mini-workshop on BSM at ILC

Report of Contributions

https://agenda.linearcollider.org/e/9575

Contribution ID: **2** Type: **not specified**

Testing the neutrino mass generation mechanism at the future colliders

Wednesday, 2 March 2022 22:00 (15 minutes)

The generation of the neutrino mass is an essential observation from the neutrino oscillation experiments. This indicates a major revision of the Standard Model which initiated with the massless neutrinos. A possible interesting scenario is the seesaw mechanism where SM gauge singlet Right Handed Neutrinos are introduced. Another interesting aspect is the extension of the SM with SU(2) triplet fermions. Alternatively a general U(1) extension of the SM is also an interesting idea which involves three generations of the SM singlet RHNs to generate the tiny neutrino mass through the seesaw mechanism. Additionally such models can contain a Z' boson which could be tested at the colliders through the pair production of the RHNs.

Primary author: DAS, Arindam

Presenter: DAS, Arindam

Session Classification: PST-friendly

Contribution ID: **3** Type: **not specified**

The string landscape predicts: light higgsinos at ILC

Wednesday, 2 March 2022 22:40 (15 minutes)

Our current understanding of string theory is that the 4-d laws of physics are determined by the topological properties of the compactified manifold. There may be 10ˆ500 (or many more) possibilities, and indeed this gives at present our only understanding of the tiny yet non-zero value of the cosmological constant. Arguments suggest the landscape of string vacua favor large soft SUSY breaking terms, but these must be tempered by a value for the weak scale which lies within the ABDS window. This scenario then predicts a Higgs mass m(h)˜125 GeV with sparticles beyond present LHC bounds. It also predicts light higgsinos in the range
m(higgsino)˜100-350 GeV. The ILC with sqrt(s)˜500-600 GeV would then be a higgsino pair factory in addition to a Higgs factory. We show sparticle and Higgs mass probability distributions using the new DEW4SLHA code which can be used to calculate the pocket-universe weak scale in vacua where the MSSM is the low energy EFT from any SUSY Les Houches Accord output file.

Primary authors: Mr MARTINEZ, Dakotah (University of Oklahoma); BAER, Howard (University of Oklahoma); Prof. BARGER, Vernon (University of Wisconsin)

Presenter: BAER, Howard (University of Oklahoma)

Session Classification: PST-friendly

Contribution ID: **4** Type: **not specified**

Heavy Neutrinos at Future Linear e+e- Colliders

Monday, 28 February 2022 16:00 (15 minutes)

Neutrinos are probably the most mysterious particles of the Standard Model. The mass hierarchy and oscillations, as well as the nature of their antiparticles, are currently being studied in experiments around the world. Moreover, in many models of New Physics, baryon asymmetry or dark matter density in the universe are explained by introducing new species of neutrinos. Among others, heavy neutrinos of the Dirac or Majorana nature were proposed to solve problems persistent in the Standard Model. Such neutrinos with masses above the EW scale could be produced at future linear e+e- colliders, like the Compact LInear Collider (CLIC) or the International Linear Collider (ILC).

We studied the possibility of observing production and decays of heavy neutrinos in the qql final state at ILC running at 500 GeV and 1 TeV and CLIC running at 3 TeV. The analysis is based on the WHIZARD event generation and fast simulation of the detector response with DELPHES. Dirac and Majorana neutrinos with masses from 200 GeV to 3.2 TeV are considered. Estimated limits on the production cross sections and on the neutrino-lepton coupling are compared with the current limits coming from the LHC running at 13 TeV, as well as the expected future limits from hadron colliders. Obtained results are stricter than other limit estimates published so far.

Primary authors: MEKALA, Krzysztof; REUTER, Jürgen (DESY Hamburg, Germany); ZARNECKI, Aleksander Filip (University of Warsaw)

Presenter: MEKALA, Krzysztof

Session Classification: CET-friendly

Contribution ID: **5** Type: **not specified**

Alternative searches of quintuplet fermions at ILC

Monday, 28 February 2022 07:40 (20 minutes)

Large fermionic multiplets appear in different extensions of the Standard Model, which are essential to predict small neutrino masses, relic abundance of the dark matter and the measured value of muon anomalous magnetic moment. Such models may contain quintuplet of fermions along with scalar multiplets. If the quintuplet fermions (doubly and singly charged fermions, neutral fermion) are heavier than the scalars, once pair produced, they decay via the charged and neutral scalars. The scalars decay into W/Z bosons, resulting in a final state of multiple leptons and jets. As ILC has relatively cleaner environment than the hadron collider, it is possible to obtain exclusion and discovery limits in these channels and mass reconstruction of the quintuplet fermion is also possible.

