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**Julius Edgar Lilienfeld Prize Talk: Measuring the Electron Magnetic Moment and the Fine Structure Constant**
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The electron magnetic moment in Bohr magnetons has been measured to a precision of 3 parts in $10^{13}$. This measurement, with quantum electrodynamics (AED) theory, provides the most precise value of the fine structure constant. This measurement, with a value of the fine structure from other measurements, also tests QED and sets a limit on the internal structure of the electron. A one-electron quantum cyclotron is at the heart of the measurement – an electron suspended in a magnetic field and cooled enough that its lowest cyclotron and spin quantum states can be deduced with quantum nondemolition (QND) measurements. A cylindrical Penning trap cavity inhibits spontaneous emission and feedback methods make the electron excite and sustain its own motion for detection. A new apparatus is being commissioned in pursuit of more precise measurements. Adapted methods are promising for observing a proton spin flip, which should make it possible to compare the antiproton and proton magnetic moments a million times more accurately than is currently possible.