Mercury Trapped Ion Frequency Standard For Space Applications

R.L. Tjoelker, S. Chung, R. Glaser, R. Hamell, L. Maleki, J.D. Prestage, N. Raouf, T. Radey, G. Sprague, B. Tucker, B.Young

Jet Propulsion Laboratory
MS 298-100
4800 Oak Grove Drive
Pasadena, California 91109
USA

Mercury trapped ion microwave frequency standards provide a number of advantages for ground based applications requiring both very high stability and robust continuous operation. Space applications also require low volume, power, mass, and insensitivity to a highly variable external environment (e.g. temperature, magnetic, radiation). In addition the standard must be able to withstand mechanical vibration and shock associated with launch and orbit insertion maneuvers.

We will report on recent activities to develop a small, low power, and low mass mercury trapped ion frequency standard flight demonstration model. The goal is provide 10 year operational life and an order of magnitude improved stability over existing flight standards at all averaging time intervals. The prototype design takes advantage of recent advances including using a Nitrogen buffer gas for long vacuum pump life and a multi-pole ion trap to minimize sensitivity to the second order Doppler shift [1,2]. The present development effort, design, tradeoffs, and a number of recent laboratory results will be presented.

[1] R.L. Tjoelker, S. Chung, W. Diener, A. Kirk, L. Maleki, J.D. Prestage, B. Young, « Nitrogen Buffer Gas Experiments in Mercury Trapped Ion Frequency Standards », 2000 IEEE/EIA International Frequency Control Symposium and Exhibition, pp. 668-671, Kansas City, MO June 7-9, 2000.

[2] John D. Prestage, Robert L. Tjoelker, Lute Maleki, « Mercury Ion Clock Based On Linear Multipole Ion Trap », 2000 IEEE/EIA Int. Freq. Contr. Symp. , pp. 706-710, Kansas City MO, June 7-9, 2000.