HIP SUMMER JOBS IN 2019

INTERNATIONAL OPPORTUNITIES AT CERN AND AT ESRF

Research domain	1. Higgs physics at the LHC
Number of employees	1 - 2
Job description	Data analysis in the context of searching for a charged Higgs boson in CMS and/or Collaboration within the LHC Higgs Cross Section Working Group.
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. - 31.8.2019 (or as agreed)
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 OpenData and high energy collisions at 13 TeV to investigate the possibility of using jet composition for their high-precision calibration.
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. - 31.8.2019 (or as agreed)
Contact person	Kati Lassila-Perini, supervisor Tel. +41 22 767 9354 Email: kati.lassila-perini@cern.ch Mikko Voutilainen, supervisor Tel. +358 2 50565 mikko.voutilainen@cern.ch

****

Research domain	3. Track reconstruction with Machine learning
Number of employees	1
Job description	Reconstruction of charged-particle trajectories (tracks) is a crucial ingredient of the particle reconstruction software at the CMS experiment, both for physics analyses and in online selection (trigger). With machine learning techniques, useful correlations can be extracted from large amounts of high-dimensional data collected by the CMS and exploited in tasks like classification and regression. The summer student will participate in developing and implementing machine learning based solutions that enhance the CMS track reconstruction performance in the increasingly difficult high luminosity conditions of the detector. The project allows the student to combine unique particle collision data and simulations to the state-of-the-art machine learning techniques, with a high potential of producing improvements to the tools and methods used in the CMS collaboration.
Preferred student profile	Physics, computer science or engineering student interested in applying machine learning to real world research problems; interested in working in a truly international research environment.
Special skills required	C++ and python programming, familiar with linux/UNIX, basic physics knowledge
Training period	1.6. - 31.8.2019 (or as agreed)
Contact person	Joona Havukainen, supervisor Tel. +358 50 432 0606 email: joona.havukainen@cern.ch

****

Research domain	4. Research and development for instrumentation in nuclear and material physics at ISOLDE
Number of employees	1 - 2
Job description	Projects 1: Testing PMTs for COLLAPS Collinear laser spectroscopy, as performed at COLLAPS, is a versatile tool to study the structure, shape and size of radioactive nuclei. These nuclear properties are obtained by precisely probing the atomic hyperfine structure: lasers are used to induce transitions between hyperfine levels, after which the emitted fluorescence light is detected in single-photon sensitive photomultiplier tubes (PMTs). High quality PMTs, showing good efficiency in the UV range and low dark count rate, are therefore one of the key

components of the experimental set-up. However, the type of PMTs which are currently used at the COLLAPS degrade already after 1 week of operation. The goal of the proposed project is therefore to identify a better type of PMT by characterizing and testing the robustness of different types on the market.

Project 2: Collinear laser spectroscopy
Laser spectroscopy techniques provide powerful tools to extract valuable information of atomic and molecular structures. These experiments provide observables that are of great importance for the development of many-body methods in quantum chemistry, atomic and nuclear theory. This project will focus on the design and simulations of a new experimental method that aims for extending the collinear resonance ionization spectroscopy technique to light nuclei and molecular systems. During this project, the student will be involved in several laser spectroscopy experiments with stable species. Within the context of this work, the student will gain a basic knowledge of ion sources, ion beam optics, high vacuum technology and laser spectroscopy techniques.

Project 3: Tests, modification and characterization of the WISArD offline ion-source
WISArD is a dedicated setup at ISOLDE/CERN aimed to determine the coupling constants of the electro–weak interaction in the Standard Model. The idea is to measure the beta–neutrino angular correlation via the Doppler shift in the energy of the beta-delayed protons emitted in the ^{32}Ar decay. The radioactive argon sample will be accumulated constantly on a thin catcher foil placed in the center of a superconducting magnet. Argon will be produced far away from the implantation point and will be transported by means of ion-beam optics to the center of the magnet. Usually stable beams are being employed to perform optimal ion-beam transport. For this purpose an offline ion-source is installed at the WISArD setup. The student will work on improving the stability of the source and increasing the transmission to the final implantation point. The intership will provide general training in ion-beam optics and transport as well as ultra-high vacuum systems, operation of high-voltage systems and their integration in the WISArD control system.

