Electron magnetic moment calculated precisely

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(Phys.org)—An electron, as well as other subatomic particles with an electric charge, is actually a little magnet—it spins like a top, giving it its own magnetic moment.

It's the subtle change in this magnetic moment caused by emission and reabsorption of photons, a quantum phenomenon called the anomalous magnetic moment, that Toichiro "Tom" Kinoshita, the Goldwin Smith Professor of Physics Emeritus, has studied over his long career. Kinoshita became emeritus in 1995.

In two *Physical Review Letters* papers accepted for publication, Kinoshita and colleagues have calculated the value of the anomalous magnetic moment of the electron and muon to the most precise degree known to physics.

The papers, co-authored by Kinoshita's last Ph.D. student Makiko Nio of RIKEN institute of Japan, along with M. Hayakawa and T. Aoyama of Nagoya University of Japan, explain how the researchers have evaluated the anomalous magnetic moments of the electron and muon up to the fifth power of the fine structure constant. This is the fundamental fixed value of an electromagnetic interaction.

It's an unprecedented accurate calculation that involved more than 12,000 complex Feynman diagrams, which describe pictorially how electrons and photons interact. The researchers were able to achieve this calculation over 10 years of work on supercomputers at RIKEN. The

calculations enabled the researchers to determine the anomalous magnetic moment value to a level of precision of one part in 1.5 billion.

Elementary particles and forces are described very well by the Standard Model of Physics, Kinoshita says, but there are some indications that new physics remains to be discovered—a driving principle of his work.

"If you push theory and experiment hard enough, you might get to the point where the theory and experiment definitely disagree," he said. "And that means there is some new physics just visible beyond the distant horizon."

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