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FEATURES, IDEAS

WHATEVER

Atomic superhighways ... on a silicon chip

By Alexander Colhoun

It seemed like only yesterday, when I was a seventh grade student at Gilman School in Baltimore, that I had my first encounter with a computer. Don Rodgers, our math teacher, gave us cards that we filled out with No. 2 Ticonderoga pencils and submitted to a vacuum-driven computer that filled a floor or two at Johns Hopkins University.

Eighteen years later, vacuum tubes are ancient history, replaced by microchips created with nanotechnology. Last month, researchers at the Jet Propulsion Laboratory in Pasadena, Calif., took miniaturization a step further into a nether-realm that defies the comprehension of science-challenged folk like myself.

BEYOND TINY: A silicon microchip is small by any definition. New chips will be even smaller.
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These researchers believe that quantum physics - the science of the movement of atoms and sub-atomic particles - might guide the next generation of microchip development. Quantum physics and computer chips? Modern chips are already difficult to comprehend; taking the next mental leap is staggering.

Today's microchips are not unlike photographic plates. Using powerful streams of light energy, scientists etch the film-like silicon chips with channels as the light passes through a template. The more powerful the light beam, the smaller the channel carved. At the extreme end of the spectrum are channels 2,000 atoms wide - akin to an atomic superhighway. Electrons that follow these channels do so according to the laws of traditional physics.

Enter the quantum theory. At the quantum level, particles of light begin to act differently, defying the laws of classic physics. Using quantum theory, researchers believe they can etch channels 90 percent smaller - essentially carving grooves a mere 250-atoms wide. To put that in perspective, this dash - is roughly 5 million atoms wide.

Behind the claim is nothing less than atomic science. In quantum theory, photons, which are particles of light, can become "entangled." When these special entangled photons are used, they act like photons with twice the energy, so you can create even smaller channels and even smaller chips.

"This is important because no one had previously considered using quantum properties of light to enhance the resolution of lithography," explains Dr. Daniel Abrams, co-author of the research report in the journal Physical Review Letters. "As a result we have the potential to vastly increase our ability to etch small features."

What works on paper, however, doesn't always pan out on the factory floor. Skeptics question how microchip designers will generate enough entangled photons to make this feasible. For a guy like me, who had trouble programming his seventh-grade computer card, whether they can do it doesn't really matter. If I can just begin to grasp the idea of anything 250 atoms wide, I'll be satisfied.