

OU professor awarded \$210,829 NSF grant for research on new terahertz generator

Dr. Andrei Slavin, a distinguished professor and chair of the Department of Physics at Oakland University, has been awarded a \$210,829 grant from the **National Science Foundation** as part of a collaborative research project which seeks to develop a new type of terahertz generator that can be used in a variety of fields, including communication, medical imaging and security.

“Existing generators of terahertz radiation either work at temperatures below room temperature or are based on expensive and bulky laser systems,” Slavin said. “These significant deficiencies severely limit their usefulness. The goal of this project is to create a new type of terahertz generator that is compact, inexpensive and works at room temperature.”

According to Slavin, terahertz radiation falls between infrared radiation and microwave radiation on the electromagnetic spectrum. It can pass through clothing, paper, cardboard, wood, masonry, plastic and ceramics, which makes it ideal for detecting concealed weapons and explosive materials.

Terahertz radiation can also detect differences in density of a tissue, which could allow for effective detection of skin and surface cancer. Some frequencies of terahertz radiation can also be used for 3D imaging of teeth and may be more accurate than conventional X-ray imaging.

In addition, terahertz waves, which operate at a much higher frequency than microwaves, could one day be used to deliver data up to 100 times faster than today’s cellular or Wi-Fi networks.

“We believe that communication technology will go further with increased frequencies,” Slavin said. “So the next generation of 5G communication will probably use frequencies that are higher than current frequencies.”

According to Slavin, the research project is a collaborative effort between a team of experts in magnetic device fabrication at the University of California, Irvine, and leading theorists in field of magnetic devices at Oakland University.

“As a result of this three-year research effort, we expect the result will be a terahertz generator that will be micro-sized – approximately 10 microns in diameter and less than 1 micron thickness,” Slavin said, noting that 10 microns is approximately twice the size of a human blood cell.

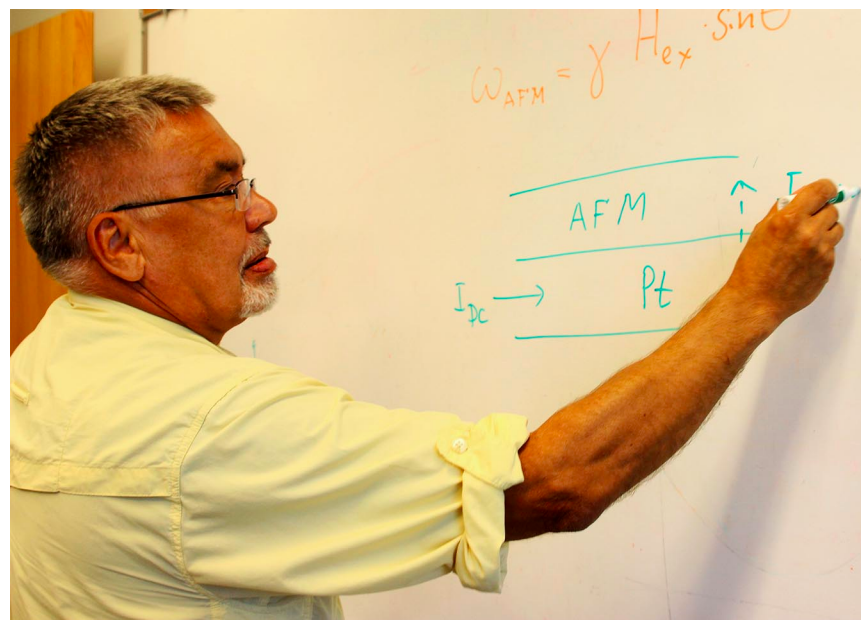
“With this device, we will be able to generate approximately 1 microwatt of power at a frequency of about one-half terahertz,” he added. “You might think one microwatt isn’t a lot, but microwatt is sufficient power for many applications, especially communication applications.”

The new generators will be based on readily available antiferromagnetic materials, such as iron oxide and nickel oxide, and will operate via conversion of magnetic oscillation in these materials into terahertz electromagnetic waves.

“Our invention is an example of trying to tap into the naturally existing internal magnetic field in the antiferromagnetic material using the fact that current propagating in the heavy metal creates a perpendicular current of spins,” Slavin said.

The NSF grant is for a three-year period.

“The grant allows us to concentrate more and intensively collaborate with our experimental counterparts at the University of California, Irvine, and creates a possibility to check our theoretical ideas experimentally,” Slavin said. “We’re very grateful to the NSF. Nobody knows whether it will work or not, but we will try to do our best to bring them an experimental prototype within three years. “



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