Single-Layer Atom Chip for Quantum Sensors

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Atom interferometry can be used for high-precision fundamental experiments and numerous applied problems. Among the fundamental problems are the following: the detection of gravitational waves, the search for dark matter, tests of dark energy theories, tests of the equivalence principle and validity of quantum mechanics at the macroscopic scale. Among the applied problems, the most important is the study of the Earth's gravitational field and applications to navigation.

One of the most important approaches to atomic interferometry is atom chip technology [1]. Atom chip is the combination of advanced microelectronics technology and atom optics. An atom chip can provide the ability to trap and control ultracold atomic ensembles. The atom chip also enables Bose-Einstein condensation (BEC) of atoms. Such ensembles can be used as atom sources for quantum sensors. The simplest sensors are atomic clock and gravimeter. Atom chip can provide the technology for such sensors for moving platforms.

Recently [2] single-layer atom chip was demonstrated. The main advantage of such a chip is the possibility of continuous loading of magneto-optical trap near the surface using a single-layer configuration. It's shown [2] that near the atom chip was trapped about $N \approx 3 \times 10^5$ atoms with concentration of $n \approx 10^{10}\ cm^{-3}$. The temperature of the atoms in the trap was about 200 μK. Such a chip can be used as a source of cold atoms for atom interferometry experiments. For this purpose, atoms will recapture with a magnetic trap with additional cooling.

References

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