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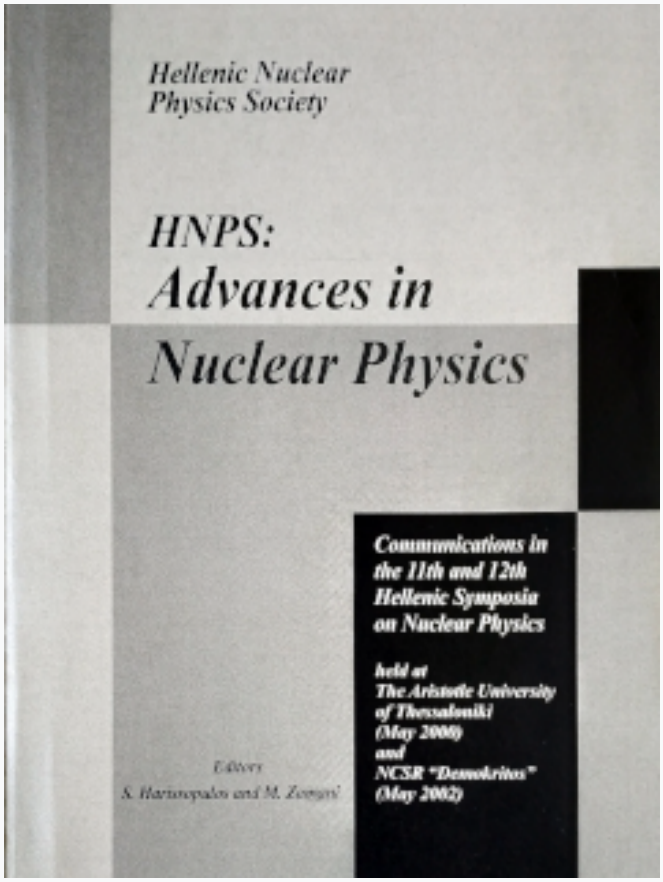

Nuclear matrix elements for exclusive transitions of semi-leptonic processes

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Abstract

The formal description of the transition matrix elements for semi-leptonic processes in nuclei, is improved. By utilizing the multipole decomposition of the hadronic currents, a procedure which is appropriate in the case when the initial and final nuclear states have well-defined spin, isospin and parity, the operators responsible for any semi-leptonic process can be written in terms of seven basic single-body tensor operators. It is known, that the many-particle nuclear matrix elements which determine the cross section of the considered reaction, are described by one-body matrix elements and one-body transition densities, where the latter quantities are obtained within some nuclear model.

In the present work, simple closed expressions for the single-particle reduced matrix elements of the basic multipole tensor operators are constructed by using a harmonic oscillator basis. These expressions (product of a polynomial with constant coefficients, usually simple numbers, times an exponential) are functions of the momentum transfer to the nucleus. The constant coefficients of these polynomials are calculated (using appropriate code) for single-particle nuclear matrix elements which cover the whole periodic system. With the aid of this formalism, previous unified methods used for the calculation of the transition matrix elements involved in the cross sections of all semi-leptonic reactions, are improved. Also past formulas, which give the nuclear moments of any order (e.g. in neutrinoless double beta decay, neutrino-nucleus reactions, etc.), are simplified.