Ultrasonics without a source-Thermal Fluctuation Correlations at Mhz Frequencies

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In an LRC (inductor-resistor-capacitor) circuit, the noise power is the product of the voltage noise and the current noise and is constant from the 1/f- boundary at low frequencies to the correlation limt (10^14 Hz) at high frequencies. This "white" Johnson noise is, however, usually examined with a voltage sensing probe. In that case, the voltage noise is colored, and shows a peak at the parallel resonant frequency. Thus noise can be used to extract physical information about the complex impedance. Exactly the same thing happens in a mechanical resonator, where volume velocity and pressure replace current and voltage. Examination of the noise spectrum provides useful information about the mechanical resonances (phonons).

In this paper, this concept is carried further by an examination of the noise autocorrelation function. The result is the ability to capture real information about the dynamical propagation of sound via noise analysis. The authors see in the noise, just what one might get with a "perfect" ultrasonic transducer bonded with an infinitely thin, acoustic matching bond during a pulse-echo experiment. This is an important work, and leads to many interesting questions about what physics might be visible with such a technique, noting that the fluctuation-disspation theorem and the measurement of noise are intimately connected in elucidating dynamics near phase transitions.