Petrov *et al.* Reply: In our recent Letter [1], we reported on modification of the spontaneous emission of dye molecules embedded in a photonic crystal fabricated by impregnating an artificial opal with a higher-refractive polymer containing a fluorescent dye. The spontaneous emission of the dye in the inverted opal recorded at the red edge of the stop band was found to decay nonexponentially exhibiting both inhibited and accelerated components compared to a single-exponential decay of the dye fluorescence in a reference polymer film. The preceding Comment by Megens *et al.* [2] reduces to the three following statements: (i) Inhibition of the spontaneous emission of a dye in a photonic crystal can be observed only at the blue edge of the stop band, (ii) the dielectric contrast in our experiments was insufficient for observing a modification of the spontaneous emission rate, and (iii) their fluorescence kinetics measurements do not reveal a considerable difference in mean fluorescence decay times for dye molecules attached to silica spheres forming ordered and disordered aqueous suspensions.

The homogeneous fluorescence emission band of a complex molecule is formed by numerous vibronic transitions; however, its fluorescence lifetime is constant over the homogeneous emission spectrum as a result of fast thermalization of the electronically excited state [3]. Therefore, modification of radiative transition rates relevant to certain subsets of vibronic transitions in a dye molecule (by, e.g., a photonic crystal environment) will lead to a change in the wavelength-independent fluorescence decay time of the homogeneous emission band. In our experiment [1], the upper (most pessimistic) estimate of the inhomogeneous-to-homogeneous width ratio is 0.15, and thus the fluorescence emission band is essentially homogeneous and should exhibit similar decay kinetics at all emission wavelengths.

The difference between our experimental results and those by Megens *et al.* can be explained by different topologies of the systems investigated. Theoretical calculations [4] show that for a given dielectric contrast, the network topology of the higher-refractive material (as in our experiment) provides stronger spatial variations of the local photon density of states (DOS) in a photonic crystal. (Notice that, when comparing our experimental data with the theory, Megens *et al.* refer to Fig. 7 of [5], presenting the total rather than local photon DOS for artificial opal.) In addition, whereas in our structure dye molecules are uniformly distributed over the entire higher-refractive network, in [2] dye molecules are located only within narrow spherical layers of higher-refractive balls, and therefore, in our structure, dye molecules should experience stronger variations of the local photon DOS and stronger position-dependent variations of fluorescence lifetimes. Unlike atoms, dye molecules in a rigid environment have fixed directions of emission dipole moments, and therefore, in this case modification of the spontaneous emission rate of a molecule will be not only position- but also orientation dependent. Thus, our experimental data cannot be directly compared with the presently available theoretical predictions [5] based on orientation-averaged calculations.

Similar to Megens *et al.*, we have found no substantial difference between the *mean* fluorescence decay time of the dye in the photonic crystal and the reference sample, as can be estimated from Fig. 4 of [1]. Indeed, the decay time of the *single*-exponential fluorescence decay of the reference sample (9.54 ns) differs by only 5% from the *mean* decay time (9.05 ns) of the *non*exponential fluorescence decay from the opal-polymer photonic crystal (cf. with the 2% change in [2]). However, a nonexponential decay cannot be fully quantified by the mean decay time, since there exists an infinite set of different nonexponential decays having an identical mean decay time but different lifetimes and contributions of decay components. In [1], an analysis of the fluorescence decays in terms of distributions of decay times revealed existence of both inhibited and accelerated decay components for emission from the photonic crystal that were attributed to dye molecules assuming different positions and/or orientations with respect to the unit cell of the crystal lattice. Raw fluorescence decay data for our system and details on the decay data analysis can be found in [6].

In conclusion, we believe that there is no contradiction between our results and results presented in the preceding Comment if the difference in topology of the photonic crystals and the different approaches to data analysis are taken into account.

E. P. Petrov,[1] V. N. Bogomolov,[2] I. I. Kalosha,[3] and S. V. Gaponenko[3]
[1]B. I. Stepanov Institute of Physics
National Academy of Sciences of Belarus
Minsk 220072, Belarus
[2]A. F. Ioffe Physico-Technical Institute
Russian Academy of Sciences
St.-Petersburg 194021, Russia
[3]Institute of Molecular and Atomic Physics
National Academy of Sciences of Belarus
Minsk 220072, Belarus

Received 19 February 1999
PACS numbers: 42.70.Qs, 42.50.−p

[1] E. P. Petrov, V. N. Bogomolov, I. I. Kalosha, and S. V. Gaponenko, Phys. Rev. Lett. **81**, 77 (1998).
[2] M. Megens, H. P. Schriemer, A. Lagendijk, and W. L. Wos, preceding Comment, Phys. Rev. Lett. **83**, 5401 (1999).
[3] J. B. Birks, *Photophysics of Aromatic Molecules* (Wiley, New York, 1970).
[4] E. N. Economou and M. M. Sigalas, Phys. Rev. B **48**, 13 434 (1993).
[5] K. Busch and S. John, Phys. Rev. E **58**, 3896 (1998).
[6] E. P. Petrov, V. N. Bogomolov, I. I. Kalosha, and S. V. Gaponenko, Acta Phys. Pol. A **94**, 761 (1998).

 0031-9007/99/83(25)/5402(1)$15.00