model values (Fig. 5(*a*)) in order to improve the fits to the angular distribution at 10·74 MeV (Fig. 3).

The background phases at the resonance energy were then changed by the same amounts. The fits to the differential cross sections presented in Figure 1 were obtained

TABLE 1

PARAMETERS USED IN LEVEL ANALYSES

Proton Energy E_p (MeV)	^{17}F-Level Energy E_x (MeV)	Spin and Parity J^π	Orbital Angular Momentum l	Total Width Γ (MeV)	Ratio of Partial to Total Width Γ_p/Γ	$\frac{\gamma_{lj}^2}{3\hbar^2/2Ma^2} = \theta_{lj}^2$
10·52	10·50	$\frac{7}{2}-$	3	0·15	0·3	0·010
12·40	12·26	$\frac{3}{2}-$	1	0·20	0·3$_5$	0·23

using the parameters presented in Table 1, which also gives the fractions θ_{lj}^2 of the Wigner sum rule limit $3\hbar^2/2Ma^2$ (Teichmann and Wigner 1952) constituted by γ_{lj}^2. Note that use was made of Lane and Thomas's (1958) definition of the reduced width γ^2, being Wigner's γ^2 divided by the channel radius a. Note also that the

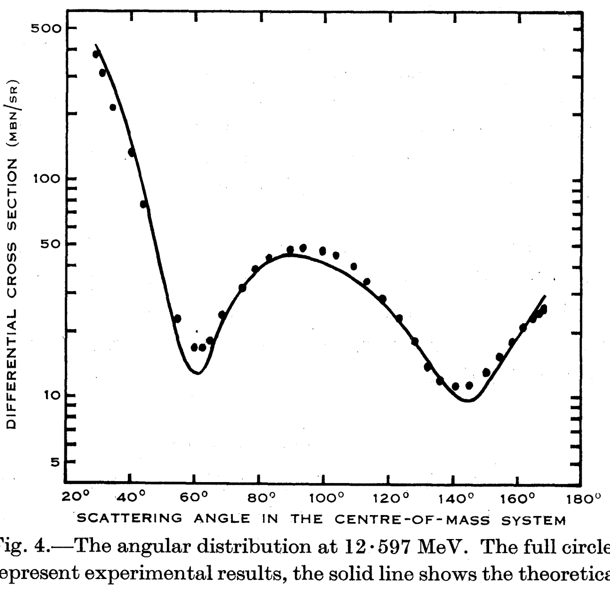

Fig. 4.—The angular distribution at 12·597 MeV. The full circles represent experimental results, the solid line shows the theoretical fit obtained. (See also caption of Figure 5.)

values of l, given in Table 1 are not, of course, quantum numbers of the compound nucleus levels of ^{17}F.

The same procedure was applied to the level at 12·39 MeV (Figs. 2, 4, and 5(*b*)) except that, in addition to the combinations of values (l,j) tried for the level at $10 \cdot 52$ MeV, $(4, \frac{7}{2})$ and $(4, \frac{9}{2})$ were tried. (It was assumed that $\delta_{4,7/2} = \delta_{4,9/2} = 0$.) The best fit was obtained for $l = 1$ and $j = \frac{3}{2}$. The parameters used are presented in Table 1.

IV. Comparison with Optical Model Calculations

Duke (1963) obtained good fits to the $^{16}O(p,p)$ cross sections at energies between $8 \cdot 66$ and $19 \cdot 2$ MeV in an optical model analysis. No resonance analysis was attempted by Duke but he obtained nevertheless a reasonable fit to the resonance structure at $10 \cdot 5$ MeV by allowing the parameters describing the optical potential

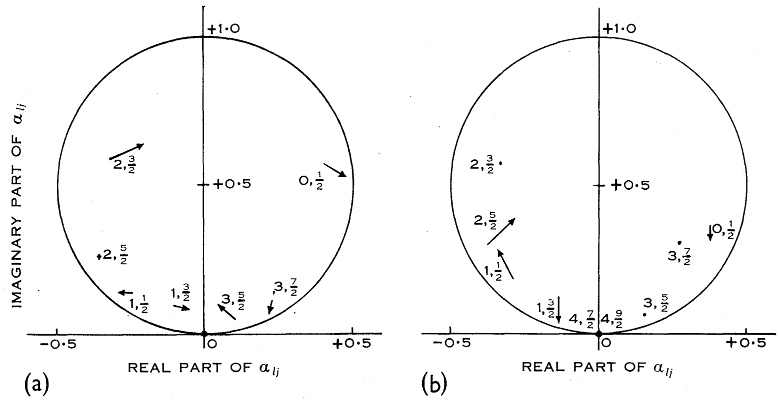

Fig. 5.—The optical model phase shifts at (*a*) $10 \cdot 74$ MeV, (*b*) $12 \cdot 6$ MeV, for the different partial waves as obtained by Hardie, Dangle, and Oppliger (1963) are represented in the complex plane by tails of arrows in the points $\alpha_{lj} = \{\exp(2i\delta_{lj}) - 1\}/2i$. An improved fit to the angular distribution was obtained by small alterations of the phase shifts, the new values being represented by the tips of the arrows. (For the absorption cross section to remain positive, the values of α_{lj} have to be kept inside the circle.)

to vary rapidly with energy. In such a description one would expect a single partial wave to be "suddenly" absorbed at the resonance energy; for the resonance at $E_p = 10 \cdot 52$ MeV this would be the $f_{7/2}$ partial wave. Duke (1963, p. 689) reported such a strong absorption at this energy. This seems to support our spin and parity assignment of the $10 \cdot 52$ MeV level.

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VI. References

Dangle, R. L., Oppliger, L. D., and Hardie, G. (1964).—*Phys. Rev.* **133**: B647.
Duke, C. B. (1963).—*Phys. Rev.* **129**: 681.
Hardie, G., Dangle, R. L., and Oppliger, L. D. (1963).—*Phys. Rev.* **129**: 353.
Lane, A. M., and Thomas, R. G. (1958).—*Rev. Mod. Phys.* **30**: 257.
Lepore, J. V. (1950).—*Phys. Rev.* **79**: 137.

Mather, K. B., and Swan, P. (1958).—"Nuclear Scattering." (Camb. Univ. Press.)
Messiah, A. (1961).—"Quantum Mechanics." (North Holland: Amsterdam.)
Robson, D. (1963).—Ph.D. Thesis, University of Melbourne.
Robson, D., and Toutenhoofd, W. (1963).—*Aust. J. Phys.* **16**: 370.
Shute, G. G., Robson, D., McKenna, V. R., and Berztiss, A. T. (1962).—*Nuclear Phys.* **37**: 535.
Teichmann, T., and Wigner, E. P. (1952).—*Phys. Rev.* **87**: 123.