Spectral functions in the two-dimensional Hubbard model within a spin-charge rotating frame approach

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We have performed electronic spectral function calculations for the Hubbard model on the square lattice using recently developed quantum SU(2)×U(1) rotor approach that enables a self-consistent treatment of the antiferromagnetic state. The collective variables for charge and spin are isolated in the form of the space-time fluctuating U(1) phase field and rotating spin quantization axis governed by the SU(2) symmetry, respectively. As a result interacting electrons appear as composite objects consisting of bare fermions with attached U(1) and SU(2) gauge fields. This allows us to write the fermion Green's function in the space-time domain as a product of the SU(2) gauge fields, U(1) phase propagator and the pseudo-fermion correlation function. Consequently, the calculation of the spectral line shapes now reduces to performing the convolution of spin, charge and pseudo-fermion Green's functions. The collective spin and charge fluctuations are governed by the effective actions that are derived from the Hubbard model for any value of the Coulomb interaction. The emergence of a sharp peak in the electron spectral function in the antiferromagnetic state indicates the decay of the electron into separate spin and charge carrying particle excitations.