Section II

Abstracts of Talks at Meetings

July 1970-June 1971

American Phys. Soc. Houston Meeting, Oct. 1970

The Effects of Compton Scattering on Ge(Li)-Ge(Li) Coincidence Experiments.* G.C. GIESLER, R.A. WARNER, W.C. MCHARRIS, and W.H. Kelly, Mich. State Univ.—In γ-γ coincidence spectrometry, Compton scattering can become a nuisance by increasing the number of unwanted coincidence events and generally obscuring the weaker peaks. When gate and photopeak widths approach each other, "artificial photopeaks" can be generated. This was recognized as a serious limitation with NaI(Tl)-NaI(Tl) spectrometers. With Ge(Li)-NaI(Tl) coincidence system these "artificial peaks" are very broad and are not so serious because of the poor resolution of the scintillation detector. With the advent of large Ge(Li) detectors and Ge(Li)-Ge(Li) coincident spectrometers coming into general use, the presence of these artificial photopeaks can lead to the reporting of false transitions. We describe the results of a study of the effects of Compton scattering and narrow gates and methods that can be used to suppress these unwanted additions to the coincidence spectrum.

*Work supported by the National Science Foundation and the U.S. Atomic Energy Commission.

American Phys. Soc. Houston Meeting, Oct. 1970

The Sum-Coincidence Method Applied to the Evaluation of Ge(Li)-Ge(Li) Coincidence Results.* G.C. GIESLER, K.L. KOSANKE, R.A. WARNER, W.C. McHARRIS, and W.H. KELLY, Mich. State Univ.—In 1958, Hoogenboom proposed a new method of measuring γ-γ coincidence events. His "sum coincidence" method[1] involves adding the coincidence signals from two NaI(Tl) detectors, then gating on this sum peak and looking at the output from one of the detectors. It reduces the Compton background in the displayed spectrum and improves the resolution of the peaks. With the advent of large Ge(Li) detectors and Ge(Li)-Ge(Li) multiparameter coincidence spectrometers, this method may be useful in unraveling complex decay schemes. We have applied this technique to the studies of the decay schemes of ^{63}Zn and ^{205}Bi. We will present some of the results obtained and will discuss the advantages and limitations of the sum coincidence method as compared to a conventional 2-dimensional mega-channel coincidence system.

*Work supported by the National Science Foundation and the U.S. Atomic Energy Commission.

[1]A.M. Hoogenboom, Nucl. Instr. and Methods 3, 57(1958).

American Phys. Soc. Houston Meeting, Oct. 1970

Energy of the Second Excited State of ^{12}C and the 3α Reaction Rate.* S.M. AUSTIN, Mich. State Univ. and the Niels Bohr Inst., G.F. TRENTELMAN and E. KASHY, Mich. State Univ.—The rate for the 3α reaction in helium burning stars depends critically on the excitation energy E_x of the second excited state of ^{12}C near 7.6 MeV. We have measured E_x with an uncertainty of ±2.1 keV to resolve an inconsistency in earlier results. In the present measurements, E_x was obtained by comparing the momentum of protons from the $^{12}C(p,p')^{12}C(E_x \simeq 7.6$ MeV) reaction with the momenta of protons inelastically scattered from states of well known energy in ^{12}C and ^{16}O. We find $E_x = 7.6562 \pm 0.0021$ MeV. This value of E_x leads to a change by a factor of exp[-11.9/(86.17T_9)] of the 3α reaction rate of Fowler, Caughlan and Zimmerman. Implications for nucleosynthesis in helium burning stars will be discussed.

*Research supported by the National Science Foundation.

[1]W.A. Fowler, G.R. Caughlan and B.A. Zimmerman, Ann. Review Ast. and Ap. 5, 525(1967).

