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Composite light-pulse atom interferometry with Bragg and Raman double diffraction

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Double diffraction in light-pulse atom interferometry represents one of the key elements to scale the phase sensitivity and suppress noise via symmetric interferometer configurations, however suffers from parasitic diffraction orders. Aiming at highest sensitivities, the performance of future space missions employing atom interferometers, e.g. proposed for gravitational wave detection, dark matter exploration or tests of the universality of free fall, will crucially depend on the choice of diffraction mechanism, and ultimately be limited by spurious atoms in parasitic interferometer paths.

On the other hand, intrinsic couplings to various momenta naturally results in multipath interference, which makes double diffraction an ideal candidate for fundamental tests of quantum mechanics. While double-diffraction schemes have been implemented using either Bragg or Raman transitions, one has to decide between an enhanced noise suppression and the straight-forward application of blow-away pulses depending on the absence or presence of internal state changes.

In this talk, I am going to present a composite light-pulse approach, which employs sequences of Bragg and Raman pulses rather than individual ones to access their complementary advantages. Exploiting the manipulation of both the external and internal degrees of atom, the interfering atoms remain entirely in a single internal state with additional momentum-selective state-flips to either purify the interferometer output or construct a novel test of Born's rule.

In Kooperation mit Prof. E. Giese