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Links and Twists within the Stokes Field

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Skyrmions are a class of stable quasi-particles with non-trivial topological structures categorized by integer invariants called skyrme numbers. In terms of field configurations, a skyrmion is formed by the twisting of field lines into links between said field lines where the stability originates from the energy requirement to form or break any of these linkages. It is this topological stability which has made the study of skyrmions appealing in many fields such as condensed matter physics where the stability of so called magnetic skyrmions created on the surface of meta-materials has allowed for the development of new memory storage devices. Although originally formulated in the language of particle physics, the generality of the skyrmion definition allows for the creation of analogous structures in different fields. Here we present a formalism to create the Optical Skyrmion within the Stokes Field, using structured light techniques. This Optical Skyrmion exists in the plane perpindicular to the direction of propagation, with a characteristic polarization layout which achieves every possible polarization state and where the skyrme number indicates the number of times this structure repeats itself. Here we employ the use of structured light techniques to create and categorize skyrmions with different skyrme numbers and textures. Furthermore, we show the advantages of using non-diffracting spatial modes to create optical skyrmions. The categorization of these topological vector beams as skyrmion beams allows for a new degree of freedom in vector mode creation which may have intriguing applications in areas such as optical communication and cryptography.

Apply to be considered for a student ; award (Yes / No)?

Yes

Level for award;(Hons, MSc, PhD, N/A)?

MSc

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