Comment on "Missing $2k_F$ Response for Composite Fermions in Phonon Drag"

In a recent Letter, Zelakiewicz *et al.* report on the mysterious absence of a Kohn anomaly in the phonon mediated drag of composite fermions (CFs) in double layer electron systems [1]. In particular the temperature dependence and the magnitude of the drag transresistivity when moving away from $\nu = 1/2$ are claimed to be inconsistent with current expectations for CFs. Here we show that all the results in [1] can be simply explained by phonon drag of free electrons in the lowest Landau level [2]. In this model the electron-phonon interaction follows a universal behavior when plotted as a function of l_B/λ_p, where $\lambda_p = \hbar v/k_B T$ is the typical phonon wavelength for acoustic phonons with a sound velocity v and $l_B = (\hbar/eB)^{1/2}$ is the magnetic length. This universality entails a scaling of the phonon mediated drag $\rho_D(T, B) = \rho_s(\nu)f(l_B/\lambda_p)$ with a filling factor dependent normalization factor $\rho_s(\nu)$ and a scaling function $f(l_B/\lambda_p)$.

In Fig. 1 the results of such an analysis are shown. The drag transresistivity ρ_D as presented in [1], arbitrarily normalized to its value ρ_s at $TB^{-1/2} = 0.6$ K T$^{-1/2}$, is plotted as a function of $TB^{-1/2}$ ($\propto l_B/\lambda_p$). Indeed, as indicated by the lines, all the drag data presented in [1] scale to a single function, in particular around the position where a maximum occurs in ρ_D/T^2. The identical dependence of ρ_s on B and the inverse electron concentration $1/n$ (insets of Fig. 1) show that ρ_s indeed depends only on $\nu = hn/eB$, supplying an additional indication of the validity of a free electron model for all the data presented in [1].

It was indicated in [1] that such a simple rescaling does not seem to work for data at $\nu = 1/4$, where a 10% *lower* position of the "Kohn-anomaly maximum" was observed. We note, however, that these data are taken at a considerably lower electron concentration. On the other hand, when extrapolating the data from Fig. 2a of [1] to lower fields, the maximum for $\nu = 3/4$ definitely occurs at much lower T than that for $\nu = 1/2$. Therefore it seems that the data obtained on the 1/4-3/4 CF family are far from being conclusive to discriminate between a CF model and a free electron picture.

Moreover, it is worthwhile mentioning that experiments on the *direct* phonon drag of CFs measured by thermopower (TEP) showed that any CF signature disappears as soon as the related minima in ρ_{xx} at odd denominator filling factors start to weaken [3]. At the high temperatures used in [1] the phonon drag TEP is well described by the model of noninteracting Landau-quantized electrons [4]. Of course it can not be excluded that CFs still exist at these high temperatures. However, no specific property which cannot be simply related to free electrons is observed in phonon drag and a CF interpretation becomes meaningless. The fact that even the $\nu = 1/3$ and $\nu = 2/3$ minima (inset of Fig. 2a in [1]) are merely visible in ρ_D and very
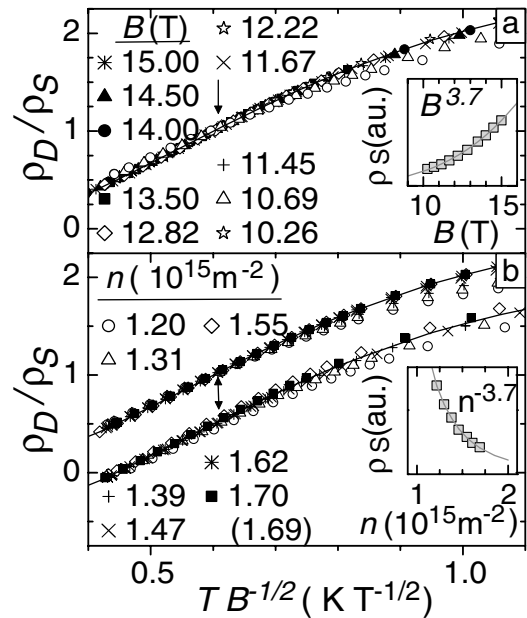

FIG. 1. Dependence of the normalized drag transresistivity ρ_D/ρ_s on $TB^{-1/2}$ when varying the magnetic field at constant density $n = 1.55 \times 10^{15}$ m^{-2} (a), varying the density at constant $B = 12.82$ T [(b), top trace], and varying both B and n at constant Landau level filling $\nu = 1/2$ [(b), bottom trace, shifted for clarity by -0.5]. The data are extracted from Figs. 2a, 2b, and 3 of [1] using the same symbols. The arrows mark the position where ρ_D/T^2 reaches its maximum. The insets show the dependence of ρ_s on B at constant n (a) and on n at constant B (b).

weakly developed in ρ_{xx} strongly proposes that it is sufficient to use a model as in [4] for a proper analysis of the data in [1].

In conclusion we have shown that all the data on the phonon mediated drag in coupled two-dimensional electron systems in high magnetic fields presented in [1] can be straightforwardly explained in a framework of electrons in the lowest Landau level without the need to use any new CF models.

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