FOMO Lectures 2021: Abstract

Controlling multipole moments of magnetic chip traps -

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Magnetic chip traps are a standard tool for trapping atoms [1, 2]. These are robust devices with multiple fields of use ranging from fundamental physics experiments [3] to applications of inertial sensing [2]. While magnetic traps do provide good confinement potentials, they are not necessarily harmonic, in particular, they can exhibit strong cubic anharmonicity. In this contribution, the methods of designing printable 2D wire guides which compensate for unfavorable multipole moments are discussed. A theoretical approach is proposed to reduce the unwanted multipole moments of a Z-chip trap by introducing a small disturbance to the standard wire configuration. Using a suitable representation of the disturbance, the resulting magnetic field is calculated via the Biot-Savart law and the finite element method. This allows one to examine the multipole moments in proximity to the trap minimum. As a result, the rogue multipole moments can be minimized.

[1] J. Reichel, and V. Vuletic, *Atom Chips* (WILEY-VCH, Weinheim, 2011).
[2] M. Keil et al., *Fifteen years of cold matter on the atom chip: promise, realizations, and prospects,* Journal of Modern Optics **63**, 1840 (2016).
[3] D. Becker et al., *Space-borne Bose-Einstein condensation for precision interferometry*, Nature **562**, 391 (2018).