SECTION II

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

(JULY 1980-JUNE1981)

Leak Checking a Superconducting Cyclotron Cryostat with Liquid Helium,* H.W. LAUMER, M.L. MALLORY, D.R. POE, Michigan State University.--Large superconducting magnets are now being developed in many areas of nuclear physics and will soon become an everyday tool of nuclear physicists. Successful operation of these magnets requires new technologies and engineering techniques. In the process of building a superconducting cyclotron, a method has been developed for finding ultra small helium leaks with liquid helium. The method consists of correlating helium leak rate in the cryostat vacuum jacket with the level of liquid helium. A change in the helium leak rate as the leak channel is covered or uncovered by liquid helium is clearly detected. Single phase liquid compared to gaseous helium at the same temperature would be expected to flow about twice as freely, but the opposite effect is observed. This decrease is attributed to two phase helium being transported through an ultra small channel. Using this method detection of greater than three magnitudes beyond the present state of the art at room temperature can be achieved.

*National Science Foundation Grant No. Phy 78-22696.

A Reaction Product Mass Separator for Energetic Particles,* J.A. NOLEN, JR., L.H. HARWOOD, M.S. CURTIN, and W.E. ORMAND, Michigan State University.--A Reaction Product Mass Separator (RPMS) has been designed and is under construction for use with the K=500 superconducting cyclotron at MSU. The device will focus outgoing particles from heavy ion reactions to a focal plane which is dispersive in mass. The version currently under construction will focus particles with E/A up to 30 MeV, will pass a 16% energy range with a solid angle of 1 msr, and has a mass resolving power $m/\Delta m$ = 100 base-to-base at E/A = 20 MeV. (A larger version of the RPMS is currently being designed for use at the higher particle energies of MSU Phase II.) The mass resolving power varies inversely with particle rigidity and will be 200 base-to-base for fusion-evaporation products with beam energies per nucleon of 5 MeV. Examples of experiments which will be possible with early beams from the new cyclotron will be discussed. The main emphasis is on studies of nuclei far from the valley of beta stability produced via fusion-evaporation, deep inelastic, and fragmentation reactions.

*National Science Foundation Grant No. Phy 78-22696.

Rotational Bands in $f_{7/2}$ Nuclei Described by R(4) Group Theoretical Methods,* WM. C. MCHARRIS, Michigan State University.--The tensor algebra methods of the rotational group in four dimensions, R(4), have been applied to the interpretation of rotational bands in $f_{7/2}$ nuclei, including the odd-odd nucleus, ^{48}V.[1] (R(4) is uniquely suited for describing deformed nuclei because it uses the fourth parameter to connect the three body-centered axes with the fixed frame - and its functions are expressible in *closed form*.) Positions of the odd-parity rotational bands, including Coriolis-induced distortions, are duplicated with a minimum of numerical calculation; those for even-parity bands are not so good, probably because of the limited basis set.

*National Science Foundation Grant No. Phy 78-22696.

[1]L.E. Samuelson, W.H. Bentley, W.H. Kelly, R.A. Warner, and Wm. C. McHarris, to be published; preliminary version, Phys. Rev. C 15, 821 (1977).

Practical Comparison of Runga-Kutta and Predictor-Corrector Integration Methods,* M. DISTASIO and WM. C. MCHARRIS, MIchigan State University.--Computer comparisons have been made for the one-step Runga-Kutta (fifth order) and multi-step Predictor-Corrector (Hamming method) numerical integration methods, using practical electrostatic problems. Some 5000 integration steps were performed for equations of the form,

$$d^2f(x)/dx^2 = g(x,x')$$

On the average the Runga-Kutta method requires 40% more computer time than the Predictor-Corrector method.

*National Science Foundation Grant No. Phy 78-22696.

[1]M. Distasio and Wm. C. McHarris, Am. J. Phys. 47, 440 (1979).

Pulse-Shape Discrimination for Improving Ge Detector Resolution and Peak-to-Compton Ratios: Coaxial Detectors,* N. MATSUSHITA, J. KASAGI, and WM. C. MCHARRIS, Michigan State University.--Discrimination on pulse rise times and energy centroid positions can be used to improve the performance of coaxial as well as planar Ge γ-ray detectors. Owing to the more complex geometry and rise-time distributions, pulse-height discrimination has to be made for two rise-time intervals, e.g., from 0.1 to 0.5 fraction and from 0.1 to 0.7 (using constant-fraction time discriminators). Improvements of up to ≈50% have been achieved with relatively little loss in efficiency.

