SLAC Topics for Japanese Ozaki Exchange Program Students for Summer 2024

(John Seeman, editor)
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1) ATLAS ITk Pixel Inner System Assembly and QC:
(Dr. Charles Young, (young@slac.stanford.edu), SLAC Atlas Group)

ATLAS will replace its charged particle tracker with a new one, known as ITk, for the HL-LHC era. The Pixel Inner System made up of the innermost two layers is a US deliverable and will be assembled at SLAC. We have just gone through a thorough cost and schedule review. Prototypes are being assembled; they will be integrated into larger detector units; and quality control (QC) tests will be applied to ensure proper functionality. There are many opportunities for intellectual contributions at this pre-production stage and to participate in the assembly of a real-life experimental detector. Hands-on experience in a laboratory is helpful.

2) ATLAS Physics Analysis:
(Dr. Charles Young, (young@slac.stanford.edu), SLAC Atlas Group)

The SLAC ATLAS group is deeply invested in the study of the Higgs boson. Current activities include the search for Higgs boson decay to so far unobserved final states as well as the search for the production of two Higgs bosons in multiple final states. The student will work on one of these analyses with local researchers. Familiarity with computing tools such as Jupyter and Python are helpful.

3) MATHUSLA Proposal:
(Dr. Charles Young, (young@slac.stanford.edu), SLAC Atlas Group)

MATHUSLA is a new proposal to search for long-lived particles (LLP) at the LHC. The proposed detector has a footprint of 100 m x 100 m and will be located above ground near the CMS interaction point. MATHUSLA is in the design stage and there is a wide spectrum of studies available to the exchange student. Some examples of possible topics: One is the design of mechanical support for silicon photomultipliers (SiPM), and another is to use simulations to optimize detector layout. We will determine project details based on the student's interests and background.

4) Transverse Laser Fluctuations in Electron Photo-Injectors
(Dr. Nicole Neveu, (nneveu@slac.stanford.edu), SLAC Accelerator Physics Group)

The beam injector project is a study on how transverse laser fluctuations effect optimization results by finding a robust optimum by sampling a database of real laser images taken during

LCLS-II Injector Commissioning and using them as the initial distributions for the simulations. This would mostly be simulation work and working with recent VCC camera images. The student would learn about photo-injector beam dynamics and simulations. Python experience preferred, but they could also learn that as part of the project.

5) Neutrino Physics:

(Prof. Hirohisa Tanaka, (tanaka@slac.stanford.edu), SLAC Fundamental Science)

The SLAC neutrino group participates in several accelerator-based neutrino oscillation experiments, including T2K, MicroBooNE, ICARUS, and DUNE. The student would work on one of the activities of our group: 1. Development of algorithms to reconstruct neutrino interactions using modern machine learning techniques. 2. Neutrino detector development, particularly for the DUNE near detector 3. Development and testing of front end electronics for the DUNE far detector. In the next several months, the group is also expected to be active in looking at early data from the ICARUS detector, which will start operations at Fermilab.

6) Additive Manufacturing:

(Asst. Prof. Emilio Nanni, (nanni@slac.stanford.edu), Technology Innovation Directorate)

The topic covers 3D additive manufacturing of manufacturing of THz accelerating structures. The student would help use advance fabrication tools (Nanoscribe) to additively manufacture accelerating structures with nanometer scale precision. Perform measurements to test quality and performance of resonant structures. Gain experience in modern design and manufacturing techniques, understand novel concepts in accelerator physics.

7) Superconducting Thin Films:

(Asst. Prof. Emilio Nanni, (nanni@slac.stanford.edu) Technology Innovation Directorate)

The topic covers superconducting thin-film quantum transducers. The student would participate in the design and fabrication of superconducting thin film transducers to link resonators to quantum sensors. Develop new technologies in quantum transduction for dark matter searches.

8) Topics in High Power RF Generation:

(Prof. Sami Tantawi, Asst. Prof. Emilio Nanni, (nanni@slac.stanford.edu) Technology Innovation Directorate)

The student would work on one of the following:
a) Writing codes for finite element based simulations to model complicated RF sources that relay on novel beam wave interaction configurations
b) Help in the experimental setups of mm-wave measurements and quasi-optical components measurement.
c) Simulation of advanced plasma physics apparatus
d) Simulation of deposition systems for creating thin layers of superconducting materials.

e) Growth and characterization of superconducting thin films for high-power RF.

9) Particle Collider Physics:

(Prof. Michael Peskin, (mpeskin@slac.stanford.edu) Particle Theory Group)
The student would work on a topic related to a physics program of a e+e- or gamma-gamma collider at a center of mass energy above 10 TeV. The project could involve physics reactions or the beam-beam interaction in collisions. The student should have some practical knowledge of Feynman diagrams and quantum field theory.

10) Detectors and Sensors:

(Dr. Christopher Kenney, (kenney@slac.stanford.edu), Fundamental Science Directorate)

The student would help with one of the following projects:

a) Help design and/or test unique Low Gain Avalanche Diode pixel sensors.
b) Testing of novel, high-density interconnects at cryogenic temperatures.
c) Post processing and/or characterization of CMOS pixel sensors with thin entrance windows for full depletion.

11) LSST Camera Commissioning and Characterization, Vera Rubin Observatory

Prof. Aaron Roodman, Dr. Utsumi, Yousuke (youtsumi@slac.stanford.edu) , Fundamental Science Directorate)

A student would work with the team commissioning the LSST Camera on the Vera Rubin Observatory. Possible topics include:

1. Characterization and correction of CCD-level and Camera-level systematic effects on image quality, astrometry and photometry in commissioning or early operations of the Rubin Observatory
2. Analysis of In-dome and on-sky photometric calibration data for precision photometry
3. Point spread function characterization and estimation
4. Weak gravitational lensing shear estimation and systematics