



Dr. Wolf von Klitzing

Principal Investigator

BEC & Matter-Wave Optics Group

Talk Title: Quantum Matterwave Optics in Rings-shaped waveguides

Saurabh Pandey^{1,2,4}, Hector Mas^{1,3,5}, Giannis Drougakis^{1,2},
Georgios Vasilakis¹, and Wolf von Klitzing^{1,*}

Abstract: Atomtronics aims at exploiting the wave or superfluid nature of ultra-cold atoms by building matter-wave circuitry in close analogy to photonic or electronic circuits. One of the stumbling blocks has been for a long time that the roughness of atomtronic waveguides has prevented the propagation of the matter-waves over anything but a few micrometers. In this talk, I will discuss coherent matter-wave optics using BECs in waveguides.

I will present our recent experiments of coherent transport of matterwaves in ultra-smooth waveguides over macroscopic distances of up to 40 cm [1]. We use optimal control theory to accelerate the atom clouds with minimal heating. The BECs move at speeds of many times the critical velocity of superfluidity. I will discuss the role of roughness of the guides and the limits for coherent transport. In these waveguides we superimpose co-moving gravito-magnetic lenses, which allow us to manipulate the BECs, to focus and collimate them to very low kinetic energies down to 800 kK. [2]

1. Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, Heraklion 70013, Greece
2. Department of Materials Science and Technology, University of Crete, Heraklion 70013, Greece
3. Department of Physics, University of Crete, Heraklion 70013, Greece
4. Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545, USA
5. Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91109, USA

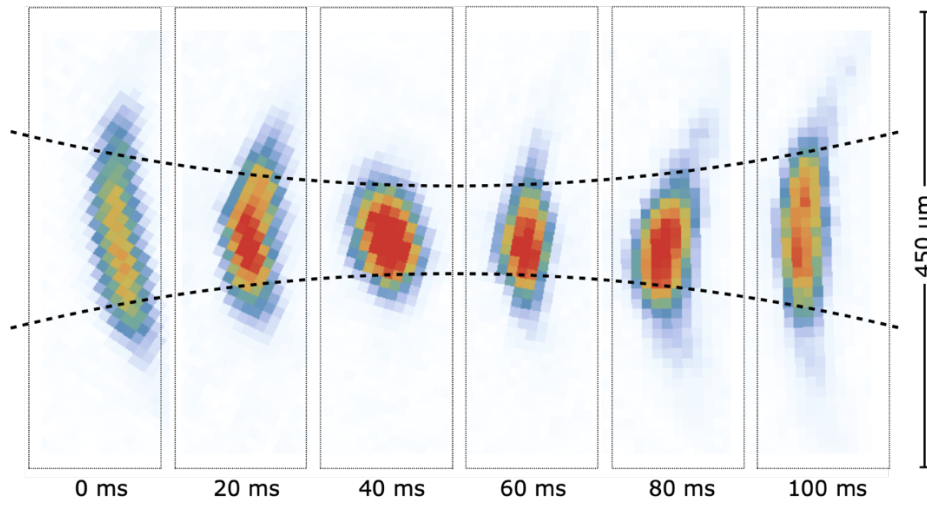


Figure: The focus of a BEC in a matter wave guide based on Time-Averaged Adiabatic Potentials

References:

1. Saurabh Pandey, Hector Mas, Giannis Drougakis, Premjith Thekkepatt, Vasiliki Bolpasi, Georgios Vasilakis, Konstantinos Poullos, and Wolf von Klitzing Hypersonic Bose--Einstein condensates in accelerator rings [Nature](#) 570:7760 205--209 (2019)
2. Saurabh Pandey et al. Atomtronic Matter-Wave Lensing [Phys. Rev. Let.](#) 126 17 (2021)