2011 NIST Precision Measurement Grants

Alex Cronin, University of Arizona, Tucson

Atomic polarizability measurements for atomic clocks and parity non-conservation studies

The aim of this research is to measure the polarizability of several different atoms to support atomic clock development and parity non-conservation studies. The static electric dipole polarizability of atoms will be measured in the laboratory by using an atom interferometer with an electric field gradient. The polarizabilities of Cs, Sr, Yb, Sr^*, and Yb^* will be measured with an uncertainty of 0.01%. These measurements will provide crucial tests of atomic structure calculations that are needed for next generation atomic clocks and atomic parity non-conservation studies.

Eric A. Hessels, York University, Toronto, Ontario, Canada

Precise separated-oscillatory-field microwave measurements of the atomic helium $n = 2$ triplet P fine structure and of the atomic hydrogen $2S_{1/2}$–$2P_{1/2}$ Lamb shift

The aim of this project is twofold. One objective is to measure the fine-structure intervals in atomic helium to a precision of 30 Hz using microwave transitions induced by the Ramsey method of separated oscillatory fields. The proposed 30 Hz measurements, when combined with sufficiently precise theory, would lead to a determination of the fine-structure constant α to a precision of 0.5 parts per billion. In a second separate experiment, it is proposed to measure the $2S_{1/2}$–$2P_{1/2}$ and $2S_{1/2}$–$2P_{3/2}$ intervals in atomic hydrogen to an accuracy of 2 kHz. Each of these latter two measurements will determine the *rms* charge radius of the proton to an accuracy of 0.6% and will shed light on the current discrepancy between measured values of this radius.