Abstract Submitted
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**Lattice with a Twist: A Helical Waveguide for Ultracold Matter**[1]

M. BHATTACHARYA, University of Arizona — The behavior of matter is governed by the geometry of the potential it experiences. We consider the construction of optical potentials with helical symmetry, which can confine cold atoms and molecules. Microparticles have been experimentally confined in similar potentials [1]. Using two counter-propagating Laguerre-Gaussian beams we show that this simple chiral system realizes a superlattice of helical waveguides for ultracold matter and allows experimental control of their number, helicity, radius, pitch as well as strength and aspect ratio of confinement. In the simplest nontrivial case the potential has double-helical symmetry, similar to DNA. In general the behavior of massive particles in a helical potential is expected to be rich due to the periodic modulation of their motion along the lattice; negative group velocities and effective masses are expected. Effects such as spin squeezing and Berry's phase are also possible. A helical waveguide can provide a phase hologram for atom-waves, and perhaps support geometrically bound states. We will also address the curious possibility of simulating atom transport in carbon nanotubes.

[1] M. P. MacDonald *et al.* Opt.Commun. **201**,21(2002).

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