

Introduction to topology in optics

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Plan of the course

1) A brief tour of topology (4 hour lectures)

Manifolds. Differential form. Homotopy and homology. Fiber Bundles.

2) Topological invariants (4 hour lectures)

Berry curvature. Winding number. Chern number. Linking number. Geometric phase.

3) Electromagnetism and beam optics (3 hour lectures)

Paraxial optics and Wave equation. Polarization. Gaussian beam. Laguerre-Gaussian beam. Bessel-Gauss beam.

4) Vortices and polarization in singular optics (6 hour lectures)

Morphology of optical vortices. Dynamics of vortices. Examples of vortices in free space and in nonlinear media. Generation and detection. Bloch sphere and Monstardom.

5) Knotted singularities and hopfions (4 hour lectures)

Introduction to knot and link. Generation of knots in optics. hopfion.

6) Topological photonics (6 hour lectures)

Topological phase of matter and its analogy in optical systems

7) Some examples of Non-Hermitian topological photonics (3 hour lectures)

gain and loss in optical systems. Exceptional points. Phase transitions.

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