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Classical Acoustic Echoes in Model Glasses JUSTIN BURTON , SIDNEY NAGEL, University of Chicago — For the last 40 years, the low-temperature excitations in glasses have traditionally been explained in terms of a distribution of dilute, two-level quantum states that are created by clusters of particles tunneling between two nearly degenerate ground states. Strong evidence for this model has come from ultrasonic saturation effects and acoustic echoes [1] observed in experiments. Recently, a classical analysis of vibrational modes in model glasses has shown that at low frequencies, the modes are quasi-localized and highly anharmonic [2]. Using molecular dynamics simulations, we show that this anharmonicity can produce an acoustic echo due to the shift in the mode frequency with increasing amplitude. We observe this both in jammed packings of spherical particles with finite-range, Hertzian repulsions, and in model glasses interacting with a Lennard-Jones potential. In contrast to pulse echoes in two-level systems, a distinguishing feature of these "anharmonic echoes" is the appearance of multiple echoes after two excitation pulses, a feature also observed in experiments.

[1] B. Golding and J. E. Graebner. Phys. Rev. Lett. 37, 852 (1976).
[2] N. Xu, V. Vitelli, A. J. Liu, and S. R. Nagel. Europhys. Lett. 90, 56001 (2010).

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