Single-nucleon transfer reactions induced by 376-MeV ^{17}O on ^{208}Pb

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The one-nucleon ^{208}Pb(^{17}O,^{16}O) and ^{208}Pb(^{17}O,^{18}F) transfer reactions have been investigated at $E_{lab}(^{17}O)=376$ MeV. The data were analyzed in terms of the distorted-wave Born approximation. The distorted-wave Born approximation predictions reproduce fairly well the bell shape of the various angular distributions and the relative intensities of the various single-particle and single-hole transitions.

I. INTRODUCTION

The recent results[1] of a DWBA analysis of single-nucleon transfers induced by 352-MeV ^{18}O on ^{28}Si suggest that transfer reactions at high bombarding energies ($\gtrsim 20$ MeV/nucleon) are able to distinguish between different types of optical potentials that yield similar fits to forward angle elastic data, provided independent spectroscopic information is available. It was shown in Ref. 1 that the magnitude of the DWBA predictions at high energies is sensitive to the type of potential used in the calculations, and this feature is related to the different degrees of absorption the various potentials provide for the peripheral collisions responsible for transfer reactions. In the present study of the one-nucleon transfers, ^{208}Pb(^{17}O,^{16}O) and ^{208}Pb(^{17}O,^{18}F), at the incident energy of 376 MeV we have further investigated this sensitivity at high beam energies for heavier systems.

During the past few years,[2,3] light-ion-induced single-nucleon transfer reactions (both pickup and stripping) at bombarding energies of 40–50 MeV/nucleon have been used in systematic studies of deeply-bound hole states (both neutron and proton) and high-lying proton and neutron particle states in medium and heavy nuclei. The present one-nucleon transfer measurements with heavy ions at 22 MeV/nucleon incident energy cover the same large excitation energy region as in the light-ion studies. This allows one to compare the excitation of these simple states of the nucleus by heavy-ion beams with that by light ions.

The experimental procedure and results are described in Secs. II and III, respectively. The DWBA analysis of the transfer data and its comparison with analogous studies is presented in Sec. IV. Finally, Sec. V contains the conclusions of this study.

II. EXPERIMENTAL PROCEDURE

The experiment was carried out using the 376-MeV ^{17}O beam from the coupled tandem and cyclotron accelerators at the Holifield Heavy Ion Research Facility (HHIRF). A self-supporting enriched ($>99.9\%$) ^{208}Pb target with a thickness of $\simeq 500$ μg/cm^2 was used. The reaction products were momentum analyzed and identified in the HHIRF broad-range spectrograph, using a detector system composed of a vertical drift chamber (VDC) located in the focal plane, followed by an ionization chamber.[4] Differential cross sections were obtained from the measured target thickness and integrated beam current. An estimated $\pm 10\%$ uncertainty in the absolute cross sections is due to uncertainties in the target thickness measurement and charge collection in the Faraday cup.

III. EXPERIMENTAL RESULTS

Typical energy spectra for the ^{208}Pb(^{17}O,^{16}O) and (^{17}O,^{18}F) transfers are shown in Figs. 1 and 2, respectively. An overall energy resolution of ~ 250 keV (FWHM) and single mass identification were achieved. The angular distributions were measured in 0.48° acceptance bins in the angular range $7.4° \lesssim \theta_{lab} \lesssim 13.7°$.

In Fig. 1 the strong ^{16}O groups correspond to the $2g_{9/2}$, $1i_{11/2}$, $1j_{15/2}$, $3d_{5/2}$, and $2g_{7/2}$ low-lying single-neutron states in ^{209}Pb. The results of previous analogous transfer measurements[5–7] show that with the exception of the $1j_{15/2}$ strength, the other single-particle strengths are mainly ($\geq 80\%$) concentrated in a single level. In fact, weak-coupling model calculations[8,9] predict appreciable fragmentation of the $1j_{15/2}$ single-particle state between 3 and 4 MeV. Part of the $1j_{15/2}$ missing strength could be in the yield observed at ~ 4 MeV excitation in Fig. 1. This peak most probably also contains contributions from the excitation of the 3.96- and 4.22-MeV levels strongly populated in the ^{208}Pb(α,^{3}He) study.[3] In the latter work, a definite transferred angular momentum l_t identification for these states was not possible, due to the similarity of the DWBA predictions when assuming $l_t=7$ and 8. However, their excitation energies and the spectroscopic strengths deduced from DWBA analyses assuming $l_t=8$ were in good agreement with the theoretical predictions.[10] The absence of a group associated with the 2.03-MeV ($4s_{1/2}$) state in the present (^{17}O,^{16}O) study can be understood because the DWBA predicts cross sections for this state that are ~ 100 times smaller than those for the $2g_{9/2}$ ground state when one uses spectroscopic factors $S_p=1$ and the S_T obtained from the (d,p) study.[11]