American Phys. Soc. Houston Meeting, Oct. 1970

Neutron Yields from Proton Bombardment of Thick Targets.* T. AMOS, A. GALONSKY, and R. JOLLY, Mich. State Univ.—Stopping targets of natural C, Al, Cu, Ta and Pb were bombarded by 30 and 40 MeV protons. The resultant neutron spectra were measured at laboratory angles of 0, 30, 60, 90, 120, and 150 degrees by a .7 nsec/meter neutron time-of-flight spectrometer for neutron energies above 2 MeV. Preliminary analysis of the data indicates the following results for the energy- and angle-integrated yields:

	Neutrons/Proton	
Target	30 MeV	40 MeV
C	.004	.02
Al	.02	.04
Cu	.035	.07
Ta	.02	.07
Pb	.025	.07

Neutron time-of-flight spectra, energy spectra, angular distributions and total yields will be presented and discussed.

*Work supported by National Science Foundation.

American Phys. Soc. Houston Meeting, Oct. 1970

Ultra-High Resolution Spectrometer System for Charged Particle Studies of Nuclei.* H.G. BLOSSER, G.M. CRAWLEY, R. deFOREST, E. KASHY, and B.H. WILDENTHAL, Mich. State Univ.—This paper describes an arrangement for introducing feedback into a charged particle magnetic analysis system for nuclear reaction studies. In initial tests of the system, a resolution of 5 keV has been obtained in (p,p') studies at 30 MeV with 70% of the cyclotron internal beam on target. This corresponds to a resolving power p/Δp of 12,000. Essential features of the system, in addition to the feedback, are a careful definition of the cyclotron source by means of internal slits and the use of dispersion matching[1] to cancel the effect of coherent on-target energy spread.

*Work supported by the National Science Foundation.

[1]B.L. Cohen, Rev. Sci. Instr. 30, 415(1959).

American Phys. Soc. Houston Meeting, Oct. 1970

Proton Spin-Flip in (p,p') Reaction on ^{120}Sn and ^{124}Sn.* R.H. HOWELL, R.R. DOERING, and A. GALONSKY, Mich. State Univ.—The angular distributions for proton spin-flip in the excitation of the first 2+ state in ^{120}Sn and ^{124}Sn are being studied at 30 MeV. The technique requires measuring the p-γ angular correlation function at 90° from the scattering plane. Coincidence particle-gamma spectra were stored in a live time, two parameter array with the single-particle spectrum stored separately by a computer. Measurements have been made from 30° to 150°. The angular distribution showed a typical shape with small forward-angle values and a peak at back angles. Values ranged from .04±.013 at 30° to .22±.04 at 150° for ^{120}Sn and from .005±.004 at 30° to .26±.04 at 150° for ^{124}Sn. These values do not include corrections ranging between -0.1 and -.02 for finite solid angles. The integrated spin-flip probability is (4.3±1.3)% for ^{120}Sn and (1.6±0.8)% for ^{120}Sn.

*Supported by the National Science Foundation.

American Phys. Soc. Houston Meeting, Oct. 1970

$^{27}Al(p,n)^{27}Si$ at Ep=30 MeV.* R.K. JOLLY, T. AMOS, A. GALONSKY, and R. ST.ONGE, Mich. State Univ.—Neutron spectra from the $^{27}Al(p,n)^{27}Si$ reaction have been measured using the MSU TOF facility. The ground state transition is observed to be the strongest except at very forward angles (<20°). Energy resolution in these measurements was limited to count rate considerations. Angular distribution for the ground state was measured from 0° to 95° and compared with i) DWBA calculations using a real derivative form factor for the t·T interaction ii) simple microscopic calculations (by F. Petrovich) involving charge exchange on a single $1d_{5/2}$ proton hole in the ^{28}Si core and using harmonic oscillator wave functions. Agreement of these calculations with the experimental angular distribution is quite good. The question of normalization still remains to be investigated.

*Supported by the National Science Foundation.

American Phys. Soc. Houston Meeting, Oct. 1970

The Michigan State University Isochronous Cyclotron, Neutron Time-of-Flight Facility.* R. ST.ONGE, T. AMOS, A. GALONSKY, and R. JOLLY, Mich. State Univ.—A description of the MSU Isochronous Cyclotron neutron time-of-flight facility (TOF) will be given. This will include: the cyclotron's time and energy resolutions, internal cyclotron beam pulser, beam line and dump, scintillation detector, electronic instrumentation, spectrum stabilizer, and the on-line data computer system. The proton beam time resolution is 0.2 ns and a resultant neutron spectrum [$^{27}Al(p,n)^{27}Si$] has a time resolution of 0.3 ns and an energy resolution of 200 keV for 26 MeV neutrons. With 2-dimensional n-γ pulse shape discrimination we achieve a figure of merit[1] "M" of 5 to 6. The TOF spectrum was stabilized by a zero level ADC stabilizer locked on the target gamma-ray peak.

