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Polarization-dependent transformation of a paraxial beam upon reflection and refraction: a real-space approach

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We analyze the paraxial beam transformation upon reflection and refraction at a plane boundary. In contrast to the usual approach dealing with the beam angular spectrum, we apply the continuity conditions to explicit spatial representations of the electric and magnetic fields on both sides of the boundary. It is shown that the polarization-dependent distortions of the beam trajectory (in particular, the "longitudinal" Goos-H\"anchen shift and the "lateral" Imbert-Fedorov shift of the beam center of gravity) are directly connected to the incident beam longitudinal component and appear due to its transformation at the boundary.

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