Additional components of the $1j_{15/2}$ strength have been

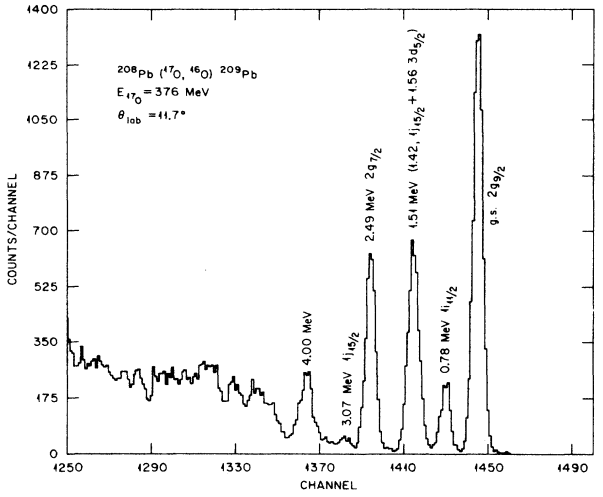

FIG. 1. Energy spectrum for the ^{208}Pb(^{17}O,^{16}O)^{209}Pb reaction at $\theta_{lab}=11.7°$.

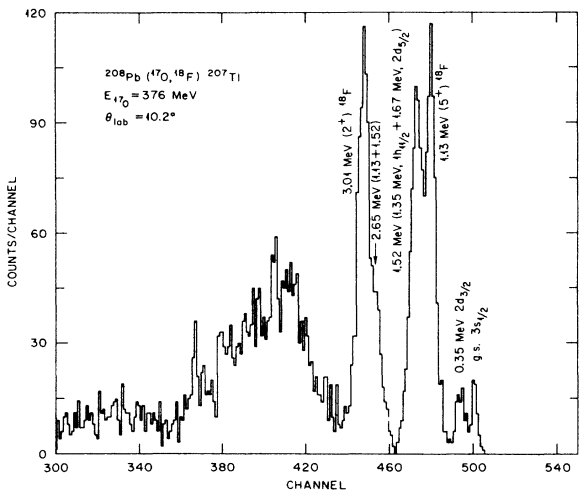

FIG. 2. Energy spectrum for the ^{208}Pb(^{17}O,^{18}F)^{207}Tl reaction at $\theta_{lab}=10.2°$.

identified in the 3–4 MeV of excitation energy region in the ^{208}Pb(α,^{3}He) reaction.[3] A broad structure centered at ~ 10.7 MeV of excitation in ^{209}Pb was also observed and dominates the high energy region. Both DWBA calculations[3] and theoretical predictions[12] suggest as the origin of the 10.7-MeV structure the excitation of the $2h_{11/2}$, $1k_{17/2}$, and $1j_{13/2}$ subshells. In neither the present ^{208}Pb(^{17}O,^{16}O) transfer reaction at 376 MeV, nor the ^{208}Pb(^{16}O,^{15}O) (Ref. 5) study at 312.6 MeV, was such a structure observed, probably because the bombarding energies are still not high enough to allow these states to be appreciably excited.

