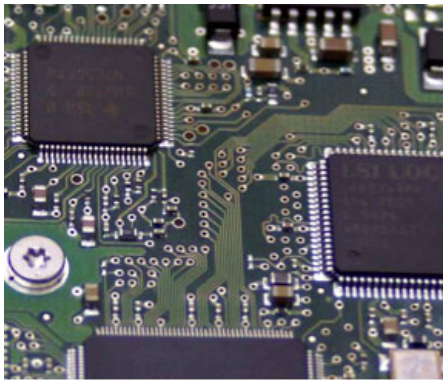
Synopsis: Preventive circuitry

April 25, 2011

In transistor circuits, preventing logical errors with physical fault tolerance is more efficient than correcting errors with a fault-tolerant architecture.



Credit: Sami Mitra

The electronics industry's access to smarter, lighter, and more powerful devices depends on whether transistor circuits—the building blocks of such devices—can process large amounts of information. As circuits get faster and smaller, errors—arising from heat dissipation, noise, and structural disorder—in the physical information they process can impede development. Experts debate on whether to concentrate on inherent physical fault tolerance that prevents error generation, or on architectural fault tolerance that corrects errors by sophisticated algorithms.

Writing in *Physical Review Letters*, Thomas Szkopek at McGill University, Canada, and colleagues in the US quantify these error-suppressing processes for model nanoelectronic systems. Using the electron number as the dimensionless size parameter for logic gates, they estimate the minimum number of electrons necessary for reliable circuit logic. They find that the physical fault tolerance in transistor circuits suppresses the error rate per electron number exponentially, compared to only subexponential suppression of error rate in the most efficient fault-tolerant architecture of logical gates. Their conclusion—that error prevention is better than error correction—has implications for transistor device technologies and CMOS scaling, and may impose a minimum limit on the size of devices. – *Manolis Antonoyiannakis*

Physical Fault Tolerance of Nanoelectronics
Thomas Szkopek, Vwani P. Roychowdhury, Dimitri A. Antoniadis, and John N. Damoulakis
Phys. Rev. Lett. 106, 176801 (2011)
Published April 25, 2011

Announcements

One Hundred Years of General Relativity
November 2015 marks the centennial of Einstein's theory of general relativity. Here is a collection of*Physics* articles about APS papers that grew out of Einstein's ideas.

More Announcements »

Subject Areas

Quantum Information | Semiconductor Physics | Nanophysics

Previous Synopsis

ATOMIC AND MOLECULAR PHYSICS

Time doesn’t stand still

April 21, 2011

Read More »

Next Synopsis

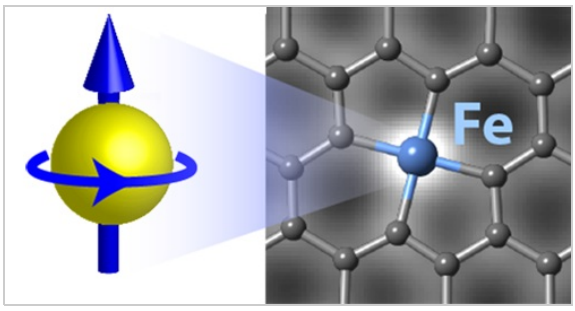
FLUID DYNAMICS

Fruit flies swim through air

April 26, 2011

Read More »

Related Articles

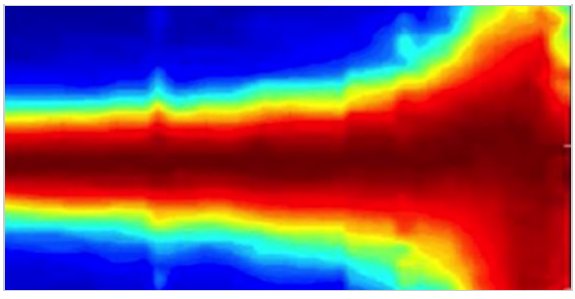


MAGNETISM

Synopsis: Measuring Spin One Atom at a Time

November 12, 2015

Electron microscopy experiments have measured the spin state of individual metal atoms on a graphene layer, characterizing their potential for information storage applications. Read More »

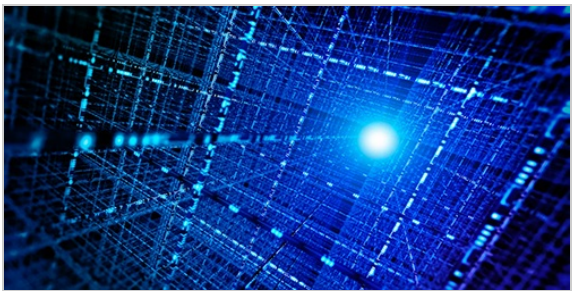


PLASMONICS

Viewpoint: All Together Now

October 29, 2015

A “Schrödinger’s cat”-type effect entangles collective excitations in a semiconductor nanostructure, making a new infrared light source. Read More »



QUANTUM INFORMATION

Synopsis: Optical Computing Under the Lens

October 14, 2015

A theoretical analysis quantifies the technical resources required to build a quantum computer based on photons. **Read More »**

More Articles

Sign up to receive weekly email alerts from *Physics*.

Enter your email

Sign Up