Contribution ID: **791** Type: **Poster (Student, Not in Competition) / Affiche (Étudiant(e), pas dans la compétition)**

Two-dimensional accelerating beams along arbitrary trajectories and enhancement of their peak intensities

Wednesday, June 17, 2015 7:00 PM (2 minutes)

In the last few years, accelerating optical beams propagating along a curved trajectory have attracted a lot of attentions. Since Airy beams were the first to be introduced into optics, they have been employed in a variety of applications, such as the generation of curved plasma channels, optical trapping and manipulation, and micro-fabrication. It has been shown that accelerating beams can be designed to propagate along arbitrary convex trajectories through engineering the phase of a light wave in either real or Fourier space. However, most of the work thus far focused on one-dimensional configurations only, with the emphasis on the engineering of beam trajectories. The dynamics of two-dimensional (2D) accelerating beams, a useful knowledge for practical applications, has not been investigated in a general way. In this work, we study analytically and experimentally the dynamics of two dimensional accelerating beams generated from the Fourier-space phase modulation of a light. We demonstrate that the trajectory of a 2D accelerating beam can be designed from a direct mapping between the spatial spectrum and the propagation distance. In addition, the main lobe of the beam can be approximately described by an analytical solution in a generalized way. Moreover, we also propose a method to optimize the accelerating beam generation, aiming at obtaining enhanced peak intensities. Our theoretical analyses are in good agreement with the experimental results. Our findings may be relevant to many applications as mentioned in the introduction.

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Session Classification: DAMOPC Poster Session with beer / Session d'affiches avec bière DPAMPC

Track Classification: Division of Atomic, Molecular and Optical Physics, Canada / Division de la physique atomique, moléculaire et photonique, Canada (DAMOPC-DPAMPC)