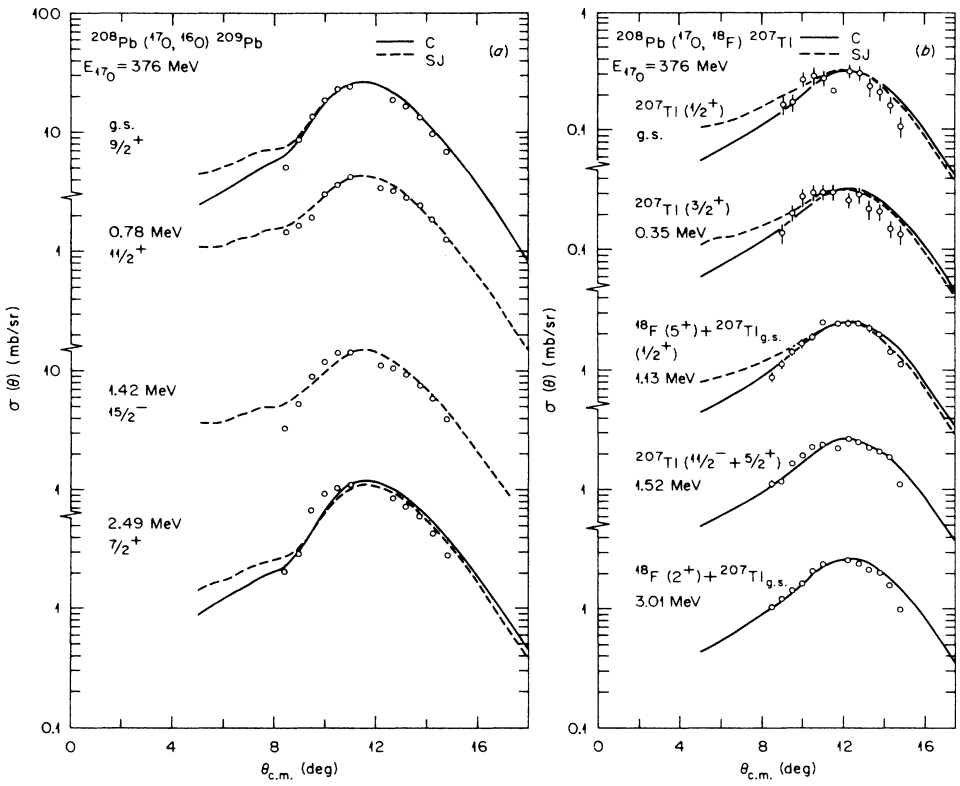

FIG. 3. (a) ^{208}Pb(^{17}O,^{16}O) angular distributions. (b) ^{208}Pb(^{17}O,^{18}F) angular distributions. The solid curves are DWBA predictions.

Figure 2 shows the ^{208}Pb(^{17}O,^{18}F)^{207}Tl energy spectrum at $\theta_{lab}=10.2°$. In agreement with ^{17}O(^{3}He,d)^{18}F results[13] and DWBA calculations, we observe strong excitation of the 1.13-MeV (5^+) and 3.06-MeV (2^+) states in ^{18}F with ^{207}Tl in its ground state. DWBA calculations predict cross sections for the 0.940-MeV (3^+) and 1.04-MeV (0^+) excitations of the ^{18}F ejectile smaller by factors of 0.2 and 0.1, respectively, with respect to the cross section for exciting the 1.13-MeV state. The width of the peak at 1.13 MeV also suggests that the strength observed must correspond to the excitation of a single state. The group at 1.52 MeV of excitation corresponds to transitions to the 1.35-MeV ($\frac{11}{2}^-$) and 1.67-MeV ($\frac{5}{2}^+$) states in ^{207}Tl. The yield at 2.65 MeV must be associated with the mutual excitation of the 1.13-MeV state in ^{18}F and the unresolved doublet at 1.52 MeV in ^{207}Tl. The main contribution to the yield in the group at 3.01 MeV of excitation may be attributed to the transition to the 3.06-MeV state in ^{18}F with ^{207}Tl in its ground state. The broad structure centered at $\sim$5.4 MeV of excitation must result from the population of several states in the residual nucleus and/or ejectile, as has been suggested by previous analogous transfer studies,[14,15] as well as the ^{17}O(^{3}He,d)^{18}F results.[13] In fact, the ^{208}Pb(d,^{3}He) energy spectrum at $\theta_{lab}=8°$ and $E_d=108$ MeV (Ref. 15) is similar to the present (^{17}O,^{18}F) spectra in the excitation energy region above 3.5 MeV. The (d,^{3}He) angular distributions for the structures observed in the $E_x=2.5-8.3$-MeV region were described by contributions of $l_t=2$ and 4 transfers. These groups would correspond to various components of the $2d_{5/2}$ and $1g_{7/2}$ valence-hole strengths in ^{207}Tl. No structures are observed above $\sim$8-MeV excitation in either (d,^{3}He) or (^{17}O,^{18}F) reactions.

