Section III

ABSTRACTS OF PAPERS IN PRESS

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Study of the ^{173}Hf Level Scheme from the Decay of ^{173}Ta*

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ABSTRACT

The decay of ^{173}Ta was studied using high resolution Ge(Li), Si(Li) and Si surface barrier detectors in singles and coincidence modes. The ^{173}Ta activity was produced via the reaction ^{165}Ho (^{12}C,4n)^{173}Ta, at a carbon beam energy of 63-69 keV per nucleon. All spectra were obtained from chemically separated Ta sources. Besides the previously known energy levels of ^{173}Hf, the following levels in keV were determined: 255.5, 451.9, 508.9, 635.8, 775.5, 785.3, 811.7, 872.6, 927.5, 942.5, 1020.3, 111.4, 1127.0, 1192.8, 1248.3, 1450.0, 1574.2, 1655.6, 1667.1, 1694.3, 2263.3. Rotational bands based on the 1/2$^-$[521] (G.S.), 5/2$^-$[521] (107.2 keV), 7/2$^+$[633] (197.5 keV), and 5/2$^+$[642] (9/2$^+$[624] Nilsson states were observed. The mass difference between ^{173}Ta and ^{173}Hf was determined to be 3670±150 keV from measurement of the β^+ end-point energy.

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States in ^{163}Ho and ^{167}Tm Populated Through the (p,t) Reaction on ^{165}Ho and ^{169}Tm*

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ABSTRACT

The (p,t) reaction at 30 MeV on the deformed nuclei, ^{165}Ho and ^{169}Tm, strongly populates collective states in the residual nuclei. Indirect multiple step processes evidently play an important role, and the reaction is a powerful tool for populating higher-lying rotational band members.

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Nuclear Spectroscopic Studies of ^{252}Es

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ABSTRACT

The decay scheme of ^{252}Es has been investigated with high-resolution semiconductor detectors in conjunction with coincidence techniques. The half-life of ^{252}Es was measured by following the decay alpha count rate associated with ^{252}Es decay and was found to be 350±50 d. The electron capture and alpha decay branchings were measured to be 22±2%, and 78±7%, respectively. The EC decay almost entirely populates a level at 969.8 keV in ^{252}Cf with a log(ft) value of 8.7. This state has been identified as the two-neutron state (n[613]7/2$^+$; n[620]1/2$^+$)3$^+$. A $K^\pi=2^-$ band has been identified at 830.8 keV. A rotational band built on a 804.8-keV level has been interpreted as the γ-vibrational band ($K^\pi=2^+$). On the basis of the observed log(ft) value, the ground state of ^{252}Es has been given as assignment of (n[613]7/2$^+$; p[521]3/2$^-$)5$^-$. The favored α transition of ^{252}Es has been found to populate a level at 590 keV in ^{248}Bk. The ground state of ^{248}Bk has been given a spin-parity assignment of 6$^+$ with two-quasi-particle configuration (n[734]9/2$^-$; p[521]3/2$^-$).

E | RADIOACTIVITY [from ^{252}Cf(d,2n), ^{249}Bk(α,n)]; measured $T_{1/2}$, E_α, I_α, E_γ, I_γ, I_{ce}, γγ-, αγce-, αγ- coin, α/EC ratio; deduced log(ft). ^{252}Cf and ^{248}Bk deduced levels, J,π. γ-multipolarity.

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Decays of $f_{7/2}$ Isomers, ^{53g}Fe and ^{53m}Fe*

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ABSTRACT

The decays of 8.5-min. ^{53g}Fe and 2.5-min ^{53m}Fe have been studied with a variety of γ and β^+ detectors in many different singles and coincidence configurations. States in ^{53}Mn populated by ^{53g}Fe decay were found to lie at 0(J^π=7/2$^-$), 377.9(5/2$^-$), 1288.0([3/2$^-$]), 1619.9([9/2$^-$]), 2273.5([7/2]), 2685.6(7/2), 2946.6([9/2]), 3126.7([9/2,7/2]), and 3248.0 keV ([9/2]). States in ^{53}Fe populated by 3040.6-keV (19/2$^-$) ^{53m}Fe decay were confirmed at 0(7/2$^-$), 1328.1(9/2$^-$), and 2339.6 keV (11/2$^-$). In addition, a 3040.6-keV E6 and a 1712.6-keV M5 transition were found to compete with the 701.1-keV E4 isomeric transition in deexciting ^{53m}Fe, this being the first observation of such high multipolarities. The E6 has an intensity of 6.0×10^{-4} and the M5 an intensity of 1.3×10^{-2} relative to the E4 transition. Shell-model calculations have been performed for both ^{53}Mn and ^{53}Fe, using the Oak Ridge Shell-Model Code, and these are compared with the observed states and with other shell-model calculations. We also calculate the transition probabilities of the higher multipolarity transitions and compare them with experiment.

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Techniques for the Study of Short-Lived Nuclei

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The Numerical Accuracy of ^3He Optical-Model Calculations at 70 MeV*

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ABSTRACT

Small differential cross sections, such as those measured at back angles for 70 MeV ^3He elastic scattering (typically below 10^{-4} mb/sr past 130°), are difficult to calculate accurately when they result from considerable cancellation in the partial-wave sum. The codes GENOA, GIBELUMP, SNOOPY3, and DWUCK differ by as much as 2-1/2 orders of magnitude on σ(0) for an optical-model potential describing $^{60}Ni(^3He,^3He)^{60}Ni$ scattering at 71 MeV. This calculation is repeated with a modified version of GIBELUMP for wide ranges of the parameters affecting numerical accuracy. A study of errors in scattering matrix elements and cross sections, as functions of these parameters, reveals that criteria commonly used to determine the matching radius and number of partial waves employed in optical-model calculations yield insufficient values in this case.

