Comments and Addenda

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Ballistic-phonon-pulse transmission through the interface between solid sapphire–liquid He II at $T = 0.25$ K

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The sample impulse response function must be deconvolved from heat-pulse data in order to determine pulse-propagation parameters.

In a recent Letter Salemink *et al.* report some ballistic-phonon pulse-transmission data for sapphire to He II at a temperature of 0.25 K.[1] Their conclusions derive from the ratio of the longitudinal (L) and transverse (T) mode conversion at the interface. Their Letter reports the ratio of the peak heights of two portions of the observed temperature signal from a superconducting bolometer as this desired conversion ratio.

However, the ratio of the peak observed signals is not the ratio of L to T excitation in the helium, since the temperature signal is the convolution, successively, of the probe heat pulse with the sapphire crystal impulse response, with the helium chamber impulse response, and with the bolometer thermal impulse response. Since the convolutions are not affine transformations, but mixed algebraic and integral transformations, the observed signal must be deconvolved from the bolometer impulse response (probably trivial) and from the helium chamber impulse response to obtain the excitation signal in the He II at the sapphire face.[2,3] A final deconvolution of the sapphire crystal impulse response is necessary to determine the L and T excitation in the sapphire.

Since the data were not deconvolved, the L/T ratio reported is not the ratio of the L and T excitations produced in the He II. The conclusions drawn in their Letter may be correct, but the conclusions can not be said to be supported by the data presented until further sophisticated data reduction, a series of deconvolutions, is carried out.

There are similar difficulties to be found in the theoretical analysis in the recent summary paper of Narayanamurti *et al.*[4] It seems clear that the phonon bottleneck contributes to the lengthening of the "effective" quasiparticle recombination time. But the analytical basis they present for this understanding must be accepted with reservation. The sample is finite, but the impulse response used is that for a slab of infinite cross section. Since the analysis uses the shape of the tail of the observed signal, the sample would have to be more than ten times the sample thickness, and closer to 100 times the thickness, for the transverse dimensions not to enter significantly into the impulse response, Eq. (3.29) in Ref. 4. To compare Eq. (3.29) with the observed response, it must also be modified to include boundary thermal loss, and then convolved with the quasiparticle-generating heat pulse.[3] Note also that to decide that the arrival times of Fig. 5, Ref. 4 are in excellent agreement with known sound velocities, a deconvolution of the data in Fig. 5 must be carried out. My main point is to avoid epistemological chaos, since, if these things are done, the excellent agreement of the observed response with theory could vanish, though, as I have said, the conclusions of the paper could remain valid.

[1] H. W. M. Salemink, H. van Kampen, and P. Wyder, Phys. Rev. Lett. 41, 1733 (1978).

[2] M. W. P. Strandberg and L. R. Fox, Phys. Lett. A 62, 151 (1977).

[3] M. W. P. Strandberg and L. R. Fox, Phys. Rev. B 17, 3014 (1978).

[4] V. Narayanamurti, R. C. Dynes, P. Hu, H. Smith, and W. F. Brinkman, Phys. Rev. B 18, 6041 (1978).

