Section III

Abstracts of Papers in Press

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Proton Scattering and the Optical Model Differences Between ^{40}Ca and ^{48}Ca*

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ABSTRACT

Elastic proton scattering from ^{40}Ca and ^{48}Ca has been measured at 25, 30, 35, and 40 MeV. The r.m.s. radius determined by the optical model is 0.15 fm larger for ^{48}Ca than for ^{40}Ca, consistent with the $A^{1/3}$ law.

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Neutron Hole State Structure in N=81 Nuclei. I* ^{144}Sm and $^{142}Nd(p,d)$

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ABSTRACT

Angular distributions of deuterons from the (p,d) reaction (Energy Resolution ∿35 keV) on ^{144}Sm and ^{142}Nd at Ep=35 MeV have been measured and compared with Distorted Wave Born Approximation (DWBA) calculations. The DWBA calculations were performed both with and without the finite range and non-locality corrections. In some typical cases corrections were also included for the nuclear density dependence of the effective pn interaction. The DWBA cross sections for ℓ=5 show an enhanced sensitivity to the inclusion of these corrections. Calculations including both the non-locality and finite range corrections yield acceptable spectroscopic factors. Considerable fractionation of the $(2d_{5/2})_\nu^{-1}$ and the $(1g_{7/2})_\nu^{-1}$ states is observed. No measurable population of neutron states in the $82<N\leq126$ major shell was observed. The neutron single hole energies (in MeV) are as follows: $d_{3/2}$-0.0, $s_{1/2}$-0.45, $h_{11/2}$-1.22, $d_{5/2}$-1.52, and $g_{7/2}$-2.12 for ^{143}Sm and $d_{3/2}$-0.0, $s_{1/2}$-0.43, $h_{11/2}$-1.07, $d_{5/2}$-1.47 and $g_{7/2}$-2.20 for ^{141}Nd. Data on the systematics of splitting and movements of these single neutron hole states as a function of the proton number (Z) in ^{143}Sm, ^{141}Nd, ^{139}Ce, and ^{137}Ba shall be presented in a subsequent paper.

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Neutron Hole State Structure in N=81 Nuclei*.II ^{140}Ce and $^{138}Ba(p,d)$

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ABSTRACT

In continuation of our program of neutron hole state studies in N=81 nuclei angular distributions of deuterons from (p,d) reactions (Energy resolution ∿35 keV) on ^{140}Ce and ^{138}Ba at Ep=35 MeV have been measured and compared with Distorted Wave Born Approximation (DWBA) calculations including finite range and non-locality corrections. These calculations yield acceptable spectroscopic factors and are in fair agreement with the shapes of the experimental angular distributions. The neutron single hole energies have been determined. These energies (in MeV) are $d_{3/2}$-0.0, $s_{1/2}$-0.33, $h_{11/2}$-1.07, $d_{5/2}$-1.72, and $g_{7/2}$-2.90 for ^{139}Ce and $d_{3/2}$-0.0, $s_{1/2}$-0.54, $h_{11/2}$-1.07, $d_{5/2}$-1.71, and $g_{7/2}$-2.93 for ^{137}Ba.

Considerable fractionation of the $(2d_{5/2})_\nu^{-1}$ and the $(1g_{7/2})_\nu^{-1}$ states is observed while the $(3s_{1/2})_\nu^{-1}$ and the $(1h_{11/2})_\nu^{-1}$ states are each observed to split mostly into two components. Systematics on the energies and strengths of the various neutron single hole states and their components is presented for all N=81 nuclei from ^{137}Ba thru ^{143}Sm and the significance of the systematics discussed. No measureable population of any neutron state in the $82<N\leq126$ major shell has been observed.

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The Mass of ^{25}Si and the Isobaric Multiplet Mass Equation*

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ABSTRACT

The mass excess of ^{25}Si has been measured via determination of the Q-value for the $^{28}Si(^3He,^6He)^{25}Si$ reaction. The results are used to test the isobaric multiplet mass equation for A=25.

