CRC 1227
Designed Quantum States of Matter

GUEST LECTURE

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(Guest of Dr. Dennis Schlippert)

Leibniz Universität Hannover
DQ-mat Colloquium
25 June 2020, 4:30 pm
(via Zoom-Meeting)

"A Quantum Transport Approach to Precision Atom Interferometry"

Interferometry with matter waves is a leading technique for precision measurements with applications ranging from sensing accelerations and gravitational effects, to tests of fundamental physics such as the equivalence principle and quantum electrodynamics. Pulsed optical lattices are the standard tools for performing matter wave splitting and recombination, the central processes in atom interferometric devices. We discuss the Bloch solutions, originally devised to explain quantum transport of electrons in solids, as a convenient analysis framework for precision atom interferometry [1]. We will focus on interferometry experiments with Bose-Einstein condensates to increase the momentum separation between interferometer arms and thus the measurement sensitivity, while suppressing undesired phase noise from lattice intensity fluctuations. We will report on phase-stable atom interferometry with large momentum separation using Bragg diffraction processes in a three-path geometry [2] and using Bloch oscillations in excited bands of an optical lattice [3].

[1] D. Gochnauer, K.E. McAlpine, B. Plotkin-Swing, A.O. Jamison, and S. Gupta:
Bloch-bands Picture for Light Pulse Atom Diffraction and Interferometry, Phys Rev A 100, 043611 (2019).
[2] B. Plotkin-Swing, D. Gochnauer, K.E. McAlpine, E.S. Cooper, A.O. Jamison, and S. Gupta: Three-path Atom Interferometry with Large Momentum Separation, Phys. Rev. Lett. 121, 133201 (2018).
[3] K.E. McAlpine, D. Gochnauer, and S. Gupta: Excited-band Bloch Oscillations for Precision Atom Interferometry, Phys Rev A. 101, 023614 (2020).

All DQ-mat members and all interested
are cordially invited to attend.