The Energy-Weighted and Non Energy-Weighted Gamow-Teller Sum Rules in Relativistic Random Phase Approximation

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abstract The non energy-weighted Gamow-Teller (GT) sum rule is satisfied in relativistic models, when all nuclear density-dependent terms, including Pauli blocking terms from nucleon-antinucleon excitations, are taken into account in the RPA correlation function. The no-sea approximation is equivalent to this approximation for the giant GT resonance state and satisfies the sum rule, but each of the total $\beta^-$ and $\beta^+$ strengths is different in the two approximations. It is also shown that the energy-weighted sum of the GT strengths for the $\beta^-$ and $\beta^+$ transitions in RPA is equal to the expectation value of the double commutator of the nuclear Hamiltonian with the GT operator, when the expectation value is calculated with the ground state in the mean field approximation. Since the present RPA neglects renormalization of the divergence, however, the energy-weighted strengths outside of the giant GT resonance region become negative. These facts are shown by calculating in an analytic way the GT strengths of nuclear matter.