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An electron beam manipulated by circularly polarized Laguerre-Gaussian modes

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Manipulation of an electron beam by Laguerre-Gaussian (LG) modes is investigated using finite-difference time-domain particle-in-cell (FDTD-PIC) simulations. The azimuthal velocity profiles of macro-particles exhibit a 3-D spiral pattern with the number of strands equal to a sum of the state number of spin angular momentum and the orbital angular momentum of LG modes. These spiral patterns move along with the electron beam like a helical traveling wave. The electrons also exhibit both an orbit revolution and a small rotation motion. The former is very similar to the gyromotion of electrons under an external magnetic field. The small rotation motion has the same frequency as that of the LG mode while the orbit revolution frequency or gyrofrequency is far lower. This gyrofrequency can be manipulated by the frequency, electric field strength, and beam waist size of the LG mode. Furthermore, a larger-current electron beam can be confined within the LG mode by increasing the electric field strength. It is demonstrated that the manipulation of an electron beam can be realized by using circularly polarized LG modes. The fundamental mechanism and simulation results will be presented.

Footnotes

Paper preparation format

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Region represented

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