Published on *GazetteNET* (http://www.gazettenet.com)

Eureka!: UMass researchers study messengers from the stars

By *Kristin Palpini*
Created *05/07/2010 - 09:00*

local sci-tech umass amherst

It may be a significant contributor to the heat generated inside the Earth, influencing volcanos and tectonic plate movement, but little is known about the geoneutrino- a subatomic particle produced in radioactive decay.

However, University of Massachusetts researchers recently were able to collect the clearest data yet on what the hard-to-find geoneutrinos do. About 5,000 feet under the Italian Alps, Laura Cadonati, Andrea Pocar and a team of scientists recently recorded geoneutrino interactions using Borexino, the large neutrino detector.

Geo, and other forms of anti-neutrinos, are difficult to pinpoint because they can travel through most matter.

Cadonati described neutrinos- which are produced in the Earth as well as the sun and other stars- as "messengers." Because they rarely interact with other matter, neutrinos can provide clear information about the places they originated. They can inform scientists about how celestial bodies, and life in general, is formed.

"They are messengers from inside the planet and stars," Cadonati said. "Neutrinos and their behavior are one of the fundamental components of matter itself."

The find has already provided information Cadonati said provides clues about what is at the Earth's core. Geophysicists and geologists have long questioned whether there is a huge, natural nuclear reactor in the center of the Earth.

Based on her research, Cadonati said the answer is no. Using data on the Earth's inner temperature and the number of geoneutrinos found, Cadonati surmised that there are not enough geoneutrinos inside the Earth to signify a large nuclear reactor.

Over the course of two years, Borexino discovered about 20 geoneutrinos produced in the radioactive decay of the Earth's natural uranium, thorium, potassium and rubidium deposits. Borexino, one of only a handful of underground neutrino detectors in the world, finds anti-neutrinos and other subatomic particles by providing an arena for them to interact: a 300-ton sphere of scintillator fluid, surrounded by an 18-foot-diameter nylon balloon. This all floats inside another 700 tons of buffer fluid encased in a 45-foot-diameter stainless steel tank immersed in a gigantic tub of ultra-pure water.

If scientists are lucky, the geoneutrino will bump into a proton in the scintillator fluid and interact, causing the geoneutrino to release its energy in a burst of light. This allows scientists to record the energy contained in these particles.

"We need more data to draw conclusions on what is made inside the Earth" said Cadonati. "It is like we have opened a new window inside the Earth by studying neutrinos."

###

Putting carbon dioxide to work

Derek Lovley, a UMass microbiologist, has a plan to turn carbon dioxide into organic transportation fuel.

He calls the groundbreaking process microbial electrosynthesis, or ME. Last week the process - and Lovely - were recognized by Vice President Joe Biden when the nation's second-in-command announced 37 grants for what he called "cutting-edge research projects with the potential to dramatically transform how we use energy." Lovely's research will receive $1 million, plus additional funds, in stimulus money to improve ME.

"It's always nice to have that kind of high visibility for your research," Lovely said. "And to get that support at that level for what you're doing is always helpful."

Lovely is the scientist behind Geobacter, the biological electricity-conducting microbe. It was this research that led him to develop ME, which is akin to biological electrical production in reverse.

"Rather than making electricity we feed electricity to the microorganism," Lovely explained. "We can feed it CO2 and it spits out an organic compound."

The ME process combines carbon dioxide and water to produce organic compounds with an oxygen byproduct. ME is primarily designed to work with solar panels. The panels pick up the sun's rays, providing the power to strip electrons from the water. The electrons then go on to power microbes that have colonized a nearby electrode. The energized microbes take in carbon dioxide, and through the natural consumption process, expel fuels and chemicals.

"Plants put their carbon compound into biomass, to produce more plants," Lovley said. "The electrosynthesis process turns it into fuels."

ME also has the potential to improve solar panel power production, Lovley said. Panels can produce power when the sun is shining, but have no way to store the energy for later. ME uses solar energy to make physical fuel and chemicals, thus storing the power for later use.

Lovely has uses ME to spur the production of acetate, but with a few genetic changes- adding enzymes to the microbe's DNA that will modify its metabolism - he thinks he has found a way to use the same process to make butanol, a flammable alcohol. The process will also yield other chemicals, butanediol, for example, from which plastics are made.

"It's actually pretty low risk," said Lovley. "It's clear what genes we need to put in and how to do it."

Source URL: http://www.gazettenet.com/2010/05/07/umass-researchers-study-messengers-stars