*Supported by the National Science Foundation.

[1]Nucl. Instr. & Methods 69, 25(1969).

American Phys. Soc. Houston Meeting, Oct. 1970

Electron Capture Decay Scheme of Bi^{203}.* Wm.C. McHARRIS, J.B. CROSS, and W.H. KELLY, Mich. State Univ.—The ε decay of 11.7-h Bi^{203} has been investigated using high-resolution Ge(Li) spectroscopy. The Bi^{203} sources were prepared by the $Pb^{206}(p,4n)Bi^{203}$ reaction, using a 40 MeV proton beam from the MSU Sector-Focused Cyclotron and Pb^{206} separated isotope. A total of 147 γ-ray were observed. Aided by coincidence and anti-coincidence data, including 2-dimensional Ge(Li)-Ge(Li) megachannel coincidence, we have placed 51 γ-rays (accounting for >80% of the γ-ray intensity) in a primary decay scheme having 26 levels. A secondary decay scheme with transitions placed solely on the basis of energy sums and weak coincidence data is also proposed. Spin and parity assignments of the nuclear states investigated are made on the basis of relative γ intensities to states of known spin and parity, transition multipolarities (for those transitions where internal conversion-electron intensities were available), and log ft values. A comparison with existing scattering data is presented, and intrinsic structures for some low-lying states will be suggested.

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American Phys. Soc. Houston Meeting, Oct. 1970

Electron Capture Decay Scheme of Bi^{204}.* J.B. CROSS, Wm.C. McHARRIS, and W.H. KELLY, Mich. State Univ.—The ε decay of 11.2-h Bi^{204} has been investigated with high-resolution Ge(Li) detector systems. The Bi^{204} sources were prepared by the $Pb^{206}(p,3n)Bi^{204}$ reaction, using a 30 MeV proton beam from the MSU Sector-Focused Cyclotron and Pb^{206} separated isotope. A total of 210 γ-rays were observed. Utilizing a 2-dimensional mega-channel coincidence system, 60 γ-rays (accounting for >90% of the γ-ray intensity) have been incorporated in a primary decay scheme having 31 states. A secondary decay scheme is proposed; γ-ray transitions in this decay scheme are placed solely on the basis of precise energy sums and weak coincidence data. Limits on spin and parity assignments of the nuclear states investigated are made on the basis of log ft values, relative γ intensities to states of known spin and parity, and transition multipolarities for those transitions were internal conversion-electron intensities were available. A comparison with previously reported scattering reaction data is presented.

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American Phys. Soc. Houston Meeting, Oct. 1970

The (p,t) Reaction on Pr^{141}.* R.W. GOLES, Wm.C.McHARRIS, W.H. KELLY, and R.A. WARNER, Mich. State Univ.—40 MeV protons accelerated by the Michigan State University Isochronous Cyclotron were used to study this (p,t) reaction. Besides the ground state, 14 states ranging in energy up to 2.5 MeV were observed to be excited in the residual nucleus Pr^{139}. Angular distributions were taken between 15° and 65° using a ΔE-E semiconductor counter telescope. Particle Identification was performed on-line with an XDS Σ-7 computer. Theoretical angular distributions for this reaction have been calculated using the DWBA code JULIE, and these predicitions will be compared to the experimental results. A comparison will be made between the states populated by this reaction and those populated through the β^+/ε decay of Nd^{139m+g} [1]. It is found that the (p,t) reaction on Pr^{141} strongly populates collective states of the residual nucleus Pr^{139}.

*Work supported in part by the U.S. National Science Foundation and the U.S. Atomic Energy Commission.

[1] D.B. Beery, W.H. Kelly, and Wm.C. McHarris, Phys. Rev. 188, 1851(1969).

