AN OVERVIEW OF PRIMARY FREQUENCY STANDARDS AT NIST

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Abstract

The National Institute for Standards and Technology (NIST, formerly NBS) has been building the nations primary frequency standards based on the ground-state hyperfine transition in cesium-133 for more than 40 years. The newest generation of frequency standard, NIST-F1, is fundamentally different from its predecessors NBS-1 through NIST-7. NIST-F1 relies on laser cooling of atoms and a vertical interrogation scheme that allows interaction times of about 1 second as opposed to 10 ms in the old thermal beam geometry. The increased observation time results in an unprecedented relative frequency accuracy of 10^{-15}. If NIST-F1 were to operate continuously for 30 million years it would neither lose nor gain 1 second.

The talk will outline the physics and engineering which underlies all cesium based atomic clocks. The concepts that apply specifically to NIST-F1 will be discussed in more detail. A somewhat detailed discussion of the sources of error in NIST-F1 will be included.