Project 4: Implantation station for PAC experiments
Setup and off line tests of the new implantation station for Perturbed Angular Correlations experiments with short lived isotopes - PAC-SLI.

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. For project 4, knowledge of Arduino software and hardware is welcome as implementation of a motorized annealing furnace synchronized with the data taking system is foreseen.

Training period	1.6. - 31.8.2019 (or as agreed)
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	5. New physics searches with CMS/TOTEM at the LHC
Number of employees	1
Job description	A novel way to search for new physics phenomena is by detecting leading protons scattered only very little in the proton-proton collision and combine their information with the measurement of the central system with CMS. The task would be to participate in the physics analysis of the data taken with the CMS experiment at the Large Hadron Collider (LHC) and combine it with the leading proton measurement either by CMS or TOTEM. The work will consist of analysis of data or simulations related to such searches for new phenomena.
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 C++ and/or object oriented programming a big plus. Basic knowledge of statistical methods and data analysis is an advantage.
Training period	1.6. - 31.8.2019 (the dates are flexible)
Contact persons	Laurent Forthomme, supervisor Tel. +41 22 7674696 Email: laurent.forthomme@cern.ch Kenneth Österberg, supervisor Tel. +358 50 5225166 Email: kenneth.osterberg@helsinki.fi

****

Research domain	6. R & D of gas detectors
Number of employees	1

Job description	Generic development and testing of Micro Pattern gas detectors. Hands-on in detectors and studies of components and its characterization, including laboratory tests. A core task during this year will be dedicated to study of the performance of photocathodes used in gas-filled radiation detectors.
Preferred student profile	Physics Student – with interest in material science, programming and data analysis.
Special skills required	Basic knowledge of interaction of radiation with matter, programming, statistics methods and electronics and very well motivated.
Training period	1.6. - 31.8.2019 (or as agreed)
Contact person	Francisco García, supervisor Tel. +358 9 1915 1086 Email: Francisco.Garcia@helsinki.fi

****

Research domain	7. CLIC module
Number of employees	1
Job description	Position for a mechanical engineering summer trainee is available in the framework of the conceptual module design for future particle accelerator Compact Linear Collider (CLIC) located at CERN, Geneva, Switzerland. (http:/clic-study.web.cern.ch/) CLIC module is a two meter long assembly group containing all of the necessary subsystems for the potential future particle accelerator still in conceptual design phase. The best possible integration for the accelerating structure into the CLIC module, together with its connection to every sub-system needs to be guaranteed for proper functioning. The student will participate to R&D tasks of CLIC module and its subsystems conceptual design update. The work tasks are including drafting and design work of adjustable high precision systems, manufacturing optimisation or analysing the behaviour of such systems by the means of thermo-mechanical measurements and simulation. The exact job description will be adjusted to the interests and competences of the student.
Preferred student profile	Mechanical engineering (preferably 2 years or more). The student should be interested in challenging multidisciplinary product development.

Special skills required	3D CAD skills required, thermal/structural analysis skills advantage. (CATIA and ANSYS are used at CERN)
Training period	1.6. - 31.8.2019 (exact dates are negotiable)
Contact persons	Markus Aicheler, supervisor markus.aicheler@cern.ch Tel. + 41 22 766 2182 Jukka Väinölä, supervisor jukka.vainola@cern.ch Tel. +41 22 766 2174

