SECTION II

ABSTRACTS AND/OR TITLES OF TALKS AT AMERICAN PHYSICAL SOCIETY MEETINGS AND OTHER MEETINGS AND CONFERENCES

(JULY 1, 1982 TO JUNE 30, 1983)

Comparison of $\vec{s}\vec{\tau}$ Strengths Extracted from Magnet Dipole Data with the Analogous Values from Gamow-Teller Data. B.A. BROWN and B.H. WILDENTHAL, Mich. State U.*--Measured values of isovector magnetic dipole moments and transition strengths in A≤41 nuclei have been alalyzed with shell-model wave functions to extract the values of the $\vec{s}\vec{\tau}$ matrix elements in these systems. This analysis involves subtraction from the measured value of an orbital contribution calculated from full 0p-shell, truncated p-sd-shell or full sd-shell model wave functions. Alternates to these M1-based measures of $\vec{s}\vec{\tau}$ strength are directly available from the analog Gamow-Teller beta-decay transitions. We find that, starting from mass 3, the G-T measures of $\vec{s}\vec{\tau}$ become quenched relative to the shell-model estimates progressively as A increases. The M1-based values tend to follow this same trend but to have systematically larger values.

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Inelastic Electron Scattering and ΔJ = 1, ΔT = 1 Transitions in ^{24}Mg. B.A. BROWN and B.H. WILDENTHAL, Mich. State U.*--The strong M1 transition between the ground state and the second $J^{\pi},T=1^{+}$, 1 excited state in ^{24}Mg might constitute a practical case with which to study the momentum transfer dependence of spin excitation and the influence of excitation modes not explicitly considered in the conventional (neutrons, protons, Δn=0, Δℓ = 0) description of the M1 giant resonance. We find that the best available shell-model wave functions account for all the q=0 data involving 0^{+} - 1^{+} transitions in A=24 with good accuracy. These wave functions yield quite different shapes for the form factors of the lowest several 1^{+} states of ^{24}Mg. Hence, deviations from single-particle form factors are not significant evidence for unconventional excitation mechanisms. In addition, the contributions of neighboring levels of higher spin are predicted to yield cross sections at larger momentum transfer which are comparable to those of the M1 excitation.

*Supported by NSF grand PHY-80-17605

Measurements of Gamow-Teller Strength for Double-Beta Decaying Nuclei via the (p,n) Reaction at 135 MeV.* SAM M. AUSTIN, Mich. State U.; R. MADEY, J.W. WATSON, B.D. ANDERSON, A. BALDWIN, B.S. FLANDERS, C. LEBO, Kent State U.; C.C. FOSTER, IUCF.--Measurements (or limits) on the lifetimes of nuclei which decay by emission of two electrons (2β) have been used to place limits on the masses of Majorana neutrinos.[1] Unfortunately there are discrepancies both between experiment and theory and between the results of direct and geochemical experiments. In an attempt to provide constraints on the calculations we have used the neutron time-of-flight system at Indiana U. to obtain (p,n) spectra at 0°, 4° and 8° for ^{76}Ge, ^{82}Se and ^{128,130}Te. The L=0 strength at 0° (low q) is essentially proportional to the Gamow-Teller (GT) strength to the (virtual) intermediate states of the 2β process. Strength is observed to the giant resonance region and to narrow low lying structures populated with ~10^{-2} the strength of the giant resonance. The GT strengths for ^{128}Te and ^{130}Te are rather similar except for the weak sturctures at low excitation.

*Supported in part by the NSF.
[1] W. Haxton, et al., Phys. Rev. Lett. 47, 153 (1981).

Probing the Nuclear Stratosphere with Sub-Coulomb Heavy Ion Elastic Scattering.* W.G. LYNCH and M.B. TSANG, NSCL, Michigan State University; J.G. CRAMER, S. GILL, and R. LOVEMAN, NPL University of WA.**--Sub-Coulomb elastic scattering measurements of ^{12}C, ^{16}O and ^{18}O projectiles on the target nucleus ^{208}Pb have been used to probe the heavy ion optical potential at distances greater than 12 fm. the influence of the imaginary potential at these sub-Coulomb energies is observed to be small and the onset of nuclear potential scattering is quite sensitive to the shape of the real part of the optical potential at large radii. The data will be compared to calculations using optical model real potentials obtained by folding model techniques. Possible complications arising from dynamically induced nuclear deformations will be discussed.

*Work supported in part by the NSF.
**Work supported in part by the U.S. DOE.

Energy and Angle Dependence of Fission Fragment Mass Widths for ^{32}S Induced Reactions on ^{208}Pb Between 180 and 270 MeV.* M.B. TSANG, D. ARDOUIN, W.G. LYNCH, Z. XU, C.K. GELBKE, NSCL, Mich. State U.; B.B. BACK, R. BETTS, S SAINI, Argonne National Lab; P.A. BAISDEN and M. MCMAHON, Lawrence Livermore Lab.--Fission fragment mass widths and cross sections have been measured for the ^{32}S + ^{208}Pb reaction at the Argonne National Laboratory tandem-linac heavy-ion accelerator. Mass identification was obtained by standard time-of-flight techniques. In addition, fission fragment folding angle distributions were measured to eliminate contributions from sequential fission following deeply inelastic reactions. The widths of the mass distributions corresponding to fusion-fission reactions are observed to increase dramatically with beam energy, corroborating similar results obtained in literature.[1] The angular dependence of the fission fragment mass widths will be discussed. The measured cross sections will be compared with predictions of various fusion models and the angular distributions will be used to determine the parameters K_0 and the corresponding effective moments of inertia that determine the angular distributions of the fusion-fission process.

*Supported in part by the NSF.
[1] B. Borderie, et al., Z. Phys. A299, 263 (1981).

