Some Properties of Nuclei of Mass 19

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We have sought to determine the properties of some of the states of nuclei of mass 19 since this region of the periodic table is of interest in illustrating competition between the $1d_{5/2}$ and $2s_{1/2}$ shells. This we have done by investigating (i) the Coulomb excitation of F^{19} by alpha particles; (ii) the positron decay of Ne^{19}; and (iii) the beta decay of O^{19}. Some results of (i) have been reported already[1] and similar work on Coulomb excitation has been published by other groups.[2,3] The results of investigations (ii) and (iii) are summarized in Fig. 1. Previous work on Ne^{19} has

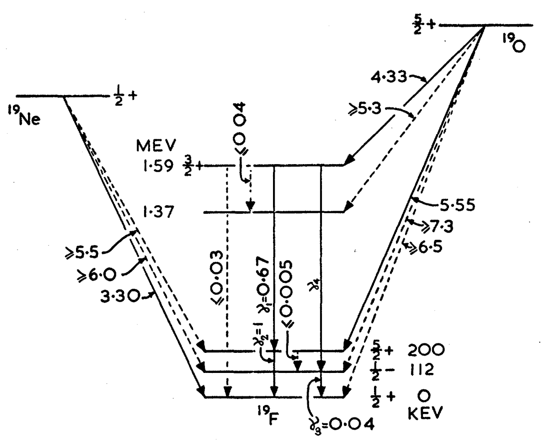

Fig. 1. Properties of Ne^{19}, F^{19}, and O^{19}. The numbers on the beta transitions are their $\log_{10} ft$ values; the numbers on the gamma transitions are their abundances in the decay of O^{19} relative to that of the 200-kev gamma ray as unity. The ground state of F^{19} has been assumed to be $(\frac{1}{2}+)$; the other assignments emerge from the present study. (The limit on the abundance of the transition between the 1.59- and 1.37-Mev states assumes that the decay of the latter is prompt.)

been confined to positron energy and lifetime measurements and to a search for high-energy gamma rays,[4] and on O^{19} to lifetime and beta energy and branching ratio measurements.[5]

Our observation that the decay of Ne^{19} leads to the ground state of F^{19} shows that no Coulomb cross-over of the F^{19} ground state triplet[6] has been induced and that the ground state of Ne^{19} is unquestionably $(\frac{1}{2}+)$. The limits on the ft values of the decay to the excited states of F^{19} are based on the absence of low-energy gamma rays. The large limit on the ft value for the decay of O^{19} to the 112-kev state of F^{19} makes it very probable that that transition is at least first forbidden as probably also, but with less certainty, is that to the F^{19} ground state. This observation, together with the Coulomb excitation data, the absence of the transition between the 200- and 112-kev states and our observations that the lifetime of the 200 kev state is $(1.0\pm0.2)\times10^{-7}$ sec while that of the 112-kev state is $\ll10^{-6}$ sec demand the spin and parity assignments shown for the first two excited states of F^{19}. These conclusions are identical with those reached by the California Institute of Technology workers[3,7-9] using largely different arguments. The assignment for the 1.59-Mev state we reach from the beta-decay of O^{19}, by a study of γ_4 and by an angular correlation measurement between γ_1 and γ_2 (some $\frac{2}{3}$ of the full correlation remains in Teflon). Our assignment for the ground state of O^{19} accepts the ft value of the ground-state beta transition as evidence against an allowed transition; $(\frac{3}{2}+)$ must remain a possible assignment since this evidence is not conclusive.

We may note that our direct lifetime measurement for the 200-kev state agrees with that determined by the recoil method[8] $(0.8\times10^{-7}$ sec with factor of 2 uncertainty) and with the matrix element as determined by Coulomb excitation.[1-3]

Our measurements of the gamma-ray energies are: $\gamma_1=1.366\pm0.008$ Mev; $\gamma_2=199.6\pm1.5$ kev; $\gamma_3=111.5\pm1.5$ kev.

The positions and properties of the even-parity states of the whole mass-19 system, including matrix elements for gamma and beta decay, are remarkably well described by a shell-model computation of Elliott and Flowers.[10]

A full account of this work will be presented shortly.

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Alpha-Gamma Directional Correlation Measurements with Liquid Film Sources

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A series of earlier measurements[1-3] of alpha-gamma directional correlation in Th^{228}, Th^{230}, Ra^{224}, Ra^{226}, Pa^{238}, Am^{241}, and others has yielded anisotropies lower than theoretically predicted. These discrepancies have been explained on the basis of the electric quadrupole interaction due to the presence of large electric field gradients in the solid sources used. That these attenuations are due to external field interactions has been indicated by the experiments of Milton