*National Science Foundation Grant No. Phy 78-22696.

[1]N. Matsushita, Wm. C. McHarris, and R.B. Firestone, Bull. Am. Phys. Soc. 24, 823 (1979); accepted for publication in Nucl. Instr. Meth.

Multipole Moments from Proton Scattering at 35 MeV to Ground Band States in ^{232}Th and ^{234,236,238}U,* R.C. MELIN**, R.M. RONNINGEN, J.A. NOLEN, JR., G.M. CRAWLEY, and J.E. FINCK, Mich. State Univ., and C.E. BEMIS, JR., ORNL†,--Angular distributions of elastically and inelastically scattered protons have been measured in the angular range of 20° to 144.5° in steps of 2.5° and 5°. The scattered protons were detected in the focal plane of an Enge split-pole spectrograph with a delay-line detector. The angular distributions for states in the ground band with $J^\pi = 0^+$ through 8^+ were analyzed within a coupled channels framework. Quadrupole, hexadecapole, and hexakontatetara mass moments were deduced. The sign of the deformation parameter β_6 was determined to be positive for ^{232}Th and ^{234,236}U, and negative for ^{238}U. Our results will be compared to those from (e,e'),[1] (α,α'),[2,3] Coulomb excitation,[4] and (p,p')[5] studies.

*National Science Foundation Grant No. Phy 78-22696.

[1]T. Cooper et al., Phys. Rev. C13, 1083 (1976).
[2]P. David et al., Z. Physik A278, 281 (1976).
[3]D.L. Hendrie, et al., Phys. Rev. Lett. 30, 571 (1973).
[4]C.E. Bemis, Jr. et al., Phys. Rev. C8, 1466 (1973).
[5]J.M. Moss et al., Phys. Rev. Lett. 26, 1488 (1971).

†Operated by Union Carbide Corp. for the U.S. D.O.E.

AMERICAN PHYS. SOC. MINNEAPOLIS, MN MEETING, October 1980 (con't.)

Light Attenuation in the Liquid Organic Scintillators NE213 and NE224,* John E. YURKON and AARON GALONSKY, Michigan State University.--Using a collimated white light source, cells of several thicknesses, and a SPEX double monochrometer, the attenuation length was measured for light as a function of its wavelength for each of the above two scintillator types. The scintillation spectrum (in response to uv light) was also measured. Having the initial scintillation spectrum and the wavelength-dependent attenuation length, we have predicted the overall light transmission from different parts of a large scintillation detector. The predictions were compared with transmissions measured when the scintillations were induced by a collimated beam of γ rays.

*National Science Foundation Grant No. Phy 78-22696.

AMERICAN PHYS. SOC. NEW YORK, N.Y. MEETING, January 1981

M1 and Gamow-Teller Transition Rates in Light Nuclei,* B.H. WILDENTHAL, Michigan State University.--The data available on magnetic dipole (M1) and Gamow-Teller (GT) transitions in light ($<$Ca) nuclei have been analyzed by comparison with the microscopic many-body aspects of these excitations which are predicted by detailed shell-model wave functions.[1] An initial survey indicates that such many-body, state-dependent effects account for most of the observed variation in relative strength from transition to transition. This sort of analysis is being continued on several fronts.[2] The features of the M1-GT "giant resonances", as experimentally inferred from M1 inelastic electron and gamma ray scattering or by beta-delayed proton studies are analyzed in an attempt to clarify their relation to the properties of the ground states and of the effective nuclear Hamiltonians and the degree to which they exhaust the total available strength for such excitations. The absolute values of observed transition strengths are reduced with the shell model one-body transition densities in an attempt to isolate the effective values for the nucleonic matrix elements of the GT and M1 operators. Particular attention is paid to comparisons of GT and M1 strengths for analogous transitions since in these instances it may be argued that nuclear structure effects, including those not incorporated into the shell model, are identical.

*Supported by the National Science Foundation.
[1]W. Chung and B.H. Wildenthal, unpublished.
[2]B.A. Brown and B.H. Wildenthal, unpublished.

