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【8】Wave-particle duality in atom interferometers: precision measurements at the quantum limit

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Atom interferometers are among the most precise measurement devices for inertial forces, electromagnetic fields and fundamental interactions. Their working principle is a beautiful embodiment of deBroglie's wave-particle duality of matter: while the wave nature of atoms gives rise to interference of the different paths through the interferometer, their particle nature gives rise to fundamental quantum noise in the detection of the resulting interference pattern. For uncorrelated atoms, this results in the so-called standard quantum limit of interferometric measurement, which is reached by today's best instruments. Surprisingly, another quantum phenomenon - entanglement - can be harnessed to overcome this limit. I will give an overview of the operating principle, applications and fundamental quantum limits of atom interferometers and show how we can use many-particle entangled states to improve their sensitivity, which promises significant advances for science and technology.

Primary author: TREUTLEIN, Philipp

Presenter: TREUTLEIN, Philipp

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