Excitation of ℓ=0, Spin-Flip Transitions in Ca(p,p') Reactions at 200 MeV.* A. GALONSKY, N. ANANTARAMAN, G. CRAWLEY, J. DUFFY, NSCL Mich. State U.; C. DJALALI, J.-C. JOURDAIN, N. MARTY, M. MORLET, A. WILLIS IPN - Orsay.--In the (p,p') reaction at 200 MeV ℓ=0, spin flip (M1) transitions are enhanced above most other transitions when observed at small angles. With the synchrocyclotron and magnetic spectrometer at Orsay we were able to make such observations down to 3° in ^{40,42,44}Ca and to 2° in ^{48}Ca. Unlike the spectra on Zr targets[1] where the M1 transition strength in ^{48}Ca is concentrated in a single peak (at 10.2 MeV) whose width is limited only by the 70-KeV resolution of the equipment. This agrees with the (e,e') experiment.[2] In the angular region studied, 2° to 16° in ^{48}Ca, The shape of the distribution is in agreement with a microscopic DWBA calculation, but the magnitude is less than half the calculated value.

*Supported by NSF Grants Phy 80-17605 and INT-8116064.
[1] N. Anantaraman et al., Phys. Rev. Lett. 46, 1318 (1981).
[2] W. Steffan et al., Phys. Lett 95B, 23 (1980).

Composite Fragment Production in Intermediate Energy Heavy Ion Reactions,* B.V. JACAK, C.K. GLEBKE, L.H. HARWOOD, W.G. LYNCH, D.K. SCOTT, M.B. TSANG and G.D. WESTFALL, National Superconducting Cyclotron Laboratory, MSU, and T.J.M. SYMONS, Lawrence Berkely Laboratory.--Inclusive production cross sections of isotopes of hydrogen, helium, lithium, beryllium, and boron have been measured for reactions of 50, 100, and 150 MeV/nucleon argon from the LBL Bevalac with gold and calcium targets. The differential cross sections were measured using three solid state detector telescopes and are fitted with a moving source model to extract temperatures, source velocities and total cross sections in the intermediate rapidity region. The results are compared with values for light charged particles produced at bombarding energies from 9 to 800 MeV/nucleon[1]. The He/p ratio was found to drop dramatically with increasing projectile energy, whild the d/p and t/p ratios remained nearly constant. The ratios of heavier nuclei to protons are added to investigate production of composites as a function of composite mass.

*National Science Foundation Grant No. Phy 80-17605.

[1]G.D. Westfall, et. al., Physics Letters, to be published.

Gamow-Teller Lifetime Predictions for ^{17}C and ^{19}N,* M.S. CURTIN, B.H. WILDENTHAL, and B.A. BROWN, National Superconducting Cyclotron Laboratory, MSU.-The nuclear shell model was used to predict the properties of light exotic nuclei, with particulr interest focusing on lifetime predictions of such nuclei. Starting with the effective Hamiltonian of Reehal and Wildenthal, which spans the model space ($0p_{1/2}$, $0d_{5/2}$, $1s_{1/2}$), the necessary eigenvectors and eigenvalues were generated for the parent-daughter combinations (^{17}C-^{17}N) and (^{19}N - ^{19}O). Gamow-Teller matrix elements were then computed and used to obtain theoretical ft - values for specific JT transitions. The prescription of Wilkinson and Macefield was used to calculate the statistical factors and the associated partial half-lives. It was found that ^{17}C has three candidates for its ground state, all lying within 570 keV of each other ($5/2^+$, $3/2^+$, $1/2^+$). Lifetime predictions varied depending upon which state was used as the ground state. Study of these nuclei is continuing with a Hamiltonian spanning a larger model space ($0p_{3/2}$, $0p_{1/2}$, $0d_{5/2}$, $1s_{1/2}$, $0d_{3/2}$) which we hope will resolve the ground state J^π assignment and correct for the interference between orbits of the same ℓ value which are known to influence lifetime calculations.

National Science Foundation Grant Phy 80-17605.

The NSCL K=800 Magnetic Spectrograph,* A. ZELLER, J.A. NOLEN, R. BURLEIGH, L.H. HARWOOD, and H. BLOSSER National Superconducting Cyclotron Laboratory.--A progress report on the design and construction of a large (k=800) magnetic spectrograph for NSCL Phase II will be given. The optical design has been finalized by using the raytracing program MOTER. It is a vertical QQDD layout with a solid angle 20 msr, energy range of 10% (800 MeV for 8 GeV ^{40}Ca beams), a calculated energy resolution $E/\Delta E$ = 10,000, and angular resolution of 1 mr. Dispersion matching and kinematics effects are included in the raytracing calculations. The magnetic components will utilize superconducting coils but will operate with iron dominated magnetic fields. The resulting cost will be significantly less, both initially and in operation, than if conventional copper coils were utilized. The mechanical problems associated with the construction of the superconducting dipoles, including the coil bobbin and bobbin supports will be discussed. The dipoles will also feature unique tapered gaps behind the pole tips and field shaping trim coils in the magnet gap.

*U.S. DOE Contract DE-AC02-80-ER10579.

Liquid-Gas Phase Instabilities in Nuclear Systems,* M.W. CURTIN, H. TOKI and D.K. SCOTT, National Superconducting Cyclotron Laboratory, MSU.--Analysis of experimental data involving heavy ion induced reactions yielding temperatures less than 20 MeV differ markedly from similar data at higher temperatures with regard to the cross section for α production. The single phase gas model predicts the mass distribution resulting from the decay of an intermediate rapidity source for T≥20 MeV but requires modification at lower temperatures. The enhanced α production could originate from a liquig-gas instability but it is also possible to modify the single phase gas model to reproduce the light ion cross sections by inclusion of binding energy effects of the α particle. Entropy considerations lead to a strong attenuation of heavier fragments. Questions arise regarding the possibility of preformed α particles, due to α-clustering in the participating nuclei, which survive the collision and enhance the α cross section. Both considerations indicate that measurements of larger fragments are necessary to study the influence of the liquid-gas phase instability, the predicted consequences of which may be relevant to phase instabilities conjectured to occur at higher densities.

