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Quantum atom optics with Bose-Einstein condensates

The generation and detection of non-classical states of the electric field is the topic of experimental quantum optics. Bose-Einstein condensates are described as a macroscopically populated coherent matter-wave field and quantum atom optics aims for entangled states of the atomic field. Here we report on the generation and detection of two kinds of entangled atomic states: Spin-squeezed states are experimentally realized and they are used to achieve interferometric precision beyond the standard quantum limit in a nonlinear interferometer. Recently we implemented a matter-wave analog of the homodyne detection technique and used it to detect atomic Einstein-Podolsky-Rosen entanglement generated by spin changing collisions.

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