Light and matter waves propagation in artificial atomic crystals: periodic and disordered configurations

In these lectures we present some results concerning the theoretical study of light waves [1-3] and of atomic matter waves [4-6] propagating in artificial atomic crystals realized by atoms trapped at the notes of an optical lattice and forming 2D or 3D (Bravais or non-Bravais) crystals. The case of not perfectly filled lattices will be also considered to study of the absence of transport due to the occurrence of the Anderson localization in disordered systems.

[1] Fano-Hopfield model and photonic band gaps for an arbitrary atomic lattice
Mauro Antezza, Yvan Castin
Phys. Rev. A **80**, 013816 (2009)

[2] Spectrum of light in a quantum fluctuating periodic structure
Mauro Antezza, Yvan Castin
Phys. Rev. Lett. **103**, 123903 (2009)

[3] Photonic band gap in an imperfect atomic diamond lattice: penetration depth and effects of finite size and vacancies
Mauro Antezza, Yvan Castin
Phys. Rev. A **88**, 033844 (2013)

[4] Quantitative study of two- and three-dimensional strong localization of matter waves by atomic scatterers
Mauro Antezza, Yvan Castin, David A. W. Hutchinson
Phys. Rev. A **82**, 043602 (2010)

[5] Matter waves in atomic artificial graphene
Nicola Bartolo, and Mauro Antezza
Europhys. Lett. **107**, 30006 (2014)

[6] Matter waves in two-dimensional arbitrary atomic crystals
Nicola Bartolo, and Mauro Antezza
Phys. Rev. A **90**, 033617 (2014)