Yields for the individual transitions were obtained using a peak fitting procedure. Figures 3(a) and (b) show the bell-shaped (^{17}O,^{16}O) and (^{17}O,^{18}F) measured angular distributions.

IV. DWBA ANALYSIS

Full-recoil finite-range DWBA calculations for both ^{208}Pb(^{17}O,^{16}O) and (^{17}O,^{18}F) transfers were performed with the code PTOLEMY.[16] The effective interaction consisted of the light-ion binding potential, the Coulomb potential including core corrections, and the (real) nuclear core-core corrections.

Since ^{17}O + ^{208}Pb elastic cross sections were not measured in the present experiment and are also not available in the literature, we used optical potentials *I*3 and *C* which describe ^{16}O + ^{208}Pb elastic data[5] at $E_{lab}=312.6$ MeV and the potential *SJ* obtained in the optical model analysis of ^{16}O + ^{208}Pb data at 400-MeV bombarding energy.[17] These potentials (listed in Table I) yield similar elastic ^{208}Pb(^{17}O,^{17}O) angular distributions as shown in Fig. 4. Although they are not identical, they would be difficult to distinguish experimentally. The moduli (i.e., $|S_L|$) of the elastic *S*-matrix elements, displayed in Fig. 5 for the three potentials, show, however, that potentials *SJ* and *I*3 yield similar absorption profiles, whereas potential *C* implies stronger absorption in the surface region. Therefore, potentials *SJ* and *I*3 will predict larger transfer

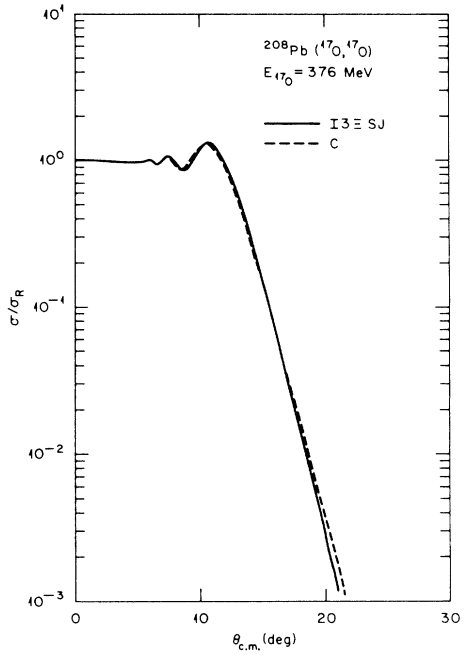

FIG. 4. ^{208}Pb(^{17}O,^{17}O) optical model predictions with potentials *I*3, *C*, and *SJ*.

cross sections (and thus smaller spectroscopic factors) for the various transitions, when used in DWBA calculations, than potential *C*. As discussed in Ref. 1, such behavior is due to the different degree of absorption experienced by the partial waves contributing to peripheral processes (e.g., transfer) as shown in Fig. 5. The same optical potential parameters were used for the entrance and exit channels.

The magnitude of the absolute cross sections and consequently of the spectroscopic factors is known to be sensitive to the choice of the parameters for the Woods-Saxon potential that generates the bound state in the heavy system. We have adopted those used in analyses of analogous heavy-ion transfer data[5,6] in order that a consistent comparison between the results of the different studies be possible. The parameters are listed in Table II.

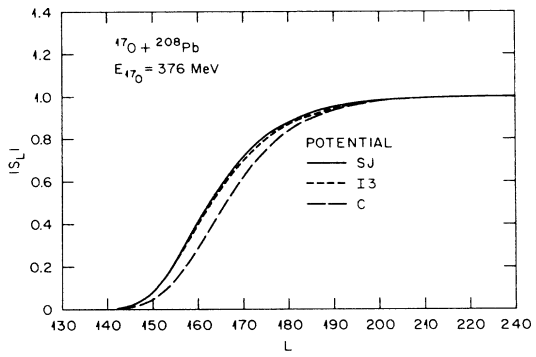

FIG. 5. Moduli of the partial-wave elastic *S*-matrix elements S_L for potentials *I*3, *C*, and *SJ*.

