Skyrmion-like polarization distributions

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Keywords: optics, polarization, polarization distributions, skyrmions

In this work we discuss a type of optical field in which the polarization varies spatially, so that a complete manifold of parameters describing polarization is covered. The simplest case is that of what is called a "Stokes skyrmion", which corresponds to a paraxial field that covers all states of full paraxial polarization over a transverse plane or a section of it. The term skyrmion, borrowed from particle theory, denotes a physical field that is locally described by a real, normalized vector constrained to a sphere, such that over a spatial region this vector covers the complete sphere, yielding a configuration that is topologically stable. For paraxial polarization, this sphere can be the Poincaré sphere. Early examples of Stokes skyrmion include the Full Poincaré beams [1]. We recently proposed periodic Stokes skyrmionic fields in which the sense of the coverage (that is, the sign of the Jacobian between a spatial plane and the sphere) does not change. This includes mappings that are conformal [2], and others that are invariant under propagation [3]. We also considered short pulses that cover the sphere not over a transverse plane but over a longitudinal one [4]. Finally, we extended the concept to higher dimensions by considering non-paraxial polarization states, which are described not by a 2-sphere but by either a 4-sphere or a complex projective plane. We find simple optical fields that, over a 4D space-time region, span completely this parameter space [5].

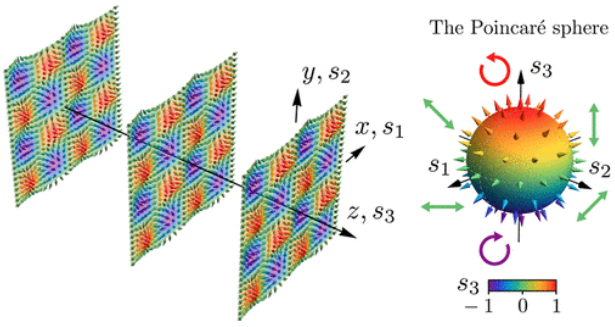

Fig. 1: Propagation-invariant Stokes-skyrmionic lattice [3]

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