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**Coherence-based cross-phase modulation of arbitrarily weak fields in disordered molecular ensembles** MARINA LITINSKAYA, University of British Columbia, FELIPE HERRERA, Universidad de Santiago de Chile, and Millennium Institute for Research in Optics — Nonlinear optical signals such as cross-phase modulation can be coherently enhanced in multilevel atomic gases under conditions of electromagnetically induced transparency. The quality of these coherent signals can dramatically decrease in presence of inhomogeneous broadening. In atomic gases, coherently enhanced cross-phase modulation can still be achieved with inhomogeneous broadening, but only over a narrow range of system parameters and specific laser geometries. In solids, inhomogeneous broadening is unavoidable and is believed to be an intractable obstacle to coherence-based nonlinearities. We analyze the cross-phase modulation of two arbitrarily weak classical fields in a resonant cavity with molecules under conditions of vacuum-induced transparency (VIT) subject to strong inhomogeneous broadening. We show that for a specific family of molecules, the VIT-enhanced cross-phase modulation signal can surpass the detection limit despite disorder. Our work shows that coherence-based non-linear optics for weak optical fields is feasible in strongly disordered organic materials, extending the realization of vacuum-enhanced cross-phase modulation beyond the gas phase.

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