Radiofrequency-dressed magnetic waveguides and lattices for neutral atoms

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We present and detail the theoretical background as well as the experimental requirements for the implementation of robust and dynamic matter-waveguides [1] and atom-lattices [2].

Our scheme relies on the trapping and manipulation of neutral atoms in radio-frequency (rf) dressed potentials. The creation of such potentials relies solely on static and rf magnetic fields, thus enabling highly versatile, purely magnetic matter-waveguides and lattices.

Furthermore, rf-dressed potentials allow dynamic manipulation of neutral ultra-cold atomic clouds by means of polarization control of the applied magnetic fields. This control permits synchronous and state-dependent manipulation of the atomic clouds and promises a wide range of possible applications in ultra-cold atomic physics. It paves the way for example towards atom interferometry using internal state-labelling.

Specifically, our current experimental setup is based on rf-dressing a static, ring-shaped quadrupole field produced by an atom-chip. This setup will be used to demonstrate fully guided atom interferometry of the Sagnac-type, in a scheme that in principle can be scaled down to allow further development of miniaturized sensors.

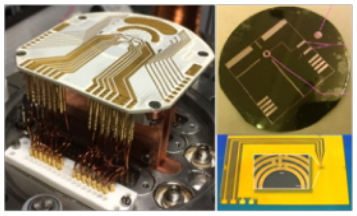

Figure 1: Current PCB (left), rf chip (top right) and atom-chip (bottom right).

We corroborate our proposed theoretical analysis with initial characterization and testing of various subcomponents, e.g. controlled generation and detection of rf-dressed ^{87}Rb spectra [3]. We further discuss the design of novel printed circuit boards (PCBs) for the generation of multipole magnetic field geometries that can produce rf-dressed ring-shaped lattices for ultra-cold atoms.

Keywords: ULTRA-COLD ATOMS, DRESSED ATOMS, MATTER-WAVEGUIDES, ATOM LATTICES, ATOM INTERFEROMETRY

References

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