APR21-2021-001876

Abstract for an Invited Paper
for the APR21 Meeting of
the American Physical Society

The High Energy-Intensity Frontier at the Particle-Physics Renaissance

YU-DAI TSAI, Fermi National Accelerator Laboratory (Fermilab)

I will give a general overview of experimental facilities with high energies and high intensities, focusing on proton fixed-target (at Fermilab) and hadron collider experiments (at the LHC). I will classify the searches as "decay" searches and "scattering" searches, and detail the new physics models of interest. These models provide attractive dark matter candidates and aremotivated by other experimental anomalies (including the anomalous muon g-2 measurement), and the experiments can help close the gap between the low-mass/high-mass regions for the dark sector searches, and the low-energy/high-energy gap for the neutrino study. I will present two new experimental proposals, LongQuest and FORMOSA. LongQuest is a multi-purpose proton fixed-target experiment, studying the decay particles, including dark photons and axion-like particles. FORMOSA is a specialized LHC forward experiment that is the world-most sensitive proposal to study millicharged particles, and also has the potential ability to study heavy neutrino and tau neutrino dipole moments. FORMOSA is directly inspired by similar experiments installed and proposed at LHC (milliQan) and at Fermilab (FerMINI). I will also mention the analyses based on existing experiments and proposals (MiniBooNE, MicroBooNE, SBND, DUNE, and SHiP), and searches of new physics based on cosmic-ray productions at Super (Hyper)-Kamiokande. Some of these ideas can be further applied to ILC and future muon colliders. Finally, I will discuss the possibility of constructing liquid Argon neutrino detectors at the LHC forward physics region to study high-energy neutrino cross-sections, named nu-FLArE. This talk is based on arXiv:2008.08608, arXiv:1908.07525, arXiv:2010.07941, arXiv:1812.03998, and ongoing works.