量子材料科学中心
International Center for Quantum Materials

Weekly Seminar

From Josephson vortices to simulations of the universe with coupled Bose-Einstein condensates

Joachim Brand
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Time: 4:00 pm, June.19, 2013 (Wednesday)
时间：2013年6月19日（周三）下午 4:00
Venue: Conference Room A (607), No. 5 Science Building
地点：理科五号楼607会议室

Abstract

Analogies between Josephson junctions and tunnel-coupled Bose-Einstein condensate (BEC) provide access to interesting physics when the tunnel coupling is extended in space over one, two, or three dimensional domains. These systems support Josephson vortices [1], which can be understood as vortices that are restricted by geometry to move along a one-dimensional path and thus present topological solitons. I will discuss proposals to generate and observe Josephson vortices in double-ring BECs by rotation [2], and to test Kibble-Zurek type scaling laws of spontaneous defect formation upon rapid cooling of an atomic gas through the BEC phase transition [3].In a regime of weak coupling, the system realizes the relativistic sine-Gordon field theory, which is useful as a simplified model of the early universe. I will discuss numerical modeling [4] of possible experiments on quantum simulations of the decay from an unstable vacuum.

[1] V. M. Kaurov and A. B. Kuklov, Phys. Rev. A 71, 011601(R) (2005).
[2] J. Brand, T.J. Haigh, and U. Zuelicke, Phys. Rev. A 80, 011602(R) (2009).
[3] S.-W. Su, S.-C. Guo, A. Bradley, O. Fialko, and J. Brand, Phys. Rev. Lett. 110, 215302 (2013).
[4] B. Opanchuk, R. Polkinghorne, O. Fialko, J. Brand, and P. D. Drummond, Quantum simulations of the early universe, arXiv:1305.5314(2013).

About the Speaker

Prof. Joachim Brand graduated from the University of Heidelberg (Germany) with a Diplom Physiker degree in 1996 and PhD in 1999 after studies in Erlangen (Germany), London (UK) and Heidelberg. After his PhD research on applications of many-body Green's functions to molecular excitations and scattering problems, he moved his interest to nonlinear waves and quantum phenomena in quantum degenerate atomic gases. Professor Brand spent his postdoctoral years at the University of Washington in Seattle (USA) as a Feodor Lynen fellow of the Alexander von Humboldt foundation and a PKS distinguished Postdoctoral Fellow at the Max Planck Institute for the Physics of Complex Systems in Dresden (Germany). In 2006 he became Senior Lecturer at the Institute of Fundamental Sciences of Massey University in Auckland, New Zealand and was promoted to Associate Professor in 2007. In 2010he moved to a chair at the New Zealand Institute for Advanced Study at Massey University. Professor Brand is deputy director of the Centrefor Theoretical Chemistry and Physics and Vice President of the New Zealand Association of von Humboldt Fellows.

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