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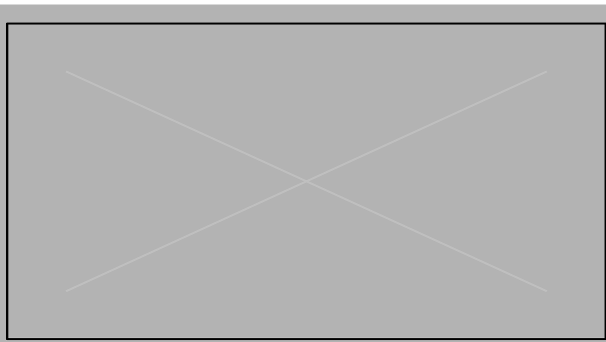

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Demonstration of the overall layout of the *Laser Physics Letters* LaTeX class

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1. First section of your article

The dramatic advances of quantum- and atom-optics allow at present accurate control over the internal and external degrees of freedoms of atoms. In particular, atoms can be routinely cooled down to temperatures in the nK range, they can be stored in magnetic or optical traps for up to several minutes and a precise control over their quantum state is possible. These achievements motivate several new directions, such as the implementation of quantum information processing using neutral atoms or the construction of matter-wave interferometers.

Besides these final goals, experiments investigating the coherent quantum behaviour of neutral atoms provide new insights into quantum physics and into new applications of quantum technology in a rapidly expanding area of science and technology. Engineering quantum systems with neutral atoms require means for coherent manipulation and state sensitive detection.

A natural way to attempt coherent control over atoms is using potential structures which are comparable in size with the de Broglie wavelength of the atom. Optical standing wave fields, so called optical lattices, generate potential structures on this length scale, typically on the order of the optical wavelength ($\sim \lambda/2$), and are sufficiently strong to confine and structure an ultracold cloud of atoms. Alternatively, optical micro traps using diffractive and refractive elements and magnetic micro traps, based on microfabricated magnets have been introduced. In micro traps, the potential is defined by the geometry of the microstructure and almost arbitrary spatial and temporal potential shaping is possible. The implementation of optical, electrostatic, electrodynamic and magnetic micro potentials on a single chip not only promises a versatile control over

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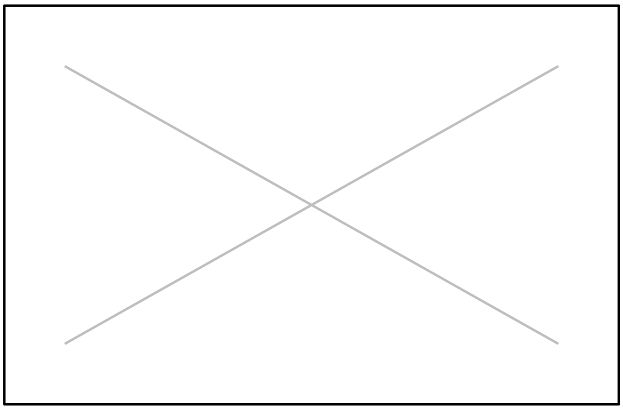

Figure 1 A figure over one column

atomic quantum states but also makes widespread applications possible. Matter wave interferometers using micro traps have recently been realized [2,4]. Interference fringes related to the quantum mechanical phase of atomic Bose-Einstein condensates were thereby detected by standard absorption imaging. This is possible due to the large number of atoms involved in the interference. However, quantum information processing or interferometry with single atoms require the development of detectors, sensitive to the signal of single atoms. At present, research is focussed on both coherent manipulation techniques and state selective single atom detection. Some aspects of the recent progress on coherent manipulation using micro traps based on micro-fabricated current-carrying and optical structures are reviewed in this article. The selection is far from being complete. The tremendous growth of the field during the last years does not allow us to present a comprehensive overview and we are forced to restrict ourselves to describe an admittedly biased selection.

2. Second section

Quantum information processing with neutral atoms offers a set of advantages over other approaches:
(1) Flexible implementation of qubits: atoms and molecules as carriers of quantum information represent intrinsically identical systems of qubits which can be decoupled from their environment to a high degree. In addition, there exist a range of possibilities to encode quantum information in quasi spin-1/2 systems. For atoms in micro-traps quantum information can be encoded in the internal (e.g. Hyperfine ground states) as well as external degrees of freedom (e.g. vibrational modes of the trapping potential).

(2) Scalability: trapping geometries based on magnetic and optical micro-traps (Fig. 1) allow for the implementation of hundreds or even thousands of identical atomic qubits in parallel. Based on optical lattices the number of qubits can be increased to about 10^5. This gives the unique possibility to develop and experimentally test schemes for quantum information processing on large scales.

3. Further section of your article

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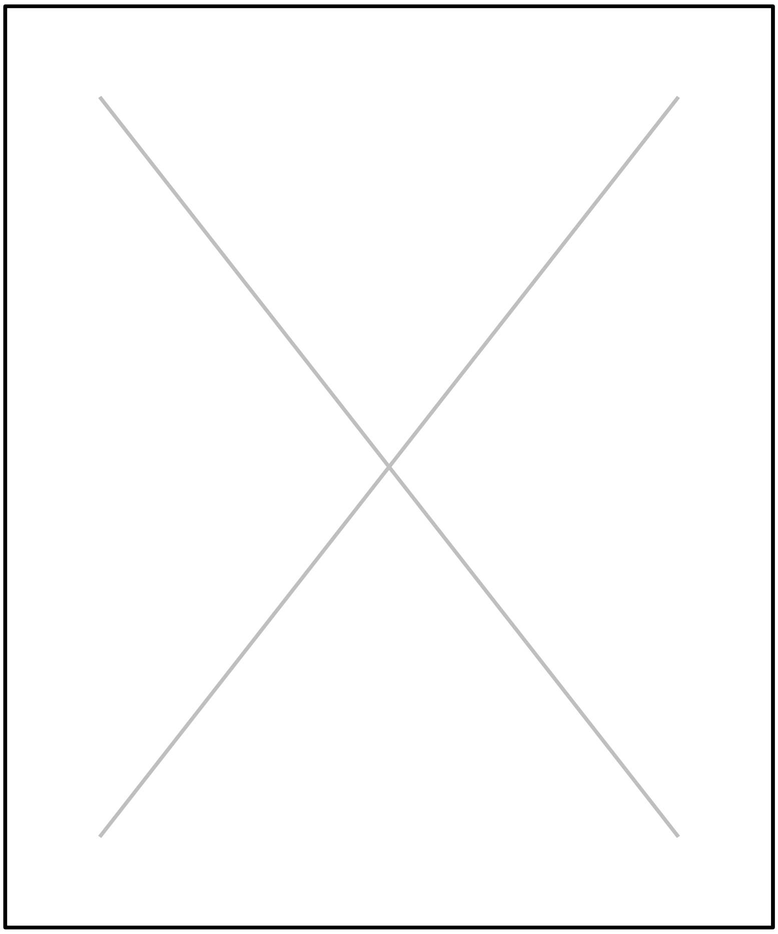

Figure 2 A figure wider than 1 column. Use the `\beginfigure*` command.

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