PARTICLE ACCELERATOR CONFERENCE, WASHINGTON MEETING, March 1981

Calculation of Forces on the Aluminum Heat Shield Produced by Eddy Currents During Discharge of a Superconducting Cyclotorn Magnet, FELIX MARTI and M.M. GORDON, Michigan State University, East Lansing, MI - The superconducting magnet in our 500 MeV cyclotron contains a (liquid nitrogen cooled) aluminum heat shield within the cyrostat, and when, after more than two years of operation, the cryostat was disassembled, it was discovered that the outer surface of the heat shield had collapsed inward, thereby compressing the underlying super-insulation tightly against the can containing the liquid helium and coil. Consideration of the resultant geometry of the heat shield indicated that the collapsing force was produced by eddy currents generated in the aluminum either during discharge of the magnet or else when one of the radial support links happened to break. These forces have been calculated under both conditions, and the procedures used for these calculations are presented here together with the results. We conclude that the collapse of the heat shield was most probably caused when, on one occasion, the dump resistor accidentally burned out thereby producing an exceptionally fast discharge of the magnet..

*National Science Foundation Grant No. Phy. 78-22696.

K-500 Superconducting Cyclotron Deflector High Voltage Tests,* T. ANTAYA, P. MILLER and D. POE, Michigan State University, East Lansing, MI - A compact coaxial transmission line which will carry 100 kV DC to an electrostatic deflector in the K-500 Superconducting Cyclotron has been developed. This transmission line is designed to penetrate the magnet cryostat at the median plane. The vacuum wall consists of metal and alumina. With a stainless steel cathode, anodes made of stainless steel and titanium both give satisfactory performance in conditioning tests carried out in the de-commissioned K-50 cyclotron, which is being used as a test stand. The voltage has been maintained above the operating requirement of 94 kV for periods of several days without problems. (Maximum electric field at 100 KV is 184 KV/cm in the transmission line, vs. 140 KV/cm in the deflector gap.) Dark current is 1 μA at 100 KV. The breakdown voltage has been raised to 114 KV by conditioning with a 1.1ΩM current limiting resistor in the power supply lead, and sparking damage has been reduced by increasing the lead resistance to 5.2ΩM .

*National Science Foundation Grant No. Phy 78-22696.

Operating Experience with the Cryogenic Systems for a Superconducting Cyclotron,* M.L. MALLORY, H. LAUMER, D. POE, P. BRINDZA, Michigan State University, East Lansing, MI, - The successful operation of the superconducting cyclotron cryogenic system has been primarily dependent on understanding and improving its performance. In particular, operating experience with a superconducting magnet coil, a vacuum cryopanel, and a cryogenic distribution system has been gained during the past three years. The coil cryostat cooldown, boiloff rate, warmup, eddy current pulse, medium plane heat leak, and helium leakage into the cryostat vacuum jacket have been measured. The vacuum cryopanel cooldown rate, heat load, pumping speed and long term gas storage have been determined. The present measurements have been conducted with simple independent transfer lines. A subcooled cryogenic distribution system, with parallel branches, has been designed and is presently under construction.

*National Science Foundation Grant No. Phy 78-22696.

Beam Transport Calculations for K-500 Cyclotron Operation at Michigan State University,* J. KASAGI, S. ANGIUS, and E. KASHY, Michigan State University, East Lansing, MI, - The beam transport and analysis system for the experimental facility using the K-500 superconducting cyclotron at M.S.U. has been designed and is currently being assembled. It consists of dipoles, quadrupoles and a sextupole. The system provides for a variable linear dispersion at the target positions of the magnetic spectrographs so that matching conditions in the "energy-loss" mode can be achieved for a wide variety of reactions. The design was influenced by an unusual feature of the extraction system of the cyclotron, whose magnetic elements consist entirely of inert focusing elements and results in beams with different phase space at the cyclotron exit. The first section of the transport system is used to give the various beams a very similar phase space at the first slit position. The matrix calculations of the beam transport were carried out using the code TRANSPORT.[1] The results of these calculations will be presented.

*National Science Foundation Grant No. Phy 78-22696.

[1]K.L. Brown, D.C. Carey, Ch. Gselin and F. Rothacker, Cern Report 72-16.

Final Design of the Magnetic Field for The K-800 Superconducting Cyclotron at M.S.U. G. BELLOMO, E. FABRICI, D. JOHNSON, F. RESMINI, Michigan State University, East Lansing, MI, - A satisfactory final configuration of the pole tips and main coils for the K-800 superconducting cyclotron, now under construction at M.S.U., has been obtained. Several changes were introduced with respect to the geometry initially proposed in the conceptual design (MSUCL-282). In particular, the hill gap has been increased to 3", and the minimum main coils distance from the median plane to 2". Detailed beam dynamics studies over the anticipated operating gauge of the machine show that 200 MeV/n of fully stripped light ions can be comfortably accelerated, while total trim coils power requirements are confined within ≈50 KW for any beam. Only two electrostatic deflectors, with respect to the three originally proposed, will be sufficient. A detailed analysis of magnetic field properties, including a study of the stresses in the main coils, will also be presented.

