Going beyond current nanotechnology could be profitable

By KRISTINE PORTER
Business Journal Staff

Kutztown University physics professor Dr. Kunal Das and co-scientist atomic physicist Seth Aubin at the College of William and Mary in Williamsburg, Va., are collaborating on a new technology, one that they hope will revolutionize the nanotechnology industry. Their goal is to improve circuits and reduce the heat generated in electronic devices.

"It's too early to tell how it will affect the costs of commercial products," Das said. "It's cutting edge technology, but it will be years before it starts generating money. It has the potential to generate."

Das calls the technology a quantum pump.

"We have become so spoiled to think that our computers are going to keep getting faster," Das said. "Heat means that the process is not efficient."

Aubin, who is an experimental physicist, will be conducting the tests.

"We are trying to build the electronic circuits of the future," Das said.

The two are hoping that their theory proves correct.

To explain what a quantum pump is, Das said that electronic devices use a technology for circuits that has remained unchanged for 40 years. He explained that a group of electrons carry a charge. As these electrons move from one point to another in an electronic device, they complete a circuit. As the device gets smaller and the distance for the electrons to travel gets shorter, the electrons speed up. This increase in speed creates heat, he

Academic basics

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single electron, quantum physics views electrons like a wave. Somewhere along that wave is the electron. Where the electron exists in the wave is known as the phase, Das said, and it is "kind of a fragile thing."

Since other scientists have not been able to move a single electron in a predictable, controlled manner, Das said he and Aubin intend to start with atoms. The phase of electrons has been too unstable, he said. If they succeed in moving the atom in a controlled manner, then they believe they can prove that the idea behind the quantum pump can work.

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Das explained that the pump can be

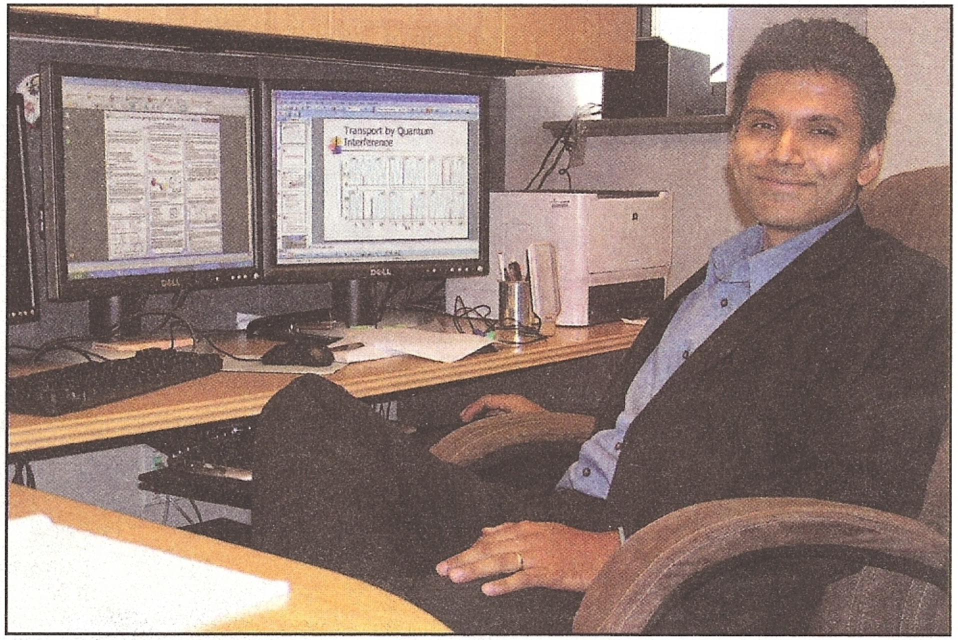


Photo by Kristine Porter

Physics professor Kunal Das shows slides he uses to explain the quantum pump.

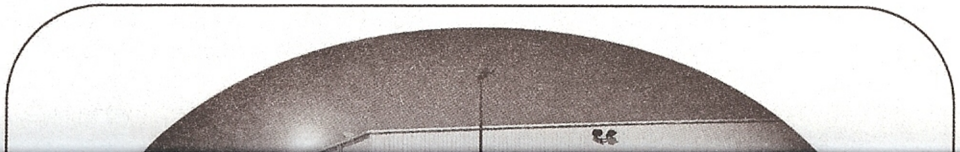
said. These alternating voltage barriers are raised and lowered propelling the electron forward in a controlled, predictable manner.

"If you have precise control, you have more efficiency and less heat in the system," Das said.

Ultra cold atoms are much easier to control, he said. For this reason, Das thinks that the atoms will help him and Aubin prove the workability of the quantum pump. The physicists intend to create a device using a laser and magnets to create a channel trap for the atom. They will use the atom's own magnetic quality to control its movement.

Machine technology continues to move toward smaller circuits and faster devices. These devices are used in everything with a computer component. Reducing the number of electrons from a mob to one allows circuits to get small and fast.

"Both of them rely on being able to move fewer electrons faster," Das said. "In a sense, it underlies everything."



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"Begin to think of each separate electron as its own entity," Das said. "You can predict the behavior of a mob, lots of electrons, but not so much with one."

In classical physics, Das explained, electrons are thought of as particles. Their behavior as a group is predictable, but the behavior of a single electron isn't as precise.

In order to understand the behavior of a

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Das explained that the pump can be compared to a canal. A boat enters the canal, and the lock closes behind it. Water is pumped in, and the boat rises with the water level. The lock in the front is opened and the boat can move forward.

With electronic devices, "you move electrons by applying a voltage," Das said. "The quantum pump takes advantage of the quantum mechanics of the electrons."

In the quantum pump, a voltage barrier (a canal lock) interferes with the electron wave (the boat). A second voltage barrier is enacted creating a voltage well where the electron is trapped or contained, he forward in a controlled, predictable manner.

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