

THE $^{12}\text{C} + ^{15}\text{N}$ REACTION : EXAMPLE OF A COUPLED-CHANNEL RESONANCE

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Measurements of the γ -ray yields¹ from the $^{12}\text{C} + ^{15}\text{N}$ reaction have revealed a certain amount of structure in the excitation functions. In particular a prominent double-humped resonance was observed for the yield of the 5.27 MeV γ rays of ^{15}N . The experimental results in the vicinity of this resonance are shown in the upper part of the figure. The two maxima occur at ^{15}N bombarding energies of 55.5 and 57.5 MeV. An effect like this could result from the coupling between resonances in the entrance and exit channels, where in the present case the exit channel is an inelastic excitation of the 5.27 MeV level of ^{15}N . The present results appear to be a

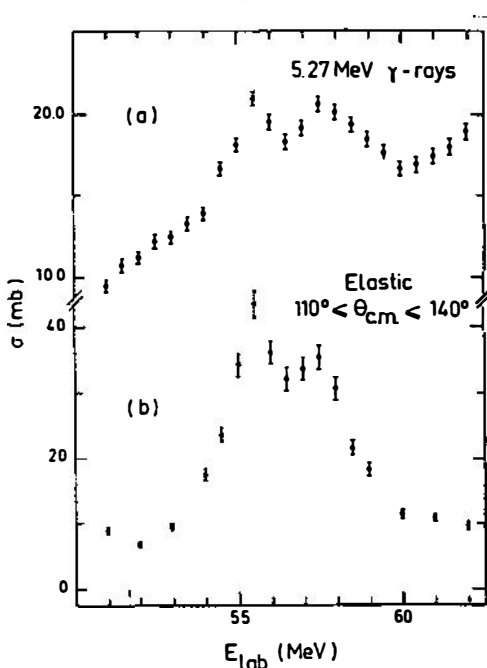


Figure 1
Cross sections of the $^{12}\text{C} + ^{15}\text{N}$ reaction as a function of the ^{15}N bombarding energy for (a) Yield of 5.27 MeV γ rays of ^{15}N (b) Elastic angular distributions integrated from $\theta_{c.m.} = 110^\circ$ to 140°

relatively simple example of a double resonance of this kind and merit further study. We have therefore employed particle techniques to study the reaction over energies spanning the resonance.

In the region of this resonance we have studied the $^{12}\text{C} + ^{15}\text{N}$ reaction using a kinematic coincidence technique. The outgoing particles were detected in two position-sensitive silicon detectors in coincidence. Each detector covered 28° and they were placed with an angle of 88° between the two centers. The cross section as a function of angle for the elastic and reaction channels were thus measured for ^{15}N bombarding energies from 51 to 62 MeV. The double resonance was quite apparent in these results and showed up most clearly at large angles in the elastic scattering. The cross sections obtained by integrating the elastic distributions from 110° to 140° are shown in the lower part of the figure. It is evident that the same resonant structure has been observed in both experiments.

From a preliminary analysis of the reaction channels it has been established that it is the 7.57 MeV level rather than the 5.27 MeV level of ^{15}N which is resonating in

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this energy region. The γ -ray results can be explained because the 7.57 MeV level cascades 100 % through the 5.27 MeV level. From the inelastic scattering of α particles on ^{15}N it has been suggested² that the 7.57 MeV, $7/2^+$ level is well described by a 3^- octupole vibration coupled to a $p_{1/2}$ hole. The collective nature of the state as well as the good matching between the entrance and exit channels are conditions which favour the importance of the 7.57 MeV level in this reaction. At present we are proceeding with a more complete analysis of the data of the reaction channels.

References :

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- ² A. Bussière et al., Phys. Lett. **16** (1965) 296