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Non Abelian artificial gauge field and topological invariants in optics KYLE BALLANTINE, PAUL EASTHAM, Trinity College Dublin — Photons experience a synthetic magnetic field when the phase of the electromagnetic wave changes as the light propagates. This varying phase is generally defined for a scalar field of uniform polarization. However light is a vector field and the polarization may also change as the field propagates; indeed this is generally unavoidable when the light scatters from defects or an interface. We show that the change in polarization and phase of a propagating beam of light gives rise to a non-Abelian gauge theory. We derive expressions for the gauge potential and field strength and calculate these for a specific example, a chiral biaxial medium. The phase winding number in such a medium is a half-integer, but it is not, in general, a topological invariant. We show that there is an integer topological invariant associated with the non-Abelian gauge field, corresponding to the combined winding of both phase and polarization.

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