Guiding Trojan Beams Using Lagrange Points

Mercedeh Khajavikhan, Yunxuan Wei, Haokun Lou, Demetrios Christodoulides
University of Southern California, USA

The guided transmission of optical waves is critical for light-based applications in modern communication, information processing and energy generation systems. Traditionally, the guiding of light waves in structures such as optical fibers has been predominantly achieved through the use of total internal reflection. In periodic platforms, a variety of other physical mechanisms can also be deployed to transport optical waves. However, transversely confining light in fully dielectric, non-periodic and passive configurations remains a challenge in situations where total internal reflection is not supported. Here we present an approach to trapping light that utilizes the exotic features of Lagrange points—a special class of equilibrium positions akin to those responsible for capturing Trojan asteroids in celestial mechanics. This is achieved in arrangements in which optical Coriolis forces induce guiding channels even at locations where the refractive index landscape is defocusing or entirely unremarkable. These findings may have implications beyond standard optical waveguiding schemes and could also apply to other physical systems such as acoustics, electron beams and ultracold atoms.