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Nonclassical Nucleation and Growth of Cohesive Tensile Cracks
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WILLIAM KLEIN, Boston University — We analyze the nucleation and growth
of cohesive tensile cracks using a Hamiltonian which is written as a functional of the
crack separation (offset field). We simulate the nucleation events on a square lattice using a Metropolis Monte Carlo algorithm. Several modes of crack propagation
are seen in the simulations. Our results indicate that for certain materials, crack
nucleation and growth proceed through the formation and extension of a diffuse
“halo” surrounding the classical portion of the crack. This is similar to nonclassical
nucleation near the spinodal in magnetic systems. Theoretical considerations and
numerical calculations strongly suggest that the diffuse halo can be identified with
the fracture “process zone” seen in laboratory studies of advancing cracks. We are
investigating scaling exponents associated with this apparent phase transition.