****

Research domain	8. Experimental particle physics in ALICE I
Number of employees	1
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 lead-lead collisions in the ultra relativistic energy regime at the LHC. The selected candidate will participate in the data analysis in our group. We study the transport properties of the quark-gluon plasma (QGP), created in these collisions, trough flow fluctuation analysis. This analysis resembles harmonic analysis of cosmic microwave background, the early universe sound harmonics. Second main branch of the analysis is to study jet quenching in the expanding QGP to better understand how the jet looses energy during the dynamical evolution of the plasma. Student will work closely in ALICE analysis working ground and our PhD student stationed at CERN.
Preferred student profile	Physics student who has studied basic particle physics and is interested in data-analysis. Students who are interested in the machine learning and advanced coding skills.
Special skills required:	Programming skills (C/C++) and basic knowledge of Unix-like OS help in getting into work.
Training period	1.6. - 31.8. 2019 (or as agreed)
Contact person	

DongJo Kim, supervisor
Tel. +358 50 313
Email: djkim@cern.ch

Sami Räsänen, supervisor
Tel. +358 50 355 7082
Email: sami.s.rasanen@jyu.fi

Jan Rak, supervisor
Tel. +358 50 428 0812
Email: janrak@bnl.gov

****

Research domain	9. Experimental particle physics in ALICE II
Number of employees	1
Job description	We offer a summer trainee position within the ALICE experiment. ALICE studies the properties of matter at extreme temperatures. Such conditions are similar to those present shortly after the Big Bang and nowadays occur routinely during ultra-relativistic heavy-ion collisions at CERN. The accelerator complex and all LHC experiments, including ALICE, entered the Long Shutdown 2, a 2-year period of extensive upgrades. After the upgrade, ALICE aims at recording almost two orders of magnitude more collision events than during all previous runs combined. This requires significant improvements in detector hardware, readout electronics and data analysis software. Our group leads the Fast Interaction Trigger project. This detector will be used in ALICE for triggering, luminosity monitoring, event time and vertex position determination and reconstruction of event parameters related to collision geometry – multiplicity, centrality and event plane. Depending on individual skills and interests the selected candidate will be able to participate in the following FIT-related tasks - development of detector control system (C++) - development of online and offline data reconstruction and simulation software (C++) - data analysis - development of FPGA firmware (VHDL) - testing and characterization of FIT detector components The student will work closely with a member of our group, present at CERN during the training period.
Preferred student profile	Physics student who has studied basic particle physics and is interested in data analysis, detector control systems or embedded programming.
Special skills required	Programming skills (C/C++) and basic knowledge of Unix-like OS help in getting into work. VHDL programming skills or other experience in hardware or embedded systems programming would be an additional asset.
Training period	1.6. - 31.8. 2019 (or as agreed)
Contact person	Maciej Slupecki –maciej.slupecki@cern.ch Wladyslaw Trzaska – wladyslaw.h.trzaska@jyu.fi

****

Research domain	10. Mechanical engineering (Design, Materials, Production)
Number of employees	1
Job description	Mechanical engineering R&D on a particle tracking system for the upgrade of the CMS experiment, https://ep-news.web.cern.ch/content/new-paradigms-cms-phase-2-upgrades. That new tracker will comprise state-of-the-art composite materials, light metals, plastics and two-phase CO_2 cooling. The trainee will work in a multi-disciplinary team in the CERN EP-DT group, https://ep-dep.web.cern.ch/organisation/dt. Depending on the trainee's profile and interests, the tasks may consist of CAD design, structural/thermal (FE) analysis, manufacturing process design and/or conducting measurements on prototypes. Note: There may be further job opportunities (including Thesis work) in this project.
Preferred student profile	Technical University engineering student (Engineering Design, Engineering Materials, Production Engineering, Aeronautics, Applied Thermodynamics, Mechatronics, Instrumentation, etc.). The tasks will be chosen and tuned following the study background and interests of the trainee.
Training period	1.6. - 31.8.2019 (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	11. Technology Programme, Academia-Industry Collaboration 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.
Number of employees	1 - 2
Job description	Enhancing Helsinki Institute of Physics collaborative R&D&I activities at CERN, in particular with Knowledge Transfer Group and Idea Square teams. Analysing CERN knowledge and technology transfer platforms' functioning mechanisms and the related innovation ecosystems.

