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Anomalous Fresnel coefficients for quadrupole polaritons in $\mathbf{Cu_2O}$[1] JOON JANG, YI SUN, SHAHIN MANI, JOHN KETTERSON, Department of Physics, Northwestern University, KETTERSON'S TEAM — In a direct-gap semiconductor, a polariton is a quantum superposition of an exciton and a photon, formed near the light cone. Unlike dipole polaritons that have been strongly confined in a 2D microcavity structure, a quadrupole polariton in a bulk Cu_2O is a coherently propagating bosonic state with an unusually long decoherence time owing to its unusual underlying electronic structure. Therefore, this unique semiconductor provides a model system for studying the theory of so-called additional boundary conditions at the vacuum-crystal boundary. Using resonant two-photon excitation, we create a coherently propagating polariton wave packet at 2 K and measure its reflectance (R) and transmittance (T) at the boundary opposite to the incoming surface. Surprisingly, we find an enhanced reflection of polaritons from sample surfaces such that the ratio T/R deviates significantly from the present theory. This anomalous boundary effect most likely arises from the quadrupole excitonic (matter) component of polaritons. Our experimental results have implications for the design of polariton-based waveguides and resonators in which traveling polaritons are effectively confined in the medium.

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