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Calculations with a 1s,0d Shell-Model for A=34-38 Nuclei*

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ABSTRACT

Results are presented of calculations made in the full space of sd shell-model wave functions for positive-parity states in the nuclei with A=34-38. We employed in this work several different effective Hamiltonians, some of which had two-body parts obtained by reaction matrix techniques from the Hamada-Johnston scattering potential. The observables calculated were energy level spectra, single-nucleon spectroscopic factors, and E2 and M1 moments and transition strengths. These calculations yield fair-to-good agreement with many of the observed nuclear structure data in this mass region.

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Shapes of Angular Distributions in the ^{89}Y (^{3}He,t) ^{89}Zr Reaction to Antianalog and Other $T_<$ States*

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ABSTRACT

The $^{89}Y(^{3}He,t)^{89}Zr$ reaction to $T_<$ states in ^{89}Zr shows the angular distributions to have shapes characteristics of non-allowed L transfers and not similar to microscopic predictions. The antianalog states appear not to be unique in possessing this feature.

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The Structure of Nuclei with Masses A=30-35, as Calculated in the Shell-Model

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ABSTRACT

Properties of positive-parity states of nuclei with A=30-35 have been calculated in a shell-model space which encompasses all Pauli- allowed basis vectors of all configurations $(0s)^{4}(0p)^{12}$ $(0d_{5/2})^{n_1}(1s_{1/2})^{n_2}(0d_{3/2})^{n_3}$ for which $n_1 \geq 10$. Two different empirical Hamiltonians, one of a delta-function form, were used. Calculated energies and spectroscopic factors are in good agreement with an extensive body of experimental data. The model wave functions also yield satisfactory agreement with many available experimental data on electric quadrupole observables if effective charges of 0.5e are added to the proton and neutron. The model predictions for magnetic dipole observables are generally in qualitative agreement with experimental observations, but inconsistencies between theory and experiment are more noticeable in this area.

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Study of Charge-Exchange Coupling in Proton Induced Reactions on $^{95,98,100}Mo$ and $^{92,94}Zr$*

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ABSTRACT

The presence of isospin coupling in the incident channel has been studied via proton induced reactions on $^{95,98,100}Mo$ and $^{92,94}Zr$. Anomalous behavior in the excitation functions at backward angles was observed in deuteron and proton outgoing channels. In the deuteron channels these anomalies, located near the (p,n) threshold to the ground state analog were, for most all cases, similarly characterized as double dip in shape. Their strength is generally much weaker than the single minimums observed in (d,p) reactions near mass 90 and can be categorized by the proton decay energy from the analog state formed in the charge exchange process. The proton elastic excitation functions showed no structure near the (p,n) thresholds although the (p,p') curves did exhibit fluctuations.

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The (p,t) Reaction on Even-Even N=Z Nuclei in the 2s1d Shell*

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ABSTRACT

The (p,t) reaction on the even-even N=Z nuclei in the 2s1d shell has been used to study the energy level of ^{18}Ne, ^{22}Mg, ^{26}Si, ^{30}S, ^{34}Ar, and ^{38}Ca. The energies of the excited states observed are reported along with spin and parity assignments when possible. Two nucleon transfer distorted wave calculations were carried out. Comparisons are made with the shapes of the experimental angular distributions. It is found that the calculated shapes are primarily dependent upon the L-transfer and the optical model parameters. The magnitudes of the calculated cross-sections are found to depend strongly not only on the optical model parameters, but also the bound state parameters and the configuration mixing in the initial and final nuclear wave functions.

* Work supported by the National Science Foundation.

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Preparation of Thin Film Deposits from Biological, Environmental and Other Matter*

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ABSTRACT

A technique for preparing uniform thin film deposits (10-1000 μgm/cm^2) of practically all materials of biological, environmental and nuclear physics interest is proposed. The technique involves preparing a solution or colloidal suspension of micron size particles of the substance of interest, generating a nebulized (practically invisible) mist from this liquid and condensing the mist on a rotating substrate. The cost in time and money for several materials is minimal.

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