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A two-dimensional four-beam annular accordion optical lattice for ultra-cold atoms[1] JOHN HUCKANS, Bloomsburg University of Pennsylvania, IAN SPIELMAN, NIST Gaithersburg — In his seminal 1976 paper[2] "Energy levels and wave functions of Bloch electrons in rational and irrational magnetic fields," Hofstadter suggested that his intriguing fractal spectrum be tested experimentally by creating a lattice with a larger period than Nature provides us. In his words: "This is not to say that the idea is easy; but such an intriguing spectrum deserves a good experimental test." To measure this spectrum we developed a technique for creating artificial magnetic fields for neutral atoms, and now are constructing a wide-range two-dimensional accordion optical lattice[3,4,5] by steering four paraxial laser beams onto an atom cloud using a single large annular lens. In addition to eliminating spherical aberration, this novel design leaves the central solid angle surrounding the optical axis completely unobstructed for imaging and other purposes.

[1]Bloomsburg University Foundation Margin of Excellence Grant
[2]D.R. Hofstadter, Phys. Rev. B 14, 2239 (1976).
[3]L. Fallani et al., Opt. Express 13, 4303-4313 (2005).
[4]T.C. Li et al., Opt. Express 16, 5465-5470 (2008).
[5]R.A. Williams et al., Opt. Express 16, 16977-16983.

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