Abstract

The sensitivity for estimating an unknown parameter from repeated (ensemble) measurement is typically constrained by the standard quantum limit (SQL) $\propto 1/\sqrt{N}$, where $N$ is the number of ensembles involved.

When applied to atomic clock (frequency metrology), the clock frequency is the parameter corresponding to a chosen atomic transition, and $N$ is the total number of atoms. It is widely known that quantum correlation or entanglement between different atoms (ensembles) can enhance parameter estimation beyond the SQL.

The required atomic correlation or entanglement can be generated from controlled interactions when quantum coherence can be sustained, as conveniently afforded in atomic quantum gases. This talk will discuss some of our recent results enabling parameter estimation beyond the SQL in two-component as well as in spin-1 atomic Bose-Einstein condensates.

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