# T 107: Searches – Neutrino at accelerators

Time: Thursday 15:50–17:20 Location: HSZ/0101

T 107.1 Thu 15:50 HSZ/0101

**Identification of displaced $\tau$ leptons for long-lived $\tau$ slepton searches at CMS** — •Mykyta Shchedrolosiev — Deutsches Elektronen-Synchrotron DESY

Searches for the supersymmetric (SUSY) partner of the tau lepton are of high interest, since scenarios in which the tau slepton ($\widetilde{\tau}$) is the next-to-lightest supersymmetric particle can lead to the observed relic density. In gauge mediated symmetry breaking scenarios, $\widetilde{\tau}$ can have macroscopic lifetime. Direct searches of $\widetilde{\tau} \rightarrow \tau\widetilde{\chi}_0^1$, where $\widetilde{\chi}_0^1$ is the lightest SUSY particle are limited by the reconstruction efficiency of displaced tau leptons at CMS, which are produced up to 50 cm away from the IP. In addition, the small cross-section of slepton production at the LHC makes such searches challenging. In our study, we explore a new displaced $\tau$ lepton tagger using a deep neural network.

T 107.2 Thu 16:05 HSZ/0101

**Search for new physics in $t\bar{t}$+$\mathbf{E}_T^{miss}$ final states in pp collisions at 13 TeV with the ATLAS experiment** — •Simran Gurdasani, Daniele Zanzi, and Christian Weiser for the ATLAS-Collaboration — Albert-Ludwigs-Universität Freiburg

This talk will present the recent developments of an ongoing search for Beyond Standard Model (BSM) signatures that can be probed using the $t\bar{t}$+$E_T^{miss}$ final state at the Large Hadron Collider (LHC). The search is performed on proton-proton collision data at $\sqrt{s} = 13$ TeV collected by the ATLAS experiment during the LHC Run 2, corresponding to a luminosity of 139 $fb^{-1}$. Targeted signatures include Dark Matter production via scalar or pseudo-scalar mediators and SUSY stop pair production. A machine learning approach via Neural Networks (NN) is used in two stages of the search (i) to reconstruct the hadronic decays of top quarks and (ii) to discriminate signal events from background events exploiting information on the full event kinematics. The presence of signal events is inferred via a template fit to the distributions of the NN output values in samples of events at different kinematic phase spaces. This talk will give an overview of the machine learning strategy developed, background modeling techniques and the expected sensitivity estimates.

T 107.3 Thu 16:20 HSZ/0101

**Search for Compressed Elektroweakinos in Events with Two Soft and Displaced Leptons at the CMS Experiment** — •Alexandra Tews — University of Hamburg, Hamburg, Germany

A variety of supersymmetric (SUSY) extensions of the Standard Model lead to light elektroweakinos with small differences in mass between the eigenstates.

One example is that of Higgsino-like electroweakinos, where the four states $\chi_1^{\pm}, \chi_2^0$, and $\chi_1^0$ are nearly mass degenerate. The production of two elecroweakinos followed by the decay of the semi-stable second neutralino through an off-shell $Z$ boson can lead to a pair of same-flavor opposite-sign leptons. The leptons can have very low momentum if the mass spectrum of the SUSY particles is sufficiently compressed and be displaced from the primary interaction vertex.

Searches for new physics in events with two low-momentum opposite-sign leptons are particularly sensitive to such SUSY models. Scenarios with compressed Higgsinos with a mass splitting below 2 GeV with the CMS experiment are studied. We exploit new reconstruction and vertexing techniques for oppositely charged displaced lepton tracks with very low momentum of order of a few hundred MeV to extend the sensitivity of current searches to unexplored phase-space.

T 107.4 Thu 16:35 HSZ/0101

**DUNE-PRISM: An innovative technique for neutrino oscillation predictions** — •Ioana Caracas for the DUNE-Collaboration — JGU Mainz

As long baseline experiments are approaching the high precision era, an increased sensitivity towards constraining the oscillation parameter space is expected. Since the oscillation predictions are based on neutrino interaction cross sections, a classical approach is prone to systematic uncertainties, due to the incompleteness in the physical description of such models. This would in turn limit the capability to obtain the physics goals set for modern long baseline neutrino experiments, such as the Deep Underground Neutrino Experiment (DUNE).

An innovative technique, the Precision Reaction-Independent Spectrum Measurement (PRISM), has been proposed and investigated within the DUNE collaboration. This novel method is designed to measure neutrino oscillations based on a data-driven approach, eluding most theoretical modeling uncertainties. In this regard, the Near Detector (ND) is designed to move off the neutrino beam axis at several locations up to a distance of 33m, sampling thus several neutrino energy spectra. These ND off-axis results are used as a basis to predict the oscillated neutrino spectrum at the DUNE Far Detector, located at a baseline of 1300 km. The prediction obtained with the DUNE-PRISM analysis framework and the systematics impact on the oscillation parameters are presented. Additional studies needed to improve the overall sensitivity to the oscillation parameters and reduce their dependence on the interaction model uncertainties are also discussed.

T 107.5 Thu 16:50 HSZ/0101

**Monoenergetic neutrino cross-section measurements with DUNE PRISM** — •Lukas Koch for the DUNE-Collaboration — Johannes Gutenberg Universität Mainz

Next generation neutrino oscillation experiments like DUNE and Hyper-Kamiokande will require a precise understanding of systematic uncertainties to realise their physics goals. This includes a better understanding of neutrino-energy dependent cross sections of neutrino interactions with the target material. The DUNE near detector complex presents an opportunity to measure these cross sections using the PRISM approach. After recording interaction rates at different off-axis angles, and thus different neutrino energy spectra, we can make linear combinations of these measurements to create "virtual neutrino fluxes". These can be much narrower than the real fluxes, allowing for more precise cross-section measurements. This talk will explore the potential of the PRISM approach at the DUNE near detector complex and its potential implications for our understanding of neutrino cross sections.

T 107.6 Thu 17:05 HSZ/0101

**The ESS$\nu$SB(+) design study: Achievements and Prospects** — •Tamer Tolba — Institut für Experimentalphysik, Universität Hamburg, Hamburg, Germany

The European Spallation Source neutrino Super Beam (ESS$\nu$SB) is a long-baseline neutrino project that will be able to measure the CP-violation (CPV) in the leptonic sector at the second oscillation maximum, where the sensitivity of the experiment is close to three times compared to that at the first oscillation maximum. As shown in the recently published ESS$\nu$SB conceptual design report (CDR), the initially foreseen physics performance of the ESS$\nu$SB project has surpassed earlier expectations by covering, after 10 years of data collection, more than 70% of the range of possible CP-violating phase, $\delta_{CP}$, values with a confidence level of more than $5\sigma$ to reject the no-CP-violation hypothesis. The expected measurement precision of the value of $\delta_{CP}$ is smaller than 8∘ for all $\delta_{CP}$ values, making it the most precise proposed experiment in the field by a large margin. The extension project, ESS$\nu$SB+ to be performed between 2023 and 2026, aims in addressing the challenging task of measuring the neutrino-nucleon cross-section, which is the dominant term of the systematic uncertainty, in the energy range from 0.2 to 0.6 GeV, using a Low Energy nuSTORM (LEnuSTORM) and an ENUBET-like Low Energy Monitored Neutrino Beam (LEMNB) facilities. With the successful end of the previous design-study program and the publication of the ESS$\nu$SB CDR, an overall status of the project, as well as the recently accepted, by the Horizon-Europe program, extension project, the ESS$\nu$SB+, will be presented.