SPECTROSCOPIC FACTORS FOR ONE-NUCLEON TRANSFER REACTIONS IN THE CLUSTER-VIBRATION MODEL

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The particle-vibration model is applied to calculate the spectroscopic factors for one-nucleon transfer reactions. To analyse the structure of the spectroscopic factors, the perturbational calculation up to the second order in the coupling constant a is performed with a single-j shell, for both the transition from a one-particle to a two-particle system and the transition from a two-particle to a three-particle cluster. The spectroscopic factor for the first of these two cases is of the form

$$S_j^{(0+2)} = [M^{(0)} + M^{(2)}(S) + M^{(2)}(V)]^2 ,$$

and for the second case it reads

$$S_j^{(0+2)} = \frac{1}{2j+1} [M^{(0)} + M^{(2)}(S) + M^{(2)}(V)]^2 .$$

In both cases, the perturbational calculation shows that the two second-order corrections, $M^2(S)$ and $M^2(V)$, which are due to the self-energy and vertex contributions, respectively, mutually approximately cancel, so that the remaining matrix element is very close to the unperturbed value. The zeroth-order result for the spectroscopic factor is thus approximately preserved, although the coupling strength may be quite large. This is another example of the Ward identity which has already been applied to nuclear physics to describe energies and electromagnetic properties of vibrational nuclei.

In addition to the perturbational estimates, exact calculations of the spectroscopic factors are performed using the wave functions obtained by diagonalization for reactions such as $^{A}Te \rightarrow {}^{A+1}I$, $^{A}Fe \rightarrow {}^{A-1}Mn$, etc. The results obtained are compared with the perturbational estimates, as well as with the available experimental data.