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Bose-Einstein Condensates in Optical Lattices: Resonantly Enhanced Tunneling and Nonlinear Effects ALESSANDRO ZENESINI, CARLO SIAS, LIGNIER HANS, YESHPAL SINGH, DONATELLA CIAMPINI, SANDRO WIMBERGER, RICCARDO MANNELLA, OLIVER MORSCH, ARIMONDO ENNIO, University of Pisa — In our experiments we study the tunneling between different sites of a periodic potential in the presence of an external force. As a consequence of Wannier-Stark localization of atomic wavefunctions inside the single lattice sites, *Resonantly Enhanced Tunneling (RET)* occurs when the spacing between energy levels in a potential well is equal to the field-induced energy shift between different wells. These resonances are an important modification to the smooth Landau-Zener formula. We observed RET using Bose-Einstein condensates in accelerated optical lattice potentials. We have perfect control over the parameters of this system: the depth of the lattice U_0, the recoil energy E_{rec} and the peak density n_0 in the dipole trap. The latter determines the nonlinear interaction energy of the system, which allowed us to study the behavior of condensates in different regimes of the nonlinearity. In the linear case, as predicted in the Wannier-Stark solution, we observed RET and we verified the dependence between the positions of the resonances and the lattice depth for tunneling between 1^{st}, 2^{nd} and 3^{rd} neighboring sites. In the nonlinear regime, we observed a suppression of the resonances for increasing nonlinearity, in agreement with numerical simulations.

Alessandro Zenesini
University of Pisa

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