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Scattering fidelity in random matrix elastodynamics, the effect of temperature on diffuse ultrasound[1]

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Temperature variations in a high Q elastic body provide access to a slowly and reversibly tuned wave chaotic random ultrasound "Hamiltonian." This allows benchtop measurements of scattering fidelity in quantum chaotic, and other, systems. To a first approximation, temperature changes merely rescale time, as the wave speeds and specimen size change. But inasmuch as the shear and longitudinal wave speeds change by different amounts, the wave fields are distorted as well. The degree of distortion is a measure of how rapidly the shear and longitudinal waves mix. We show how that distortion varies with temperature, with the age of a transient waveform, with frequency, and with specimen size and geometry. Measured scattering fidelities are found to be in accord with predictions from random matrix theory for both irregular and regular bodies, up to a scaling parameter that is related to the rate of mixing of the rays. That rate is very different depending on the regularity of the specimen. Fidelity is greater in ray-chaotic bodies than in regular bodies.

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