THE SPIN AND PARITY OF THE 10.9 MeV RESONANCE IN $^{16}O+^{12}C$

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Investigation of resonances in heavy-ion reactions has shown the existence of a fragmented rotation-like band in ^{24}Mg and yielded similar data on resonances in ^{28}Si. Recently, Resmini et al. (1) have predicted one positive- and one negative-parity band in ^{28}Si. These bands were based on two pairs of resonances: (13.7 MeV, $J^{\pi}=9^{-}$; 18 MeV, $J^{\pi}=11^{-}$) and (10.9 MeV, $J^{\pi}=10^{+}$; 19.7 MeV, $J^{\pi}=14^{+}$; energies in E_{CM} of $^{16}O+^{12}C$) where the spin assignments seemed to be well established. The spin assignment of the 13.7 MeV resonance (2), however, has been questioned (3) and a new value ($J^{\pi}=8^{+}$) assigned. In this context we have re-examined the 10.9 MeV resonance and found that $J^{\pi}=5^{-}$ is a more likely assignment.

Fig. 1 shows that the angular distribution of $^{12}C(^{16}O,\alpha_o)^{24}Mg$ at E_{CM}=11.1 is nicely fitted by a $P_5^2(\cos\theta)$ form. Also, the fit in terms of orthogonal polynomials, $\sum_{k=0}^{k_{max}} a_k P_k(\cos^2\theta)$ shows a marked improvement when a fifth polynomial (k_{max}=5) is added. The $\chi^2(k_{max})$ analysis shows that the fit does not improve by further increase of k_{max}. Hence we conclude that the J^{π} of the resonance in $^{12}C+^{16}O$ at ∿11 MeV c.m. is 5^{-}.

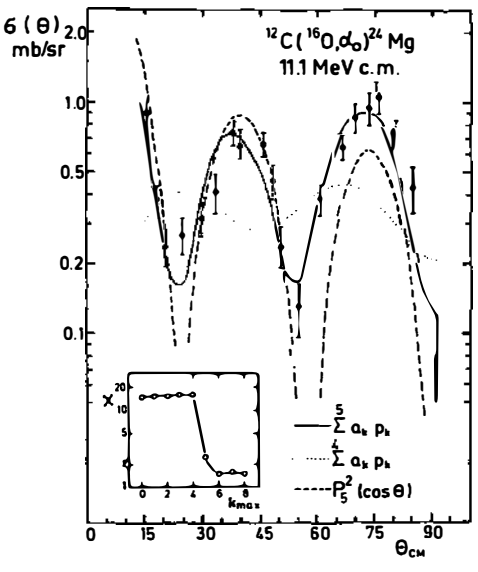

Fig. 1

The available data on resonances in ^{28}Si are shown in fig.2. A behaviour similar to that in ^{24}Mg is observed: the resonances are located in a domain of the E_{exc} vs. J(J+1) plane. We are thus inclined to interpret these data using the model of ref. (4). This model is based on the molecular picture, with the coupling to the collective states introduced phenomenologically. The rotor is supplied by a $^{16}O-^{12}C$ "molecule"

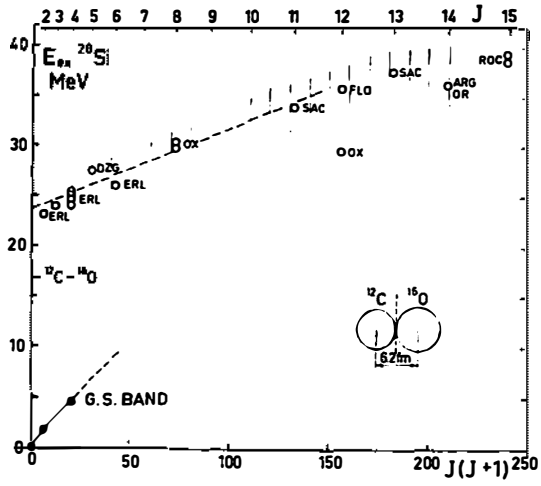

Fig. 2

yielding (with R_o=1.3) a moment of inertia around a median axis $\mathcal{J}_{mod}$ = $= 4.1\times10^{-42}$ MeV s^2. This value compares well with the value of the effective moment of inertia obtained from the slope of the band in fig. 2, $J^{res}_{eff} \approx$ $\approx 2.7\times10^{-42}$ MeV s^2 and is much larger than the value extracted from the g.s. band in ^{28}Si, $J^{g.s.}_{eff} \approx$ $\approx 0.7\times10^{-42}$ MeV s^2. All this indicates a profound structural change for the resonant band and strengthens its molecular interpretation.

The fragmentation of the band, apparent in fig. 2, could be interpreted in terms of a rotation-vibration coupling (4). The present data, however, do not allow the determination of the coupling parameters E_β and E_γ.

(1) F.G. Resmini et al., Phys. Rev. C15 (1977) 2241.
(2) R.E. Malmin and P. Paul, USERDA-ORO-4856-26(1975) p. 540.
(3) F.P. Brady et al., Phys. Rev. Lett. 39 (1977) 870.
(4) N. Cindro, J. Phys. G.4 (1978) L23.