American Phys. Soc. Houston Meeting, Oct. 1970

E6 and M5 Gamma-Ray Transitions in the Fe^{53m} Decay.* J.N. BLACK, Wm.C. McHARRIS, and W.H. KELLY, Mich. State Univ.—Evidence has been found for the existence of E6 and M5 transitions in Fe^{53m} decay. This 2.6-min isomer has been interpreted as being the highest spin state, J-19/2-, of the three-particle multiplet resulting from the configuration $(\pi f7/2)^{-2}(\nu f7/2)^{-1}$. This 19/2- state decays to an 11/2- state by a 701.1 keV E4 (≡100), to a 9/2- state by a 1712.6 keV M5(0.7) and to the ground state by a 3040.6 keV E6(0.02). The isomer was prepared by the $Mn^{55}(p,3n)Fe^{53m}$ reaction. Since single-particle estimates revealed E6/E4 and M5/E4 transition probability ratios of only 0.003 and 0.008 respectively, 3.6% Ge(Li) detector was used. Each experiment consisted of a continuous cycle of bombarding and counting such that a fresh source was counted every two minutes for a period of 24 hours. A series of experiments was designed which demonstrated that the observed transitions were not the restul of summing effects. The result of this effort was the direct observation of γ rays corresponding to E6 and M5 transitions.

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American Phys. Soc. Houston Meeting, Oct. 1970

The $^{34}S(^{3}He,t)$ Reaction at 35 MeV.* R.A. HINRICHS, B.H. WILDENTHAL, and J.A. RICE, Mich. State Univ.—Energy levels in ^{34}Cl up to 5 MeV have been studied with the $^{34}S(^{3}He,t)$ reaction at 35 MeV. Angular distributions were taken between 5° and 45° using an Enge split-pole spectrograph with a resolution of 25 keV. Twenty-eight levels are observed. In addition to the well established low-lying levels, states at 2.61, 2.74, 3.16, 4.74, 4.94, and 5.14 MeV (±30 keV) are populated with significant intensity. Of particular interest are the transitions to the known 1^+ states at 460 and 667 keV. Their angular distributions are quite different. A comparison of the experimental angular distributions with microscopic DWBA calculations will be made.

*Supported by the National Science Foundation.

American Phys. Soc. New York Meeting, Feb. 1971

The (p,t) Spectra of Tm^{169}, Ho^{165}, and Tb^{159}.* R.W. GOLES, R.A. WARNER, Wm.C. McHARRIS, and W.H. KELLY, Mich. State Univ.—Triton spectra resulting from the (p,t) reaction on Tm^{169}, Ho^{165}, and Tb^{159} were measured at an incident proton energy of 36 MeV and lab observation angle of 20° using a broad-range magnetic spectrometer. The proton beam, accelerated from the MSU Sector Focused Cyclotron, was analyzed to give an energy spread of ∿0.06% and focused on ∿800 μg/cm² metallic foils of the above target material. The scattered tritons were detected using both a 3 cm Si position sensitive detector and photographic plates. The resulting spectra are all characterized by strong collective excitations of the residual nuclei. In particular, it is found that members of the ground state rotational band up to 6 spin units above the band head are strongly excited by this reaction.

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American Phys. Soc. New York Meeting, Feb. 1971

Levels of ^{56}Co Below 2 MeV Excitation from $^{56}Fe(p,n)^{56}Co$ and ^{56}Ni EC Decay.* L.E. SAMUELSON, R.A. WARNER, W.H. KELLY, R.R. TODD, and W.C. McHARRIS, Mich. State Univ.—Angular distributions have been measured for 11 γ-rays depopulating 8 levels of ^{56}Co excited by the $^{56}Fe(p,n)^{56}Co$ reaction using proton beams of 5.77, 6.65, 7.03, and 7.30 MeV from the MSU Isochronous Cyclotron. Branching ratios and precise energies of γ-rays including 5 γ-rays not observed in the ^{56}Ni decay will be given. Spin and parity assignments of energy levels and multipolarity mixing ratios have been determined by comparing the experimental data with theoretical calculations using the code MANDY.[1] A 0^+ assignment is confirmed for the 1.4509 MeV level which is believed[2] to be the anti-analog of the ^{56}Fe 0^+ ground state.

