Gaidarzhy *et al.* Reply: In our Letter [1], we reported experimental data on a novel multielement nanomechanical oscillator with mechanical motion at frequencies up to 3 GHz [2]. At a higher cryostat temperature of 1 K, where the thermal occupation number $N_{\rm th} \equiv k_B T/hf \sim 14$ for a 1.5 GHz mode, the oscillator behaves classically according to Hooke's law. At 110 mK, where $N_{\rm th} \equiv k_B T/hf \sim 1$, response to the driving force shows clear transitions between two discrete states in a dramatic deviation from the monotonic Hooke's-law response. After ruling out a number of classical interpretations, we conjecture that the discrete transitions are possibly of quantum mechanical origin.

In their Comment [3], Schwab *et al.* contend that the discrete transitions observed in the experiment cannot have "any connection to quantum phenomena." We show that such a conclusion cannot be drawn on the basis of their arguments. Second, they claim that the conjecture of energy quantization in the observed mode of the oscillator is in conflict with elasticity theory and magnetomotive detection technique. In addition, Schwab *et al.*, claim that the preamplifier noise will drive the resonator to 440 K "far above the temperature of 100 mK." They also derive an effective resonator temperature of 8800 K from the experimental parameters. As we show below, our experimental data clearly indicate that both of these statements are incorrect.

(i) On the measurement scheme.—Contrary to the claim of Schwab *et al.* [3], quantum nondemolition (QND) measurement is not necessary for the detection of quantized spectrum, as is well known since measurements of discrete atomic spectra over a hundred years ago. Of course, QND is necessary for measurement with *continuous monitoring* of the quantum system. However, ours is not a continuous measurement. Furthermore, linear driving can prepare a system in certain nonclassical states (e.g., coherent states). The system can be prepared also in an energy eigenstate by linear drive in a two-step process by driving the system to a highly excited state, and then allowing it to relax to an eigenbasis of energy or number states.

(ii) On heating due to the preamp backaction noise.—The preamp input noise indeed contributes to the heating of the oscillator, but the question is whether this heating raises the sample temperature to hundreds of Kelvin or a few tens of millikelvin. Our measurement of temperature dependence of the mechanical response (frequency shift and jump statistics) enables us to discern the oscillator temperature within a few tens of millikelvin down to 110 mK. At the top of the cryostat, the preamp input voltage noise of $S_v^{1/2} = 1.1$ nV/Hz$^{1/2}$ translates to a noise power of $P_N = S_v BW/(50\,\Omega) = 0.7$ pW, in the effective bandwidth $BW = 30$ MHz. The high frequency noise power incident on the sample is attenuated by the coaxes down to ~300 fW. Even for a broadband response with a 1.5 GHz bandwidth, the noise power translates to ~15 pW. In fact, the backaction noise contribution to heating (temperature increase) in our experiments is negligible compared to other sources, although the electrical noise is visibly present in the signal. The dominant source of heating is due to the 300 blackbody radiation coming down the inner conductor of the BeCu coaxial cable, which raises the temperature from 6 mK (cryostat base temperature with cooling power of 350 μW at 100 mK) to the measured 110 mK, in spite of multiple-stage thermal anchoring.

(iii) On the average lifetime.—The alleged lifetime of 10 ns is extracted from $t \simeq Q/\omega$, which is the classical energy relaxation time of an oscillator. The time scale in Fig. 4d of [1] is in fact the experimental time scale, where every point is actually a separate measurement. It is neither the ring-down time, nor is it the decay time of the quantum system.

(iv) On the magnetomotive response and signal amplification.—In the magnetomotive detection technique, mechanical response in the linear regime is represented by B^2 dependence [driving force: $F(\omega) = I(\omega)LB$]. We see this dependence on the magnetic field on resonance in a large number of GHz modes, as shown in Ref. [2]. Also, the detected signal $V_{\rm emf}$ is amplified by 2–3 orders of magnitude in comparison to an equivalent signal from a 1.5 GHz simple beam.

There are three contributions to the signal enhancement in our structure: (a) We specifically designed the multielement structure to have a low effective spring constant $k_{\rm coll}$ in the collective mode. The measured value of $k_{\rm coll}$ is in fact an order of magnitude lower than the spring constant of the 1.5 GHz straight beam, which enhances the signal by an order of magnitude. (b) Induced voltage $V_{\rm emf}$ in the detection electrode depends on the enclosed flux, $V_{\rm emf} = {\rm Re}(d\Phi/dt) \sim \eta BL(dy/dt)$. The area swept by the central beam is roughly a factor of 100 larger than that of the straight beam. (c) Finally, the antenna structure consists of 40 single cantilevers, 20 on each side. As we describe in the Letter, all cantilevers move coherently in phase in some of the high order collective modes. A system of coherently coupled oscillators, quantum or classical, in certain symmetry, can be described by a collective coordinate with an effective displacement greater than the displacement of the individual oscillators.

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