TABLE I. Optical model parameters[a] used in the DWBA analysis.

Type	V (MeV)	r_v (fm)	a_v (fm)	W (MeV)	r_W (fm)	a_W (fm)	r_c (fm)
I3	50.0	1.181	0.682	50.0	1.145	0.682	1.30
C	100.0	1.090	0.777	20.0	1.273	0.597	1.30
SJ	60.0	1.170	0.665	38.0	1.170	0.665	1.20

[a]The potential had the form

$$U(r)=-Vf_V(r)-iWf_W(r)+V_C\ ,$$

where

$$f_i(r)=\left[1+\exp\frac{r-R_i}{a_i}\right]^{-1},$$

$$R_i=r_i(A_p^{1/3}+A_T^{1/3})\ ,$$

$i=v$, W, and V_C is the Coulomb potential between a point charge and uniformly charged sphere of radius r_c $(A_p^{1/3}+A_T^{1/3})$.

The potential *B* for the ^{208}Pb + n systems was obtained from a sub-Coulomb stripping study.[18] The (d,p) (Ref. 11) and (α, ^{3}He) (Ref. 3) spectroscopic factors for the ^{209}Pb states, listed in Table III, were obtained using a binding potential with $r_0=1.25$ fm in a zero-range DWBA (ZR DWBA) analysis, and are in good agreement with the theoretically predicted values.[10,19]

The spectroscopic factors for the ^{207}Tl proton-hole states deduced in ^{208}Pb(d,^{3}He) and ^{208}Pb(t,α) studies[14,15] were obtained from ZR DWBA analyses (using as bound-state parameters $r_0=1.25$ fm and $a_0=0.65$ fm), and are in reasonable agreement with the theoretically predicted values[19] (Table IV). If instead of the adopted set *A*, the parameters $r_0=r_{so}=1.25$ fm and $a_0=a_{so}=0.65$ fm are used in the (^{17}O,^{18}F) transfer calculations, the predicted cross sections are reduced by a factor of about 0.57 and consequently the spectroscopic factors increased by 72%. The new spectroscopic factors, e.g., $S_T^{g.s.}=1.95$ and $S_T^{0.35}=3.35$, obtained when using optical potential *C*, are in good agreement with the theoretical predictions and the light-ion results.

Potential *L*, used in Ref. 5, was chosen for both light-ion systems ^{16}O + n and ^{17}O + p. It generates a charge distribution for ^{17}O which has a rms charge radius of 2.703 fm, while the experimental value[20] is 2.662±0.026 fm.

The spectroscopic factors were extracted using the following relation between experimental and calculated differential cross sections:

$$\frac{d\sigma(\theta)}{d\Omega}=NS_p^{l_1j_1}S_T^{l_2j_2}\sum_{l_t}\left[\frac{d\sigma_{l_t}(\theta)}{d\Omega}\right]_{\rm DW},$$

where l_t is the angular momentum transfer, and S_p and S_T are the spectroscopic factors for the light and heavy systems, respectively, and N is an overall normalization factor. We should expect $N=1$ if the DWBA description is correct. $S_{p,T}$ is an abbreviation for $C^2S_{p,T}$ (*C* being the isospin Clebsch-Gordan coefficient). As observed in Ref. 1, we verify that transfers l_t with unnatural parity ($l_t+l_1+l_2=$odd) are as important as the natural parity transfers ($l_t+l_1+l_2=$even) at high bombarding energies. Consequently, it is important that the DWBA analysis takes recoil effects into account.

At 376-MeV bombarding energy, we find that for grazing collisions, the transferred angular momenta $l_t=|l_1-l_2|$ dominate for the transitions $j_1=l_1+\frac{1}{2}\rightarrow j_2=l_2+\frac{1}{2}$, while $l_t=l_1+l_2$ dominate for the transitions $j_1=l_1+\frac{1}{2}\rightarrow j_2=l_2-\frac{1}{2}$. Indeed, in the case of the (^{17}O,^{16}O) transition to the $2g_{9/2}$ (g.s.) and $2g_{7/2}$ ($E_x=2.4$ MeV) states in ^{209}Pb we find that the smaller l_t transfers

TABLE II. Bound state parameters.

