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Percolation Processes in Scintillation of Organic Crystals[1] VINCENZO LORDI, SEBASTIEN HAMEL, LESLIE CARMAN, STEPHEN PAYNE, NATALIA ZAITSEVA, Lawrence Livermore National Lab — The use of organic crystals as scintillators that can discriminate between incident neutrons and gamma rays is gaining interest, particularly for applications in nonproliferation and diagnostics. Discrimination is achieved by measuring the delay of scintillation from neutrons, which arises from the predominant generation of triplet excited states that must diffuse and undergo a bimolecular Auger process to produce excited singlets before luminescence occurs. To understand this delayed scintillation process, we have studied triplet migration in two organic crystals: trans-stilbene (TS) and diphenylacetylene (DPAC). Both TS and DPAC show delayed neutron scintillation when pure, but the effect is quenched in DPAC if small amounts of TS impurity are present. We find that the first triplet excited state of TS is 0.3 eV lower than that of DPAC, creating a triplet trap in the impure DPAC crystals. Percolation theory is applied to predict a critical concentration of the mixed crystal to restore delayed scintillation, which compares favorably to experiments. We compute the triplet migration rate in different directions in the crystals and discuss the transport anisotropy in view of our percolation model.

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Vincenzo Lordi
Lawrence Livermore National Lab

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