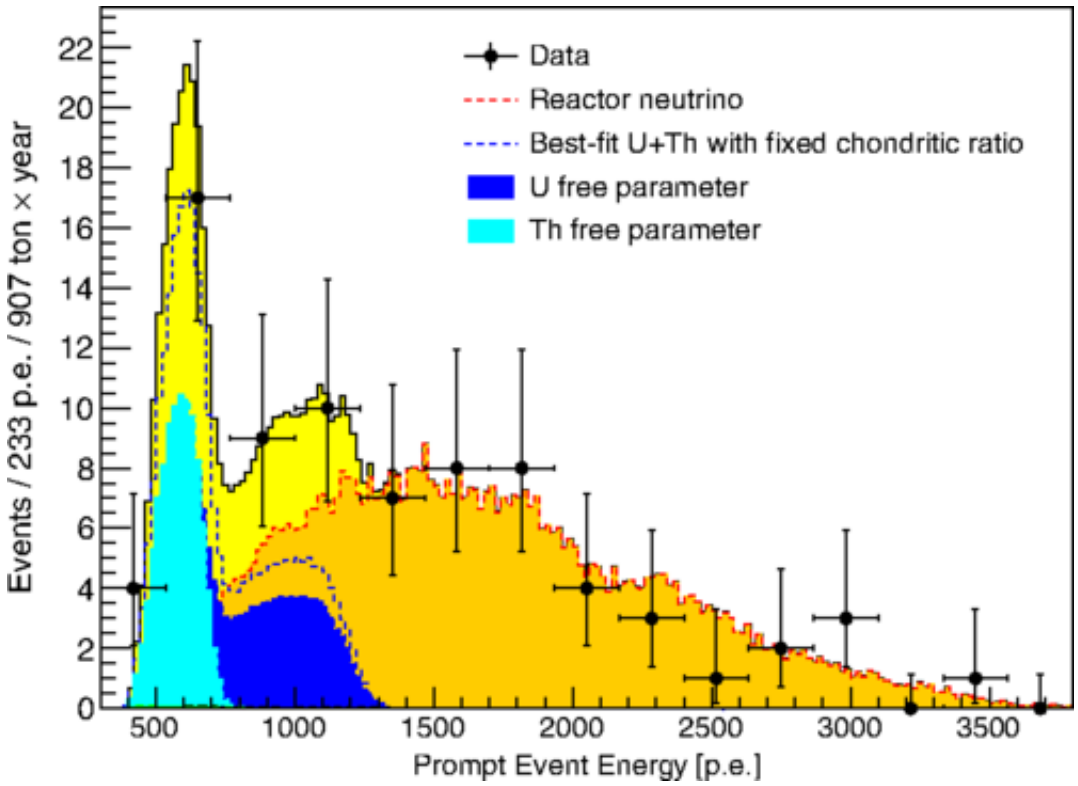
Team records neutrinos from the Earth's mantle

August 10 2015, by Bob Yirka



Prompt light yield spectrum, in units of photoelectrons (p.e.), of anti-neutrino candidates and best-fit. The best-fit shows the total contribution of geoneutrino, reactor neutrino and background (yellow colored area) and reactor neutrino (orange colored area) assuming the chondritic ratio. The result of a separate fit with U (blue colored area) and Th (light-blue colored area) set as free and independent parameters is also shown. Credit: arXiv:1506.04610 [hep-ex]

(Phys.org)—A team of researchers working on the Borexino

Collaboration at Gran Sasso National Laboratory in Italy is reporting that they have detected neutrinos emanating from the Earth's mantle. In their paper published in the journal *Physical Review D,* the team describes the neutrinos that have been detected at their site and how they came to believe that approximately half of them come from inside the Earth, rather than from the crust.

Neutrinos are neutrally charged particles that have nearly no mass, making it possible for them to pass though most matter, such as our bodies. Scientists believe they come into existence as part of radioactive decay and have been working on ways to prove their existence physically by capturing them with detectors. At the facility in Italy, researchers have set up a large underground tank filled with 300 metric tons of liquid scintillator—when a neutrino collides with one of its particles, a flash of light is emitted, indicating that a single neutrino has been detected.

The team at the site has been monitoring the detector since 2007. In this latest research effort, the team is reporting on what have been named geo-neutrinos, which are neutrinos that come from the Earth, either the crust (many of which are thought to come from man-made nuclear reactors) or the mantle. These particles, the team notes, are actually antimatter versions of neutrinos, and have been recorded before, but the detections were very faint, making it difficult to confirm their source. In this new effort, the team looked at detections occurring over 2056 days, with 5.9 sigma significance.

The large amount of data allowed the researchers to measure the ratios between neutrinos that emanated from the crust versus the mantle because for the first time, they were actually able to distinguish between the two. They also believe that most if not all the neutrinos originated in either uranium-238 or thorium-232 and estimate that 53 of the 77 detected geo-neutrinos emanating from the crust, were from man-made

sources.

The work done by the team is likely to help scientists gain a better understanding of how radioactive decay of material inside the Earth drives other processes, including convection over long periods of time, of rock in the mantle.

More information: Spectroscopy of geoneutrinos from 2056 days of Borexino data, *Phys. Rev. D* 92, 031101(R) – Published 7 August 2015. On *Arxiv*: arxiv.org/abs/1506.04610