DAMOP06-2006-020133

Abstract for an Invited Paper
for the DAMOP06 Meeting of
the American Physical Society

Laser Technology in Commercial Atomic Clocks[1]

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Commercial atomic frequency standards (AFS) are deployed in diverse civilian, military, and aerospace applications, ranging from high-precision measurement and calibration to navigation, communications and, of course, timekeeping. Currently, commercially available AFS include magnetically-selected cesium beam frequency standards and hydrogen masers and lamp-pumped rubidium oscillators. Despite the revolution in atomic physics and laboratory-scale AFS brought about by the advent of the tunable laser in the early 1970s, commercial AFS invariably rely on more conventional atomic physics technology developed in the 1950s. The reason for this lack of advancement of commercial AFS technology is the relatively poor reliability and environmental sensitivity of narrow-linewidth single-mode laser sources at atomic resonance wavelengths. Over the past 8 years, Symmetricom, in collaboration with laser manufacturers, has developed specialized laser sources for commercial AFS applications. These laser devices, optimized for high spectral purity and long-term reliability, will enable a new generation of commercial AFS. This talk will briefly describe two laser-based atomic frequency standard development programs at Symmetricom. The Chip-Scale Atomic Clock, two orders of magnitude smaller and lower power than any commercial AFS, will enable atomic timing accuracy in portable battery-powered applications. The Optically-Pumped Cesium Beam Frequency Standard, under development for deployment onboard the GPS-III satellite constellation, will provide enhanced short-term stability and longer lifetime compared to magnetically-selected cesium beam AFS.

[1]This work is supported by Symmetricom, by the Defense Advanced Research Products Agency, Contract #NBCHC020050, and by the Space and Missiles Systems Center Contract #FA8807-05-C-0008.