

Quantum Physics

Prospects for a mHz-linewidth laser

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We propose a new light source based on having alkaline-earth atoms in an optical lattice collectively emit photons on an ultra-narrow clock transition into the mode of a high Q-resonator. The resultant optical radiation has an extremely narrow linewidth in the mHz range, even smaller than that of the clock transition itself due to collective effects. A power level of order $10^{-12}W$ is possible, sufficient for phase-locking a slave optical local oscillator. Realizing this light source has the potential to improve the stability of the best clocks by two orders of magnitude.

Comments: minor revisions + shortening; factor 2 algebra mistake corrected

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