

## THE SINGULARITIES OF LIGHT: INTENSITY, PHASE, POLARIZATION

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Geometry dominates modern optics, in which we understand light through its singularities. These are different at different levels of description. The coarsest level is geometrical optics, where the singularities are caustics: focal lines and surfaces: the envelopes of ray families. These singularities of bright light are classified by the mathematics of catastrophe theory. Wave optics smooths these singularities and decorates them with rich and ubiquitous interference patterns. Wave optics also introduces phase, which has its own singularities. These are optical vortices, a.k.a nodes or wavefront dislocations. Geometrically these singularities of dark light are lines in space, or points in the plane. They occur in all types of quantum or classical waves. Incorporating the vector nature of light leads to polarization singularities, also geometrical, describing lines where the polarization is purely circular or linear. As well as representing physics at each level, these optical and wave geometries illustrate the idea of asymptotically emergent phenomena. The levels form a hierarchy, leading to predictions of new phenomena at the quantum level.

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