National Science Foundation Grant PHY-80-17605.

A Mass separator for Heavy Ions of 20 MeV/A and Above,* E. ORMAND, S. BRICKER, M.S. CURTIN, L.H. HARWOOD, and J.A. NOLEN, National Superconducting Cyclotron Laboratory.--A reaction-product mass separator (RPMS) has been designed and constructed for use at the NSCL. It is primarily intended to directly separate (by m/q) the products of heavy ion fragmentation reactions, which will normally be at energies per nucleon of 20 MeV or more. The decay of mass separated samples of nuclei far from stability can be observed in the focal plane of this device. Planned experiments include, for example, measurements of lifetimes and decay schemes of neutron rich nuclei such as ^{17}C. Intense mass-separated secondary beams can also be produced. The device has a solid angle of 1 msr, an energy acceptance range of about 12%, a mass resolving power ($m/\Delta m$) of about 200, and can be positioned at scattering angles of 0° to 30°. The optical configuration is QQWDQQ, where W represents a 5 m long Wien filter previously used as a meson separator at the LBL Bevatron; the quadrupoles and magnetic dipole were also existing devices. Optical properties of the RPMS, i.e. mass line shapes, band pass, etc., have been calculated using the ray tracing programs RAYTRACE and MOTER.

*U.S. DOE Contract DE-AC02-80ER10579.

Observation of the (T_o+1) Component of the Gamow-Teller Strength in the ^{26}Mg(p,n)^{26}Al Reaction at 134 MeV*, R. MADEY, B.D. ANDERSON, J.W. WATSON, A.R. BALDWIN, B.S. FLANDERS, C. LEBO, Kent State University, C.C. FOSTER, IUCF, S.M. AUSTIN, A. GALONSKY, B.H. WILDENTHAL, Michigan State University--Neutron spectra were measured at excitation energies up to ~370 keV. Four $\Delta\ell$ = 0 peaks were observed at E_x = 13.6, 14.7, 15.9 and 18.6 MeV. An excitation energy of 13.46 ± 0.06 MeV in ^{26}Al for the analog of the known 3^+ ground state of ^{26}Na was derived from the known masses of ^{26}Na and ^{26}Mg, the systematics of Coulomb displacement energies and the known analog correspondences in the lighter isotopes of Mg and Na. A spectrum[1] of ^{26}Na from the ^{26}Mg(t,^{3}He)^{26}Na reaction reveals a state at 88 keV above the 3^+ state. Thus, the lowest possible T = 2, 1^+ state could appear in the spectrum of ^{26}Al at E_x = 13.55 ± 0.06 MeV. The strongest peak at 13.6 MeV corresponds to a strong M1 state observed by Bendel et al.[2] from backward electron scattering by ^{26}Mg.

* Supported in part by the National Science Foundation.

[1] E.R. Flynn and J.D. Garrett, Phys. Rev. C9, 210 (1974).

[2] W.L. Bendel et al., Phys. Rev. 173, 1103 (1968).

A High-Rigidity Spectrograph Constructed From Surplus Components,* B. SHERRILL, R. BLUE, S. BRICKER, L.H. HARWOOD, and J.A. NOLEN, National Superconducting Cyclotron Laboratory.--A "modular" spectrograph capable of analyzing the 320 MeV α particles and other high rigidity "light-heavy ions" from the NSCL Phase I cyclotron has been designed and constructed mainly from surplus components, i.e. and MP tandem switching magnet and an 8" only 0.5 msr, but the calculated energy resolution is $E/\Delta E \geq 1000$ with an energy range of 20% (60 MeV at 300 MeV). The optical configuration is QQDS, with the sextupole being added for aberration correction and to make the focal plane perpendicular to the optical axis. Additional aberration corrections are effected by a steel insert to change the entrance edge curvature of the switching magnet and a current-sheet octupole placed between the dipole and the sextupole. Design parameters including effects of reaction kinematics and dispersion matching were determined by using the optimizing raytracing code MOTER.

* National Science Foundation Grant No. Phy 80-17605.

Study of Higher Isospin Components of Gamow-Teller Strength in Ni(p,n) Reactions.* N. ANANTARAMAN, S.M. AUSTIN, G.M. CRAWLEY, A. GALONSKY, and H. TOKI, Mich. State U., B.D. ANDERSON, A.R. BALDWIN, C. LEBO, R. MADEY, and J.W. WATSON, Kent State U., and C.C. FOSTER, Indiana U.--We report results of an experiment to locate the (T_o-1), T_o and (T_o+1) components of the Gamow-Teller strength in ^{58,60,62,64}Cu via the Ni(p,n) reaction at a proton energy of 134 MeV. The measurements were performed at the neutron time-of-flight setup of the Indiana University Cyclotron Facility with a flight path of 86 meters. A resolution of ~400 keV was achieved. All three isospin components for ^{58,60,62}Cu and the (T_o-1) and T_o components for ^{64}Cu, were observed, with characteristic forward-peaked angular distributions. The identification of the high-lying To and (To +1) components was based upon there excitation energies, which corresponded closely to the values expected from the locations of their parent states seen in (p,p') measurements.[1] A comparison of the relative strengths between the various components in both the (p,n) and (p,p') studies will be presented.

* Supported in part by the National Science Foundation

[1] C. Djalali et al., Nucl. Phys. A, 1982, in press.