Primary author: KUMAR, Nilanjana (CCSP, SGT University, India)

Presenter: KUMAR, Nilanjana (CCSP, SGT University, India)

Session Classification: JST-friendly

Contribution ID: **6** Type: **not specified**

Dark matter production with light mediator exchange at future e+e- colliders

Monday, 28 February 2022 15:20 (15 minutes)

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.

Production of DM particles at the International Linear Collider (ILC) and Compact Linear Collider (CLIC) experiments was studied using dedicated simulation procedure developed for WHIZARD and the DELPHES fast simulation framework. Limits on the light DM production cross section in a generic model are set as a function of the mediator mass and width, and translated into the limits on the mediator coupling to electrons. If deviations from the Standard Model predictions are observed, mediator mass, width and coupling structure can be constrained from the reconstructed mono-photon event distributions.

Primary authors: KALINOWSKI, Jan (University of Warsaw); KOTLARSKI, Wojciech; MEKALA, Krzysztof; ZARNECKI, Aleksander Filip (University of Warsaw); ZEMBACZYNSKI, Kamil (University of Warsaw)

Presenter: ZARNECKI, Aleksander Filip (University of Warsaw)

Session Classification: CET-friendly

Contribution ID: **7** Type: **not specified**

Testability of CP-even axion-like particle at ILC

Wednesday, 2 March 2022 08:00 (20 minutes)

Axion and axion-like particles (ALPs) are attractive candidates of light dark matter (DM). They emerge as a pseudo-Nambu Goldstone boson in spontaneously breaking of global U(1) symmetry in the dark sector. The mass is obtained by the explicit breaking of the U(1). In many new physics models, it is usually assumed that the dark sector, in which axion/ALP exists, is CP conserving. In contrast to such a previous study, we take into account CP-violation in the dark sector, considering a simple renormalizable model where a dark Higgs field is only added. In this talk, we discuss the properties and phenomenological aspects of the predicted ALP. In particular, we demonstrate that the ALP can be probed by the SM-like Higgs boson decay into a pair of ALP at the ILC and the various signal can happen, i.e. Higgs invisible decay, displaced vertices and Higgs exotic decays.

Primary authors: SAKURAI, Kodai (Tohoku University); Dr YIN, Wen (Tohoku University)

Presenter: SAKURAI, Kodai (Tohoku University)

Session Classification: JST-friendly

Contribution ID: **8** Type: **not specified**

Low mass scalars at e+e- colliders

Wednesday, 2 March 2022 15:40 (15 minutes)

I report on studies and possible BSM scenarios with (Higgs) scalars of masses < 125 GeV. This talk is based on similar overview talks at the CEPC/ FCC workshops within the last half year, and is tailored be used as a foundation for a Snowmass White Paper on this topic.

Primary author: ROBENS, Tania Natalie (Rudjer Boskovic Institute (HR))

Presenter: ROBENS, Tania Natalie (Rudjer Boskovic Institute (HR))

Session Classification: CET-friendly

Contribution ID: **9** Type: **not specified**

Measuring neutrino dynamics via light higgsinos and sneutrinos

Monday, 28 February 2022 15:40 (15 minutes)

Supersymmetry offers a portal to study neutrino physics via sneutrinos. I shall discuss a signature that can be only detected at an electron-positron collider, namely the production of a charged higgsino pair, one of them subsequently decaying to a charged lepton and a right-sneutrino LSP. This decay is rare, with a branching ratio O(10ˆ-5) and hence the clean environment and fixed partonic collision energies are necessary. We show that we can get a signal down to Yukawa couplings below 10ˆ-6, relevant for type-I seesaw mechanism at the electroweak scale.

