

T 1: Searches/BSM I (HNL, ETmiss+X)

Time: Monday 16:45–18:30

Location: ZHG010

T 1.1 Mon 16:45 ZHG010

Simulation of heavy neutral lepton production and decays with the Sherpa event generator — ●ANTONIA BÄHR — TU Dresden - Institute for Nuclear and Particle Physics

The physics of neutrinos still pose some questions, particularly why they are so much lighter than other leptons. One explanation for this is the seesaw mechanism, where right-handed neutrinos are introduced to the Standard Model. This results in the Lagrangian density not only containing a Dirac but also a Majorana mass term. Because of this, there are two neutrino mass eigenstates, a light and a heavy one. The light neutrino is expected to be the one that has already been observed in numerous experiments, while the heavy one would be a new kind of particle, a heavy neutral lepton. Since the heavy neutral lepton would mostly be right-handed, it is not easily detectable as it would not be affected by any of the fundamental forces, apart from gravity. However, current research at the LHC investigate the decay products of heavy neutral leptons, in order to prove their existence. To achieve this, we are simulating the production of heavy neutral leptons in proton-proton collisions and their decay using Sherpa, a Monte Carlo event generator for the simulation of high-energy reactions.

In this study, we will especially include the hadronic decays of the heavy neutral leptons and the vertex offsets, as heavy neutral leptons are relatively long lived particles and therefore do not decay immediately. In this talk I will present the first results from these simulations in context of a typical LHC setup.

T 1.2 Mon 17:00 ZHG010

Search for heavy neutral leptons in decays of W bosons using leptonic and semi-leptonic displaced vertices in center-of-mass energy of 13 TeV p p collisions with the ATLAS detector — ●MARZIEH BAHMANI — Humboldt university, Berlin, Germany

In this talk, I will present a search for long-lived heavy neutral leptons (HNLs), which are produced through the decay of a W-boson into a muon or electron and an HNL. We investigate two distinct decay channels: a leptonic channel, where the HNL decays into two leptons and a neutrino, and a semi-leptonic channel, where the HNL decays into a lepton and a charged pion. This search is based on 140 fb⁻¹ of proton-proton collision data in center-of-mass energy of 13 TeV, collected by the ATLAS detector during Run 2 of the LHC. I will discuss the results within the context of both single-flavor and multi-flavor mixing scenarios and their implications for future searches in this exciting area of particle physics.

T 1.3 Mon 17:15 ZHG010

Searching for type I seesaw mechanism in a two Heavy Neutral Leptons scenario at FCC-ee — SEHAR AJMAL¹, PATRIZIA AZZI², ●SOFIA GIAPPICHINI³, MARKUS KLUTE³, ORLANDO PANELLA¹, MATTEO PRESILLA³, and XUNWU ZUO³ — ¹INFN Perugia, Perugia, Italy — ²INFN Padova, Padova, Italy — ³KIT, Karlsruhe, Germany

This contribution reports the search for heavy neutral leptons (HNL) in the type I seesaw mechanism at the Future Circular Collider in its e⁺*e^{*} stage (FCC-ee), considering an integrated luminosity of 204 ab⁻¹ collected at the Z pole. The study examines two generations of heavy neutral leptons produced in association with Standard Model (SM) neutrinos and decaying to a purely leptonic final state. This theoretical framework can explain neutrino oscillations and other open questions of the SM, providing a broader perspective on the relevance of this experimental search. The analysis is performed using a fast simulation of the IDEA detector concept to study potential HNL interactions at the FCC-ee. The sensitivity contours are obtained from a selection of kinematic variables aimed at improving the signal-to-background ratio for the prompt production case. In the case of long-lived HNLs, the background can be almost fully eliminated by exploiting their displaced decay vertices. The study shows that the FCC-ee has a significant sensitivity to observing these objects in a region of the phase space not accessible by other experiments.