Measurement of Half-Lives of Exotic Nuclei Produced in Fragmentation Reactions,* L.H. HARWOOD and G.D. WESTFALL, National Superconducting Cyclotron Laboratory, MSU; M.J. MURPHY and T.J.M. SYMONS, Lawrence Berkeley Laboratory.--A 300 MeV/u ^{56}Fe beam impinging on a 1 g/cm^2 Be target was used to produce exotic neutron-rich nuclei. A QQD spectrometer momentum analyzed the nuclei; the mass and charge of each fragment nucleus was determined with an eight-element, position sensitive counter telescope. When a nucleus stopped in the telescope, the beam was clamped, and β-decays were monitored. Elements ranging from Na to Ar were observed. Extracted half-lives will be presented.

* National Science Foundation Grant No. Phy 80-17605.

Is the "Shell Closure" at Z=64 (N=82) Pseudepigraphous? HANS G.W. KRUSE and G.H. WILDENTHAL, Mich. State U.*--We have performed shell model calculations for the N=82 nuclei from Z=52 to Z=66 with a single model basis space and an empirically derived Hamiltonian. The observed energy level spectra are in general well described up to excitation energies of about 2 MeV in off-Z systems, and up to about 3 MeV in even in even-Z systems. High-spin states at higher excitation energies are also well produced. The principal systematic discrepancy between theory and experiment is the inability to lower the energies of the first occurring 3 states to their observed values. The calculated spectrum for ^{156}Gd as well as the spectra for ^{155}Eu, ^{157}Tb, and ^{158}Dy, all agree well with the respective experimental spectra. The ground state as well as the excited states of ^{156}Gd contain $(g_{7/2}, d_{5/2})^n_n h_{1\,1/2}$ hole-particle excitations amounting to more than 50% of each wave function. The model results thus illustrate the elusive nature of a "shell closure". All of the observed features which have suggested the idea of a shell closure at Z=64 appear in the model results concurrently with wave function structures which are continuous cross the closure.

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A Universal Hamiltonian for Calculations in Complete $(sd)^n$ Spaces. B.H. WILDENTHAL, MICH. State U.*--An isospin-conserving, one-body plus two-body Hamiltonian for use in complete-space $(0d_{5/2} - 1s_{5/2} - 0d_{3/2})^n$ shell-model calculations has been empirically formulated from which a good accounting of the intra-sd-shell energy level schemes of nuclei throughout the A = 17-39 region is obtained. The essential difference between this new formulation and previous empirical sd-shell effective interactions[1,2] is that the two-body matrix elements incorporate a mass dependence in the form of a simple, uniform $(18/A)^{0.3}$ scaling. This feature has made it possible to simultaneously incorporate data dominated by $d_{5/2}$, $s_{1/2}$ and $d_{3/2}$ structure into the determination of the Hamiltonian. The new interaction appears, upon preliminary inspection, to preserve the best features of the earlier mass-independent empirical Hamiltonians and to eliminate many of their systematic residual deficiencies.

* Supported by NSF grant PHY-80-17605.

[1] B.M. Preedom and B.H. Wildenthal, Phys. Rev. C6, 1633.

[2] W. Chung, Ph. D. Thesis, Michigan State Univ., 1976.

American Physical Society Amherst Meeting, October 1982 (Con't)

Inelastic Electron Scattering and $\Delta J = 1$, $\Delta T = 1$ transitions in ^{24}Mg. B.A. BROWN and B.H. WILDENTHAL, Mich. State U.*--The strong M1 transition between the ground state and the second $J^{\pi}, T = 1^{+}, 1$ excited state in ^{24}Mg might constitute a practical case with which to study the momentum transfer dependence of spin excitation and the influence of excitation modes not explicitly considered in the conventional (neutrons, protons, $\Delta n = 0$, $\Delta \ell = 0$) description of the M1 giant resonance. We find that the best available shell-model wave functions account for all the $q = 0$ data involving $0^{+} - 1^{+}$ transitions in $A = 24$ with good accuracy. These wave functions yield quite different shapes for the form factors of the lowest several 1^{+} states of ^{24}Mg. Hence, deviations from single-particle form factors are not significant evidence for unconventional excitation mechanisms. In addition, the contributions of neighboring levels of highter spin are predicted to yield cross sections at larger momentum transfer which are comparable to those of the M1 excitation.
Supported by NSF grant PHY-80-17605.

Asmmetry Measurements in (p,n) Reactions on ^{90}Zr and ^{208}Pb at 160 MeV,* E.SUGARBAKER, P.KONCZ and D. KROFCHECK, Ohio State U; C.D. GOODMAN and C.C. FOSTER, IUCF; J. RAPAPORT, T. TADDEUCCI and T.P. WELCH, Ohio U; C. GAARDE and J. LARSEN, Niels Bohr Inst; S. AUSTIN and A. GALONSKY, Michigan State U.--Vector analyzing powers have been measured for the ^{90}Zr(p,n)^{90}Nb and the ^{208}Pb(p,n)^{208}Bi reactions using the 160 MeV proton beam from the Indiana University Cyclotron Facility. At forward angles $|A_y|$ greater than 0.05 appear to be associated only with previously identified resonances. the A_y of the giant dipole spin resonance in ^{90}Nb is very large at forward angles--about 0.6±0.16 at 3°. Comparison with DWIA calculations is made for each of the observed resonances. The A_y of the continuum out to 48° is presented and comparison is made to (p,p') results and to free N-N scattering.
*Work supported in part by the N.S.F., the D.O.E. and the Danish National Science Council.

American Physical Society New York Meeting, January 1983.