Primary author: WALTARI, Harri (University of Uppsala)

Presenter: WALTARI, Harri (University of Uppsala)

Session Classification: CET-friendly

Contribution ID: **10** Type: **not specified**

A Theory of Dark Pions

Wednesday, 2 March 2022 23:00 (15 minutes)

We present a complete model of a dark QCD sector with light dark pions, broadly motivated by hidden naturalness arguments. The dark quarks couple to the Standard Model via irrelevant Z- and Higgs-portal operators, which encode the low-energy effects of TeV-scale fermions interacting through Yukawa couplings with the Higgs field. The dark pions, depending on their CP properties, behave as either composite axion-like particles (ALPs) mixing with the Z or scalars mixing with the Higgs. The dark pion lifetimes fall naturally in the most interesting region for present and proposed searches for long-lived particles, at the LHC and beyond. This is demonstrated by studying in detail three benchmark scenarios for the symmetries and structure of the theory. Within a coherent framework, we analyze and compare the GeV-scale signatures of flavor-changing meson decays to dark pions, the weak-scale decays of Z and Higgs bosons to hidden hadrons, and the TeV-scale signals of the ultraviolet theory. New constraints are derived from B decays at CMS and from Z-initiated dark showers at LHCb, focusing on the displaced dimuon signature. We also emphasize the strong potential sensitivity of ATLAS and CMS to dark shower signals with large multiplicities and long lifetimes of the dark pions. As a key part of our phenomenological study, we perform a new data-driven calculation of the decays of a light ALP to exclusive hadronic Standard Model final states. The results are provided in a general form, applicable to any model with arbitrary flavor-diagonal couplings of the ALP to fermions. We will also discuss the indirect and direct search prospects at future e^+e^- colliders.

Primary author: LI, LINGFENG

Presenter: LI, LINGFENG

Session Classification: PST-friendly

Contribution ID: **11** Type: **not specified**

Phenomenology of dark matter in complex scalar singlet extensions of Two Higgs doublet models

Wednesday, 2 March 2022 16:00 (15 minutes)

Extensions of the two Higgs doublet models with a singlet scalar can easily accommodate all current experimental constraints and are highly motivated candidates for Beyond Standard Model Physics. It can successfully provide a dark matter candidate, explain baryogenesis and provide gravitational wave signals. In this work, we focus on the dark matter phenomenology of the two Higgs doublet model extended with a complex scalar singlet which serves as the dark matter candidate. We study the variations of the dark matter observables, i.e, relic density and direct detection cross-section, with respect to the model parameters. We obtain a few benchmark points in the light and heavy dark matter mass region. We also study possible signatures of this model at future eˆ+eˆ- colliders.

Primary author: DUTTA, Juhi

Co-authors: Prof. MOORTGAT-PICK, Gudrid (DESY & UHH); Ms SCHREIBER, Merle (UHH & DESY)

Presenter: DUTTA, Juhi

Session Classification: CET-friendly

Contribution ID: **12** Type: **not specified**

Next-to-leading-order corrections to the e+e- → hZ process in extended Higgs models

Monday, 28 February 2022 07:00 (20 minutes)

Precision measurements of the properties of the discovered Higgs boson are one of the main programs at current and future collider experiments. At the international linear collider with the center-of-mass energy 250 GeV, e+e- → hZ is the dominant Higgs production process, and the cross section would be measured with a few percent accuracies. In this talk, we present the cross section of the e+e- → hZ process at full next-to-leading order in various extended Higgs models. In addition, by using the H-COUP program, we analyze the deviations in the cross section times decay branching ratios of the discovered Higgs boson. We discuss the discrimination of extended Higgs models at the future colliders in detail.

Primary author: Mr AIKO, Masashi (Osaka University)

Co-authors: Prof. KANEMURA, Shinya (Osaka University); Prof. MAWATARI, Kentarou (Iwate University)

Presenter: Mr AIKO, Masashi (Osaka University)

Session Classification: JST-friendly

Contribution ID: **13** Type: **not specified**

The search for Leptophilic dark matter and (g-2)_mu at future lepton colliders

Monday, 28 February 2022 07:20 (20 minutes)

We consider the renormalizable leptophilic WIMP models with the scalar mediators which have lepton numbers. We perform a comprehensive analysis for such a WIMP scenario for two distinct cases with SU(2) doublet or singlet mediators considering all the relevant theoretical, cosmological and experimental constraints at present. We show that mono-photon search at ILC experiment can play a significant role to probe the yet unexplored parameter region. Furthermore, we discuss the capability of explaining the muon g-2 anomaly by combined model scenario including both the doublet and singlet mediators.