*Work supported in part by NSF and AEC.

[1]Eric Sheldon and R.M. Strang, Computer Phys. Comm. 1, 35(1969); and Eric Sheldon and D.M. Van Patter, Rev. Mod. Phys. 38, 143(1966).

[2]T.A. Belote, W.E. Dorenbuech, and J. Rapaport, Nucl. Phys. A109, 666(1968).

American Phys. Soc. New York Meeting, Feb. 1971

Shell-Model Calculations for Nuclei with A=23-29. B.H. WILDENTHAL,* Mich. State Univ. and J.B. McGRORY,** Oak Ridge Nat. Lab.—We have extended our previous calculations for A=18-22, made in the complete sd-shell configuration space, to ^{23}Na, ^{23}Ne, and ^{24}Mg. The approach has been to limit the population of the $d_{3/2}$ orbit to no more than two particles, and to limit the number of $d_{5/2}$ holes to no more than four. The Hamiltonian we have used in these calculations was obtained by empirically adjusting Kuo's two-body matrix elements so as to improve the agreement between model and observed level energies for A=18-22. The predictions obtained for A-23 and 24 with this approach are very encouraging. Spectra and transition strengths will be presented. Analogous treatments of ^{26}Al and ^{28}Si are less successful. Further calculations for the A=26-29 region will also be discussed.

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**Work sponsored by US AEC under contract with Union Carbide Corp.

American Phys. Soc. New York Meeting, Feb. 1971

(p,t) Reaction on N=82 Nuclei at Ep=35 MeV.* R.K. JOLLY and E. KASHY, Mich. State Univ. Two nucleon pickup reactions have been studied on the closed neutron shell target nuclei of ^{138}Ba, ^{140}Ce, ^{142}Nd and ^{144}Sm. Angular distribution for 6-10 states in the first 2.5-3.5 MeV of excitation energy have been measured from 12.5°/15° to 90° with an energy resolution of ∿30 keV. Absolute cross-sections were obtained by a simultaneous measurement of (p,p) and (p,t) cross at several angles. Spectroscopic analysis of these data using a direct one step reaction model in the DWBA approximation will be presented and compared with other analyses in the neighboring mass nuclei.

*Supported by the U.S. National Science Foundation.

American Phys. Soc. New York Meeting, Feb. 1971

The Ghost Anomaly in the $^{9}Be(p,d)^{8}Be$ (g.s.) Reaction.* P.S. MILLER, G.M. CRAWLEY, W.F. STEELE, and F.C. BARKER, Mich. State Univ. The magnitude and spectral distribution of the ghost anomaly in ^{8}Be can be useful in limiting the R-matrix parameters obtained from fitting α-α scattering.[1] The ghost is observed in the present work at an incident laboratory energy of 40 MeV, where complications in the analysis due to compound nucleus effects presumably are negligible. The magnetic spectrograph detector system using position-sensitive solid state detectors yield an overall resolution of 50 keV FWHM. The results are compared with previous experiments, and implications for the R-matrix analysis are discussed.

*Supported by the U.S. National Science Foundation.

[1]F.C. Barker, H.J. Hay and P.B. Treacy, Aust. J. Phys. 21, 239(1968).

American Phys. Soc. New York Meeting, Feb. 1971

Isobaric Yields of Masses 6 to 11 from Proton Spallation of ^{14}N in the Energy Range 17 to 42 MeV.* H. LAUMER, C.N. DAVIDS,** and S.M. AUSTIN, Mich. State Univ.—Time-of-flight methods were used to identify masses of reaction products stopped in a silicon surface-barrier detector. A gas cell with total exit area density 50-130 $\mu g/cm^2$ contained the ^{14}N. Total cross-sections were obtained by integrating angular distributions. The ratio mass 7/mass 6 varies from 0.5 to 42 MeV to 10 at 21.7 MeV. Mass 10/mass 11 is 1.5 at 42 MeV, 3 at 28.6 MeV, and 0.25 at 17 MeV. The importance of these cross-sections to current models to the origin of the light elements Li, Be and B will be discussed.

