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Collective State Raman Atomic Clock Using Trapped Atoms MAY KIM, RESHAM SARKAR, RENPENG FANG, YANFEI TU, SELIM SHAHRIAR, Northwestern University — Atomic clock has set the standard as the most accurate clock in the world. So far, the approach to making the atomic clock has been limited to utilizing individual atomic states. We have developed the framework for a collective atomic clock–in an ensemble of cold atoms using the method of separated Raman-Ramsey fields–by conceiving a method to detect the collective states, analyzing the signal to noise ratio, and finding the bounds for efficiency of our detector. The width of the Raman-Ramsey fringe in such a clock is narrower than that of a conventional Raman-Ramsey fringe by a factor of root-N, where N is the number of atoms in the ensemble. When the collection efficiency of the detection process is taken into account, such a clock can have a frequency stability that is expected to be better than that of a conventional Raman-Ramsey clock. The ultra-narrow fringe may also offer many other potential advantages, such as suppression of errors due to fluctuations in the bias field used for lifting Zeeman sublevel degeneracy, and the long-term bias drift. We will present the theoretical model, and describe the status of our experimental efforts towards demonstrating such a clock.

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