Primary authors: SAHA, Ipsita (Kavli IPMU); MATSUMOTO, Shigeki (IPMU, Univ. of Tokyo); KATAYOSE, Taisuke (Osaka University); HORIGOME, Shunich (Kavli IPMU)

Presenter: KATAYOSE, Taisuke (Osaka University)

Session Classification: JST-friendly

Contribution ID: **14** Type: **not specified**

Stau Searches at the ILC

Monday, 28 February 2022 15:00 (15 minutes)

"The direct pair-production of the tau-lepton superpartner, stau, is one of the most interesting channels to search for SUSY. First of all the stau is with high probability the lightest of the scalar leptons. Secondly the signature of stau pair production signal events is one of the most difficult ones, yielding to the 'worst' and so most global scenario for the searches. The current model-independent stau limits comes from analysis performed at LEP but they suffer from the low energy of this facility. The LHC exclusion reach extends to higher masses for large mass differences, but under strong model assumptions.
The ILC, a future electron-positron collider with energy up to 1 TeV, is a promising scenario for SUSY searches. The capability of the ILC for determining exclusion/discovery limits for the stau in a model-independent way is shown in this contribution, together with an overview of the current state-of-the-art. A detailed study of the 'worst' scenario for stau exclusion/discovery, taking into account the effect of the stau mixing on stau production cross-section and efficiency, is presented. The study also includes an analyisis of the effect of overlay particles in stau searches. The studies were done using the sgv fast simulation adapted to the ILD detector concept at the ILC."

Primary author: NÚÑEZ PARDO DE VERA, María Teresa (DESY)

Presenter: NÚÑEZ PARDO DE VERA, María Teresa (DESY)

Session Classification: CET-friendly

Contribution ID: **15** Type: **not specified**

Muon g-2 in SUSY and future lepton colliders

Monday, 28 February 2022 08:00 (20 minutes)

Presenter: SAHA, Ipsita (Kavli IPMU)

Session Classification: JST-friendly

Contribution ID: **16** Type: **not specified**

Light leptonic forces for (g-2) and B-anomalies

Wednesday, 2 March 2022 07:00 (20 minutes)

Presenter: PARK, Seong Chan (Yonsei University)

Session Classification: JST-friendly

Contribution ID: **17** Type: **not specified**

Stau study at the ILC and its implication for the muon g − 2 anomaly

Wednesday, 2 March 2022 07:20 (20 minutes)

Presenter: KAWADA, Shin-ichi (KEK)

Session Classification: JST-friendly

Contribution ID: **18** Type: **not specified**

Search for Higgs decaying to exotic scalers at the ILC

Wednesday, 2 March 2022 07:40 (20 minutes)

Presenter: KATO, Yu (University of Tokyo)

Session Classification: JST-friendly

Contribution ID: **19** Type: **not specified**

Probing U(1) extended Standard Models at ILC

Wednesday, 2 March 2022 22:20 (15 minutes)

Presenter: OKADA, Nobuchika (University of Alabama)

Session Classification: PST-friendly

Contribution ID: **20** Type: **not specified**

Sensitivity to Decays of Long-Lived Dark Photons at the ILC

Wednesday, 2 March 2022 15:20 (15 minutes)

Presenter: NOSLER, Laura (University of Oregon)

Session Classification: CET-friendly

Contribution ID: **21** Type: **not specified**

Sensitivity for Long-Lived particles at FCC-ee

Wednesday, 2 March 2022 15:00 (15 minutes)

Presenter: ALIMENA, Juliette (CERN)

Session Classification: CET-friendly

Contribution ID: **22** Type: **not specified**

BSM Higgs bosons

Monday, 28 February 2022 16:20 (15 minutes)

Presenter: HEINEMEYER, Sven

Session Classification: CET-friendly