*Work supported by the U.S. National Science Foundation.

**Present Address: Center for Nuclear Studies, University of Texas, Austin Texas 78712

American Phys. Soc. Cleveland Meeting, March 1971

Study of Local Modes of Lithium and Boron in Silicon.* E. DOUNCE, O.P. KATYAL, and C.R. GRUHN, Mich. State Univ.—Infrared studies of local vibrational modes of B doped Li compensated Si samples have been made. The temperature effects on-line width and centroid have been extended. Uniaxial stress was applied in an attempt to break up the local modes degeneracies, thereby, ascertaining to a greater degree the certainty of the 522 cm^{-1} line thought to be a ^7Li vibrational mode in a Li-B complex. So far, a search for the free interstitial Li local mode has turned out to be unproductive.

*Work supported in part by NASA and NSF.

American Phys. Soc. New York Meeting, Feb. 1971

Internal Conversion Studies of the 2.3 keV Transition from the Electron Capture Decay of Bi^{205}.* W.C. JOHNSTON, K.L. KOSANKE, S.K. HAYNES, W.C. McHARRIS, and W.H. KELLY, Mich. State Univ. The internal conversion spectrum for the 2.3 keV transition in Pb^{205} has been measured using the MSU $\pi\sqrt{2}$ β-ray spectrometer. This transition had never been directly observed before although it was generally accepted to be an E2 transition from the first excited state to the ground state ($1/2^- \rightarrow 5/2^-$). Internal conversion is energetically allowed for only the N and higher shells. The N conversion occurs near the threshold and should provde a good test for theoretical N shell ICC's. Our results for the relative intensity of the 2.3 keV transition, for the N and O conversion intensities and energies, and also for the M-Auger spectra for Pb^{205} and Pb^{206} will be presented.

*Work supported in part by the U.S. National Science Foundation, and the U.S. Atomic Energy Commission.

American Phys. Soc. Washington Meeting, Apr. 1971

^3He Elastic Scattering at 70 MeV on ^{50}Ti and ^{51}V.* R. A. HINRICHS, R.R. DOERING, and A. GALONSKY, Mich. State Univ.—We have begun a study of ^3He elastic scattering on medium weight nuclei at 70 MeV by examining the nuclei ^{50}Ti and ^{51}V. Angular distributions were taken from 3° to 170° with detector telescopes. One particularly interesting aspect of the data in both cases was the rapid drop in cross-section (9 orders of magnitude) over this angular range. Optical model calculations were not able to fit this decrease at angles greater than 100° and good fits at angles less than this required a larger and more diffuse imaginary potential than used at substantially lower energies. The data for ^{51}V(spin $7/2^-$) for angles greater than 50° showed less structure than the corresponding ^{50}Ti data, providing additional information on possible target spin dependences in ^3He elastic scattering.[1]

*Supported by the National Science Foundation.

[1]J.C. Hafele, C.B. Fulmer, and F.G. Kingston, Phys. Letters 31B, 17(1970).

American Phys. Soc. New York Meeting, Feb. 1971

Decay of Sm^{141m}.* R.R. TODD, R.E. EPPLEY, W.H. KELLY, W.C. McHARRIS, and R.A. WARNER, Mich. State Univ.—The decay of Sm^{141m} (≈22.1m half-life) has been studied with Ge(Li) spectrometers using sources primarily prepared by the $Nd^{142}(^3He,4n)Sm^{141m}$ reaction. The energies and relative intensities of 31 γ-rays occurring in the decay have been determined. The level scheme has been established by means of γ-γ coincidence experiments, resulting in the placement of 15 levels and the determination of a 628.6 keV delayed isomeric transition in the daughter Pm^{141}. We have identified 6, possibly 7 states belonging to a three quasi-particle multiplet of high spin states with low log ft values between 5.7 and 6.9. Some data will also be presented concerning the decay of Sm^{141g}.

*Work supported in part by the U.S. National Science Foundation and the U.S. Atomic Energy Commission.

