

An Optically Detected Cesium Beam Frequency Standard with Magnetic State Selection

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Cesium beam clocks with magnetic state selection are widely used, for their long term stability, while optically pumped cesium beam clocks have better short term stability, benefitting from the high pumping rate. This paper describes a new scheme adopting magnetic state selection together with optical detection. Our aim is to build a compact, maintenance-free clock with improved long term stability, when the short term stability is identical, or even better, with traditional magnetic-selection clocks, e.g. Symmetricom's 5071A.

The state preparation of cesium atoms is accomplished by magnetic selection, where $F=3$ atoms of the ground state are selected. During interaction with microwave of 9.192GHz in the cavity, populations on the sublevels of the ground state are rearranged. A storage bulb, instead of deflecting magnets, collects the atoms for detection, as shown in Fig.1. Light from an 852nm DFB laser diode locked on 4-5 line with an external cesium cell goes through the bulb and intersects the cesium beam perpendicularly. Photoelectric diodes are placed outside the bulb to collect the fluorescence.

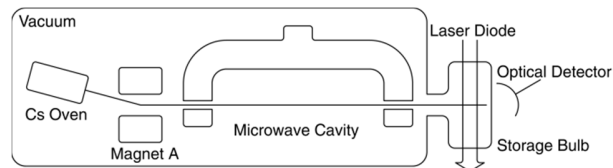


Fig.1: Schematic diagram of the tube.

Short term stability of $2 \times 10^{-11} \cdot \tau^{-1/2}$ has been achieved, as shown in Fig.2. The laser fluctuations and invalid atoms are supposed to be the main noise sources. New locking methods of the laser and other structures of the storage bulb are being tested. A digital servo system now replaces the previous servo system, and has an improvement on long term stability. Flicker floor of 2×10^{-13} is

reached at 10000 seconds. We believe that C-field and microwave amplitude stabilization will improve this value.

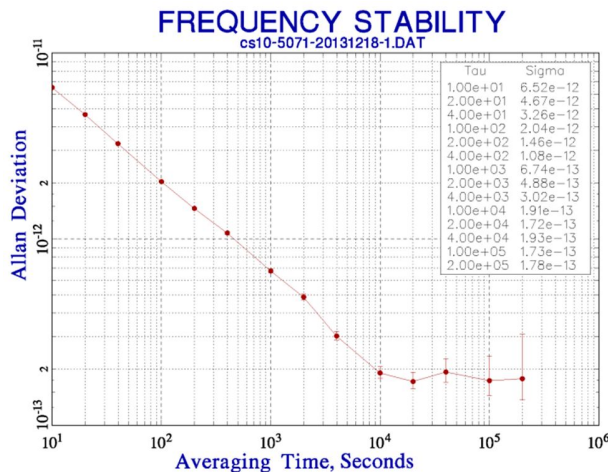


Fig.2: Allan deviation measured against 5071A.