Guenther *et al.* Reply: In a recent Letter [1], we concluded that excitation-induced dephasing (EID) is the dominant mechanism underlying the perturbed free induction decay (FID) of the coherent polarization emitted from a *single* exciton in a quantum dot (QD).

In the preceding Comment [2], Joffre questions this claim and speculates about a slow buildup of exciton bleaching, i.e., a change in oscillator strength, as a possible mechanism. This argument seems based on earlier quantum well (QW) studies [3]. We show that a slow bleaching is inconsistent with our experimental results.

Our experiments probe, at negative time delays Δt, the temporal dynamics of the field $E_{QD}(t)$ radiated from the coherent excitonic polarization $P_{QD}(t) = d^*_{QD}\rho_{01} + \text{c.c.}$, where d_{QD} denotes the excitonic dipole moment. The microscopic QD polarization ρ_{01} obeys the equation of motion

$$\frac{\partial}{\partial t}\rho_{01}(t) = -i\omega_{QD}\rho_{01}(t) + i(1-2n_{QD})\omega_R - \gamma\rho_{01}(t), \tag{1}$$

with exciton energy ω_{QD}, dephasing rate γ, exciton population n_{QD}, and generalized Rabi frequency ω_R [4]. The off-resonant pump laser creates electron-hole pairs (density n_{QW}) in the QW continuum, i.e., does not interact directly with the excitonic dipole, and thus may perturb the FID of P_{QD} only through changing ω_{QD}, n_{QD}, ω_R, γ [5] and/or d_{QD} by many-body interactions: (i) The symmetric spectral oscillations around the exciton resonance shown in Fig. 3 of Ref. [1] demonstrate a negligible change $\Delta\omega_{QD} < 0.1$ meV. (ii) We agree with the Comment that the integral $\int d\omega\Delta R(\omega, \Delta t)$ always vanishes when integrating over the full spectral range. In our case, however, *the integral already vanishes when integrating over only 2 meV around* ω_{QD}, a small fraction of the total probe bandwidth of 18 meV. This behavior is different from what has been reported in earlier studies of excitons in quantum wells [3] and indeed rules out an *instantaneous* change of d_{QD} by the pump. Instead, the FID is damped on a *slow* 3 ps time scale, demonstrating that other subpicosecond changes of $P_{QD}(t)$ are negligible. In particular, fast changes of the Rabi frequency ω_R due to the femtosecond pump field E_p and/or short-lived polarizations P_c on continuum transitions are absent. As the second term in Eq. (1) is relevant only for nonzero E_p and P_c, changes of n_{QD} [(second term in Eq. (1)] [6], do not affect our transients.

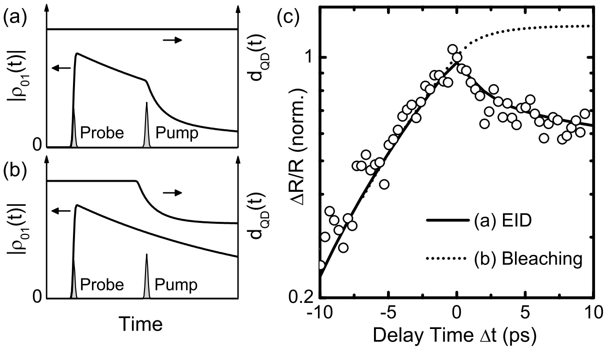

FIG. 1. Schematics of the excitation-induced dephasing (a) and bleaching (b) model. Experimental $\Delta R(\omega_{QD,\Delta t})/R_0$ dynamics (open circles) and simulations based on the two models.

(iii) In principle, there could be a pump-induced change of d_{QD} on a 3 ps time scale. As argued in the Comment, such a mechanism could account for the spectral oscillations at negative delay times. For positive delay times, this model [Fig. 1(b)] predicts an increase in $\Delta R(\omega_{QD}, \Delta t)$ on the time scale of the switch-off time, in striking contrast to our experimental data [Fig. 1(c)]. Moreover, it appears difficult to find a mechanism that changes the excitonic dipole moment d_{QD} of a quantum dot without affecting its transition energy [see (i)]. $\Delta\omega_{QD}$ is less than 1/100 of the exciton binding energy which is typically needed to significantly affect d_{QD} [7]. Thus, we rule out this model. (iv) Our data at both negative and positive delay times are very well reproduced by a model invoking EID as the dominant nonlinearity, i.e., an increase in γ due to the interaction between ρ_{01} and free carriers in continuum states [solid line in Fig. 1(c)]. For positive delays, such a model predicts an initial decay of $\Delta R(\omega_{QD}, \Delta t)$ on a time scale given by the decay of n_{QW}.

In conclusion, our results provide strong evidence that EID is indeed the dominant contribution to the observed perturbed FID of the excitonic polarization of a single quantum dot.

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Received 10 September 2002; published 4 April 2003
DOI: 10.1103/PhysRevLett.90.139702
PACS numbers: 78.67.Hc, 07.79.Fc, 78.47.+p

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