Spatially Resolved Phase Reconstruction for Atom Interferometry

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Atom interferometers are employed for numerous purposes such as inertial sensing. They measure forces by encoding their signal in phase shifts between matter waves. Signal extraction algorithms typically require the resulting interference patterns to feature a priori known spatial distributions of intensity and phase. We present an extraction algorithm designed for interference patterns featuring arbitrary and unknown temporally stable spatial phase profiles utilizing Principal Component Analysis [1]. It can avoid systematic errors, e.g. due to inhomogeneous laser wave fronts, in post-processing and help to characterize complex phase profiles. We verify the algorithm's accuracy and assess the statistical reconstruction error in the presence of atom projection noise as a function of the number of atoms and images. Finally, we extract the spatial phase profiles from experimental data obtained by an atom gravimeter.

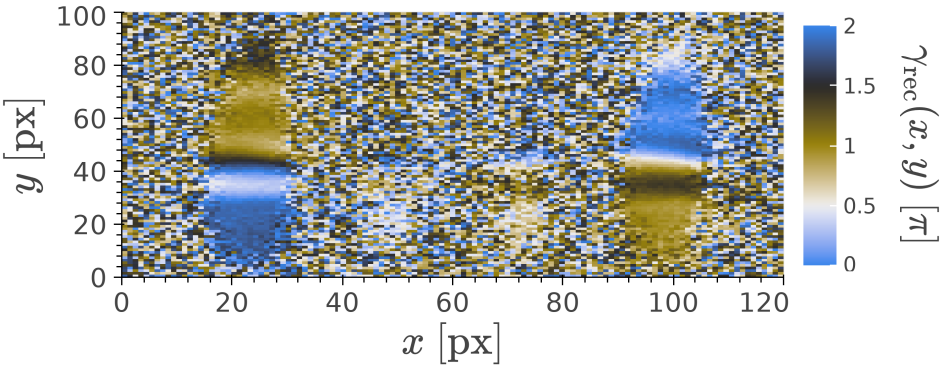

FIG. 1: The reconstructed spatial phase profile from an image set of the fountain gravimeter shown in reference [2].

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