Comments

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Response to "Overdamped soliton motion" by R. A. Guyer and M. D. Miller

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Guyer and Miller have published a critique of our work on transport in the driven and heavily damped sine-Godon chain. We allude to two of the principal defects, in our view, of their critique, without an attempt to provide a detailed rebuttal.

The nucleation theory of soliton motion for the driven sine-Gordon chain was discussed in detail by Seeger and Schiller,[1] in a review covering not only their own work, but that of a number of others (e.g., Ref. 2) motivated by dislocation theory. Combining these concepts with closely related contributions,[3–8] we put forth a more complete theory for the strongly damped case.[9] The authors of Ref. 10, treating this same problem before we did, were apparently unaware of the older literature, and of the relationship of their problem to the existing many-dimensional nucleation theories. Two of these authors, Guyer and Miller, have now published[11] a critique of our work.[9] Our viewpoint is described in our own publications, and in Refs. 1–8. We have pointed out[9] that our method, and that of Ref. 10 have distinct ranges of validity. A further detailed rebuttal to Guyer and Miller[11] would provide no new information, and we limit ourselves to two of their principal points.

The distribution function for the driven sine-Gordon chain, with transport, is expressed in Ref. 10, and by us, as a multiplier times an equilibrium distribution function. Guyer and Miller use a multiplier which depends only on the total number of particles which occur in various ranges of the particle displacement θ, and not on the way these particle displacements are placed along the chain, i.e., not on the exact shape. As indicated by Guyer and Miller, in the discussion following Eq. (57) of Ref. 11, their multiplier is not equivalent to our multiplier. This is inconsistent with their own abstract, which states "Both methods are shown to involve the same ansatz. . . ." A nucleation rate, as discussed by us, depends sensitively on the exact shape of the critical nucleus, and the correction factor used by Guyer and Miller simply does not take shape into account.

A second point raised by Guyer and Miller relates to the fact that in the presence of thermally activated transport, over a potential barrier, the distribution function minimum is displaced away from the peak of the potential. One can, of course,construct approaches which require this displacement to be expressed explicitly, as Guyer and Miller do. All of our cited literature, going back to the pioneering work by Kramers,[12] confirms that it is not necessary to do this. A more detailed discussion of this point will be found in the appendix of a conference paper.[13]

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