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Topological structures in spinor Bose–Einstein condensates and optical fields MAITREYI JAYASEELAN, JUSTIN T. SCHULTZ, AZURE HANSEN, JOSEPH D. MURPHREE, University of Rochester, JANNE RUOSTEKOSKI, Lancaster University, NICHOLAS P. BIGELOW, University of Rochester — We explore the mathematical and physical connections between the topological structures that we create in a ^{87}Rb Bose–Einstein condensate and those found in optical polarization. We sculpt the spinor wavefunction with a coherent Raman imprinting technique to create fractional and non-Abelian vortices in the F=1 and F=2 atomic ground state manifolds. Mobius strip and torus knot topologies emerge as we characterize the topology of the spinor condensate through the orientation of the order parameter around these singularities. These topologies also occur in optics; we show that the F=1 and F=2 atomic ground state phases correspond to states of monochromatic and bichromatic optical polarization when explored in the language of angular momentum. Transformations between different phases in the atomic ground state manifolds are governed by SU(2) subalgebras of the full symmetry groups of these manifolds. Of these, the subalgebra that involves rotations around the quantization axis is found to govern transformations between the corresponding states of paraxial optical polarization. This points to connections between superfluid flows and flows in optical angular momenta as well as extensions to non-paraxial optical fields and higher spin systems.

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