Lightning research sparks new discovery

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Lightning, a high-voltage discharge that strikes quickly and sometimes fatally, is very difficult to study. A new and surprising finding by Florida Institute of Technology's Dr. Joseph Dwyer and his team brings the study of lightning research into the laboratory.

Already noted for his discoveries related to x-ray emission from natural and triggered lightning, Dwyer, an associate professor of physics and space sciences, conducted a related experiment recently. He was shocked to find that laboratory-generated sparks make x-rays, too.

"We know that x-rays are made in outer space--in exotic places like the center of the sun and supernovae--but we didn't think they could be made so easily in the air," said Dwyer. "The results should allow for the detailed laboratory study of runaway breakdown, a mechanism that may play a role in thunderstorm electrification, lightning initiation and propagation, and terrestrial gamma-ray flashes."

High voltage sparks are a ubiquitous phenomenon in nature. They occur in a wide range of settings, from a finger touching a doorknob to the massive lightning flashes on Jupiter. Until Dwyer's discovery, it was believed that such electrical discharges involved only low-energy electrons, not the kind of high-energy electrons that make x-rays.

To conduct their recent experiment, Dwyer and his team; Florida Tech professor of physics and space sciences, Dr. Hamid Rassoul; Florida Tech graduate student Zaid Saleh and University of Florida graduate student Jason Jerauld, brought the instruments they had used to study

lightning in Florida to Lightning Technologies Inc., in Pittsfield, Mass. They set up the equipment next to a Marx spark generator just to see what would happen. Half the team guessed they would see x-rays, half did not.

What they found was that 14 tests of 1.5- 2.0 million-volt sparks in the air produced x-ray bursts. The bursts were remarkably similar to the x-ray bursts previously observed from lightning.

"This amazed us. It opens the door to answering really big questions about lightning by generating it in the lab," said Rassoul. "It also tells us that we have a lot to learn about how even small sparks work."

Dwyer is excited about the opportunity to study the poorly understood phenomenon of runaway breakdown--shown to be associated with lightning--in the lab. To date, the only mechanism that can account for the creation of the high-energy electrons that make x-rays is the runaway breakdown of air. In this phenomenon, the electric force experienced by electrons exceeds the effective frictional force due to collisions with air molecules, allowing the electrons to "run away" and gain very large energies.

The new finding, published in October in *Geophysical Research Letters*, will also be discussed on *Nature* online, the first week of November.

Source: Florida Institute of Technology