Beyond the Heisenberg uncertainty

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Some operations on quantum states are not restricted by the Heisenberg uncertainty principle. A famous example is teleportation, a disembodied transfer of a quantum state, which for an oscillator allows for both the position and the momentum be transferred, in principle, without adding noise. It turns out, perhaps even more surprisingly, that a trajectory of an oscillator can be *measured* with an accuracy exceeding that predicted by the Heisenberg uncertainty [1]. The conditions for this counterintuitive scenario are that firstly, the trajectory is monitored in the reference frame of another oscillator with an effective negative mass or negative frequency. Secondly, the monitored oscillator and the reference oscillator should be in an entangled state. In the talk I will first present a magnetic oscillator with a negative mass/frequency. I will review the recent teleportation experiment between two magnetic oscillators [2]. I will then describe progress towards tracing a trajectory of a mechanical oscillator entangled with a magnetic reference oscillator [3] with the precision not restricted by the Heisenberg uncertainty principle. Finally, I will outline perspectives for performing similar operations with an electrical oscillator [4].

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