

Abstract for a General Audience

The biggest research program at Fermilab is the study of neutrinos, highly abundant subatomic particles which rarely interact with matter. Neutrinos have many interesting, and sometimes confounding, properties which may lead to helping us better understand the way the universe works. Many of the experiments which aim to study neutrinos are limited by how well they understand the brightness of the neutrino beams they use. Because of this limitation, the experiments cannot reach their full potential in determining signs of new physics, or in confirming predicted physics at high precision. EMPHATIC is an experiment at Fermilab which aims to tackle this problem by studying the main process that scientists use to make neutrino beams: hadron production. EMPHATIC wants to study the process of making a neutrino beam to a high enough precision so that current and future neutrino experiments, like DUNE or Hyper-K, can make precise measurements of signs to new physics. This summer I worked on developing the simulations for EMPHATIC, allowing them to predict the efficacy of their apparatus and analysis techniques, which will help them make adjustments and predictions as they move to Phase 2 of the experiment. I also helped on the hardware side, coming up with a procedure to set up and test electronics which will go into the detector upgrades for Phase 2. Overall, I made important contributions to the experiment, making more things possible for collaborators and pushing progress forward for upgrades.