Spin squeezing and non-linear atom interferometry with Bose-Einstein condensates

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Abstrak

Interferometry, the most precise measurement technique known today, exploits the wave-like nature of the atoms or photons in the interferometer. As expected from the laws of quantum mechanics, the granular, particle-like features of the individually independent atoms or photons are responsible for the precision limit, the shot noise limit. However this “classical” bound is not fundamental and it is the aim of quantum metrology to overcome it by employing entanglement among the particles. This work reports on the realization of spin-squeezed states suitable for atom interferometry. Spin squeezing was generated on the basis of motional and spin degrees of freedom, whereby the latter allowed the implementation of a full interferometer with quantum-enhanced precision.