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Feasibility of hollow core fiber based optical lattice clock EKATERINA ILINOVA, University of Nevada, Reno, NV 89557 USA, JAMES F. BABB, Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, MS 14, Cambridge, Massachusetts 02138, USA, ANDREI DEREVIANKO, University of Nevada, Reno, NV 89557 USA, THEORETICAL ATOMIC AND MOLECULAR PHYSICS GROUP TEAM[1], ATOMIC AND MOLECULAR PHYSICS DIVISION TEAM[2] —

The possibility of building the optical lattice clock based on the narrow $^1S_0$-$^3P_0$ transition in Hg and other alkaline-earth like atoms optically trapped inside the hollow core fiber has been studied. The general form of the long range atom-surface interaction potential at non-zero temperatures has been calculated for the hollow capillary geometry. The resulting $^1S_0$-$^3P_0$ transition frequency shift has been calculated for Sr and Hg atoms as a function of their position inside the capillary. Its dependence on the geometric parameters and optical properties of the capillary material has been analyzed. The resonant enhancement of the atom-surface interaction potential and radiative decay rate of the $^3P_0$ state at certain parameters of the waveguide has been studied. For the silica capillary with inner radius $R_{in} > 15\ \mu m$ and thickness $d \sim 1\ \mu m$ the atom surface interaction induced $^1S_0$-$^3P_0$ transition frequency shift on the capillary axis can be suppressed down to the level $\delta\nu/\nu < 10^{-18}$. The additional frequency shifts and atom loss from the optical trap due to the residual birefringence of the waveguide and collisions with the buffer gas molecules have been evaluated.

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