Table of Contents

DIS2021

Abstracts

Dark matter searches with mono-photon signature at future 𝑒+𝑒– colliders

- Speaker: Aleksander Filip Zarnecki
- Status: accepted as oral presentation
- Abstract: One of the primary goals of the proposed future collider experiments is to search for dark matter (DM) particles using different experimental approaches. High energy 𝑒+𝑒– colliders offer unique possibility for the most general search based on the mono-photon signature. As any 𝑒+𝑒– scattering process can be accompanied by a hard photon emission from the initial state radiation, analysis of the energy spectrum and angular distributions of those photons can be used to search for hard processes with invisible final state production and to test the nature and interactions of the DM particles. Dedicated procedure of merging the matrix element calculations with the lepton ISR structure function was developed to model the Standard Model background processes contributing to mono-photon signature with WHIZARD. We consider production of DM particles at the International Linear Collider (ILC) and Compact Linear Collider (CLIC) experiments. Detector effects are taken into account within the DELPHES fast simulation framework. Limits on the light DM production in a generic model are set as a function of the mediator mass and width based on the expected two-dimensional distributions of the reconstructed mono-photon events. Limits on the mediator coupling to electrons are presented for a wide range of mediator masses and widths. For light mediators, for masses up to the centre-of-mass energy of the collider, results from the mono-photon analysis are more stringent than the limits expected from direct resonance search in SM decay channels.
- Slides

Pair production of charged IDM scalars at high energy CLIC

- Speaker: Jan Klamka
- Status: accepted as oral presentation
- Abstract: Compact Linear Collider (CLIC) was proposed as the next energy-frontier infrastructure at CERN, allowing to study 𝑒+𝑒– collisions at three centre-of-mass energy stages: 380 GeV, 1.5 TeV and 3 TeV. The main goal of its high-energy stages is to search for the new physics beyond the Standard Model (SM). The Inert Doublet Model (IDM) is one of the simplest SM extensions and introduces four new scalar particles: 𝐻±, 𝐴 and 𝐻; the lightest, 𝐻, is stable and hence it is a natural dark matter (DM) candidate. A set of benchmark points is considered, which are consistent with current theoretical and experimental constraints and promise detectable signals at future colliders. Prospects of observing pair-production of the IDM scalars at CLIC were previously studied for signatures with two leptons in the final state. In the current study, discovery reach for the IDM charged scalar pair-production is considered for the semi-leptonic final state at the two high-energy CLIC stages. Full simulation analysis, based on the new CLIC detector model, is presented for five selected IDM scenarios. Results are then extended to the larger set of benchmarks using DELPHES fast simulation framework. The CLIC detector model for DELPHES has been modified to take pile-up contribution from the beam-induced 𝛾𝛾 interactions into account, which is crucial for the presented analysis. Results of the study indicate that heavy, charged IDM scalars can be discovered at CLIC for most of the proposed benchmark scenarios, with very high statistical significance.
- Slides

Searches for invisible scalar decays at CLIC

- Speaker: Krzysztof Mekala
- Status: accepted as oral presentation
- Abstract: The Compact LInear Collider (CLIC) is a proposed TeV -scale high-luminosity electron-positron collider at CERN. CLIC will allow us to study the Higgs boson properties with very high precision. These measurements can also result in direct or indirect discovery of "new physics", Beyond the Standard Model (BSM) phenomena, which could help us to understand the nature of dark matter (DM). SM-like Higgs boson or new heavy scalar decays with emission of invisible DM particles can be the only way to observe "new physics" effects at achievable energy scales and establish connection between Standard Model (SM) and BSM sectors. We studied the possibility of measuring invisible Higgs boson and additional heavy scalars decays with experiment at CLIC running at 380 GeV and 1.5 TeV. The analysis is based on the WHIZARD event generation and fast simulation of CLIC detector response with DELPHES. We estimated the expected limits on the invisible decays of the 125 GeV Higgs boson, as well as the cross section limits for production of an additional neutral Higgs scalar, assuming its invisible decays, as a function of its mass. Extracted model-independent branching ratio and cross section limits were then interpreted in the framework of the vector-fermion dark matter model to set limits on the mixing angle between the SM-like Higss boson and the new scalar of the "dark sector".
- Slides

Top-quark mass determination in the optimised threshold scan

- Speaker: Kacper Nowak
- Status: accepted as recorded flash talk
- Abstract: One of the important goals at the future 𝑒+𝑒− colliders is to measure the top-quark mass and width in a scan of the pair production threshold. However, the shape of the pair-production cross section at the threshold depends also on other model parameters, as the top Yukawa coupling, and the measurement is a subject to many systematic uncertainties. Presented in this work is the most general approach to the top-quark mass determination from the threshold scan at CLIC, with all relevant model parameters and selected systematic uncertainties included in the fit procedure. Expected constraints from other measurements are also taken into account. The top-quark mass can be extracted with precision of the order of 30 to 40 MeV, including considered systematic uncertainties, already for 100 fb−1 of data collected at the threshold. Additional improvement is possible if the running scenario is optimized. With the optimisation procedure based on the genetic algorithm the statistical uncertainty of the mass measurement can be reduced by about 25%. Influence of the beam energy profile on the optimisation procedure and the expected statistical precision of the measurement is verified by comparing results obtained assuming luminosity spectra of CLIC, ILC and FCCee.
- Slides
