Department of Physics & Astronomy

PHYSICS NEWS FLASH

Taking Earth's Temperature: UT Physicists Co-Author Nature Cover Article on Geoneutrinos

July 28, 2005

UT Physicists are among the scientists keeping watch on how hot the Earth gets.

Deep inside the planet, radioactive isotopes generate heat as they undergo the natural process of beta decay. Antineutrinos are a byproduct of the process, and that just happens to be the expertise of some of UT's particle physicists.

Working with the KamLAND (Kamioka Liquid Scintillator Antineutrino Detector) collaboration, physicists Mikhail Batygov, Bill Bugg, Yuri Efremenko, Yuri Kamyshkov, and Alexandre Kozlov keep busy chasing antineutrinos. In 2003, the first KamLAND paper reported the disappearance of antineutrinos produced in nuclear reactors. That paper is still at the top of experimental particle physics citation list. Now, for the first time, the KamLAND group has detected antineutrinos produced inside the Earth.

Antineutrinos are emitted during radioactive beta decay, when a neutron decays into a proton and an electron. Difficult to detect, neutrinos fool their would-be captors by changing their identities. They come in three "flavors:" electron, muon, and tau. As they travel, neutrinos can change their flavors, a phenomenon called neutrino oscillation. Solar neutrinos produced by fusion exhibit the same oscillation pattern. Historically these particles have been nearly impossible to pin down, as they easily pass through matter undetected and penetrate the whole Earth. But KamLAND, built a kilometer underground in Kamioka, Japan, is uniquely designed to catch elusive antineutrinos. The 1,000 tons of organic chemicals inside the detector will emit light when struck by electron antineutrinos produced by man-made nuclear power reactors in Japan and North Korea.

Researchers at KamLAND have used the same method to measure antineutrinos produced inside the Earth when uranium and thorium isotopes decay naturally.

Results appear in the article, “Experimental Investigation of Geologically Produced Antineutrinos with KamLAND,” which graces the July 28, 2005 cover of *Nature*. Measuring these “geoneutrinos” can serve as a valuable crosscheck of the radiogenic heat production rate. Thus far, KamLAND estimates that the heat produced inside the Earth is in line with current predictive models. By using this powerful detector, researchers hope they can unlock still more geophysical information.

For more information see:

The New York Times: "Baby Oil and Benzene Provide Look at Earth's Radioactivity" (July 28, 2005)