Density of States in Two-Dimensional Square Lattices Around Half Filling with Strong Impurities

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Abstract: We calculate the lowest-order quantum-interference correction to the density of states (DOS) of weakly-disordered two-dimensional (2D) tight-binding square lattices around half filling. The impurities are assumed to be randomly distributed on small fractions of the sites, and have a strong potential yielding a unitary-limit scattering. In addition to the usual diffusive modes in the retarded-advanced channel, there appear diffusive π modes in the retarded-retarded (or advanced-advanced) channel due to the existence of particle-hole symmetry. It is found that the π-mode diffuson gives rise to a logarithmic suppression to the DOS near the band center, which prevails over the positive correction contributed by π-mode cooperon. As a result, the DOS is subject to a negative total correction. This result is qualitatively different from the divergent behavior of the DOS at the band center predicted previously for disordered 2D two-sublattice models with the particle-hole symmetry.

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