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Group Theory of Circular-Polarisation Effects in Chiral Photonic Crystals with Four-Fold Rotation Axes, Applied to the Eight-Fold Intergrowth of Gyroid Nets MATTHIAS SABA, Theoretische Physik, FAU Erlangen-Nuremberg, MARK D. TURNER, CUDOS & Centre for Micro-Photonics, Swinburne University of Technology, KLAUS MECKE, Theoretische Physik, FAU Erlangen-Nuremberg, MIN GU, CUDOS & Centre for Micro-Photonics, Swinburne University of Technology, GERD E. SCHRÖDER-TURK, Theoretische Physik, FAU Erlangen-Nuremberg — The *8-srs PhC* of body-centered cubic $I432$ symmetry consists of eight interwoven equal-handed dielectric Gyroid networks embedded in air. We use representation theory and scattering matrix calculations to derive analytical results for the band structure topology and the circular polarization scattering parameters of the 8-srs PhC and any other lossless $I432$ photonic crystal. All results are supported by numerically. We demonstrate in particular that all bands along the cubic [100] direction can be identified with the irreducible representations $E_{\pm}$, A and B of the C_4 point group. The E_+ (E_-) representation can be identified as the only transmission channel for right(left)-circularly polarized light. We derive explicit relationships for the (zero Bragg order) transmission and reflectance amplitudes which guarantee equal transmission rates for both polarizations and vanishing ellipticity below a critical frequency, yet allowing for finite rotation of the polarization plane. The combination of vanishing losses, vanishing ellipticity, near-perfect transmission and optical activity comparable to that of metallic meta-materials makes this geometry an attractive design for nanofabricated photonic materials.

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