Entry Line Measurements in Residues from ^{16}O + ^{12}C Fusion --$\langle E_n \rangle$, B. Remington, A. Galonsky, F. Haas, and J. Kasagi, Mich. State Univ.*; F. Prosser, Univ. of Kansas; P. DeYoung, J.J. Kolata, R. Racca, and L. Satkoviac, Univ. of Notre Dame*.--A series of experiments is nearing completion at Notre Dame to locate the entry lines in the residues from the fusion of ^{16}O with ^{12}C at seven CM energies from 20 to 26 MeV. We report here on the spectra of neutrons emitted in reaching certain of those residues. Neutron detectors were placed at 0° and at five other angles, and a Ge(Li) detector was located at 125° to the ^{16}O beam. Neutron-gamma ray coincident events were recorded on magnetic tape. The events were sorted to produce neutron time-of-flight spectra in coincidence with γ-rays from known transitions in the residues. In the nuclei ^{26}Al, ^{25}Mg, and ^{23}Mg there were nine such transitions in toto. Measurement of the charged particle spectra leading to these nuclei is underway. Both neutron and charged particle data are needed to define the entrance energies.

*Supported by grants from the NSF.
Supported by a grant from the U.S. DOE.

American Physical Society Baltimore Meeting, April 1983.

Nuclear Physics and the Solar Neutrino Problem*, SAM M. AUSTIN, Michigan State University, East Lansing, MI.--The solar neutrino problem is still with us; the observed flux of solar neutrinos is substantially smaller than that predicted by standard models of the sun and of neutrino propagation.[1] Both the strength of the neutrino source in the sun and the efficiency of the neutrino detectors on the earth depend on the detailed properties of specific nuclear reactions and structure. One must then be confident the nuclear physics is understood before introducing more exotic explanatory mechanisms such as neutrino oscillations and strong time-dependent changes in solar activity. It also happens that nuclear studies are involved in the new experimental approaches aimed at pinpointing more precisely the cause of the solar neutrino discrepancy. The status of these nuclear (1) recent studies of nuclear reactions active in the sun and the net effect they product on the predicted solar neutrino production rate. (2) measurements, via (p,n) reactions, of the matrix elements determining the efficiency of proposed solar neutrino detectors (e.g. ^{71}Ga, ^{81}Br, ^{98}Mo). (3) measurements of nuclear matrix elements necessary for determination of neutrino masses rom neutrinoless double beta decay.

*Research supported in part by NSF Grant No. PHY80-17605-05.
1. J.N. Bahcall, et al. Rev. Mod. Phys. 54, 767 (1982).

Strengths of Single-Nucleon Spin Excitations Extracted from M1, Gamow-Teller and (p,n) data.* B.A. BROWN, National Superconducting Cyclotron Lab, MSU, East Lansing, MI.--The magnetic moments of T = 1/2 nuclei in the sd shell and the Gamow-Teller beta decays which connect them are analyzed with mixed-configuration shell-model wave functions to extract the empirical properties of the effective isoscalar M1, isovector M1 and Gamow-Teller operators. The results are expressed in the form of effective single-particle matrix elements and alternatively in terms of generalized operators which include the term $[Y^{(2)} \times s]^{(1)}$. Consistency checks and possible improvements are provided by an extended analysis which includes all measured magnetic moments, M1 transitions and beta decays in the sd shell. The consistency of our calculations for the region of excitation energy which includes the Gamow-Teller giant resonance is checked by comparison to the Gamow-Teller strengths extracted from recent (p,n) experiments.[1] We find that the experimental Gamow-Teller strengths are only 60 ± 4% of that calculated. This quenching is quite independent of mass, magnitude of strength, and final-state excitation energy. We find that the $\sigma\tau$ component of the M1 operator is quenched 10-20% less than the $\sigma\tau$ component of the Gamow-Teller operator. The imlication of these and other results will be discussed in the context of recent calculations which consider the effects due to higher-order configuration mixing outside the sd shell, delta-particle-nucleon-hole admixtures and meson-exchange currents[2,3].

*Supported by National Science Foundation grant PHY-80-17605.
[1] R. Madey et al. B.A.P.S. 27, 731 (1982).
[2] E. Oset and M. Rho, Phys. Rev. Lett. 42, 47 (1979).
[3] I.S. Towner and F.C. Khanna, Phys. Rev. Lett. 42, 51 (1979) and Nucl. Phys. A, to be published.

Single and Two Particle Inclusive Measurements of Non-Compound Light Particle Emission in Nucleus-Nucleus Collisions*. W.G. LYNCH, Michigan State University, East Lansing, Mi.--The attainment of statistical equilibrium is an important concept for intermediate energy nucleus-nucleus collisions. The systematic trends of the energy spectra and multiplicities obtained in one particle inclusive measurements over the incident energy range of E/A ≈ 10-2000 MeV offer considerable support to theoretical models which incorporate statistical equilibrium as a central assumption[1]. These thermal descriptions require that local thermal equilibrium is obtained within a subset of nucleons, an assumption which is a central inggredient of many current reaction theories. The interpretation of nucleon and composite one particle inclusive spectra in terms of statistical equilibrium is not unique and other calculations employing quite different assumptions have been used to describe the singles data. More stringent tests of the assumptions of statistical emission can be provided by two particle inclusive data from the comparison of the observed correlations with correlations predicted by statistical calculations including final state interactions as the particles leave the statistical ensemble. Measurements of nucleon-neucleon correlations at small relative angles are sensitive to the special and temporal extent of the emitting region[2]. The study of light particle correlations at large relative momenta yields useful information about the number of nucleon participating in the emission process and can be used to seacrch for dynamical correlations resulting from direct knowkout reactions collective flow effects or from shadowing effects due to the surrounding cold nuclear matter.[3,4]

*Supported by the National Science Foundation.
[1] G.D. Westfall, B.V. Jacak, N. Anantaraman, M.W. Curtin, G.M. Crawley, C.K. Gelbke, B. Hasselquist, W.G. Lynch, D.K. Scott, M.B. Tsang, M.J. Murphy, T.J.M. Symons, R. Legrain and T.J. Majors, Phys. Lett. 116B, 118 (1982).
[2] S.E. Koonin, Phys. Lett. 70B, 43 (1977).
[3] I. Tanihata, M.-C. Lemaire, S. Nagamiya, and S. Schnetzer, Phys. Lett. 97B, 363 (1980).
[4] W.G. Lynch, L.W. Richardson, M.B. Tsang, R.E. Ellis, C.K. Gelbke and R.E. Warner, Phys. Lett. 108B, 274 (1982).

