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Signature of a Spin Liquid State in the Low-Frequency Optical Conductivity of the S = 1/2 Kagome Antiferromagnet Herbertsmithite DANIEL PILON, TIANHENG HAN, JOSHUA LUI, MIT, DAVID SHREKEN-HAMER, Boston College, ALEX FRENZEL, MIT, Harvard University, WILLIAM PADILLA, Boston College, YOUNG LEE, NUH GEDIK, MIT - Herbertsmithite $(ZnCu_3(OH)_6Cl_2)$ is an antiferromagnetic Mott insulator composed of a planar kagome arrangement of S = 1/2 copper atoms separated by nonmagnetic zinc atoms. It has recently emerged as one of the best candidates for exhibiting a quantum spin liquid state, showing no magnetic order down to 50 mK despite an exchange energy of 200 K. Here we report a signature of a spin liquid state in the terahertz optical conductivity of Herbertsmithite, measured via Terahertz Time-Domain Spectroscopy. A power-law dependence on frequency with exponent ~ 1.4 is observed in the inplane conductivity at low frequency, which increases in magnitude as temperature is decreased. This contribution to the conductivity is notably absent in the out-ofplane direction. Theory has predicted that the existence of a Dirac spin liquid with a gauge field serving to couple the spin and charge degrees of freedom would give rise to a power-law conductivity with exponent ~ 2 inside the Mott gap. We discuss this prediction as well as other possible sources of the observed behavior.

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