Investigating the nature of neutrinos & dark matter

Karsten Heeger
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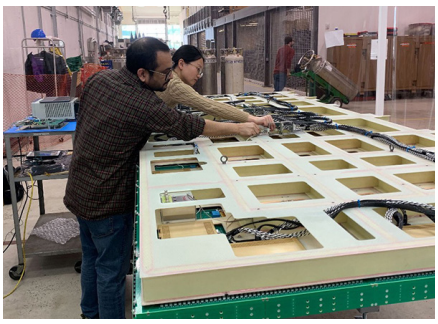
Karsten Heeger carries out cutting-edge experiments to study the properties of neutrinos, in search of rare event processes to solve some of the greatest mysteries of the Universe: What does the invisible Universe consist of? Why does the Universe have more matter than antimatter? What are the properties of neutrinos?

Heeger was awarded the 2016 Breakthrough Prize in Fundamental Physics and is a Fellow of the American Physical Society (APS). Heeger has served on numerous national and international advisory committees, including as Deputy Chair of the 2023 Particle Physics Project Prioritization Panel (P5) and as a member of the High Energy Physics Advisory Panel, the Nuclear Science Advisory Committee, and the Natural Sciences and Engineering Research Council. Heeger is the Chair of the Yale Physics Department and the Director of Yale Wright Laboratory.

Cryogenic Underground Observatory for Rare Events (CUORE)

CUORE, and its successor CUPID, both located in Italy, are searching for a previously undetected process called neutrinoless double beta decay. If such a process is observed, it would demonstrate that neutrinos are their own antiparticles, offering a possible explanation for why we live in a Universe of matter, not antimatter.

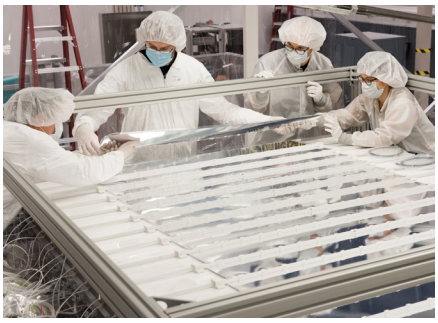
Heeger is co-spokesperson of CUPID, and, together with Reina Maruyama, co-Principal Investigator of CUORE. The Yale CUORE/CUPID team has been responsible for detector calibration, the study of cosmogenic backgrounds, double beta decay analysis, and the search for solar axions.



Deep Underground Neutrino Experiment (DUNE)

DUNE will send a high energy neutrino beam through the Earth's crust over a distance of 1,300 kilometers from Fermilab in Illinois to the Sanford Underground Research Facility in South Dakota to perform precision studies of neutrino oscillation. DUNE will study parameters of the matter-antimatter imbalance in the Universe and determine the ordering of neutrino mass states.

The Heeger group is responsible for the assembly of Charge Readout Planes at Wright Lab for the DUNE detectors and studying the detector response.



PRecision Oscillation and SPECTrum Experiment (PROSPECT)

PROSPECT is designed to make precision measurements of antineutrinos emitted from nuclear reactors, search for sterile neutrinos, and help develop technology for the remote monitoring of nuclear reactors for safeguard and non-proliferation.

PROSPECT was designed and built at Wright Lab in collaboration with Brookhaven National Laboratory, Lawrence Livermore National Laboratory, and other universities. PROSPECT operated at the High Flux Isotope Reactor at Oak Ridge National Laboratory in Tennessee.

Project 8

Project 8 utilizes a novel technique, dubbed Cyclotron Radiation Emission Spectroscopy, to perform a precision measurement of the yet unknown neutrino mass.

The Heeger group is performing research and development (R&D) on antenna and cavity prototypes, developing algorithms for event reconstruction and analysis, and performing simulations to optimize the detector resolution.