Atom's Recoil in a distorted optical field

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Exchange of momentum between photons and atoms plays an important role in atom interferometry : this is the basic mechanism used to split and recombine wave packets. Precision measurements of the photon recoil is also used to determine the fine structure constant. In vacuum, for a monochromatic plane wave of frequency ν, the momentum per photon is given by $h\nu/c$. Using a general formula, we will present how the intensity and phase fluctuations of a laser beam profile affect locally the atoms recoil. In particular, we show that the local variations of the recoil are dominated by intensity fluctuations to which they are correlated. This correlation induces a systematic effect in high precision experiments. In this talk, we will present measurements of this effect made in the atom recoil experiment of Paris. We will also discuss the conditions for which this effect appears in an atom interferometer. Our model predicts also that locally the recoil induced by the absorption of a single photon could be larger than the fundamental limit of $h\nu/c$. We will present observations of this counter intuitive result [1].

References

[1] Observation of Extra Photon Recoil in a Distorted Optical Field, S.Bade et al, to be published in PRL