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Calculations of Allowed Beta-Decay in the (0d-1s) Shell*

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ABSTRACT

Allowed β-decay transition rates and half-lives have been calculated for (0d-1s) shell nuclei with A=17-22, 23-24, 27-29, 30-34, and 35-39. For nuclei with A=17-22 and 34-39, the calculated log(ft) values have a rms deviation of 5% from experiment, with no discrepancies greater than 12%. For nuclei nearer the middle of the shell there are more significant discrepancies between experiment and theory. The calculated log(ft) values are used to predict the half-lives of some light elements. The predicted half-lives for which there are no experimental measurements are: ^{19}Na (0.3 sec), ^{21}O (2.9 sec), and ^{22}O (0.15 sec). The log(ft) values relevent to the solar neutrino experiment are discussed.

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Inelastic Proton Scattering from ^{138}Ba and ^{144}Sm at 30 MeV*

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ABSTRACT

Measurements of the inelastic scattering of 30 MeV protons from ^{138}Ba and ^{144}Sm have been carried out with better than 10 keV energy resolution. Differential cross sections were measured for levels up through 3.4 MeV excitation energy. Spin and parity assignments are suggested for most of these states on the basis of angular distributions distinctly characteristic of angular momentum transfer L=2, 3, 4, or 6.

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New Proton Rich Nuclei in the $1f_{7/2}$ Shell*

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ABSTRACT

The masses of ^{43}Ti and of the previously unknown nuclei ^{47}Cr, ^{51}Fe, and ^{55}Ni have been measured. These proton-rich members of the $1f_{7/2}$-shell mirror pairs are important for extensions of nuclear mass relationships to the Z>N region.

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Proton Decay of the Isobaric Analogues of the Ground States of ^{206}Pb, ^{207}Pb, ^{208}Pb, and ^{209}Bi*

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ABSTRACT

The $(p,n\bar{p})$ reaction has been measured on the lead isotopes ^{206}Pb, ^{207}Pb, and ^{208}Pb and on ^{209}Bi. Coulomb energy differences are extracted from the positions of the $\bar{p}$ peaks. Proton decay widths are also obtained and compared with values from resonance experiments and with a previous value from ^{209}Bi$(p,n\bar{p})$.

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Study of (^{3}He,t) Reactions at 70 MeV to Isobaric Analog States of ^{50}Cr, ^{62}Ni, and ^{90}Zr*

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ABSTRACT

The analysis of (^{3}He,t) reactions at 70 MeV to isobaric analog states of ^{50}Cr, ^{62}Ni, and ^{90}Zr have shown an energy dependence in the extracted isospin strengths consistent with results at lower energies; the interaction strengths are approximately 50% smaller than at lower bombarding energies. The shapes of the form factors in a macroscopic analysis are nuclei-dependent. A ^{3}He optical potential with a real strength of about 110 MeV and a volume imaginary term is strongly preferred in the (^{3}He,t) calculations.

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The ^{48}Ca(p,t)^{46}Ca Reaction at E_p=39 MeV*

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ABSTRACT

There has been considerable interest in using a comparison of (p,t) and (t,p) reactions to the same final states, especially 0^+ states, to compare wave functions for a series of nuclei.[1] Such a study in the calcium isotopes would benefit from a more thorough study of the ^{48}Ca(p,t) reaction. The complementary ^{44}Ca(t,p) reaction has been carried out in various laboratories[2,3] and strongly populates states of $J^\pi=0^+$ at excitation energies between 5 MeV and 7 MeV. The ^{48}Ca(p,t) has also been studied previously but at fairly low energies[4,5] or with poor resolution[6] so that the states of interest could not be resolved. In addition discrepancies between the (t,p) experiments serves as an additional motivation for the (p,t) experiment. The present paper is a preliminary report of this work.

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Investigation of the $^{32}S(^{3}He,p)^{34}Cl$ Reaction at 24 MeV

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ABSTRACT

The $^{32}S(^{3}He,p)^{34}Cl$ reaction has been studied at an incident energy of 24 MeV. The proton spectra were analyzed with a multi-angle magnetic spectrograph and angular distributions have been measured for states in ^{34}Cl up to 3.4 MeV of excitation energy. Two sets of shell-model wave functions, which use the same configuration space but different treatments of the effective residual interaction, are tested by comparing two-nucleon transfer DWBA-calculations with the experimental angular distributions.

NUCLEAR REACTIONS $^{32}S(^{3}He,p)$, E=24 MeV; measured $\sigma(\theta)$. Natural target.

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Study of the $^{27}Al(^{3}He,p)^{29}Si$ Reaction

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ABSTRACT

The $^{27}Al(^{3}He,p)^{29}Si$ reaction has been studied at bombarding energies between 9 and 14 MeV. Comparison of the experimental angular distributions at 14 MeV incident energy with two-nucleon transfer distorted-wave Born-approximation (DWBA) calculations is made to test shell-model wave functions of the target ground state and the residual ground and excited states.

E NUCLEAR REACTIONS $^{27}Al(^{3}He,p)$, E=9-14 MeV; measured $\sigma(\theta)$. Natural target.

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