T 63: Search for New Particles 4

Time: Wednesday 16:15–18:30 Location: T-H22

T 63.1 Wed 16:15 T-H22

Search for a long-lived particle in $b \to s$ transitions at Belle II — •Sascha Dreyer[1] and Torben Ferber[2] for the Belle II-Collaboration — [1]DESY, Hamburg, Germany — [2]ETP, KIT, Karlsruhe, Germany

The Belle II experiment at the asymmetric e^+e^- SuperKEKB collider in Tsukuba, Japan provides an ideal test bench for searches for light dark sectors, due to a clean collision environment leading to low backgrounds.

A hypothetical new long-lived particle could serve as a portal to dark sectors. This particle could be produced in B-meson decays via $b \to s$ quark transitions and decay to pairs of charged Standard Model particles. The displaced vertex signature can be reconstructed in case the particle decays within the tracking detectors.

This talk gives an overview of the search for such a new long-lived particle at Belle II. The sensitivity for different lifetime and mass scenarios will be shown together with work towards validating long-lived particle performance in data using control samples.

T 63.2 Wed 16:30 T-H22

Study of $e^+e^- \to D_s^{\pm} D_{s0}^*(2317)^{\mp} A$ process at Belle+BaBar — •Dmytro Meleshko[1], Elisabetta Prencipe[1,2], Jens Soeren Lange[1], and Ashish Thampi[2] — [1]Justus-Liebig Univ. Giessen — [2]IKP-1, Forschungszentrum Juelich

The present analysis is focused on the study of the $e^+e^- \to D_s^{\pm} D_{s0}^*(2317)^{\mp} A$ process in the continuum (A = anything else) combining the BaBar and Belle data sets to cure problems of insufficient statistics. The main goal of this work is the analysis of the $D_s^+ D_{s0}^*(2317)^-$ invariant mass system to look for possible resonant states with $c\bar{c}s\bar{s}$ quark content, and cross-section measurement. At the current stage of the analysis, a preliminary study over MC samples and Belle data has already been performed. The acquired results contain intriguing sign of a possible state seen in the invariant mass distribution of the $D_s^{\pm} D_{s0}^*(2317)^{\mp}$ system. In addition, the analysis is opened to a potential perspective of measuring the $D_{s0}^*(2317)^{\pm}$ width upper limit, which plays an important role in understanding the nature of the $D_{s0}^*(2317)^{\pm}$ itself.

T 63.3 Wed 16:45 T-H22

Search for inelastic Dark Matter with a Dark Higgs at Belle II — •Patrick Ecker, Torben Ferber, Pablo Goldenzweig, and Jonas Eppelt for the Belle II-Collaboration — Karlsruhe Institute of Technology, Karlsruhe, Germany

Although the Standard Model (SM) of particle physics describes most of the phenomena observed in our universe very well, there are still some observations where the SM lacks to provide an explanation. One of these observations is the presence of Dark Matter which is very well motivated. Nevertheless, it is still not clear which particles make up this Dark Matter.

This talk will present a sensitivity study based on Monte Carlo simulations for a search for an inelastic Dark Matter model which involves the presence of a Dark Higgs boson. This model has a signature of up to two displaced vertices, one from the resonant decay of the Dark Higgs and another non-resonant one emerging from the decay of the involved Dark Matter particles.

T 63.4 Wed 17:00 T-H22

Search for $B^{\pm} \to K^{\pm} a(a \to \gamma\gamma)$ with promptly decaying ALPs - A Monte Carlo study — •Lucas Weidemann, Pablo Goldenzweig, and Torben Ferber — Institute of Experimental Particle Physics, Karlsruhe, Germany

Axion-Like-Particles (ALPs) are a well motivated extension to the Standard Model. They are light, pseudoscalar particles which are dominantly interacting with Standard Model gauge bosons. As a result ALPs can be produced in a flavor-changing neutral current transition by its coupling g_{aWW} to W bosons. Subsequently, the ALP dominantly decays into two photons, which makes $B^{\pm} \to K^{\pm} a(a \to \gamma\gamma)$ a promising process for measuring g_{aWW}.

We use Monte Carlo simulation for analyzing this process by reconstructing the B meson and examining the invariant di-photon mass distribution. The study is performed with ALPs in mass range 0.1-4.6 GeV/c^2 and zero lifetime.

An outline of our analysis as well as our current status are going to be presented in this talk.

