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# Systematics effects of the Mexican cesium atomic fountain CENAM-CsF1

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The configuration of the cesium atomic fountain, CENAM-CsF1 at the Centro Nacional de Metrología (CENAM) in Mexico, along with a preliminary evaluation procedure of the systematics frequency shifts and their uncertainties are presented. Not only do we consider the main contributions of frequency shifts such as Second-order Zeeman (C-Field), collisions, blackbody radiation (BBR), gravity potential, light shifts, cavity pulling, and so forth, but also, we present a novel model to fit the velocity distribution of the cooled atoms.

By monitoring the $|F = 3, m_F = 1\rangle - |F = 4, m_F = 1\rangle$ transition, with a linear dependence on the applied magnetic field (weak fields), one may be able to calculate the correction of the second-order Zeeman. This contribution is given by the Breit-Rabi formula [1]. The frequency shift due to the collisions between cold cesium atoms are dominated by s-wave scattering, this effect has a dependence linearly on the mean atomic density $\bar{n}$ of the atomic cloud. In order to evaluate the frequency shift due to collisions, one can operate while keeping the velocity distribution constant and then extrapolating to zero density [1, 2]. Moreover, since cesium atoms are exposed to the electromagnetic temperature radiation field which is emitted from bodies with temperatures above 0 K, we have to consider the frequency shifts due to BBR. A temperature control is necessary in the flight tube to evaluate this effect [3].

The velocity distributions of ultracold atom obtained with a novel method called point by point (PBP) [4], developed at CENAM are analyzed in a more detailed fashion. Two Gaussian function are used to fit the experimental data of the velocity distribution in this new approach. The main consideration is that the cloud of atoms can be modeled by composed of two independent groups of atoms in thermodynamic equilibrium and therefore with a well-defined temperature. This approach may have an impact in the systematics frequency shifts since we have found displacements with respect to the central frequency in our Ramsey signal.

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