Comment on "Explanation of the Glasslike Anomaly in the Low-Temperature Specific Heat of Incommensurate Phases"

Recently Cano and Levanyuk proposed an attractive conjecture for explaining the glasslike anomaly in specific heat at low temperature (low-T C_p) of incommensurate (IC) phases based on the phason damping [1]. The universal features of glasses, i.e., the bump in C_p/T^3 and the quasilinear (or power-law) contribution $\Delta C_p \sim T^\alpha$ have also been found in low-T C_p of charge density wave (CDW) systems [2], which can be related to the glass transition in the CDW superstructure observed in dielectric spectroscopy [3]. The CDW pinning resonance, i.e., the phason gap, was considered as analogous to the well-known boson peak found in glasses [3]. Moreover, we have been able to explain the bump in C_p/T^3 using a modified model of the gapped or pinned phason which, however, neglects the phason damping. The explanation of the quasilinear contribution to C_p in terms of damping urged us to check the applicability to CDW systems which can be considered as canonical IC example. In the following we show that the theory presented in [1] is still not suitable to explain the quasilinear contribution to C_p in IC systems.

Two main features follow from the Eq. (2) of [1]: (i) C_p linear in T, and (ii) its amplitude being proportional to Γ/ω_0^2 (Γ representing damping and ω_0 phason gap). However, for the two examples given in [1], biphenyl (gapless phason) and $(ClC_6H_4)_2SO_2$ (BCPS) (gapped phason), the T dependence is evidently $Cp \sim T^2$ [4]. Besides, the estimated amplitudes are 100 times bigger than the measured ones.

The last is also true for the third example of IC-CDW system the blue bronze, $K_{0.3}MoO_3$. But at least this system shows a sublinear contribution, a common property of all CDW systems, as seen in Fig. 1. For all these systems the phason damping and the phason gaps have been directly measured [5–9] and the amplitude of the quasilinear term $C_{osc}/T \sim \Gamma/\omega_0^2$ can be readily estimated as shown by large symbols in Fig. 1. These estimates, unfortunately, do not show any systematic correlation with the values measured for different compounds.

In order to account for the discrepancy between measured and estimated values, the authors of [1] point out that the data for the damping are obtained for a very restricted region of the wave vectors, while they are needed for the whole Brillouin zone. However, they neglect that in the Kohn anomaly the damping is by far the strongest at the minimum frequency, i.e., at $q_0 = 2k_F$, [6] and Ref. [23] of [1], making this narrow part of Brillouin zone dominant for their amplitude estimates. Nevertheless, to circumvent the problem we compare in Fig. 1 *pure* and *doped* systems. As doping increases the pinning frequency much more than

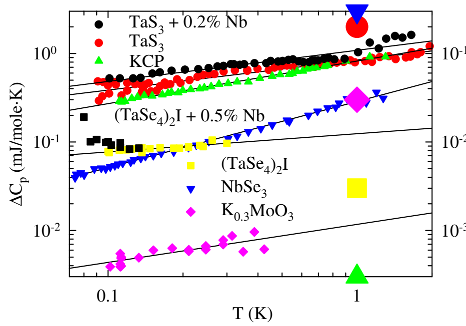

FIG. 1 (color online). Power-law specific heat of low-energy excitations of some quasi-1D systems with IC-CDW [2]. Black symbols—doped TaS_3 and doped $(TaSe_4)_2I$ (provided by J. C. Lasjaunias). Large symbols—Γ/ω_0^2 ($\sim C_{osc}$) from measured values of Γ and ω_0: TaS_3 [5], KCP [6], $NbSe_3$ [7], $(TaSe_4)_2I$ [8], $K_{0.3}MoO_3$ [9], Ref. [23] of [1].

the damping [8], while it does not influence other phonons, the expected amplitudes in doped samples should be an order of magnitude smaller than in pure samples. For TaS_3 and $(TaSe_4)_2I$, however, doping actually *increases* slightly the amplitude which is also in disagreement with the proposed explanation.

I thank E. Tutiš for valuable discussions and D. Starešinić for useful suggestions and figure preparation.

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Received 21 September 2005; published 26 January 2006
DOI: 10.1103/PhysRevLett.96.039603
PACS numbers: 65.40.Ba, 63.70.+h, 64.70.Rh, 71.45.Lr

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