SECTION II

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

(JULY 1980-JUNE 1981)
Leak checking a superconducting cryostat of liquid helium. A reaction product mass separator for energetic particles. A reaction product mass separator (RPM) has been designed and is under construction for use with the 8-500 superconducting cyclotron at MSD. The device will focus outgoing particles from heavy ion reactions onto a local plane which is dispersive in mass. The version currently under construction will focus particles with E/A up to 30 MeV. It will have an energy range of 1 to 2 MeV with a mass resolving power of m/A = 500. The larger version of the RPM is currently being designed for use at the higher particle energies at MSD Phase II. The mass resolving power varies inversely with particle rigidity and will be 200 to base-to-base for fusion-evaporation product 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 fusion-fission reactions.

National Science Foundation Grant No. Phy 78-22696.

Rotational bands in 40Ca Nuclei Described by J(4) Group Theoretical Methods. The tensor algebra methods of the rotational group in four dimensions, J(4), have been applied to the interpretation of rotational bands in 40Ca nuclei, including the odd-odd nucleus 43Ca. The group is uniquely suited for describing deformed nuclei because it uses the four-body coordinate to capture 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-excited 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.


Practical Comparison of Runga-Kutta and Predictor-Corrector Integration Methods. A. Dis- tasio and Wm. C. McIvor, 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

\[ \frac{d^2r}{dx^2} = g(x, r) \]

On the average the Runga-Kutta method requires 403 more computer time than the Predictor-Corrector method.

National Science Foundation Grant No. Phy 78-22696.


Pulse-Shape Discrimination for Improving Ge Detector Resolution and Peak-to-Count Ratios. H. Matsushita, J. E. Pire, Bell. Am. J. Phys. 34, 3 (1976); accepted for publication in Nucl. Instr. Meth.

National Science Foundation Grant No. Phy 78-22696.

H. Matsushita, Wm. C. McIvor, and J. E. Pire, Bell. Am. J. Phys. 34, 3 (1976); accepted for publication in Nucl. Instr. Meth.


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Operated by Union Carbide Corp. for the U.S. D.O.E.
Light Attenuation in the Liquid Organic
scintillators NE213 and NE217.* John G. FORER
and AMOS BADEH, MICHIGAN STATE University. -
-Using a collimated white light source, cells 
of several thicknesses, and a SPER double mono-
chromator, 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. During the initial scintil-
lum 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 r-rays.

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22696.

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

MI and Gamow-Teller Transition Rates in Light Nuclei.† B.H. MILDENTHAL, MICHIGAN STATE Univer-
sity.--The data available on magnetic dipole (MI) 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.‡ An initial survey indicated 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. † The features of the MI-
GT "giant resonances", as experimentally inferred from MI 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 MI operators. Particular attention is paid 
to comparisons of GT and MI 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.
‡W. Chung and B.H. Wildenthal, unpublished.

PARTICLE ACCELERATOR CONFERENCE, WASHINGTON MEETING, March 1981

Calculation of Forces on the Aluminum 
Heat Shield Produced by Eddy Current Heating 
Discharge of a Superconducting Cyclostron Magnet. PR Fritz 
and N.M. GOSON, MICHIGAN STATE University, East Lansing, MI. - The superconducting magnet 
in our 500 MH cyclotron contains a (liquid nitrogen
gooned) aluminum heat shield within the cryo-
stat, and when, after more than two years of opera-
tion, the cryostat was disassembled, it was dis-
covered that the outer surface of the heat shield 
had collapsed inward, thereby compressing the 
underlying super-insulation tightly against the 
ca containing the liquid helium and coil. Con-
sideration of the resultant geometry of the heat 
shield indicated that the collapsing force was 
produced by eddy currents generated in the alumi-
num heater 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 heater resistor accidentally 
burned out thereby producing an exceptionally 
fast discharge of the magnet.

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

E-500 Superconducting Cyclostron Deflector 
High Voltage Tests.†† D. AMATA, 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 E-500 Superconducting Cyclostron has been 
developed. This transmission line is designed to penetrate the magnet cryostat at the median 
plane. The vacuum wall consists of metal and 
aluminum. 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 E-500 cyclotron, which is being used as a test stand. This 
have been maintained above the operating require-
ment 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 1.25 M current 
limiting resistor in the power supply lead, and 
sparking damage has been reduced by increasing 
the lump impedance to 5.2 MΩ.