T 1.4 Mon 17:30 ZHG010

Searching for heavy neutral leptons at the NA62 experiment in beam dump mode — ●JONATHAN SCHUBERT — Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), Boltzmannstr. 8, 85748 Garching, Germany — Technical University of Munich, TUM School of Natural Sciences, Physics Department, Chair for Data Sci-

ence in Physics, 85748 Garching, Germany

Heavy neutral leptons are a commonly considered hypothetical class of particles with the potential to explain several puzzles of fundamental physics. The NA62 experiment at the CERN SPS can be operated in beam-dump mode, where 400 GeV protons are dumped on an absorber. Due to the large number of interactions in the dump feebly interacting particles like heavy neutral leptons may be produced abundantly. Their downstream decays could be observed with excellent sensitivity using the existing detector apparatus. We report on the status of the first search at NA62 for such decay signatures.

T 1.5 Mon 17:45 ZHG010

Search for new physics in the electron plus missing transverse momentum channel using Run-3 CMS data — THOMAS HEBBEKER, KERSTIN HOEPFNER, ●MIRAC NOYAN ÖZDEMİR, VALENTINA SARKISOVI, ALEXANDER SCHMIDT, and KARL JOSEPH SCHUMACHER — III. Physikalisches Institut A, RWTH Aachen University

There are many Beyond the Standard Model (BSM) theories that predict new particles in the final state with a high-energy lepton and missing transverse momentum as their experimental signature. Now, using the newly acquired data of the CMS detector from the ongoing Run-3 at an unprecedented center-of-mass energy of 13.6 TeV, a new window is opened for searches in the high-energy regions.

This talk presents the main ideas behind a high-energy physics search and the analysis strategy in the electron plus missing transverse momentum channel. First results, like the comparison of 2022+2023 data to the Standard Model background, the resulting exclusion limit on the Sequential Standard Model (SSM) W⁺ boson mass, as well as the variable coupling strength limit and a model independent (MI) limit, are being shown.

T 1.6 Mon 18:00 ZHG010

Search for New Physics in Events With an Energetic Jet and Missing Transverse Momentum With the ATLAS Experiment — ●MORITZ HESPING, VOLKER BÜSCHER, CHRISTIAN SCHMITT, and DUC BAO TA — Johannes Gutenberg Universität Mainz

A wide range of theories beyond the Standard Model predict particles which only weakly interact with SM particles. If such particles are produced in collisions at the Large Hadron Collider, they are invisible to the detector. However, their presence can be inferred from a large missing transverse momentum when they recoil off a highly energetic jet. This requires a precise estimation of the SM processes resulting in a similar signature, such as the production of Z bosons decaying to neutrinos.

Searches for new physics in such events have been previously carried out at the ATLAS experiment using the full 140 fb⁻¹ dataset of the LHC Run 2 (2015-2018). This talk shows the progress of an updated analysis using data from the ongoing LHC Run 3, which has already exceeded Run 2 in luminosity, including an overview of the analysis strategy and data-simulation comparisons in the control regions.

T 1.7 Mon 18:15 ZHG010

Search for new physics in the final state with a tau lepton and missing transverse momentum. — ●VALENTINA SARKISOVI, KERSTIN HOEPFNER, ALEXANDER SCHMIDT, and THOMAS HEBBEKER — III. Physikalisches Institut A

Various Beyond the Standard Model (BSM) theories anticipate the existence of new particles that could decay into final states characterized by the presence of a charged lepton and missing transverse momentum (pT_{miss}) as their most distinctive experimental signature. The CMS detector at the CERN LHC is used to hunt for novel physics in the high mass region of final states containing a tau lepton and pT_{miss}. Efficient identification and reconstruction of TeV tau leptons, good description of the high mass region and effective search for the wide range of BSM models are crucial in a tau + pT_{miss} search for such phenomena. CMS data recorded in 2022 and 2023 in pp collisions with the center-of-mass energy of 13.6 TeV have been analysed. This talk addresses the key concepts of the analysis techniques employed in the search for new physics in the final state with a tau lepton and pT_{miss}, including various theoretical interpretations. Models with enhanced coupling to third generation leptons are of special interest.