Simulation of Integrated Sensors Based on Cold Atom Technology

Ch. Koller[1], A. Nemecek[1], M. Fromhold[2]

[1]University of Applied Sciences Wiener Neustadt, Austria
[2]University of Nottingham, United Kingdom

Abstract

Ultra-cold atom systems are excellent probes for various physical properties such as gravity, rotations or magnetic and electric fields. An integrated for solution for this technology is the atom chip, which uses magnetic fields in order to trap and manipulate ultra-cold atomic systems. For further integration, optical detection and manipulation capabilities such as lasers and photodetectors need to be integrated on the same chip as the structures generating the trapping fields.
In this work, we will present numerical simulations of silicon-based photodetectors compatible with CMOS atom chip technology. We will show that this setup can be used as a foundation for ultra-cold atom based sensors by displaying 3D integrated magnetic traps including the corresponding quantum mechanical states of the trapped cloud. This will illustrate how the AC/DC and Semiconductor modules of COMSOL Multiphysics® are able to perform a comprehensive simulation of the major components of cold atom based sensors.

Figures used in the abstract

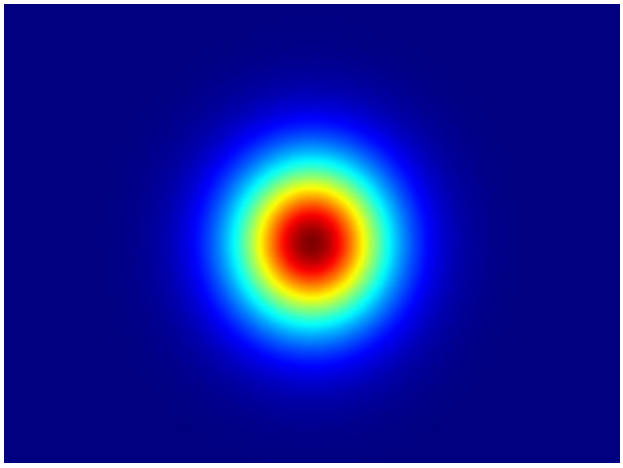

Figure 1: BEC ground state in a magnetic trap.