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

The successful operation of the cryogenic system has been primarily dependent on understanding and improving its performance. In particular, operating experience with a superconducting magnet coil, a vacuum cryostat, and a cryogenic distribution system has been gained during the past three years. The coil cryostat cooldown, boiloff rate, warming, eddy current, pulse, medium plane heat leak, and helium leakage into the cryostat vacuum jacket have been measured. The vacuum cryostat 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.*


A satisfactory final configuration of the pole tips and main coils for the K-500 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 (M.S.U., 1972). In particular, the hill gap has been increased to $2\times10^6$ and the minimum main coil distance from the median plane to $2\times10^5$. Detailed beam dynamics studies over the anticipated operating range of the machine show that 200 MeV of fully stripped light ions can be comfortably accelerated. While total main coil power requirements are confined within $50 \text{ kW}$ 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-AC02-80ER25105.*


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 dipole, quadrupole 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' node can be achieved. The design is flexible and can be modified to accommodate a variety of reactions. The design was influenced by an unusual feature of the magnetic system of the cyclotron, whose magnetic elements consist entirely of iron 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 are carried out using the code TRANSPORT. The results of these calculations will be presented.

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


**Progress on the Coupled Superconducting Cyclotron Project.**  H. G. Blesser.  *Michigan State University, East Lansing, MI.*

Construction of the coupled superconducting cyclotron project is proceeding at a vigorous pace with the 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 K500 MeV cyclotron continues to operate smoothly and reliably and the magnet is now complete and ready to be installed in the experimental facility. The radiofrequency system for the K500 MeV cyclotron has been designed and assembled. Several minor design changes, problems areas being 1) the contact fingers on the sliding short and 2) damage to amplifier components due to transient modes in the very broad bandwidth required for the system, have been overcome. Operation of all system components has been achieved in the test resonator and RF components for the actual magnet are being manufactured and assembled as rapidly as possible. Construction activity on the second stage E500 cyclotron is presently centered on the manufacturing of major components of the project. Wiring of the superconducting coil for the E500 is scheduled to begin in the spring of this year. Design of major experimental devices for use with the coupled cyclotrons is also proceeding, including a large high resolution spectrograph similar in configuration to the ERS at LAMPF, a high resolution on-line recoil mass separator, and an expanded, modernized data processing system.

Construction of K500 under NSF Grant PHY-80-41254; construction of E500 and related equipment under DOE Contract DE-AC02-80ER25105.
Interaction for Inelastic Scattering Derived from the Paris Potential.** W. ANANTHARAMAN, H. TORK, and D. BERTCH, Michigan State U.---Oscillator G-matrix elements of the Paris nucleus-nucleon potential have been derived by the method of Barrett et al. These matrix elements are very close to those obtained for the Reid potential. 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 $^{1}Hg$, for which good shell-model wave functions as well as good data are available.

**National Science Foundation Grant No. NSF 78-22694.


** Bertch 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. BARNWOOD and J.A. WULDS, 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, 8000, 20 msc magnetic spectrograph with a design goal of 1 part in 26,000 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 "perfectly 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 $^{12}$He. R.D. EAGLE and A.B. MCDONALD, AEC, Chalk River, Ont., J.S. SIMPSON, U. of Guelph, Ont., and R.C. ROBERTSON, MSU, Michigan; H.B. MAK, Queen's U. Ont.---The low limit measured for the circularly polarized light of the 7289 keV γ-ray from $^{12}$He has been interpreted 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 $3^{-}$ of $^{12}$He is predominantly E1 as calculated by Millener et al.* 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 $^{12}$C(α,γ)$^{16}$O reaction: $^{12}$C(α,γ)$^{16}$O. This limit may be combined with previous measurements of lifetimes and the branching ratios to determine the sensitivity of the circular polarization to the parity mixing matrix element:

$$ P(7289) = 8.6 \times 10^{-2} \text{ ev}^{-1} \text{ cm}^{-2} \text{ sr}^{-1}.$$  


