Abstract Submitted
for the DAMOP17 Meeting of
The American Physical Society

A Cd_+ microwave frequency standard based on dual-trap and sympathetic cooling. YANI ZUO, PENGFEI CHENG, XIAOLIN SUN, JIANWEI ZHANG, LIJUN WANG, Tsinghua Univ, JOINT INSTITUTE FOR MEASUREMENT SCIENCE TEAM — The passive microwave atomic clocks are studied widely, and the frequency stability of the state-of-the-art ones are close to the quantum projection noise limit. Most of those frequency standards work in pulse mode, which means that there exits dead time in each locking cycle due to states initialization and detection, laser cooling. High frequency fluctuations of the local oscillator (LO) are down-conversed to the feedback loop to degrade the frequency stability, namely, Dick effect. The microwave frequency standard based on laser-cooled $_{113}Cd_+$ ions in our laboratory has similar issue. Although it achieved the frequency stability to 6e-13 $\tau_{-1/2}$, it is far from the limit of theoretical performance. Analyses show that the Dick effect and RF heating are the two main limitations. Thus, we propose and design a new scheme to overcome these two limits by sympathetic cooling and interleaving lock. The $_{24}Mg_+$ ions cooled by 280nm laser are used to sympathetically cool the $_{113}Cd_+$ ions via Coulomb interaction to decrease the RF heating in ion traps. Meanwhile, two ion clouds in two identical ion traps are interrogated alternatively to lock the same LO to estimate dead time. The new scheme could improve the performance of the microwave atomic clocks greatly.

Yani Zuo
Tsinghua Univ

Date submitted: 21 Jan 2017 Electronic form version 1.4