Sanford Underground Research Facility

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Deep Thoughts

Notes from the underground by Communications Director Constance Walter

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Neutrino Day celebrates discovery

In September 1967, Dr. Ray Davis Jr. released the first results from his Solar Neutrino Experiment. His discovery led to three decades of controversy in the physics community: he had captured less than two neutrinos per day, two-thirds fewer than had been predicted.

Still, it offered humankind a glimpse into what Dr. Michael Landry calls, "a dark sector" of the universe. Landry, director of the Laser Interferometer Gravitational-Wave Observatory (LIGO) in Hanford, Wash., is this year's keynote speaker for Neutrino Day.

The free science festival celebrates the persistence leading to breakthrough discoveries that help us better understand the universe and our place in it. Landry's presentation will focus on LIGO's discovery of gravitational waves, first theorized by Albert Einstein in his General Theory of Relativity.

In September 2015, the Hanford observatory was one of two LIGO facilities to discover gravitational waves. The cataclysmic event, which happened approximately 1.3 billion light years away, sent ripples across the fabric of spacetime and throughout the scientific community.

"Discovering gravitational waves is akin to acquiring a new sense that allows us to listen to the universe instead of just looking at it," Landry said in a Ted Talk. "It alters our perception and allow us to access things we haven't seen before.

"The universe is grander, more complicated and, at times, intimidating," Landry said. "It needs particularly tenacious people to track down the dark sectors of the universe"—things like dark matter, black holes, gravitational waves and neutrinos.

Davis was one of those tenacious people. For three decades he measured neutrinos, always with the same results.

"The solar neutrino problem caused great consternation among physicists and astrophysicists," Davis said in his Nobel biography. "My opinion in the early years was that something was wrong with the standard model; many physicists thought there was something wrong with my experiment."

The story ended happily for Davis. In 2000, a discovery by the Sudbury Neutrino Observatory vindicated him with its discovery of a phenomenon called neutrino oscillation, which showed that neutrinos change between three types as they travel. Davis' experiment could only count electron neutrinos. In 2002, he received the Nobel Prize in Physics for his work.

For decades, physicists expressed doubt about the existence of gravitational waves—even Einstein thought he might be wrong. Could their tenacity earn them the next Nobel Prize in Physics?

DUGL

A LIGO-related project, the Deep Underground Gravity Laboratory (DUGL), placed 24 seismometer stations in several levels of Sanford Lab and on the surface. Placed in a grid that probed approximately 1 cubic mile, the seismometers measured ground movement to velocities less than a micron per second. DUGL's findings could inform the design of future gravitational wave detectors.

"LIGO's observation is just the beginning," said Vuk Mandic, associate professor of physics and astronomy at the University of Minnesota and a member of both collaborations. "Not only did we see gravitational waves, we saw black holes merging for the first time ever. It was a spectacular event! More sensitive detectors will allow us to learn so much more about the universe."

Neutrino Day: Discovery, July 8

Dr. Bonnie Fleming, a researcher at Fermilab and Yale, will talk about progress on the Deep Underground Neutrino Experiment (DUNE).

Features: children's activities, demonstrations by "Science" Steve Rokusek, hoistroom tours and videoconferences with scientists at Fermilab and underground.

"Now then again," a play about physicists and love, opens Friday, July 7. Playwright Penny Penniston will be on hand for a discussion after the show.

Volunteer or register an activity for Neutrino Day:
http://www.sanfordlab.org/neutrinoday2017