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

AMERICAN PHYS. SOC. BALTIMORE, MD MEETING, April 1981

Progress on the Coupled Superconducting Cyclotron Project,* H.G. BLOSSER, Michigan State University, East Lansing, MI - Construction of the coupled superconducting cyclotron facility is proceeding at a vigorous pace with first beam in the K500 cyclotron now expected in the latter part of 1981 and first beam in the double cyclotron system in late 1984. The 50 kilogauss superconducting magnet for the 500 MeV cyclotron continues to operate smoothly and reliably and the magnet is now in complete final form with all extraction elements, trim coils, etc. installed and tested. The radiofrequency system for the K500 has required several design changes, problem areas being 1) the contact fingers on the sliding short and 2) damage to amplifier components due to transient modes at some tuning points in the very broad frequency range (9 to 31.5 MHz) which the system is designed to cover; satisfactory full-power operation of all system components has now been achieved in the test resonator and rf components for the actual cyclotron are being manufactured and assembled as rapidly as possible. Construction activity on the second stage K800 cyclotron is presently centered on the manufacturing of major components of the magnet and the fabrication of prototype assemblies for the rf system. Winding of the superconducting coil for the K800 is scheduled to begin in the spring of this year. Design of major experimental devices for use with the coupled cyclotron is also proceeding, including a large high resolution spectrograph similar in configuration to the HRS at LAMPF, a high resolution on-line recoil mass separator, and an expanded, modernized data processing system.

*Construction of K500 under NSF Grant PHY76-83254; construction of K800 and related equipment under DOE Contract DE-AC02-90ER10579.

AMERICAN PHYS. SOC. BALTIMORE, MD MEETING, April 1981 (con't.)

Interaction for Inelastic Scattering Derived from the Paris Potential.* N. ANANTARAMAN, H. TOKI, and G. BERTSCH, Michigan State U.--Oscillator G-matrix elements of the Paris nucleon-nucleon potential have been derived by the method of Barrett et al.[1] These matrix elements are very close to those obtained for the Reid potential.[2] By fitting them to the matrix elements of a sum of Yukawas and, for the tensor force, other closely related forms, an effective local interaction for inelastic scattering will be derived. We shall also present the results of a microscopic analysis carried out with this interaction for inelastic proton scattering on a sd-shell target such as ^{24}Mg, for which good shell-model wave functions as well as good data are available.

*National Science Foundation Grant No. PHY 78-22696.

[1]B. Barrett et al., Phys. Rev. C3, 1137 (1971)
[2]G. Bertsch et al., Nucl. Phys. A284, 399 (1977)

CONFERENCE ON CHARGED PARTICLE OPTICS, GIESSEN, W. GERMANY, September 1980

Problems in Simultaneous Second- and Third-order Aberration Optimization,* L.H. HARWOOD and J.A. NOLEN, JR., Cyclotron Lab., Michigan State University, East Lansing, MI 48824 USA--Problems associated with the optimization of second- and higher-order aberrations in two quite different electromagnetic systems will be discussed. The first is a large, K=800, 20 msr magnetic spectrograph with a design goal of 1 part in 20,000 momentum resolution. The second is a reaction product mass separator for energetic (E/A up to 200 MeV) heavy ions. A common problem encountered in these systems, and presumably many others, is that large higher-order aberrations are often induced by the second-order correcting elements. In some cases, a "prefectly corrected" second-order solution actually produces larger line widths than those obtained with no second-order correction. Various approaches to obtaining the optimized solution have been investigated. These include "scaling" the second-order corrections of the "perfect" second order solutions and use of the ray tracing optimization program MOTER developed at LAMPF.

*National Science Foundation Grant No. Phy 78-22696.