System	Set	V (MeV)	r_0[b] (fm)	a_0 (fm)	V_{so} (MeV)	r_{so}[b] (fm)	a_{so}	r_c[c]	Ref.
^{208}Pb-p	*A*	a	1.28	0.76	6.0	1.09	0.60	1.20	7
^{208}Pb + n	*B*	a	1.25	0.63	7.0	1.10	0.50		6,7
^{16}O + n ^{17}O + p	*L*	a	1.2	0.65	7.0	1.20	0.65	1.20	6

[a]The real depth V is adjusted for each state to reproduce the experimental separation energy.
[b]Radii defined as $R_i=r_iA_c^{1/3}$, where $r_i=r_0,r_{so},r_c$; A_c equals the mass number of the core to which the transferred nucleon is bound.
[c]Coulomb potential from a uniform charge distribution with radius $r_CA^{1/3}$.

TABLE III. Comparison of the spectroscopic factors S_T for the ^{209}Pb states extracted in the present and other works. The first values represent relative spectroscopic factors normalized to the ground-state theoretical value (Ref. 19).

E_x (MeV)	J^π	nlj	(^{17}O,^{16}O)[a] 376 MeV S_T (Pot. *SJ*)	S_T (Pot. *C*)	(^{16}O,^{15}O)[b] 312.6 MeV S_T (Pot. *I*3)	(^{11}B,^{10}B)[c] 72.7 MeV S_pS_T	S_T	(α,^{3}He)[d] 183 MeV S_T	(α,^{3}He)[e] 58 MeV S_T	(d,p)[f] (20 MeV) S_T	Theory Ref. 18/Ref. 22
0.0	$\frac{9}{2}^+$	$2g_{9/2}$	0.89(0.53)	0.89(0.67)	0.89	1.50	0.89(1.38)	0.89(0.69)	0.89(1.30)	0.89(0.92)	0.89/0.92
0.78	$\frac{11}{2}^+$	$1i_{11/2}$	0.62(0.37)	0.61(0.46)	0.89	1.70	1.00(1.56)	1.26(0.98)	1.00(1.46)	1.10(1.14)	0.96/0.98
1.42	$\frac{15}{2}^-$	$1j_{15/2}$			0.84	0.64	0.37(0.58)	0.76(0.59)	0.54(0.79)	0.74(0.77)	0.65/0.82
1.56	$\frac{5}{2}^+$	$3d_{5/2}$			0.91	1.07	0.63(0.98)			0.86(0.89)	0.91
2.03	$\frac{1}{2}^+$	$4s_{1/2}$				1.07	0.63(0.98)			0.82(0.85)	0.94
2.49	$\frac{7}{2}^+$	$2g_{7/2}$	0.81(0.48)	0.84(0.63)	1.37	1.70	1.00(1.56)	1.21(0.94)		0.96(0.99)	0.84/0.94

[a]Present work. In parentheses are shown the S_T values obtained assuming $N=1$ and $S_p=1$ for the (^{17}O,^{16}O) system.
[b]Reference 5. The S_T values were obtained by normalizing to the theoretical (Ref. 19) ground state S_T and assuming $S_p^{g.s.}=2$, $N=0.371$.
[c]Reference 6. S_T values in parentheses were obtained with $S_p=1.09$ [S. Cohen and D. Kurath, Nucl. Phys. **A101**, 1 (1967)].
[d]Reference 3.
[e]Reference 7. The values in parentheses were obtained using zero-range DWBA and a normalization constant $N=36$, which agrees with determinations of the volume integral D_0 for (α,t) and (α,^{3}He) reactions (Ref. 20) and exact finite range (EFR) calculations.
[f]Reference 11.

dominate in the former transition whereas the larger l_t values dominate in the latter, in agreement with the above expressions. We also find, as pointed out in Ref. 21, that non-spin-flip transitions (e.g., $2g_{9/2}$) are preferentially populated at this high bombarding energy.