T 63.5 Wed 17:15 T-H22

Sensitivity study in the Search for $B^{\pm} \to K^{\pm} a$ (displaced $a \to \gamma\gamma$) Decays at Belle II — •Alexander Heidelbach, Pablo Goldenzweig, and Torben Ferber — Institute of Experimental Particle Physics, Karlsruhe Institute of Technology, Karlsruhe, Germany

In a set of extensions of the Standard Model, Axion Like Particles (ALPs) arise as (pseudo) Nambu-Goldstone bosons of an additional spontaneously broken U(1) symmetry. Due to constraints in flavour-changing processes, involving the coupling of ALPs directly to Standard Model fermions and gluons, direct couplings of ALPs to the electroweak gauge bosons are particularly interesting. As a result of coupling to W bosons, ALPs can emerge in flavour-changing-neutral-current $b \to s$ transitions. Depending on the ALP model, mass and the coupling to photons possible signatures become probeable in $B \to Ka$ transitions which can be studied at e^+e^- colliders like the Belle II experiment. I present a search for $B^{\pm} \to K^{\pm} a, a \to \gamma\gamma$ with long-lived ALPs. We investigate the mentioned decay based on a full Belle II Monte Carlo study. In this talk, I will show sensitivity estimates established by the reconstruction of the B meson, an optimised candidate selection and a scan of the invariant di-photon mass spectrum for different ALP lifetimes.

T 63.6 Wed 17:30 T-H22

Dark Photon Searches at Future e^+e^- Colliders — •Sepideh Hosseini[1,2], Jenny List[2], Mikael Berggren[2], and Gudrid Moortgat-Pick[1,2] — [1]Universität Hamburg, Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany

The dark photon (A_D) is a hypothetical particle that can be possibly produced through its kinetic mixing with the ordinary, visible photon. The existence of kinetic mixing means that the two gauge bosons can transform into each other as they propagate and this provides a link between the dark and visible sectors. The decay modes of the dark photon to the standard model charged fermions motivate to look at $A_D \to \mu^+\mu^-$ as signal. The dark photon will have a specific mass and hence, the invariant mass of the muon pair is the main observable to look for the dark photon in the presence of standard model background. For this, we evaluate the prospects to detect the dark photon and to determine the mixing parameter for the example of the International Large Detector (ILD) concept at the International Linear Collider (ILC).

T 63.7 Wed 17:45 T-H22

Investigation of Collider Effects of Flavour Anomalies Using EFTs and Simplified Models — Philip Bechtle, Klaus Desch, Christian Grefe, and •Murillo Vellasco — Rheinische Friedrich-Wilhelms-Universität Bonn

The Standard Model of particle physics (SM) is undoubtedly one of the most successful scientific theories in history. Despite its overwhelming success, several tensions with its predictions have been discovered in recent years, including the measurements of the muon g-2 at Fermilab and rare B-decays at the LHC. The natural next step is to build even more powerful future colliders, but exactly which combination of future experiments is best to investigate further these hints is non-trivial.

The most challenging possibility is a scenario where the energy scale of New Physics is out of reach of direct discovery at future colliders. Therefore, our approach is to use the formalism of the Standard Model Effective Field Theory (SMEFT), performing scans over several operators which could perhaps explain the hints of experimental deviations from the SM. Kinematic observables of collider signatures can be directly affected by the presence of these operators, and the optimal combination of future experiments would be the one that optimizes the observation of these kinematic deviations. In this talk, we will discuss a possible strategy to choose the best combination of experiments given all current measurements in the electroweak and the flavour sectors. Ideally, any strategy for future colliders should aim for a "no-lose" scenario, analogous to the situation for the approval of the LHC.

T 63.8 Wed 18:00 T-H22

Heavy neutrino search at LHCb — Martino Borsato, Rebecca Gartner, and •Maurice Morgenthaler — Physikalisches Institut - Universität Heidelberg

Neutrino masses could be explained by the existence of heavy neutrinos. These elusive particles might have escaped detection at previous experiments due to their long lifetimes and low production rate. If their mass is in the range of a few GeV, heavy neutrinos are produced copiously from the weak decays of beauty hadrons and can be searched effectively at the world-brightest source of these hadrons: the Large Hadron Collider (LHC). In this talk I will present an ongoing search for heavy neutrinos produced in (semi)leptonic beauty-hadron decays using the dataset collected by the LHCb experiment at the LHC. The search strategy relies on the heavy-neutrino macroscopic lifetime and its decay to a pion and a muon. The sensitivity is maximised by targeting all beauty hadron species (including strange and charmed B mesons) and using a partial reconstruction of the decay. The sensitivity of the search in comparison to other experiments will be discussed.

T 63.9 Wed 18:15 T-H22

Search for Heavy Majorana Neutrinos in same-sign W Boson Scattering — •Jonas Neundorf — Deutsches Elektronen-Synchrotron, Notkestraße 85, 22607 Hamburg

Among the open question of particle physics is the origin of neutrino masses. While they are predicted to be zero by the Standard Model, oscillation measurements have shown that at least two of the three neutrino flavours observed in nature are massive. These masses can be explained by the "Seesaw Mechanism", which introduces Majorana neutrinos with a mass on the TeV scale. For the first time at the LHC, a search for Heavy Majorana Neutrinos produced via same-sign W boson scattering is performed. This talk will discuss the discovery potential and outline the analysis design.