	Mapping R&D&I landscape around CERN and its collaborations. Analysing Societal Impact of large scientific research infrastructures like cost-benefit analysis and life cycle assessment and industrialisation. Participating in various roles in research projects at CERN.
Preferred student profile	Independent and hard-working, commercially oriented technical MSc student. Interested in creating and participating in international R&D&I projects and business ventures, involving academic and industrial partners. Good synthetizing and documentation skills in English are particularly needed.
Special skills required	Good written/spoken communication skills in English, knowledge of other languages, in particular French, an asset. On the wish list, experience in preparing project documentation and analytical mind-set. Good knowledge of MS-office tools required.
Training period	1.6. - 31.8.2019 (some flexibility on dates possible)
Contact person	Saku Mäkinen, PhD. Professor of Industrial Management, Tampere University of Technology Tel. +358 40 544 1088 Email: saku.makinen (at) tut.fi Pietari Kauttu HIP/CERN pietari.kauttu (at) cern.ch Tel. +41 75 411 1057

****

Research domain	12. Physics teacher student with interest in open data
Number of employees	1 - 2
Job description	The CMS experiment at the LHC at CERN has released high-level particle physics data for public use. Tools are being developed to make possible the use of these data in high-school and undergraduate education. We are looking for an enthusiastic student to generate ideas for teaching methods based on these open data and/or develop them further. Depending on the applicant profile, the task can consist either of defining a learning context and goal matching the Finnish high-school programme, or developing tools and user interfaces for an already defined

	learning target.
Preferred student profile	Physics or IT student with interest in teaching and education
Special skills required	Familiarity with and/or interest in online teaching
Training period:	1.6.-31.8.2019 (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 synchrotron light source ESRF (www.esrf.eu)
Number of employees	1
Job description	These projects will be done at the European Synchrotron Radiation Facility in Grenoble, France. ESRF is a highly sophisticated accelerator facility that produces high-energy x-rays with extremely high brilliance. The x-rays are used for studies in different fields in physics and materials science. Within the following projects the student will participate in the development of the new high-energy beamline for x-ray scattering and imaging, ID31 (http://bit.ly/2gxpC87). The scientific aim of the beamline is to study heterogeneous devices such as fuel cells, organic solar cells, rechargeable batteries, catalytic materials, etc. The beamline uses hard x-ray synchrotron methods for studying both real devices under operating conditions and idealized model systems under precisely controlled environments. Project (1): How the wood burn without oxygen? Analysis of a set of wood pyrolysis experiments where various wood samples were heated to high temperature in the absence of oxygen. Use of advanced X-ray diffraction analysis techniques (Pair Distribution Function, Rietveld analysis) to determine the key structural transformation in the process. This project falls into the field of environmental science. Project (2): Determination of Lithiation processes of battery electrodes (Li-ion batteries) and 3D tomography of running batteries and fuel cell. Data analysis of previous experiments on Si electrodes for next-generation Li-ion batteries. Students will learn the modern approaches for characterization of materials used for energy generation and storage

	Project (3): pyBIB - software tool for data visualization and analysis. The student will develop a python graphical software package for data visualization and analysis. The main building blocks will be taken from silx which is a custom library at ESRF. The student is expected to have a basic knowledge of python and will collaborate strongly with the data analysis unit. Project (4): Hydrogen generation from water. The student will design electrolyzer (device to generate hydrogen) which can be used for X-ray characterization of state of the art catalysts. This project falls into the category of scientific engineering.
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. The student should ideally have some experience in putting together basic experimental setups and handling of experimental data with tools such as Python numlib, Matlab, or Octave.
Training period	1.6. - 31.8.2019 (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.