A. The ^{208}Pb(^{17}O,^{16}O)^{209}Pb reaction

The comparison between DWBA predictions and measured cross sections for the strong (^{17}O,^{16}O) transitons to low-lying states in ^{209}Pb is shown in Fig. 3(a). The shape of the calculated angular distributions using both potentials *SJ* and *C* are similar and reproduce the shape of the measured ones quite well. However, the data seem to suggest a slight shift of the grazing peak towards smaller angles than those calculated, the shift increasing with excitation energy, as had been observed at lower energies for analogous reactions.[5,6]

In Table III the spectroscopic factors S_T for the ^{209}Pb states obtained in the present work are compared with the S_T values extracted in analogous studies. The present S_T values relative to the ground-state theoretical spectroscopic factor ($S_T^{g.s.}$) derived from DWBA calculations with potentials *SJ* and *C* for the various states are in good agreement. They are also similar to the corresponding relative spectroscopic factors obtained in the other experimental works[3,5–7,11] and with theoretical predictions.[10,19] The absolute S_T values obtained by assuming $N=1$ and $S_p=1$ for the (^{17}O,^{16}O) system are in somewhat better agreement with the corresponding values extracted in a recent (α,^{3}He) study[3] at 183-MeV incident energy and the theoretical predictions[10,19] if potential *C* is used in the calculations.

The groups corresponding to the excitation of the 1.42-MeV ($\frac{15}{2}^-$) and 1.56-MeV ($\frac{5}{2}^+$) states in ^{209}Pb could not be resolved. The theoretical curve shown in Fig. 3(a) represents their summed strength calculated with potential *C* assuming $S_p=1$, S_T values taken from the (d,p) study,[11] and a normalization factor $N=0.753$.

B. The ^{208}Pb(^{17}O,^{18}F)^{207}Tl reaction

The DWBA predictions and measured angular distributions for the (^{17}O,^{18}F) transitions to the low-lying ^{207}Tl states are compared in Fig. 3(b). The transitions to the 1.13- and 3.06-MeV states in ^{18}F with ^{207}Tl in its ground state were also analyzed. A ^{18}F group corresponding to the 3.47-MeV ($\frac{7}{2}^+$) state in ^{207}Tl was not populated although it is strongly excited in the (d,^{3}He) study.[15] The low cross section predicted by a DWBA calculation for a (^{17}O,^{18}F) transition to this state provides an explanation for its absence from the energy spectrum.

In Table IV are listed the spectroscopic factors for the ^{207}Tl states normalized to the theoretical value[19] for the ground state and the absolute values extracted in the various works. In the present study, the absolute values of S_T were obtained by assuming $N=1$ and by using theoretical S_p values that were calculated using the wave functions of Ref. 22. As for the (^{17}O,^{16}O) neutron transfer, the bell shape of the measured angular distributions is reproduced quite well. The relative spectroscopic

TABLE IV. Comparison of the spectroscopic factors S_T for the ^{207}Tl states obtained in this and other studies. The first values are the spectroscopic factors S_T normalized to the ground-state theoretical value (Ref. 19).

^{207}Tl		^{18}F		(^{17}O,^{18}F) 376 MeV[a]						
E_x		E_x		Pot. C	Pot. SJ	(^{11}B,^{12}C)[b] 72.2 MeV		(d,^{3}He)[c] 108 MeV	(t,α)[d] 20 MeV	
(MeV)	J^π	(MeV)	J^π	S_T	S_T	S_TS_p	S_T	S_T	S_T	Theory[e]
0.0	$\frac{1}{2}^+$	0.0	1^+	1.90(1.13)	1.90(0.79)	3.7	1.90(1.30)	1.90(1.80)	1.90	1.9
0.35	$\frac{3}{2}^+$	0.0	1^+	3.26(1.94)	3.25(1.35)	5.4	2.78(1.90)	4.01(3.80)	4.60	3.8
0.0	$\frac{1}{2}^+$	1.13*	5^+	1.95(1.16)	1.92(0.80)					
1.35	$\frac{11}{2}^-$	0.0	1^+	unresolved		20.0	10.23(7.0)	8.13(7.70)	10.70	10.1
1.67	$\frac{5}{2}^+$	0.0	1^+			8.1	4.09(2.80)	3.70(3.50)	3.70	4.5
0.0	$\frac{1}{2}^+$	3.01*	2^+	6.90(4.10)	6.98(2.90)					
3.47	$\frac{7}{2}^+$	0.0	1^+					3.70(3.50)	3.20	

