ON THE SPLITTING OF AN EXPECTED 4+ SIMPLE STATE IN ^{24}Mg

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According to the doorway-state interpretation of heavy--ion resonances simple excitations are expected to be coupled to more complicated states[1)]. This is also the basic concept of a recent classification and prediction of heavy-ion systems showing resonant behaviour[2)]. The strength of the coupling i.e. the spreding width plays a crucial role in such a description. To extract quantities like this the parameters of the fragments are needed. The Erlangen work[3)] gives us such results, and based on them we applied two different ways of analysis which were earlier used for other kind of intermediate structures[4,5,6)].

The low-energy 4+ states are considered as $^{12}C+^{12}C$ molecule states, while levels with J=6 and 8 are thought having structures of core+α. The weights of the special configuration in real nuclear states in ref.3) are: $R_i=(\Gamma_i/\Gamma)/(\Gamma_i/\Gamma)_{HF}$. The physical assumption behind the analysis used here is, that the partial widths of the real states leading to the investigated channel come from the special state, while other partial widths from the background states. Though the above R's do not describe formally this parentage, they are related to it; and other usual quantities (like ratio to the Wigner--limit) also have some uncertainty in practice. The separation by solving the equations as described in refs. 4,5) gives the energie of the simple state E_o=6.24 MeV, while that of the background states: 5.98, 6.58, 6,85, 7.62, and 7.79 MeV. The squared matrix elements of the coupling are: 0,004, 0,072, 0.012, 0.166, and 0.019 MeV^2, respectively. The spreding width as a Lorentzian average of the squared matrix elements over the level spacing is $\Gamma^{\downarrow}\approx$0.32 MeV. The requirement of its constancy over a reasonable averaging interval[4)] say $0.4\leq I\leq 0.58$

and $5.76 \le E \le 6.72$ fulfils within a factor ∿2: $0.13 \le \Gamma^{\downarrow}(E,I) \le 0.53$. On the other hand determining the parameters from a fit to the continuous experimental strength function[6] one gets $\bar{E}_o = 6.1$ MeV and $\overline{\Gamma^{\downarrow}} = 0.35$ MeV. The $\overline{\Gamma^{\downarrow}}$ saturates for $I \ge 0.5$ MeV. A practical shortcoming of using R's is that the total width of the special state can not be simply determined. The parameters of the two methods are consistent i.e. $\overline{\Gamma^{\downarrow}} \approx \Gamma^{\downarrow}$ and $\bar{E}_o \approx E_o$. As for the relatively large change in $\Gamma^{\downarrow}(E,I)$, it may be due to the errors in the resonance parameters, but they probably reflect the limited validity of the assumptions, too.

The meaning of a similar analysis for the 6^+ or 8^+ states is quastionable since levels with the same J^{π} do not prefer one specified channel. This alone does not exclude their common origin, but more detailed information is needed to answer the question. More systematic knowledge of the simple states and their spreding would be highly desirable and would give the real value of such considerations, but many more measured partial widths would be necessary to this end.

References

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