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RADIAL FORM-FACTOR FOR TRANSFER REACTIONS AND THE SHELL-MODEL POTENTIAL

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The radial form factors for single-nucleon transfer reactions satisfy an inhomogeneous Schrodinger-like equation[1] that incorporates both mean-field and many-body aspects of the interaction responsible for transfer. Austern[2] and Rae[3] have proposed an approximation scheme that retains the simplicity of a one-body Schrodinger equation while accounting for the main many-body corrections. The method consists in introducing a shell-model (SM) potential for the motion of the transferred nucleon in the field of the core nucleus plus a surface-peaked potential to simulate the many-body corrections. The strength of the surface term is varied to reproduce the experimental separation energy of each final state. Winfield et al.[4] have recently applied this method to study (^{9}Be,^{10}B) reactions.

The SM potentials available in literature yield varying predictions concerning the properties of single-nucleon orbits. As an example, the root-mean-square (RMS) radii[5-12] of the neutron hole states in ^{208}Pb are tabulated in Table I; the RMS radii vary widely. The DWBA cross section for transfer reactions, and hence the spectroscopic factor (viz., the normalization factor of the transfer form-factor), are known to depend sensitively on the RMS radii.

Attempts are being made to obtain SM potentials by making fits to more extensive data. The radial wave functions predicted by these potentials will be compared with those deduced from magnetic electron scattering[13] and will also be tested by their application to single-nucleon transfer reactions at intermediate energies.

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Table I. Root-Mean-Square Radii of Neutron Hole States in ^{208}Pb Predicted by Various Phenomenological Shell-Model and Hartree-Fock Potentials.[a]

Orbit :	$3p_{1/2}$	$2f_{5/2}$	$3p_{3/2}$	$1i_{13/2}$	$2f_{7/2}$	$1h_{9/2}$
1. Rost (V_o = -40.6, r_o = 1.347)	6.41	6.34	6.34	6.87	6.29	6.36
2. Batty and Greenlees (V_o = -40.13, r_o = 1.357)	6.51	6.44	6.41	6.92	6.33	6.40
3. Mukherjee et al (V_o = -42.479, r_o = 1.310)	6.36	6.23	6.24	6.77	6.16	6.15
4. Bertsch (V_o = -46.77, r_o = 1.27)	5.94	5.87	5.92	6.50	5.91	5.95
5. Blomqvist and Wahlborn (V_o = -44.0, r_o = 1.27)	6.16	6.02	6.11	6.57	6.04	6.02
6. Streets et al. (V_o = -45.76, r_o = 1.238)	6.17	6.07	6.08	6.34	5.92	5.99
7. Brown (Hartree-Fock theory)	6.05	5.99	5.96	6.34	5.90	5.86
8. Leigh et al. (Experiment)	6.14	5.94	6.01	6.26	5.80	5.94

[a]All energies are in MeV and radii in fm.

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