PHYSICS IN CANADA, June 1981

Measurement of Pair Emission from the 2.8 MeV Parity Mixed Doublet of ^{21}Ne. E.D. EARLE and A.B. MCDONALD, AECL, Chalk River, Ont., J.J. SIMPSON, U. of Guelph, Ont.; R.G.H. ROBERTSON, MSU, Michigan; H.B. MAK, Queen's U. Ont. - The low limit measured[1] for the circularly polarization of the 2789 keV γ-ray from ^{21}Ne has been interpreted[2] as arising from a cancellation between isoscalar parity mixing matrix elements and isovector matrix elements enhanced by the presence of weak neutral currents in the Weinberg-Salam model. This interpretation assumes that the multipolarity of the ground state transition from the $J^{\pi} = \frac{1}{2}^-$:2789 keV level is predominantly E1 as calculated by Millener et al.[3] The predominantly E1 nature of this transition was confirmed experimentally by measuring its pair emission branching ratio with two Si detector telescopes following population via the $^{18}O(\alpha,n)^{21}Ne$ reaction; $|\delta(M2/E1)|<0.6$. This limit may be combined with previous measurements of lifetimes and γ-ray branching ratios to determine the sensitivity of the circular polarization to the parity mixing matrix element;

$$P_{\gamma}(2789) = 8.6 \begin{smallmatrix} + 1.1 \\ - 2.0 \end{smallmatrix} \times 10^{-2} \text{ eV}^{-1} \langle \tfrac{1}{2}^+ | H_W | \tfrac{1}{2}^- \rangle .$$

[1]K.A. Snover et al., Phys. Rev. Lett. 41 (1978) 145.
[2]W. Haxton et al., Phys. Rev. Lett. 45 (1980) 1677.
[3]D.J. Millener et al., Phys. Rev. C18 (1978) 1878.

SIXTH CONFERENCE ON THE APPLICATION OF ACCELERATORS IN RESEARCH AND INDUSTRY, DENTON, TX, November 1980

The Superconducting Cyclotron Program at Michigan State University. G. BELLOMO, H.G. BLOSSER, R. BURLEIGH, E. FABRRICI, M.M. GORDON, D. JOHNSON, W. JOHNSON, M. MALLORY, F. MARTI, P. MILLER, F. RESMINI, J. REIDEL, Michigan State University, East Lansing, MI

The superconducting cyclotorn program at M.S.U. is centered upon two coupled cyclotrons, one with K=500 presently near completion, and one with K=800, whose construction starts this year. The main characteristics of the machines are briefly reviewed and the expected performances discussed. The current status of the project is presented in some detail, the emphasis being on novel features from the point of view of accelerator technology.

*National Science Foundation Grant No. PHY 78-22696.

TITLES OF TALKS WHICH HAVE NOT YET APPEARED IN PROCEEDINGS (Section III)

ANNUAL CONGRESS OF THE CANADIAN ASSOCIATION OF PHYSICISTS, HALIFAX, NOVA SCOTIA, JUNE 1981.
Relativistic Heavy Ion Collisions, D.K. Scott

ADRIATIC EUROPHYSICS STUDY CONFERENCE ON DYNAMICS OF HEAVY ION COLLISIONS, HVAR, JUGOSLAVIA, FIZIKA, VOL 13, SUPPL. 1 (1980) p. 83.
Elastic and Inelastic Scattering of 120 MeV/u α particles, N. Alamanos, J. Arvieux, B. Berthier, B. Bonin, G. Bruge, J.L. Escudie, H. Faraggi, L. Farvacque, D. Legrand, J.C. Liegol, W. Mittig, L. Papineau, M. Buenerd, M. LeVine, D.K. Scott and A.I. Yavin.

INTERNATIONAL CONFERENCE ON NUCLEAR PHYSICS, BERKELEY, CA 1980.
Giant Resonance Excitation in ^{208}Pb with 120 MeV/nucleon Alpha Particles, B. Bonin, N. Alamonos, B. Berthier, G. Bruge, J.L. Escudie, H. Faraggi, L. Farvacque, J. Gastebois, J.C. Lugol and L. Papineau, CEN Saclay, France; J. Arvieu and M. Buenerd, ISN Grenoble, France; P. Doll, K.F. Z. Karlsruhe, W. Germany; M.J. LeVine, BNL, Upton, L.I., NY, USA.

Energy Systematics of M1 and E1 Isovector Giant Resonances Observed in (p,n) Reactions, W. Sterrenburg, S. Austin, T. Nees, D. Fainum, J. Nees, D. Bainum, J. Rapaport, R. DeVito, and A. Galonsky.

Isovector Giant Resonances in ^{90,92,94}Zr(p,n) at 80, 120 and 160 MeV, W. Sterrenburg, S. Austin, A. Galonsky, C. Foster, C. Goodman, D. Horen, C. Goulding, and M. Greenfield.

NUCLEAR STRUCTURE AND PARTICLE PHYSICS CONFERENCE, OXFORD, ENGLAND, April 1981
A Critique of Nuclear Spectroscopy, B.H. Wildenthal.