Light Science & Applications

Topological Protection of Optical Skyrmions through Complex Media

Department of Engineering Science, University of Oxford, Parks Road, Oxford, OX1 3PJ, UK

An Aloysius Wang
Email: an.wang@stcatz.ox.ac.uk

At the heart of optical communications and photonic computing is the capacity to encode information into electromagnetic fields. This can be achieved in many ways but traditionally revolves around the modulation of the amplitude, phase, and wavelength of light, or some combination thereof. Recent experimental realizations of optical Skyrmions through the techniques of structured light have opened the doors to a completely new way of representing data in electromagnetic fields, namely its topology. Apart from potentially enhancing the bandwidth of optical systems, the intrinsically discrete nature of the topological number allows Skyrmions to naturally interface with the digital world. However, investigations into the topological protection of optical Skyrmions through various media remain limited to date. Here, we rigorously define the optical Skyrmion and establish a framework that can be used to analyze the effects of complex media on the topology of Skyrmion fields. Using this framework, we establish simple criteria for spatially varying retarders, diattenuators, depolarizers, and combinations of the former under which topological protection is guaranteed. We also discuss experimental results demonstrating the robustness of the Skyrmion number against corrupting media and discuss ways of extending the optical Skyrmion to more general settings.

Short Bio:

An Aloysius Wang is a member of the Engineering Science Department of the University of Oxford. His research mainly revolves around vectorial optics and photonics, with a focus on topological structured fields.