Cheng and McCombe Reply: The authors of the accompanying Comment[1] point out that the frequency-sweep data of Ref. 2 for the $1s$-$2p$ $(m=+1)$ transition of center-doped shallow donors deviate above about 25 meV from their field-sweep data taken on a narrower-well sample. In Ref. 2 we suggested that an apparent "pinning" behavior at frequencies well below that of the GaAs zone-center LO phonon could be due to resonant polaron interaction with zone-folded LO phonons in this superlattice. Huant and Martinez claim that this apparent pinning is rather "...a direct proof for a dielectric artifact in the FTS experiment...," similar to that which led to the suggestion of resonant interaction with TO phonons.[3] This was later correctly interpreted in terms of dielectric artifacts.[4,5] These authors further state that the experiment on a sample with donors in the buffer layer below a similar multiple-quantum-well (MQW) structure, carried out specifically to check on the possibility of dielectric artifacts, was invalid.

We have carried out model calculations for both types of structures in order to investigate these assertions. An example of the results is shown in Fig. 1. Bulk dielectric functions appropriate to the lattice properties of the wells and barriers were used, and a Lorentzian electronic oscillator was taken to represent the impurity transition. The positions of the calculated transmission minima (transmitted intensity *with*, divided by transmitted intensity *without*, an electronic oscillator) versus the resonant frequency of the oscillator are plotted. Deviations from the solid line are due solely to "dielectric artifacts." It is clear that for impurities in the centers of the quantum wells the only deviations due to dielectric effects occur *very close* to the GaAs TO phonon frequency and *in* the reststrahlen region. Calculations for bulk donors located in a buffer layer below a similar MQW structure show *very similar behavior*. At frequencies well below that of the GaAs zone-center TO phonon there is no discernible $(<1\ \mathrm{cm}^{-1})$ deviation from the oscillator resonance position *either* for impurities in the well centers *or* for the "bulk" impurities. Thus it is clear that dielectric artifacts are not responsible for the apparent pinning reported in Ref. 2, and the experimental test for such effects was valid.

The discrepancy between the results of Ref. 2 and those reported in Ref. 6 remains to be explained. It should be noted that both experiments involve photoconductivity, not transmission; for bulk samples photoconductivity measurements have been shown to be insensitive to dielectric effects.[7] The discrepancy could be related to differences between frequency sweeps and field sweeps. Field sweeps are not sensitive to electronic branches that approach a horizontal line on a frequency-field plot while growing weaker, particularly in the presence of additional strong photoconductive response associated with another transition at higher fields.[6] If the suggestion of Ref. 2 is correct, there should be higher frequency branches *between* 250 and 295 cm^{-1}. It is possible that the field-sweep measurements select out the higher-frequency branches in this case, whereas the frequency-sweep measurements tend to emphasize the lower-frequency branch in this region.

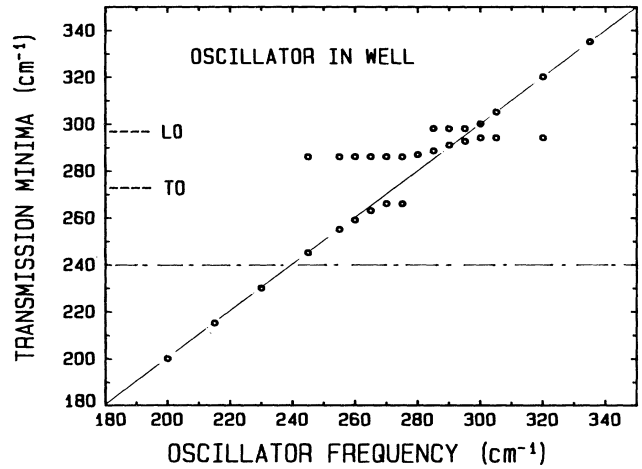

FIG. 1. Frequencies of transmission minima for electronic oscillators in each of the 138-Å GaAs wells of a 30-well structure, with 29 125-Å $Al_{0.3}Ga_{0.7}As$ barriers vs the oscillator resonant frequency. This structure is enclosed between 1500-Å AlGaAs layers. Strong deviations from linearity were observed in Ref. 2 *below* the horizontal dash-dotted line. Parameters for lattice oscillators are as follows: GaAs LO, 297 cm^{-1}; GaAs TO, 273 cm^{-1}. In $Al_{0.3}Ga_{0.7}As$, GaAs-like LO, 281 cm^{-1}; GaAs-like TO, 270 cm^{-1}; AlAs-like LO, 383 cm^{-1}; AlAs-like TO, 367 cm^{-1}. Line widths, 3 cm^{-1}.

J.-P. Cheng and B. D. McCombe
State University of New York at Buffalo
Buffalo, New York 14260

Received 5 December 1988
PACS numbers: 71.38.+i, 73.60.Br, 78.50.Ge, 78.65.Fa

[1] S. Huant and G. Martinez, preceding Comment, Phys. Rev. Lett. **62**, 1924 (1989).

[2] Y.-H. Chang, B. D. McCombe, J.-M. Mercy, A. A. Reeder, J. Ralston, and G. A. Wicks, Phys. Rev. Lett. **61**, 1408 (1988).

[3] R. J. Nicholas, L. C. Brunel, S. Huant, K. Karrai, J. C. Portal, M. A. Brummel, M. Razeghi, K. Y. Cheng, and A. Cho, Phys. Rev. Lett. **55**, 883 (1985).

[4] M. Ziesmann, D. Heitmann, and L. L. Chang, Phys. Rev. B **35**, 4541 (1987).

[5] K. Karrai, S. Huant, G. Martinez, and L. C. Brunel, Solid State Commun. **66**, 355 (1988).

[6] S. Huant, W. Knap, G. Martinez, and B. Etienne, Europhys. Lett. **7**, 159 (1988).

[7] R. Kaplan and R. F. Wallis, Phys. Rev. Lett. **20**, 1499 (1968).