Fermilab Argonne NATIONAL LABORATORY

HIGH-ENERGY PARTNERSHIP

Argonne, Fermilab, and UChicago collaborate for universal discoveries.

The Chicagoland area is home to one of the world's greatest concentrations of scientific research, particularly in high-energy and nuclear physics. The collaboration between Argonne, Fermilab, and the University of Chicago—which runs both laboratories—has yielded tremendous benefits across a wide range of experiments situated literally all around the world. Here are some notable collaborations happening right now among scientists at all three institutions.

STUDYING THE COSMIC MICROWAVE BACKGROUND AT THE SOUTH POLE TELESCOPE

Argonne, Fermilab, and University of Chicago researchers are studying the Cosmic Microwave Background (CMB) radiation using the South Pole Telescope. The CMB formed in the very earliest period of the universe and is a unique window into its earliest moments when scientists believe it underwent an accerlated process of universal expansion, called inflation.

Argonne has converted this recycled hospital MRI magnet into a physics facility. This large magnet, with a strength of 4 Tesla, is used to benchmark and validate experimental equipment that will be used by Fermilab during their upcoming muon experiments, called Muon G-2 and Mu2e.

To detect the CMB—a very faint thermal signal in the background of empty space—researchers need precisely tuned detectors, fabricated at Argonne and tested at Fermilab. Fermilab researchers also built the cryostat, which basically acts like a large camera, for the 10-meter South Pole Telescope. The project is led by University of Chicago Researcher John Carlstrom. The research team installed the third-generation detectors last winter, and are currently planning a more ambitious fourth generation of the experiment.

THE NEXT GENERATION OF MUON EXPERIMENTS

In the next few years, Fermilab will be hosting two new experiments to look at the properties of muons—a particle related to, but heavier than, the electron. These two experiments, called "Muon G-2" [pronounced "g minus two"] and "Mu2e", rely on precise, strong magnetic fields. Both of these experiments are designed to look at different properties of the muon (either the magnetic moment or its possible conversion to an electron) to test the Standard Model of physics, our current best understanding of how the universe is constructed.

THE UNIVERSITY OF CHICAGO

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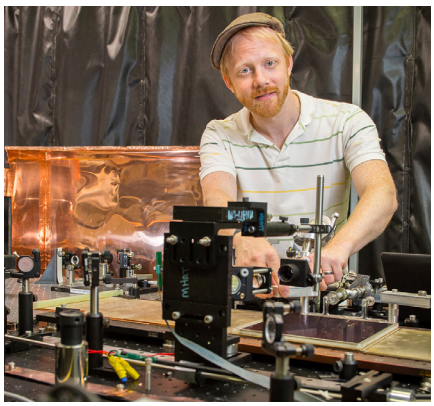

Matthew Wetstein, a physicist and former University of Chicago and Argonne postdoctoral researcher, tests the Argonne-developed Large Area Picosecond Photodetector. This design provides high-quality lower cost imaging for use in cargo scanners, neutrino experiments, and medical devices.

Argonne scientists are testing some of the components to be used in these experiments using repurposed MRI magnets, establishing benchmarks so the research at Fermilab will have as little uncertainty as possible. University of Chicago particle physicists will be closely involved in probing muon physics as these experiments proceed.

CONTINUED SEARCH FOR NEW PHYSICS AT THE LARGE HADRON COLLIDER (LHC)

After finding the Higgs Boson in 2012, researchers at the Large Hadron Collider (LHC) at CERN in Geneva, Switzerland, have continued their quest for new particles and physics. Chicago-area researchers are involved in both major experiments at the LHC—Argonne and University of Chicago researchers work on the ATLAS experiment, while Fermilab scientists work on the CMS experiment. Each experiment is needed to validate the results of the other. While preparing to upgrade the ATLAS detector to operate at higher beam intensities, Argonne physicists are using the high energy test beam at Fermilab to perform tests of new readout schemes and sensors being proposed for a new pixel detector.

STUDYING THE ELUSIVE NEUTRINO

Fermilab has a long tradition of studying the second most abundant particle in the universe, the neutrino. The study of neutrino oscillations, where one flavor of neutrino changes identity into another flavor, is one of the main areas of study of particle physics these days. Argonne has collaborated on many neutrino experiments at Fermilab. For the NOvA experiment, currently taking data in northern Minnesota, Argonne has been instrumental in designing and building the large-scale neutrino extrusion structures that detect the interactions of the neutrinos. Argonne is currently preparing elements of the next-generation detector as well.

ADVANCED ACCELERATOR TECHNOLOGY

The hallmark of high energy physics is the use of particle accelerators. Accelerating particles to higher and higher energies is key to finding new physics and potentially even new particles. Argonne is working with Fermilab to develop new technologies for the next generation of particle accelerators that will enable new physics experiments.

FOR MORE INFORMATION

To learn more about high energy physics underway at Argonne National Laboratory, visit us online at **www.hep.anl.gov**