T 44: Experimental Methods (general) 2

Time: Tuesday 16:15–17:45 Location: T-H29

T 44.1 Tue 16:15 T-H29

Particle identification with fast timing detectors at future Higgs factories — •Bohdan Dudar[1,2], Jenny List[1], and Ulrich Einhaus[1] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]Universität Hamburg, Hamburg, Germany

Future e^+e^- Higgs factory collider projects are designed for precision measurements of the Higgs boson and of electroweak observables, thereby utilizing every event to their full potential. The identification of the pions, kaons and protons plays a key role for precision measurements and event reconstruction, especially for the flavour tagging. To improve the identification of charged hadrons at low momentum we can use the time-of-flight method. It relies on current silicon sensor technologies with extremely good time resolution of 10 - 30 ps. This allows to measure the time-of-flight of particles and reconstruct their mass providing additional tool for identification of $\pi^\pm$, $K^\pm$ and p.

We study possible realistic implementation scenarios and potential physics applications of the fast timing silicon sensors into the future Higgs factory detectors using as an example the International Large Detector (ILD) at the International Linear Collider (ILC).

T 44.2 Tue 16:30 T-H29

Charged Kaon Mass Measurement via Time-of-Flight at a Future Higgs Factory — •Ulrich Einhaus[1], Bohdan Dudar[1,2], and Jenny List[1] — [1]Deutsches Elektronen-Sychrotron DESY, Notkestraße 85, 22607 Hamburg — [2]Universität Hamburg, Germany

The proposed future e^+e^- Higgs factories will allow to study not only the Higgs boson but the entire electroweak sector to an unprecendented precision. In order to utilise each event as well as possible, particle identification (PID) can be a powerful tool, which has been studied with increasing interest in recent years. The development of picosecond-timing detectors has been driven by the demand of background suppression at the LHC, but they can also be used for an effective time-of-flight (TOF) measurement to distinguish different charged hadrons. In addition to flavour physics applications, TOF can also be used to perform a competitive measurement of the charged kaon mass. This value is among the less precisely known ones and the two leading contributions from the early 1990s are at tension by more than 5σ with each other. The kaon mass value, however, is input to precision tracking and decay chain reconstruction, and can also be used to test theory predictions, e.g. from lattice QCD. This presentation discusses the prospects of a measurement of the charged kaon mass at future Higgs factories based on the full detector simulation of the International Large Detector (ILD) concept. This is the first analysis to make use of the recent implementation of TOF in a full-detector simulation for a future Higgs factory. It shows that such a measurement is feasible, but also highlights requirements and open questions.

T 44.3 Tue 16:45 T-H29

Identification of leptons inside jets at future Higgs factories — •Leonhard Reichenbach[1,2], Yasser Radkhorrami[1,2], and Jenny List[1] — [1]DESY Hamburg — [2]Universität Hamburg

One goal of a future Higgs factory is the precise measurement of the 125 GeV Higgs boson properties. As the Higgs boson predominantly decays to $b\bar{b}$, the precise reconstruction of heavy flavor jets is crucial. A source of uncertainty for these jets is missing momentum from semi-leptonic decays $b \to \ell\nu X$. Recent work has shown the possibility of correcting this missing neutrino momentum. For this, the charged lepton from the decay needs to be successfully detected and reconstructed. While particle flow detector concepts with their high granularity offer ideal conditions to identify leptons inside jets, the excellent hardware needs to be matched with corresponding reconstruction algorithms. In this work, we use the detailed simulation of the ILD detector concept to investigate how to exploit the information provided by a particle flow detector to identify single electrons and muons in a dense environment and how this improves the reconstruction of $H \to b\bar{b}$ decays.

T 44.4 Tue 17:00 T-H29

Detection of Spectra in the Strong-Field QED Regime with LUXE — •John Hallford[1,2] and Matthew Wing[1,2] — [1]University College London — [2]Deutsches Elektronen Synchrotron

Conventional QED's validity breaks down in the presence of an external strong electric field. LUXE (LASER Und XFEL Experiment), in Hamburg, intends to collide a high-intensity LASER pulse with highly boosted electrons and photons, up to 17.5 GeV from the EuXFEL, creating assisted electric fields up to and greater than the Schwinger limit.

This enables a non-negligible probability of non-linear Compton Scattering and Breit-Wheeler interactions - which represents a spontaneous boiling of the vacuum. The rates and kinematics of these interactions will be measured. Detection challenges include low-flux positron detection and tracking in a high-radiation environment, GeV-photon spectrometry, and high-flux, high-energy electron energy distribution reconstructions for a variety of spectrum shapes and dynamic ranges.

One of two detection solutions employed for the electron detection is a thin screen of a scintillating material, imaged remotely by optical cameras, and using magnetic deflection to reconstruct with respect to energy. The reconstruction methods and expected results for this detector and its consequences for LUXE are discussed.

T 44.5 Tue 17:15 T-H29

Simulation Studies for the Polarimetry of a LPA Electron Beam — •Jennifer Popp[1,2], Simon Bohlen[1], Felix Stehr[1,2], Jenny List[1,2], Gudrid Moortgat-Pick[2,1], Jens Osterhoff[1], and Kristjan Põder[1] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg — [2]University of Hamburg

Polarized particle beams are a key instrument for the investigation of spin-dependent processes and Laser Plasma Acceleration (LPA) has become a promising alternative to conventional RF accelerators. However, so far, it has only been theoretically shown that polarized LPA beams are possible.

The LEAP (Laser Electron Acceleration with Polarization) project at DESY aims to demonstrate this experimentally for the first time, using a prepolarized plasma target.

Because it is best suited for the expected energy range, the electron polarization will be measured with photon transmission polarimetry. It makes use of the production of circularly polarized Bremsstrahlung during the passage of the electrons through a suitable target. The photon polarization is then measured with the aid of the transmission asymmetry related to the magnetization direction of an iron absorber.

In this contribution an overview of the LEAP project will be given and a design for the polarimeter, simulation studies, and requirements on beam and polarimeter parameters for reliable polarization measurements will be presented.

T 44.6 Tue 17:30 T-H29

Calorimeter R&D for LPA Polarimetry — •Felix Stehr[1,2], Simon Bohlen[1], Oleksandr Borysov[1], Maryna Borysova[3,1], Jennifer Popp[1,2], Jenny List[1], Gudrid Moortgat-Pick[2,1], Jens Osterhoff[1], and Kristjan Põder[1] — [1]Deutsches Electronen-Synchrotron DESY, Hamburg — [2]University of Hamburg — [3]Institute for Nuclear Research NASU, Kyiv

The LEAP (Laser Electron Acceleration with Polarization) project at DESY aims to demonstrate the generation of polarized electron beams with a Laser-Plasma-Accelerator (LPA). Due to the expected beam energy of about 50 MeV, photon transmission polarimetry will be used to determine the achieved degree of polarization.

The key observable is an energy asymmetry of photons passing through a magnetized iron absorber. The total transmitted photon energy will be in the order of tens of TeV, which needs to be measured with percent-level accuracy in order to reliably detect asymmetries of a few ten percent. This contribution will discuss the detector requirements derived from detailed Geant4-simulations of the polarimeter and compare them to a first test of a calorimeter prototype operated in the LPA beam.