Probing spin correlations with phonons in the strongly frustrated magnet $\text{ZnCr}_2\text{O}_4$\textsuperscript{1} HOWARD DREW, ANDREI SUSHKOV, MRSEC, University of Maryland, OLEG TCHERNYSHEYOV, The Johns Hopkins University, WILLIAM RATCLIFF, SANG-WOOK CHEONG, Rutgers University — Geometrically frustrated magnets can resist magnetic ordering and remain in a strongly correlated paramagnetic state well below the Curie-Weiss temperature. The spin-lattice coupling can play an important role in relieving the frustration in these systems. In $\text{ZnCr}_2\text{O}_4$, an excellent realization of the Heisenberg antiferromagnet on the “pyrochlore” network, a lattice distortion relieves the geometrical frustration through a spin-Peierls-like phase transition at $T_c = 12.5$ K. Conversely, spin correlations strongly influence the elastic properties of a frustrated magnet. By using infrared spectroscopy and published data on magnetic specific heat, we demonstrate that the frequency of an optical phonon triplet in $\text{ZnCr}_2\text{O}_4$ tracks the nearest-neighbor spin correlations above $T_c$. Below $T_c$, the phonon triplet splits into a singlet and a doublet, separated by 11 cm$^{-1}$. This splitting is directly proportional to the spin-Peierls order parameter. We also observed a number of weak absorption bands, arising below $T_c$, which indicates doubling of the Brillouin zone at the structural/magnetic phase transition.

\textsuperscript{1}This work supported in part by NSF-MRSEC Grants No. DMR-0080008 and DMR-0348679.