Spin-Tensor and Multipole Decompositions of Effective Interactions in the sd Shell.* B.A. BROWN and W.A. RICHTER*, NSCL, Mich. State U.**--Various effective interactions for the sd shell nuclei have been analyzed in terms of their spin-tenor decomposition into central spin-orbit, antisymmetric spin-orbit, and tensor components. We compare the empirical interactions obtained from fits to binding energies with the Kuo-Brown G matrix elements as well as to G matrix elements derived from the M3Y type potentials. Further comparisons are made in terms of a multipole decomposition of the central proton-neutron interactions.

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Microscopic Calculations for the IBA Model Using the Generalized Seniority Scheme. O. SCHOLTEN, NSCL, Mich. State U.*--As was proposed by Otsuka et al.[1] there exists a direct relation between the generalized seniority scheme and the Interacting Boson Model. Using this relation it has been possible to calculate the microscopic structure of the bosons as a function of the number of nucleons from a calculation in the generalized seniority scheme. The IBA model parameters κ and χ can now be easily calculated. Furthermore, predictions can be made for g-factors and transition densities. Using the microscopic structure of the bosons also the concept of an effective number of bosons can be introduced.

*Supported by the NSF under grant PHY-80-17605.
[1] T. Otsuka, A. Arima, and F. Iachello, Nucl. Phys. A309, 1 (1978).

Mass Asymmetry and Angular Momentum Alignment*, D.J. MORRISSEY, Michigan State Univ., G.J. WOZNIAK, L.G. SOBOTKA, A.J. PACHECO, R.J. MCDONALD and L.G. MORETTO, LBL, BERKELY, CA--Projectile Fragment - sequential fission coincidences were obtained from the reaction of 340 MeV ^{40}Ar with ^{197}Au and ^{238}U at the LBL Super HILAC. The average values and variances of the angular momenta of the target-like products were determined by fitting the fission fragment angular distributions as a function of Q value (uranium only) and as a function of projectile fragment Z. The results show an increase in the inplane fission fragment anisotropy as the reaction fragments become mass symmetric. This behavior is exactly opposite from that expected for statistical equilibrium among the degrees of freedom of two tangent spheres.

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Cyclotron Dee Phase Timing with a Nuclear Technique, R.M. RONNINGEN, M.L. MALLORY and R.A. BLUE, Michigan State Univ.*--The NSCL K500 superconducting cyclotron accelerates ions with 3 dees. In first harmonic operation the phase difference between the voltages applied to each pair of dees is 120 RF degrees. A precisely centered accelerated beam requires the dee phase to differ by less than 1° (which is near the limits of electrical phasing) from the 120° phase difference. One should be able to achieve measurements of phase differences to this accuracy by using fast nuclear timing ($\leq$1 nsec resolution) techniques. We have detected x-rays produced by electrons moving in the high voltage gradients between the dees and between dees and ground. X-rays produced by dee excitation voltages of ~60 kV were observed by a 2 in. x 2 in. plastic scintillator coupled to an RCA 8575 phototube. Anode signals were processed using constant fraction timing and these pulses started a time-to-amplitude (TAC) converter, stopped by RF pulses. The TAC spectra showed peaks indicating that the x-ray production is time-correlated with the RF and it appears possible to achieve the desired phasing. We will present spectra and discuss their interpretation as well as planned improvements in this technique.

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The N=82 Isotones in the Generalized Seniority Scheme. O. SCHOLTEN and HANS G.W. KRUSE, NSCL, Mich. State U.*--A shell model calculation is compared sith a calculation in a generalized seniority basis for the N=82 nuclei. Tne shell model interaction has been adjusted in order to give the best reproduction of the energies in the odd and even mass N=82 nuclei.[1] Tne calculation in the much more restricted (dimension 10 compared to 1000 for the shell model) generalized seniority basis shows a rather good agreement for the excitation energies of the lower levels. Also electromagnetic properties will be compared.

*Supported by NSF grant PHY-80-17605.
[1] H. Kruse and B.H. Wildenthal, Bull. APS 27, 533 (1982); Bull. APS 27, 725 (1982).

Resonance-like Structures in heavy-ion collisions and the quasi-free scattering model, N. MATSUSHITA, H. TOKI and D.K. SCOTT, Michigan State Univ.*--The recent experiments of Frascaria et al[1,2] have shown resonance-like structures in the energy spectra of outgoing projectile-like heavy nuclei produced in ^{40}Ca on ^{40}Ca reactions at 284 MeV and 400 MeV, and ^{63}Cu on ^{63}Cu at 450 MeV. These structures have been attributed to giant resonances at excitations up to 100 MeV. We have developed an alternative interpretation in terms of quasi-free scattering of incoming heavy-ions with light particle clusters in the target. We obtain narrow bumps at the excitation energies, which correspond to the experimental observations after taking into account the Fermi motion of the light cluster in the target. We shall discuss the incoming energy as well as the scattering angle dependence of the quasi-free bumps within the model.

*Supported by NSF Grant No. PHY80-17605-05.

1) N. Frascaria, et al. Phys. Rev. Lett. 39 (1977(918.
2) N. Frascaria, et al. Z. Phys. A294 (1980) 167.

