T 59: Neutrino Physics with Accelerators 1

Time: Wednesday 16:15–17:50 Location: T-H18

T 59.1 Wed 16:15 T-H18

Particle Identification and Reconstruction with the DUNE ND-GAr Near Detector — •Lorenz Emberger and Frank Simon — Max-Planck-Institut für Physik

The Near Detector (ND) of the Deep Underground Neutrino Experiment (DUNE) will play an important role in the search of CP violation in the neutrino sector. Additionally, as a standalone complex, it will be an excellent laboratory to study a wide range of neutrino interactions and BSM models. The ND design consists of three independent sub-detectors, placed downstream of the neutrino production target. One of these detectors, called ND-GAr, consists of a magnetized high pressure gaseous Argon Time Projection Chamber (TPC), surrounded by an electromagnetic calorimeter (ECAL) and a magnet yoke. One key aspect of the ECAL is the reconstruction of neutral particles such as neutral pions and potentially neutrons. The ECAL also extends the detector's separation capability of muons and pions, which is further enhanced by a muon tagger in the magnet yoke. We present a simulation study of the detector system featuring a highly granular electromagnetic calorimeter inspired by the SiPM-on-Tile technology developed by the CALICE collaboration. We will introduce the detector design considerations, as well as the potential physics program. Furthermore, we will discuss the separation of muons and pions using the ECAL and study the impact of different possible muon tagger layouts. A simulation study on time-of-flight reconstruction of the kinetic energy of neutrons will also be presented.

T 59.2 Wed 16:30 T-H18

Studies on the DUNE ND-GAr ECAL Design — •Sebastian Ritter[1], Peter Bernhard[2], Andrea Brogna[2], Volker Büscher[1], Karl-Heinz Geib[1], Asma Hadef[1], Antoine Laudrain[1], Lucia Masetti[1], Marisol Robles Manzano[1], Anna Rosmanitz[1], Christian Schmitt[1], Alfons Weber[1], and Quirin Weitzel[2] — [1]Johannes-Gutenberg Universität Mainz — [2]PRISMA+ Detector Lab

The Deep Underground Neutrino Experiment (DUNE) aims to unlock the mystery of neutrinos. One of the major goals is to measure the CP-violating phase of the neutrino mixing matrix for which the DUNE near detector (ND) is crucial. A leading role in measuring neutrino interactions in the ND will be filled by the high-pressure gaseous argon TPC. A sampling ECAL based on plastic scintillators with SiPM readout is surrounding the TPC (ND-GAr). In this talk, optimized geometries are considered for the ND ECAL motivated by external boundary conditions and the beam-on-target nature of DUNE. A second focus will be on the readout of the ECAL's scintillator strips trying to efficiently use the available space and optimizing the light output.

T 59.3 Wed 16:45 T-H18

Plastic Scintillator and Light Guide Research and Development — •Patrick Deucher — Johannes Gutenberg Universität Mainz

Plastic scintillators are broadly used in physics experiments for the detection of particles and electromagnetic radiation. With tunable emissive properties and a fluorescent decay time of a few ns, plastic scintillators are a solid option that can be tailored to individual applications. First steps for the production and optimization of polystyrene based plastic scintillators have been taken at the Johannes Gutenberg University in Mainz. This includes the purification of styrene, the addition of different fluorophores and thermal polymerization. In cooperation with Tübingen, we develop dedicated active light guides for use with large SiPM arrays. Moreover, plastic scintillators with optimized capability for pulse-shape discrimination are investigated for use in the ECAL of the DUNE Near Detector. This talk will present the progress on plastic scintillator production and characterization including absorption, emission and lifetime measurements of first samples. This work is supported by funds of the Excellence Cluster PRISMA+.

Group Report T 59.4 Wed 17:00 T-H18

ANNIE: The Accelerator Neutrino Neutron Interaction Experiment — •Marc Breisch for the ANNIE-Collaboration — Physikalisches Institut, Eberhard Karls Universität Tübingen

The Accelerator Neutrino Neutron Interaction Experiment (ANNIE) is a 26-ton gadolinium doped water Cherenkov detector situated on-axis of the Booster Neutrino Beam (BNB) at FermiLab. Its main goal is to measure the final state neutron multiplicity of neutrino-nucleus interactions to improve the systematic uncertainties of next-generation long baseline neutrino experiments. An additional milestone will be the deployment of the first Large Area Picosecond Photodetectors (LAPPD). These novel detectors will feature a time resolution less than 100 picoseconds and a spatial accuracy of a few millimetres, thus improving the track reconstruction capabilities of the detector. This talk will give a general overview of ANNIE including an update on the currently running Phase Two as well as an upcoming expansion using Water based Liquid Scintillator (WbLS).

T 59.5 Wed 17:20 T-H18

Water-based Liquid Scintillators in ANNIE — Daniele Guffanti[2], David Maksimovic[1], •Michael Nieslony[1], and Michael Wurm[1] for the ANNIE-Collaboration — [1]Johannes Gutenberg-Universität Mainz, Germany — [2]Università degli Studi di Milano Bicocca, Italy

The Accelerator Neutrino Neutron Interaction Experiment (ANNIE) is a Gadolinium doped water Cherenkov detector located in the Booster Neutrino Beam at Fermilab with the primary goal of measuring the final state neutron multiplicity of neutrino-nucleus interactions. A future phase of the experiment will explore the benefits of using the novel detection medium of Gadolinium-doped Water-based Liquid Scintillators (GdWbLS) in a neutrino beam environment by placing a small vessel within the current detector. GdWbLS aims to combine the advantages of liquid scintillator and water Cherenkov detectors by accessing directional information from the Cherenkov light and simultaneously using the scintillation signal to infer additional calorimetric event properties, especially with respect to lower-energy hadronic recoil signals. The following talk will highlight the expected improvements for the neutrino energy reconstruction in beam events for GdWbLS as a target material in comparison to a more conventional water detection volume based on simulation studies.

T 59.6 Wed 17:35 T-H18

Overview of the ESSνSB Conceptual Design — •Tamer Tolba — Institut für Experimentalphysik, Universität Hamburg, Hamburg - Germany

In the search for the CP-violation in the leptonic sector, crucial information has been obtained from neutrino experiments. The measurement of the third neutrino mixing angle, θ_{13}, opened the possibility of discovering the Dirac leptonic CP violating angle, δ_{CP}, with intense "super" neutrino beam experiments. In the light of these new findings, an urgent need has arisen to improve the detection sensitivity of the current long-baseline detectors, considering proton driver at MW scale with MegaTon scale detector, with a key modification to place the far detectors at the second, rather than the first, oscillation maximum.

The European Spallation Source neutrino Super Beam (ESSνSB) aims to benefit from the high power of the ESS, LINAC in Lund-Sweden, to produce the world's most intense second-generation neutrino beam, enabling measurement to be made at the second oscillation maximum. Assuming a ten-year exposure with five-years running in neutrino- and five-years in antineutrino-mode, CP-violation could be established with a significance of 5σ over more than 70% of all values of δ_{CP}. With the current design-study program of the experiment is coming to its successful end, with the production of the CDR, an overall status of the project will be presented. The technical aspects on the current design study programs running within the collaboration and the physics potential of the experiment will be presented, as well.