

Abstract Submitted
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Miniature Microwave Frequency Standard with Trapped $^{171}\text{Yb}^+$
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DAN BOSCHEN, IGOR KOSVIN, Microsemi, Inc. — We report the development
of a low-power, miniature ^{171}Yb trapped ion clock at Sandia National Laboratories.
The ultimate goal of this development effort is to construct a frequency standard
that has a frequency stability comparable to a commercial Cs beam standard, but
with 100 to 1000 times smaller size and power consumption. The ^{171}Yb ion has
a ground state hyperfine splitting of 12.6 GHz that we use as the “clock” transi-
tion, and the linewidth of the clock resonance is expected to be less than 10^{-3} Hz,
which leads to a very high-Q clock resonance. An atomic clock using trapped ions
is an excellent candidate for miniaturization because ions are well isolated from the
environment independent of the size of the trap. We have successfully developed
miniature ion-trap vacuum packages with sizes ranging from 1 to 10 cubic centime-
ters. A few microTorr of He buffer gas is introduced into each of our miniature
vacuum packages for collisional cooling of the trapped ions. The vacuum packages
are sealed and passively pumped by non-evaporable getters. Using a sealed 3 cm^3
ion-trap vacuum package in combination with miniaturized lasers, optics, and elec-
tronics, we constructed a miniature clock prototype that demonstrated excellent
long-term stability reaching the 10^{-14} range after a few days of integration.

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