noted, however, that the behavior of the s-wave scattering determined in this analysis is dependent upon the assumption that only one resonant p-wave state is present. The resonant parameters used in the analysis of the p-wave resonant state in Be^7 at an excitation energy of 7.58 MeV are shown in Table I along with the corresponding values for the mirror level in Li^7 as given by Gabbard. (The author wishes to thank Dr. F. Gabbard for permission to use the results of his calculations.)

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New Isomers of Astatine-212

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The $_{83}Bi^{209}(\alpha,n)_{85}At^{212}$ reaction was investigated in the energy range of 17 to 25 MeV. Astatine-122 was observed to decay by alpha-particle emission. An alpha decay group of 7.60 and 7.66 MeV having a half-life of 0.305 sec and another group of 7.82 and 7.88 MeV having a half-life of 0.120 sec were observed. Relative excitation functions were obtained for both isomers. An energy-level diagram for the alpha decay of astatine-212 is proposed.

THE $_{83}Bi^{209}(\alpha,n)_{85}At^{212}$ reaction was investigated at the Crocker Laboratory 60-in. cyclotron of the University of California. Previous work on this reaction[1-4] reports that At^{212} has a half-life of 0.20 sec, and emits alpha particles of 7.6 or 7.88 MeV.

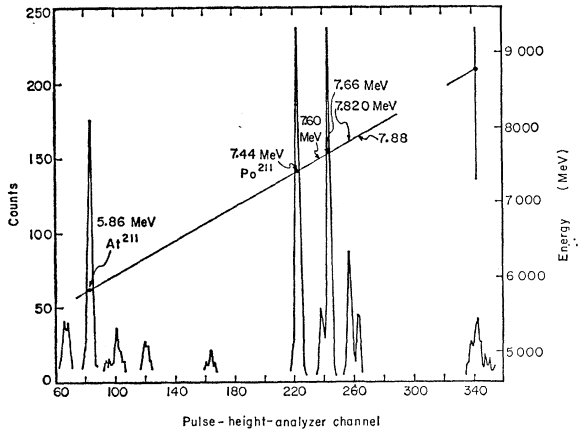

FIG. 1. Spectrum of alpha energies for 24-MeV alpha particles on bismuth.

In this experiment, the alpha decay energies were measured with a phosphorus-diffused-junction counter having an energy resolution of 30 keV. The spectra were observed at selected intervals between cyclotron beam bursts. The spectrum taken at a bombarding energy of 24 MeV is shown in Fig. 1 (the small peaks at 5.63, 6.04, 6.28, 6.78, and 8.78 MeV are due to the calibration source, Th^{228}). The results of the experiment are summarized in Table I. The half-life associated with each of these alpha energies was measured individually by time analysis of each pulse height.

A search was made for a gamma transition between the states responsible for the 7.82- and 7.60-MeV alpha groups by means of detecting the conversion electrons; however, no such transition was observed. Less than 1% of the alpha activity could have a gamma decay in the energy range from 100 to 600 keV; however, a $\approx$63-keV transition was observed with a half-life of $\sim$0.13 sec.[5]

TABLE I. Alpha-decay energies and half-lives for At^{212}.

Alpha decay energy (MeV)	Half-life (sec)	Approximate relative abundance (%)	Hindrance factor
7.60	0.305	20	6200
7.66	0.305	80	1700
7.82	0.120	80	1600
7.88	0.120	20	9500

* Work supported by the U. S. Atomic Energy Commission.
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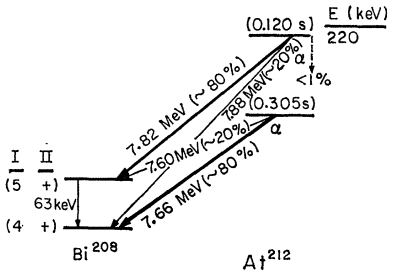

FIG. 2. Proposed energy-level diagram for alpha decay of At^{212}.

The data indicate that the level structure might be that shown in Fig. 2.

The 4+ and 5+ assignments for Bi^{208} are from theoretical computations by Wahlborn,[6] and are justified by experimental work.[7] The shell-model configuration for nuclei in the region of At^{212} suggests that the neutron outside the closed shell[8] should be $^2g_{9/2}$ and that the protons should be $(1h_{9/2})^3$; however, by the predictions of Pryce[9] this would lead to a ground state of 0− and an isomeric state of 9−. The 0− to 4+ transition is forbidden, so the assignment of 0− or 4+ does not appear to be justified. Alternately, as in Bi^{210}, the lower spin state for At^{212} could be 1−.

Figure 3 shows the relative excitation functions for these two isomers, as well as the absolute cross section

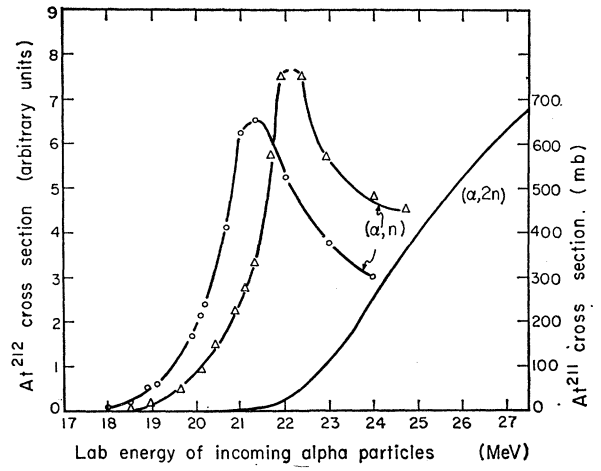

FIG. 3. Excitation functions for $Bi^{209}(d,xn)At$. The triangles refer to the 0.12-sec state; the circles refer to the 0.305-sec state. Cross section units for the two isomers of At^{212} are not the same. Data for the At^{211} cross section are taken from reference 10.

for $Bi^{209}(\alpha,2n)At^{211}$.[10] However, neither the (α,n) cross sections relative to each other nor the absolute cross sections have been determined.

The hindrance factors were calculated from the empirical relation: $\log_{10}F=\log_{10}t_{1/2}-A_ZQ_{\text{eff}}^{-1/2}-B_Z$, where A_Z and B_Z are the arithmetical means of corresponding values for the two adjacent even atomic numbers.[11]

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