Avalanches of Bose-Einstein-Condensates from open optical lattices

TSAMPIKOS KOTTOS, Department of Physics, Wesleyan University, Connecticut-USA and MPI for Dynamics and Self-Organization, Gottingen-Germany, GIM SENG NG, Department of Physics, Wesleyan University, Connecticut-USA, HOLGER HENNIG, RAGNAR FLEISCHMANN, THEO GEISEL, MPI for Dynamics and Self-Organization, Gottingen-Germany — We investigate, the outgoing atomic flux of BECs loaded in large OLs using a mean field (Discrete Non-Linear Schroedinger Equation–DNLSE) approach. We show that for some critical values of the rescaled (with respect to the lattice size) interatomic interaction strength, the current decays in avalanches that follow a power-law distribution indicating the existence of a novel phase transition. The origin of this phenomenon is identified to be the collisions between stable and moving breathers which co-exist at the lattice. Using a reduce map we are able to provide bounds for the power law exponent of the avalanche distribution which reflect the complexity of the underlying classical phase-space. Due to the inter-disciplinary nature of the DNLSE, we expect that the same phenomenon will be observed in several other branches of nonlinear physics, ranging from nonlinear optics to polarons and biological molecules.

1USA-Israel Binational Science Foundation and DFG (KO 3608/1-1)