# K-State Physics Professor Named Outstanding Junior Investigator by U.S. DOE

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The trophy case for Kansas State University's physics department continues to grow. Glenn Horton-Smith, a K-State assistant professor of physics, is just one of the recent faculty members in the department to earn national recognition. Horton-Smith has been named an Outstanding Junior Investigator by the U.S. Department of Energy.

The award is given to recognize exceptionally talented new high energy physicists early in their careers and to assist and facilitate the development of their research programs. Awards made under this program help to maintain the vitality of university research and assure continued excellence in the teaching of physics.

Horton-Smith was recognized for his work with neutrinos, one of the fundamental particles which make up the universe. According to Horton-Smith, neutrinos are the smallest, hardest to detect particle that have ever been proven to exist -- and are also one of the least understood.

"Neutrinos are emitted in the decay of radioactive elements and in the decay of some unstable elementary particles," Horton-Smith said. "Many neutrinos also were made in the 'big bang.' Neutrinos might make up as much of the mass of the universe as all of the atoms heavier than hydrogen put together, but you don't normally notice them because once created neutrinos are hardly ever absorbed again; they rarely interact with matter at all."

Horton-Smith was honored for research projects that will gather related information needed for future neutrino experiments.

One experiment that he has been working on since 1998 with 92 of his "best friends" involves building very large detectors deep underground in Japan to observe neutrinos.

"By the late 1990s, we had observed neutrinos from the sun, from nuclear power stations, from cosmic rays and from accelerators," Horton-Smith said. "But there was something strange about the number of neutrinos detected from the sun. There weren't enough of them."

Something interesting was happening, Horton-Smith said. Either the sun worked very differently than previously thought or the neutrinos themselves were changing, "disappearing" by transforming themselves into some kind of undetectable through a process called "neutrino oscillation," he said.

But why did this happen only for solar neutrinos and not to the neutrinos from reactors? Theorists calculated the properties of the oscillating neutrinos and found that all of the observations made at reactors were made too close to the reactor, Horton-Smith said.

Neutrino scientists wanted to make measurements of the neutrinos from reactors more than 100 kilometers away, but even though the most powerful nuclear power station reactor cores make over 500 trillion neutrinos in every millionth of a second, neutrinos interact so rarely that no reactor was powerful enough to make enough neutrinos to be seen that far away, he said. According to Horton-Smith, it would take almost 100 reactor cores to generate even one neutrino interaction event a day in a 1,000-ton detector.

Horton-Smith said the KamLAND reactor antineutrino observatory, in

the Kamioka mine in Japan, was built to assist in the study of neutrinos. The observatory uses a detector filled with 1,000 tons of scintillating baby oil and benzene, and makes use of neutrinos from all the reactors in Japan.

"The major reactors are something like 180 kilometers away," Horton-Smith said. "The scintillator makes a flash of light when a certain kind of radiation deposits energy in it, including the kind created when a neutrino from a reactor, very rarely, interacts with a proton in the scintillator."

Horton-Smith also plans to build a much smaller detector near K-State's Cardwell Hall that will study cosmic ray signals, which can be confused with neutrinos at shallow and intermediate depths underground.

Since the inception of the junior investigator program in 1978, 185 scientists have received Outstanding Junior Investigator Awards. Of these, 158 have achieved tenured academic positions, 11 hold tenured research appointments and 28 remain on tenure track.

Previous winners of this award from K-State include Regina Demina in 2001 and Donna Naples in 1996.

"K-State is very fortunate to have Glenn Horton-Smith on our faculty," said Dean Zollman, head of the department of physics and a university distinguished professor of physics. "His award indicates that he is considered by high energy physics community, as well as our faculty, as an excellent young physicist. His expertise in neutrino physics provides our students with access to someone who is on the leading edge of a very important and rapidly developing research area."

Horton-Smith said he was surprised to get the award in his first year of eligibility.

"In most cases where people got it in their first year of eligibility, they come in with a well-developed research program that fit into something that was already going on," Horton-Smith said. "I'm just happy to see that I qualified; that I fit that profile."

Source: Kansas State University