

Permutation group theory in construction of Feynman diagrams for mass operator of interacting electrons and electrons interacting with phonons

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The double permutation method is developed for construction of Feynman diagrams for mass operator of interacting electrons. The derived expression allowing to separate classes of permutations (Young diagrams) corresponding to disconnected Feynman diagrams, which are not taken into consideration. The criteria stated here allow omitting the permutations corresponding to disconnected and improper diagrams, depending to other classes of DPs. The other criterion is stated to avoid the repetitions of the same diagrams, denoted by different permutations (as result of different numbering of nodes). All these statements allow reducing the number of considered permutations sufficiently: from 24 to 6 and from 720 to 42 in the second and the third orders of perturbation theory. The symmetrical analysis of permutations is carried out. It allows avoiding the pairs of asymmetrical diagrams, corresponding to the same analytical expressions. Using this method Feynman diagrams for mass operator of electrons in the second and the third orders of perturbation theory are constructed. The developed method can be used as basis for algorithm of construction of Feynman diagrams for mass operator in high orders of perturbation theory.

Double permutation method is used for Feynman diagram construction for mass operator for electron-phonon interaction. The derived expressions for DPs and phonon components allow constructing the diagrams automatically. To avoid repetition of asymmetric diagrams, which correspond to the same analytical expression, we introduce the procedure of inversion in phonon component, and identify symmetric and pair of asymmetric phonon components. For every type of DP (denoted by its digital encoding), taking into account its symmetry, we perform set of transformations on this DP, list all DPs of the type and all corresponding Feynman diagrams of mass operator automatically. It is clear that no more expressions (diagrams) for the concerned order of perturbation theory for mass operator can be designed.