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**Control of Landau orbits by electromagnetic vortices** IWO BIALYNICKI-BIRULA, Ctr. for Theor. Phys., Warsaw, Poland — Electromagnetic beams of radiation endowed with orbital angular momentum have embedded vortex lines. These electromagnetic vortices act as beam guides for charged particles. Exact solutions of the classical (Lorentz) and quantum (Schroedinger and Dirac) equations, derived in Phys. Rev. Lett. 93, 20402 (2004), exhibit such a behavior. In the present contribution, I take my investigation a step further and describe the motion of particles in a combination of an electromagnetic wave with a vortex line and a constant magnetic field. I will show that an electromagnetic wave with a vortex line can be used to control and to transport the cyclotron orbits (Landau orbits in the quantum mechanical setting) across the lines of the constant magnetic field. For that we need electromagnetic beams with moving vortices. Such beams can be produced by taking a superposition of a monochromatic beam having a fixed vortex line with a detuned plane wave. Cyclotron (Landau) orbits will be trapped by the electromagnetic vortex and they will follow a moving vortex. These results are based on new analytic solutions of the Lorentz and the Dirac equations describing the motion of charged particles in the presence of an electromagnetic wave with a vortex line and a constant magnetic field.

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