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New Measurement of the Electron Magnetic Moment and the Fine Structure Constant .[1]

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Remarkably, the famous UW measurement of the electron magnetic moment has stood since 1987. With QED theory, this measurement has determined the accepted value of the fine structure constant. This colloquium is about a new Harvard measurement of these fundamental constants. The new measurement has an uncertainty that is about six times smaller, and it shifts the values by 1.7 standard deviations. One electron suspended in a Penning trap is used for the new measurement, like in the old measurement. What is different is that the lowest quantum levels of the spin and cyclotron motion are resolved, and the cyclotron as well as spin frequencies are determined using quantum jump spectroscopy. In addition, a 0.1 K Penning trap that is also a cylindrical microwave cavity is used to control the radiation field, to suppress spontaneous emission by more than a factor of 100, to control cavity shifts, and to eliminate the blackbody photons that otherwise stimulate excitations from the cyclotron ground state. Finally, great signal-to-noise for one-quantum transitions is obtained using electronic feedback to realize the first one-particle self-excited oscillator. The new methods may also allow a million times improved measurement of the 500 times smaller antiproton magnetic moment. **New Measurement of the Electron Magnetic Moment** B. Odom, D. Hanneke, B. D'Urson and G. Gabrielse, Phys. Rev. Lett. **97**, 030801 (2006). **New Determination of the Fine Structure Constant** G. Gabrielse, D. Hanneke, T. Kinoshita, M. Nio, B. Odom, Phys. Rev. Lett. 97, 030802 (2006). **AIP Physics Story of the Year** (Phys. News Update, 5 Dec. 2006)

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- Cern Courier (October 2006)
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