Scientist thinks bad-boy stars may produce elusive particle

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Stand too close to a neutron star, and you'll lose the fillings in your teeth and the iron in your blood. Try to land on one, and you'll turn into liquid. Set a sugar cube-size sample of neutron star material on a table, and it will drill down to the center of the Earth.

It's lucky that neutron stars are so far away, said Montana State University physicist Bennett Link. At the same time, he said, scientists might want to take a better look at these bad-boy stars.

Link recently published a paper in *Physical Review Letters* that said hot young neutron stars could be a source for neutrinos, a tiny particle that normally eludes detection but may reveal new clues about the universe.

The journal published by the American Physical Society is the primary publication for announcing discoveries of broad interest in all fields of physics. Link's collaborator was Fiorella Burgio from the University of Catania in Sicily.

"I think there is a very good chance that the first high-energy neutrinos to be detected will come from neutron stars," Link said.

William Hiscock, physics professor and head of the MSU physics department, said, "This is an exciting idea which deserves further study and consideration. If we can get the right instruments built, then we'll be able to see whether pulsars emit beams of neutrinos as they do radio waves, light and x-rays."

Astrophysicists are interested in neutrinos for several reasons, Hiscock

said. They want to understand the fundamental properties of neutrinos and the objects that emit them. Scientists believe neutrinos may provide another way of viewing the universe in addition to light and other electromagnetic waves.

Link said a neutron star is about the size of Montana's Gallatin Valley, but it is extremely dense and contains as much matter as the sun. A cubic centimeter of neutron star material would weigh more than 100 million tons on Earth. Its magnetic field is a million times stronger than anything a scientist could produce briefly in the laboratory. Young neutron stars normally have a surface temperature of more than one million degrees, compared to 6,000 degrees for the sun.

"Neutron stars are rapidly-rotating, strongly magnetized objects that are created by supernova explosions," Link said. "The conditions inside and around them are extreme by any terrestrial measure."
Neutron stars -- because of their magnetism and rotation -- act like super generators, Link said. They create an enormous voltage that strips charges from the surface of the star. Particles then fly off the star and produce detectable radiation. Link believes some of the charges also produce high-energy neutrinos which are extremely small and hard to detect.

"There are billions of neutrinos a second coming to Earth, but they rarely interact with particles on Earth," Link said.

When particles do interact, they create a flash of light, Link said. Scientists try to detect those flashes with telescopes pointed into the Earth and away from the atmosphere. The telescopes use the Earth as a filter to eliminate flashes that have nothing to do with neutrinos.

The United States has one neutrino observatory in Antarctica, Link said. Called AMANDA-II, its detectors are located deep in the ice at the

Admundsen-Scott South Pole station. AMANDA-II will eventually be replaced by a $272-million telescope known as IceCube. The new telescope will be 10 times stronger than AMANDA.

European scientists are also developing three observatories to be placed at the bottom of the Mediterranean Sea, Link said.

"So far, there have been no discoveries, but the field of neutrino astronomy is still in its infancy," Link said.

Source: Montana State University