American Phys. Soc. Washington Meeting, Apr. 1971

Inelastic Proton Scattering on N=82 Nuclei.* D. LARSON, S.M. AUSTIN, B.H. WILDENTHAL, and S.H. FOX, Mich. State Univ.—High resolution spectra and angular distributions from 10° to 80° have been measured for ^{138}Ba and ^{144}Sm, as part of a study of proton inelastic scattering from nuclei with 82 neutrons. 30 MeV protons from the MSU Sector-Focused Cyclotron in conjunction with the Enge split-pole spectrograph and associated equipment[1] enable us to obtain resolutions of better than 10 keV FWHM routinely. This makes it possible to separate many of the multiplets previously unresolved in these nuclei. The (p,p') results will be compared with existing (α,α') and gamma-ray data and also with each other, the latter comparison in order to delineate the effects produced by the addition of six protons between Ba and Sm. Comments will be made as to the nature of the states excited viz a viz predictions of shell-model calculations.

*Supported by the National Science Foundation.

[1]H.G. Blosser, et al. (to be published).

American Phys. Soc. Washington Meeting, Apr. 1971

Asymmetry in the Inelastic Scattering of 40.5 MeV Protons from ^{16}O and ^{12}C. W. BENENSON,* and P.J. LOCARD ISN Grenoble, France and J-L. ESCUDIE and J.M. MOSS, CEN Saclay, France—Polarized protons of 40.5 MeV from the Grenoble Cyclotron were used to study the asymmetry in inelastic scattering rom ^{16}O and ^{12}C. The detection system consisted of a quadrupole triplet and a 1 cm lithium drifted silicon detector. Resolution of 50 keV permitted observation of the ground plus lowest 3^-, 2^+, 1^- and 2^- states in ^{16}O and the ground plus lowest 2^+, 0^+, and 3^- states in ^{12}C from 5 to 120° (Lab). Distorted wave calculations were made for ^{16}O using UCLA optical model parameters. The small almost isotropic polarization of the unnatural parity 2^- state is fairly well given by the microscopic model. For the 1^- and 3^- state the microscopic model fits poorly. The 2^+ states fit is good using a full Thomas form for the distorted spin orbit force.

*Present Address: Mich. State Univ.

American Phys. Soc. Washington Meeting, Apr. 1971

Decay of Pm^{141}.* F.Y. YAP†, R.R. TODD, R.A. WARNER, W.H. KELLY, and Wm.C. McHARRIS, Mich. State Univ.—The decay of Pm^{141} has been studied with Ge(Li) spectrometers using sources prepared by the reaction $Nd^{142}(p,2n)Pm^{141}$. Nearly 50 transitions belonging to the decay of Pm^{141} have been identified on the basis of half-life, and a level scheme is proposed incorporating more than 30 of these transitions. Various coincidence experiments have so far resulted in the placement of levels at 193.8, 756.7, 1223.3, 1345.8, 1564.8, 1596.8, 1967.6, 2073.7, 2109.6, 2246.6, 2505.0 keV. Spin assignments made from log ft values are compared with results from studies[1] of charged particle reactions populating states in Nd^{141}.

*Supported in part by the U.S. National Science Foundation and U.S. Atomic Energy Commission.

†Present Address: Wilson College, Chambersburg, Pennsylvania.

[1]J.L. Foster, Jr., O. Dietzsch and D. Spalding, preprint; and R.K. Jolly and E. Kashy, Bull. Am. Phys. Soc. 16, 151(1971) and private comm.

American Phys. Soc. Washington Meeting, Apr. 1971

Inelastic Proton Scattering from ^{16}O at Bombarding Energies from 24.6 to 40.1 MeV.* D.L. BAYER, I.D. PROCTOR, and F.L. PETROVICH. Mich. State Univ.—Position sensitive detectors on the focal plane of an Enge split pole spectrometer have been used to obtain angular distributions from 10° to 100° for the doublet of states at 6.05 MeV (0^+) and 6.13 (3^-) and the doublet of states at 6.92 MeV (2^+) and 7.12 MeV (1^-). The cross sections for exciting these four states have been analyzed within the framework of the macroscopic collective model and the microscopic model with realistic forces. In the microscopic calculations inelastic electron scattering data was used as a guide in constructing the necessary transition densities.