Relative Cross Sections for (p,π^-) Reactions Calculated with $(1f_{7/2})^n$ Wave Functions. B.A. BROWN, H. TOKI, and O. SCHOLTEN, NSCL, Mich. State U.*--Recently the (p,π^-) reaction on ^{46}Ca has been found to lead to many previously unobserved states in ^{49}Ti which are presumably of high spin.[1] We have calculated the relative cross sections for this reaction within the $(1f_{7/2})^n$ shell model space[2] with various assumptions about the reaction mechanism. We also investigated the N and Z dependence for this reaction expected within the $(1f_{7/2})^n$ model and find for the total cross section σ_{0+}(N-Z) (27-Z) where N and Z are for the target nucleus.

*Supported by NSF grant PHY-80-17605.

[1] S.E. Vigdor et al., Phys. Rev. Lett. 49, 1314 (1982).
[2] W. Kutschera, B.A. Brwon and K. Ogawa, Riversta del Nuovo Cimento 1 N. 12, 1978.

Isovector M1 Transition Strength from the ^{20}Ne(p,n)^{20}Na Reaction at E$_p$ = 120 MeV*, R.P. DEVITO, C.C. FOSTER, and C.D. GOODMAN, Indiana University, T.N. TADDEUCCI, Ohio University, SAM M. AUSTIN and AARON GALONSKY, Michigan State University, U.E.P. BERG, Justus-Liebig University--Differential cross sections have been measured for the reaction ^{20}Ne(p,n)^{20}Na at 120 MeV covering the angular range 0°<θcm<38°. Excitation to the isobaric analog of the lowest 1$^+$, T=1 state in ^{20}Ne is observed. This state exhibits constructive interference of spin and orbital recoupling transition densities. Additional 1$^+$, T=1 strength in ^{20}Na is observed around 5.6 MeV excitation while no M1 strength is detected by ^{20}Ne(e,e') at comparable excitation energy. This is consistant with the destructive interference of nearly equal spin and orbital-recoupling transition densities predicted by the Chung-Wildenthal[1] wavefunctions for A=20. Results of the analysis of the (p,n) cross section as well as comparisons to ^{20}Ne(e,e') and ^{20}Ne(π^-,γ) will be presented.

*Work supported in part by the NSF.
[1] B.H. Wildenthal and W. Chung, in The (p,n) Reaction and Nucleon-Nucleon Force, edited by C.D. Goodman, et al. (Plenum, New York 1980).

Particle Accelerator conference, Santa Fe, New Mexico, March 1983.

Modifications to the Design of the K800 Superconducting Cyclotron*, F. MARTI, D. JOHNSON and H.G. BLOSSER, Mich. State Univ. - The original design of the K800 cyclotron called for a pole tip geometry with a double spiral. Up to a radius of 15 inches the spiral was to be positive ($\Delta\theta=\Delta r/13$, θ in radians, r in inches) while for larger radii the spiral was to be negative ($\Delta\theta=-\Delta r/13$). The purpose of this geometry was to allow for injection in the valleys and to move the stripping area from a valley to a hill and thus the stripping mechanism would not be inside one of the dees that occupy all three valleys. This design had two major drawbacks 1) the transition region between spirals reduced the vertical focusing frequency, and 2) increased the difficulty of fabricating the pole tips and their accompanying trim coils. After studying the feasibility of designing a stripping mechanism that would fit inside one of the dees, it was decided to use the simpler, single negative spiral, pole tips. In this paper we describe the calculations done to design the new pole tip geometry and study the injection orbits.
*Work supported by NSF grant #PHY80-17605.

Perturbation of Radial Oscillations in Superconducting Cyclotrons Due to Assymmetries in Dee Voltage or Phase*, M.M. GORDON, Michigan State University--Like many other cyclotrons, the new superconducting cyclotrons frequently operate with ν_r close to unity, and must actually accelerate the beam through the $\nu_r=1$ resonance in the central region and again just prior to extraction. The spiral shaped dees in these machines are designed to have equal voltages and prescribed phase relationships, and deviations from these values significantly perturb the radial oscillations. The effects of these perturbations, including those associated with spiral electric gaps, have been analyzed, and an outline of this analysis is presented here together with a comparison with some data obtained from realistic orbit computations. Possible applications to the control of orbit centering are also discussed.
*National Science Foundation Grant No. PHY-80-17605.

Design of the NSCL coupling Line*, L.H. HARWOOD, J.A. NOLEN, JR., F. RESMINI, and H.G. BLOSSER, Mich. State Univ. - The design of the beamline to transfer the extracted beam from the NSCL K500 superconducting cyclotron to injection into the K800 superconducting cyclotron will be presented. This line is isochronous and has an intermediate achromatic double waist to facilitate tuning. The optics conceptual design will be presented as well as details of magnet design; all magnetic elements will be superconducting. RF pulse selectors and bunchers are included in the design. Planned optics diagnostic techniques will be described.
*Work supported by NSF grant #PHY80-17605 and DOE grant #DEAC-02-80-ER-10579.

Operating Experience with an Ion Source in a Superconducting Cyclotron, T.A. Antaya, M.L. Mallory*, Mich. State Univ.--We have now operated for approximately one year a cold cathode PIG source in the K500 superconducting cyclotron. The high central magnetic field results in a compact central region with tight clearances for the dee tips and the ion source. This in turn places severe restrictions within the ion source for maintaining voltage and providing water cooling; yet we have evolved a reliable source design and in addition it offers quick recycling without ramping down the superconducting magnet. Initially, high field DC performance was obtained while operating the K500 as a DC test stand. Operating characteristics of this source are similar to previous cold cathode sources and the resulting intensities for accelerated beams will also be presented. The interaction between the source gas load and the beam chamber high vacuum system (cryopanels) lead to routine source gas mixing with an easily cryo-pumped gas as the arc support gas. Additional development work is in progress (daul arc and variable cathode separation) and the results of these programs will be reported.
*National Science Foundation Grant No. Phy-17605.

