 31.8.2026 (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