*Supported by the National Science Foundation.

Nucl. Sci. Applic. Symp. New York, Nov. 1970

Determination of Trace Elements in Samples by Nuclear Scattering and Reaction Techniques.* R.K. Jolly, C.R. Gruhn, and C. Maggiore, Mich. State Univ.—The feasibility of using low energy (15-25 MeV) α-particles scattering for detecting traces of heavy elements in a bulk of light elements as, for example, in biological and environmental matter is explored. These measurements can provide information on all elements in the sample simultaneously. Heavy elements require good energy resolution (∿10 keV) for definite identification while light elements can be identified even with very poor energy resolution (∿100 keV). Results of some measurements on a fish sample are presented.

Similarly sub-Coulomb (p,α) reactions are explored for measuring traces of very light elements in a bulk of heavy elements. Suitable choice of bombarding energy almost completely suppresses the contribution from the heavy elements. Results of a measurement in a very pure Zr sample are presented.

*Supported by the National Science Foundation.

American Phys. Soc. Washington Meeting, Apr. 1971

Shapes of (^{3}He,t) Angular Distributions to T< States in ^{89}Zr.* R.A. HINRICHS, Mich. State Univ.—In most (^{3}He,t) reactions, while the magnitude of the calculated cross-section is dependent upon the form of the radial integral, the shape is primarily dominated by the angular momentum transfer L. In several cases the angular distributions to 0^+ anti-analog states have shown a non-allowed L=1 shape. We have studied the $^{89}Y(^3He,t)$ reaction to T< states in ^{89}Zr to look for this effect when more than one L value is allowed. Angular distributions at 33 MeV were taken between 3° and 40° using an Enge split-pole spectrograph. The angular distributions to the $1/2^-$ 0.588 MeV state and possible $1/2^-$ states at 1.740 and 1.866 MeV have predominately non-allowed L=1 shapes. The angular distributions for T< states with spins other than the spin of the target could not be fit with allowed L transfers and showed shapes composed of both even and odd L values.

*Supported by the National Science Foundation.

[1]R.A. Hinrichs, R. Sherr, G.M. Crawley, and I. Proctor, Phys. Rev. Letters 25, 829(1970).

Nucl. Struc. Symp., Jyvaskyla, Finland, Apr. 1970

Inelastic Scattering of Protons from ^{16}O and the Effective Two-Body Interaction.* S.M. Austin, P.J. Locard, Mich. State Univ. S.N. Bunker, J.M. Cameron, J.R. Richardson and J.W. Verba, UCLA, W.T.H. Van Oers, Univ. of Manitoba.—Cross sections for the $^{16}O(p,p')^{16}O$ reaction leaving ^{16}O in its 2^- state at 8.88 MeV or the $6.05(0^+)$-$6.13(3^-)$ doublet (dominated by 3^-) have been measured at 23.4, 24.5, 27.3, 30.1, 34.1, 36.8, 39.7, 43.1, and 46.1 MeV. Compound nucleus effects are evident below 30 MeV but the cross sections vary monotonically at higher energies. In the direct distorted wave approximation with central forces, the 2^- transition can occur only through the term $V_\sigma \vec{\sigma}_i \cdot \vec{\sigma}_j$ in the effective interaction, while the 3^- transition is dominated by the spin-isospin independent term V_0. Strengths of V_0 and V_σ were obtained by fitting the cross sections with real interactions of the form $V_\sigma \vec{\sigma} \cdot \vec{\sigma}\, e^{-r/r}$ and $V_0\, e^{-r/r}$. We found V_σ=23 MeV, V_0=65 MeV at Ep=30.1 MeV; and V_σ=16 MeV, V_0=51 MeV at Ep=46.1 MeV. The data were also compared with the predictions of an impulse approximateion. The impulse approximation underestimates the 2^- cross section by a factor of about 4 at all energies, but predictes the 3^- cross section within about 20%. The results for V_σ and V_0 will be compared with available information on V_σ and V_0.