Three Phase R.F. Systems for Superconducting Cyclotron, J. RIEDEL, Mich. State U.- The design of the RF system for MSU's K500 superconducting cyclotron RF system was published in 1969.[1] This paper will detail the significant modifications that had to be made to that design in order to achieve a reliable RF system that now works quite well. Of particular interest will be the problems associated with the dee to dee coupling capacities and the 75 amps/cm moving short current densities.
[1] R.F. Systems, J. Riedel, IEEE Transactions on Nuclear Science, Vol. NS-26, Apr. 1979.

INTERNATIONAL CONFERENCE ON NUCLEAR STRUCTURE, AMSTERDAM, AUGUST-SEPTEMBER 1982.

Analyzing Powers of the Isovector Giant Resonances and Continuum in the $^{90}Zr(p,n)^{90}Nb$ Reaction at 160 MeV, E. SUGARBAKER, P. KONCZ, D. KROFCHECK, C.D. GOODMAN, C.C. FOSTER, J. RAPAPORT, T. TADDEUCCI, P. WELCH, C. GAARDE, J. LARSEN, T. MASTERSON, D. HOREN, S. AUSTIN, and A. GALONSKY.

Giant Resonances in ^{48}Ca Excited by 200 MeV Proton Inelastic Scattering, C. DJALALI, N. MARTY, M. MORLET, A. WILLIS, J.C. JOURDAIN, N. ANANTARAMAN, G.M. CRAWLEY and A. GALONSKY.

Observation of $\Delta L=0$, Spin-Flip Transitions in ^{48}Ca and Other N=28 Nuclei, G.M. CRAWLEY, N. ANANTARAMAN, A. GALONSKY, C. DJALALI, N. MARTY, M. MORLET, A. WILLIS and J.-C. JOURDAIN.

Proton Excitation of the M1 Resonances in the Ni Isotopes, C. DJALALI, N. MARTY, M. MORLET, A. WILLIS, J.-C. JOURDAIN, N. ANANTARAMAN, G.M. CRAWLEY and A. GALONSKY.

INTERNATIONAL CONFERENCE ON NUCLEUS-NUCLEUS COLLISIONS, EAST LANSING, MICHIGAN, SEPTEMBER-OCTOBER 1982.

High Spin States and Discrete Line Spectroscopy of ^{128}Ce, J.L.S. CARVALHO, R.M. RONNINGEN, N.R. JOHNSON, J.S. HATTULA, I.Y. LEE, M.P. FEWELL, L.L. RIEDINGER, H. OWER, J.C. WELLS AND F.M. BERNTHAL.

Liquid Gas Phase Instabilities in Nuclear systems, M.W. CURTIN, H. TOKI, D.K. SCOTT and P.J. SIEMENS.

Fission Following Capture Reactions of $^{32}S + ^{208}Pb$, M.B. TSANG, D. ARDOUIN, B.B. BACK, P.A. BAISDEN, R. BETTS, C.K. GELBKE, W.G. LYNCH, M.A. MCMAHAN, S. SAINI and Z. XU.

A Macroscopic Model for Low Energy Heavy Ion Collisions, G.F. BERTSCH.

Low Energy Particles Produced in Heavy Ion Collisions, O. SCHOLTEN, H. KRUSE and W.A. FRIEDMAN.

Composite Fragment Production in Intermediate Energy Heavy Ion Reactions, B.V. JACAK, C.K. GELBKE, L.H. HARWOOD, W.G. LYNCH, D.K. SCOTT, T.J.M. SYMONS, M.B. TSANG and G.D. WESTFALL.

Statistical Approach to Composite Particle Emission, W.A. FRIEDMAN and W.G. LYNCH.

Pineuts: A Possible Explanation for Anomalons, WM. C. MCHARRIS and J.O. RASMUSSEN.

THE INTERACTION BETWEEN MEDIUM ENERGY NUCLEONS IN NUCLEI, BLOOMINGTON, INDIANA, 1982.

Excitation of M1 Strength in N=28 Isotones by Inelastic Proton Scattering at 200 MeV, N. ANANTARAMAN, G.M. CRAWLEY, A. GALONSKY, C. DJALALI, N. MARTY, M. MORLET, A. WILLIS and J.-C. JOURDAIN.

185TH NATIONAL MEETING OF THE AMERICAN CHEMICAL SOCIETY, SEATTLE, WA, MARCH 1983.

Fission Following the Capture of $^{32}S + ^{208}Pb$, M.B. TSANG, D. ARDOUIN, C.K. GELBKE, W.G. LYNCH, Z.R. XU, B.B. BACK, R. BETTS, S. SAINI, P.A. BAISDEN and M.A. MCMAHAN.

Light Fragment Production in Intermediate Energy Heavy Ion Reactions, C.K. GELBKE.

Composite Fragment Production in Intermediate Energy Heavy-Ion Reactions, B.V. JACAK, G.D. WESTFALL, C.K. GELBKE, L.H. HARWOOD, W.G. LYNCH, D.K. SCOTT and M.B. TSANG.

INTERNATIONAL CONFERENCE ON HEAVY ION PHYSICS AND NUCLEAR PHYSICS, CATANIA, MARCH 1983.

Fusion-Fission Reactions Induced by $^{32}S + ^{208}Pb$, D. ARDOUIN, M.B. TSANG, C.K. GELBKE, W.G. LYNCH, Z. XU, B.B. BACK, R. BETTS, S. SAINI, P.A. BAISDEN and M.A. MCMAHAN.