[a]Present work. In parentheses are given the S_T values obtained assuming $N=1$ and theoretical S_p values calculated using the wave functions of Ref. 22. The asterisk means that only the state listed was considered in the DWBA calculations since the predictions for the neighbor states yield cross sections a factor 5–10 lower.
[b]Referencce 6. S_T values were obtained assuming $S_p=2.85$ [S. Cohen and D. Kurath, Nucl. Phys. **A101**, 1 (1967)].
[c]Reference 15.
[d]Reference 14.
[e]Reference 19.

factors obtained with both optical potentials agree among themselves and also with the available light- and heavy-ion results. The use of the bound-state parameters employed in the (d,^{3}He) and (t,α) studies together with optical potential C would lead to better agreement between the (^{17}O,^{18}F) absolute spectroscopic factors and the theoretical predictions as well as with the values obtained in the light-ion works. A similar result would be obtained for the S_T values extracted in the (^{11}B,^{12}C) study[6] if the bound-state potential used in the light-ion studies was also employed. Thus the bound-state potential used in the (d,^{3}He) reaction might be the appropriate one.

DWBA calculations using theoretical spectroscopic factors for the light system[22] and heavy system,[19] and assuming only the excitations of the 1.35- and 1.67-MeV states in ^{207}Tl, underestimates the experimental cross section corresponding to the 1.52-MeV yield by a factor of $\sim$2.7; hence the population of other states in ^{18}F may be contributing. In Fig. 3(b), the DWBA predictions considering only excitation of the 1.67-MeV state have been normalized to the measured angular distribution for the 1.52-MeV group; according to DWBA predictions the cross section ratio for the 1.67- and 1.35-MeV states is $\sigma(1.67)/\sigma(1.35)\simeq 4.6$. The results in Table IV suggest that the group at 3.01 MeV of excitation cannot be interpreted as resulting only from the excitation of the 3.06-MeV state in ^{18}F with ^{207}Tl in its ground state. The curve shown in Fig. 3(b) represents the DWBA predictions (assuming excitation only of the 3.06-MeV state) normalized to the data.

V. CONCLUSIONS

We have investigated the one-nucleon (^{17}O,^{16}O) and (^{17}O,^{18}F) transfer reactions on ^{208}Pb at 376 MeV bombarding energy in terms of the DWBA theory. For both reactions the results obtained can be summarized as follows.

(i) The angular distributions are fairly well reproduced by the DWBA calculations, although the data for the neutron transfers show a slight shift in angle relative to the calculations that increases with excitation energy.

(ii) A general agreement is obtained between the experimental relative spectroscopic factors and the theoretical values, as well as those measured in previous analogous one-nucleon transfer reactions (both light- and heavy-ion-induced); this shows that the DWBA accounts for the relative intensities of the various transitions.

(iii) The magnitude of the DWBA transfer cross section is sensitive to the optical potentials used in the calculations, even though the corresponding elastic cross sections, while not identical, would be difficult to distinguish experimentally.

The last behavior (iii) as shown in a previous paper[1] and in Sec. IV of this paper, can be attributed to the different degrees of absorption experienced by the peripheral partial waves responsible for transfer reactions, when different optical potentials are used.

The reasonable agreement of the experimental absolute S_T values extracted in both (^{17}O,^{16}O) and (^{17}O,^{18}F) studies on ^{208}Pb using potential C in the calculations, with the corresponding S_T values from theoretical predictions and light-ion works, suggests potential C as more appropriate at this incident energy than potentials SJ and $I3$. Moreover, it seems that the DWBA is able to reproduce the experimental absolute and relative cross sections for both proton and neutron transfers, provided reasonable choices are adopted for the bound-state and optical potentials. However, the slight shift in angle observed for neutron transfers to the higher excitation energies remains unexplained.

Comparison of the (^{17}O,^{16}O) and (^{17}O,^{18}F) energy spectra with those of the corresponding light-ion (α,^{3}He)[3] and (d,^{3}He)[15] reactions at high incident energies, reveals different selectivity for the low-lying states populated.

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