

STUDY OF HIGH SPIN STATES IN ^{30}P AND ^{32}P

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To clarify a number of features observed in the γ -ray spectra from ^{16}O and ^{18}O bombardment of ^{16}O targets ¹ we have undertaken additional experiments involving n- γ and γ - γ coincidences. In particular we wished to locate and study the $J^\pi = 7^+$ states of the $(f7/2)^2$ configuration of ^{30}P and ^{32}P . A state of ^{30}P at $E_x = 7196 \pm 6$ keV which γ -decays to the 5^+ state at 4343 keV, and which is very probably the 7^+ state, has recently been reported ². A possible candidate for the 7^+ state of ^{32}P has been observed at $E_x = 7420 \pm 50$ keV via the $^{30}\text{Si}(\alpha, d)$ reaction ³ though its γ -decay was unknown. In the present experiments these states have been fed by the $^{16}\text{O}(^{16}\text{O}, pn)^{30}\text{P}$ and $^{18}\text{O}(^{16}\text{O}, pn)^{32}\text{P}$ reactions. In addition recoil distance lifetime measurements have been made with the $^{27}\text{Al}(\alpha, n)^{30}\text{P}$ reaction.

The heavy ion reactions were studied with a neutron detector (liquid scintillator) at 90° and Ge(Li) detectors at 0° and 90° to the beam direction. For the $^{16}\text{O} + ^{16}\text{O}$ reaction a γ -ray spectrum from the 0° detector in coincidence with neutrons is shown in fig. 1. A sharp peak at $E_\gamma = 2857 \pm 2$ keV appears prominently in the spectrum. It was verified in the γ - γ coincidence spectra that this transition feeds the 5^+ state of ^{30}P and therefore corresponds to the $7^+ \rightarrow 5^+$ transition reported earlier ²

The lifetime of the 7^+ state, which is too long to be measured by DSAM, has been determined by the recoil distance technique with the $^{27}\text{Al}(\alpha, n)$ reaction at $E_\alpha = 14.6$ MeV. The value of 14 ± 3 ps was obtained as well as a lifetime of 375 ± 50 ps for the 5^- state at $E_x = 4921$ keV. This corresponds to a weak E2 transition of 5.5×10^{-2} W.u. from the 7^+ state. For the two transitions which have been observed from the 5^- state (691 keV and 3467 keV transitions seen in fig. 1) the M1 and E3 transition strengths are 2.3×10^{-4} W.u. and 1.4 W.u. respectively.

The $^{18}\text{O} + ^{16}\text{O}$ experiment was studied by γ - γ coincidence experiments at an ^{18}O bombarding energy of 35 MeV as it had been noted in the γ -ray singles spectra that the 4^- state of ^{32}P , $E_x = 3443$ keV, was strongly populated suggesting feeding from higher levels. It was found in the coincidence spectra that, besides a transition from the 5^- state at $E_x = 4275$ keV, the 4^- state was fed by 1554 keV and 2417 transitions in cascade originating from a state at 7415 keV. This level is possibly the 7^+ state of ^{32}P and agrees well in energy with that found by the $^{30}\text{Si}(\alpha, d)$ reaction. These transitions will be studied using the $^{29}\text{Si}(\alpha, p)$ reaction.

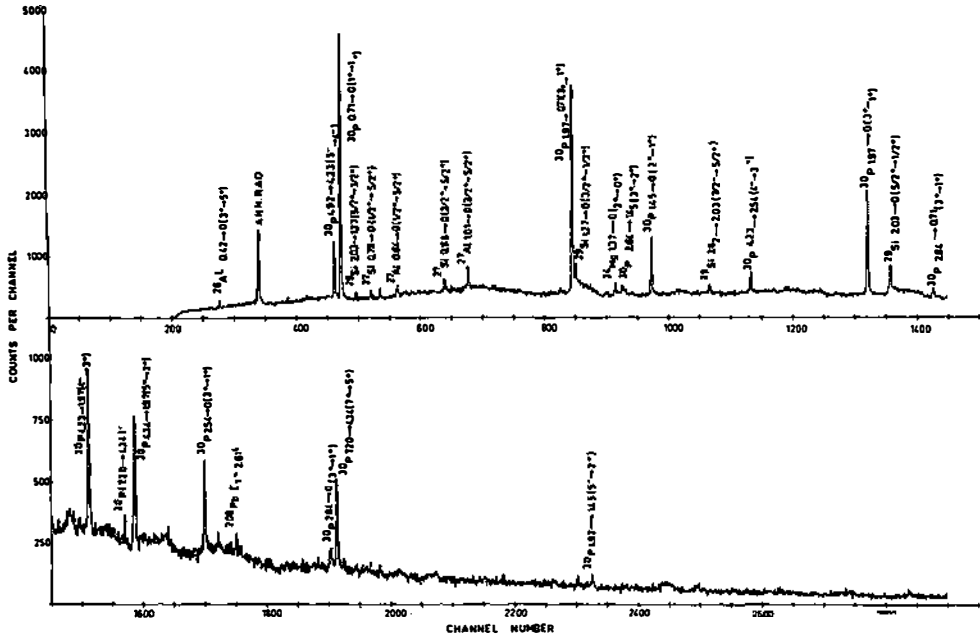


Fig. 1 : Spectrum of γ rays detected at 0° from the $^{16}\text{O} + ^{16}\text{O}$ reaction in coincidence with neutrons. The spectrum was taken for a bombarding energy of 42 MeV where high spin states of ^{30}P were expected to be most strongly populated.

REFERENCES

1. J.J. Kolata, R.C. Fuller, R.M. Freeman, F. Haas, B. Heusch and A. Gallmann, Phys. Rev. C16, 891 (1977).
R.M. Freeman and F. Haas, Phys. Rev. Lett. 40, 927 (1978).
2. R.J. de Meijer, J.C. Vermeulen, L.W. Put, D. Dijkhuizen and C.R. Bingham, Bull. Am. Phys. Soc. 22, 1008 (1977).
3. R.M. Del Vecchio, R.T. Kouzes and R. Sherr, Nucl. Phys. A265, 220 (1976).