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Diffraction and radiative lifetime within the theory of giant oscillator strength in exciton luminescence GANG XIONG, Pacific Northwest National Laboratory, Box 999, K8-88, Richland, 99352, R.T. WILLIAMS, Department of Physics, Wake Forest University, Winston Salem, NC 27109 — The remarkably fast sub-nanosecond radiative lifetimes of excitonic recombination luminescence in some wide band gap materials such as ZnO have suggested that coherence properties are important to the observations. We consider the theory of giant oscillator strength and examine the spontaneous lifetime of exciton radiation, in which a single exciton emits radiation as a coherent array. We examine the dependence of transition rate on the size of the coherent source volume, and investigate how phase cancellation will affect the overall transition rate, both for previously investigated quantum dots and for larger volumes extending above a half-wavelength of the coupled light. Taking into account phase cancellation at off-axis directions, diffraction behavior is clearly recovered at the larger limit, where transition rate increases with increased coherence volume, but emitted light is progressively confined to the forward directions. The size-dependent exciton radiative lifetime could be potentially useful in developing new fast scintillator materials, and laser materials with low lasing threshold.

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